



GOVERNMENT OF PUNJAB



**PUNJAB INDUSTRIAL ESTATE DEVELOPMENT
AND MANAGEMENT COMPANY**

DEVELOPMENT OF BHALWAL INDUSTRIAL ESTATE SARGODHA

**ENVIRONMENTAL IMPACT ASSESSMENT REPORT
FINAL**

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Executive Summary

Punjab Industrial Estates Development and Management Company (PIE) intend to implement Bhalwal Industrial Estate in tehsil Bhalwal district Sargodha.

Bhalwal Industrial Estate is located on Bhalwal-Bhera Road which is 16 km off Salam Interchange and at a distance of 36 km from Sargodha.

The main objective of Bhalwal Industrial Estate is to provide developed plots to the interested entrepreneurs for establishment of industries for the economic development of Sargodha district and to develop an industrial estate where issues of industrialists are handled and problems solved through 'One Window' operation.

Project Description

Bhalwal Industrial Estate is being established at an area of 426 acres which will have industrial plots of 0.5, 1 and 2 acres, Warehousing and cold storage, Utilities and common Facilities. The estate will have a Combined Effluent Treatment Plant and Solid Waste Collection and Disposal System.

The design of Bhalwal Industrial Estate Sargodha Project consists of two main components i.e. Land reclamation, and Master planning and infrastructure. The cost of the Project is Rs 3 billion and would be completed in 18 months.

Regulatory Requirement

The Pakistan Environmental Protection Act (PEPA), 1997 is the principal law enabling the government to enact regulations for the protection of the environment.

The key features of the law that have a direct bearing on the proposed project include compliance requirements with respect to the National Environmental Quality Standards (NEQS), and the requirement to conduct an Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE) prior to the construction of any project.

The Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000, Bhalwal Industrial Estate Sargodha falls under schedule-II that's why this project require an EIA.

EIA Methodology

This study has been conducted using standard environmental assessment methodology, in accordance with national and international environmental guidelines. The contents of this report conform to the environmental guidelines of the Pakistan Environmental Protection Agency.

Analysis of the Alternatives

Three concept plans for the Industrial Estate were proposed in which most of the facilities were same, size of road were same but the difference was in the arrangement of plots and roads. So the most feasible selected plan is concept plan option-2 which have grid iron pattern of roads in the estate. This concept plan is better than other two proposed plans as it have proper distribution of plots and other facilities; there location is good and easily accessible through main and tertiary roads. It has 2 acre plots near to main entrance which will benefit big industries to load, unload and export things outside estate.

Environmental Baseline Conditions

Knowledge on the baseline environmental conditions was obtained by collecting and reviewing the available secondary data of the project area. The review process was also helpful in establishing the scope and methodology for collection of field data inside the project area.

The EIA team comprising of environmental engineers, sociologist, and water resources specialist collected area specific primary data. A detailed account of the baseline environmental conditions in the project area pertaining to physical, biological and socio-economic environment is summarized as follows.

Physical Environment

Topography: The whole of Sargodha district is plain and lies between 150-200 meters above the sea level. The Jhelum river crosses this plain at the extreme West of the district while the Chenab at the extreme East of it. The land away from the river Chenab and the Jhelum is higher than that near the two rivers. The land between the two rivers is known as Chej Doab.

The topography of project site is plain having average elevation of 195.2 M and slop of 1%. Lower Jhelum Canal flows South-west of the project site and a small canal flows from South-east of the project site.

Geology and Soil: The Sargodha district is a part of West Indus basin that has gradually been filled up by alluvium brought by the Indus and its tributaries from the North. The alluvial deposit is generally more than 300 meters thick and extends down to several hundred meters at some places. Towards the South of Sargodha this alluvium is locally interrupted by rock out crops of a buried hill range known as Karana hill. This is a range of Precambrian age which is known on Dehbi Shahpur ridge. The soil of project area is saline.

Land use: Bhalwal is an old but fairly planned city based on the grid iron street pattern. The project site is a barren land.

Surface Water: The Chenab River, locally known as the Chanhani, which forms the East-southern boundary of the district, for a distance of 24 kilometers must at some comparatively recent period, flowed considerably to the West of its present bed. The deposit left by the annual floods of the Chenab are usually very sandy and much

inferior to the silt brought down by Jhelum and some other rivers flowing in Punjab. New alluvium has to worth cultivating and odd land is apt to deteriorate. Since the opening of the lower Chenab Canal, with its weir at Khanki, practically the river discharge is diverted, in winter about 20% of ordinary flood discharge in summer.

Ground Water: The project area near lower Jhelum canal and hence the ground water table is high at most of the places. Normally, the ground water is available at depth of 20-100 ft. at different locations in the Project area.

Climate: The climate of the Sargodha district on the whole is hot. The district has extremes of climate. May, June and July are the hottest months and December, January and February are the coldest months. Mostly rainfall in the months of July, August and September.

Air Quality: There are no major anthropogenic sources of air pollution in the Project area.

Noise and Vibration: There is no continuous major source of noise in the project area. Intermittent sources include farm tractors, farm equipment and vehicles on Bhalwal Bhera road. Considering the intermittent nature of these noise sources, it can be concluded that the noise pollution in the area is low.

Traffic count: The Bhalwal-Bhera road is a 24 ft. wide single carriageway and the traffic count shows that a total of 3,474 vehicles going from Bhalwal to Bhera and 4,104 vehicles going from Bhera to Bhalwal by Bhalwal Bhera Road in a day which shows that average 2.63 vehicles passes every minute which is medium traffic.

Ecological Environment

Flora: The area selected for the Bhalwal Industrial Estate is situated between Chak 11, Chak 13, Chak 14 and Chak 13 Rajgan village of Bhalwal. The area is almost barren and looks like a mini desert due to flooding during the monsoon season. Flooding occurs due to rising of water table and flooding from the surrounding areas. Major part of the area remains inundated from August to February. Salinity and overgrazing during late spring are other causes of denudation and absence of flora. There are few plants of Sarkenda (*sachrum* spp), lawn grass (*Cynodan dactylon*), Dhab grass (*desmostachya bipinnata*) and sedges (in the depressions) could be seen in the project area.

Fauna: Wolves are common in the district. Jackals are numerous everywhere, and do considerable damage to the crops, especially to maize and sugarcane. Wild boards are also found the abundance and damage the crops in the villages near the river. Foxes and wild cats also thrive in the district.

Among the birds Chikor and Sissi are very common. They grey partridges are found in many places but the black are only here and there in the riverine. Ducks of many kinds are found on the river and on their ponds in the jungle. The real shoveled sand smaller kind of poachers come early and stay late in winter. Quail come with the cranes at the end of August, in large numbers mostly at night.

Socio-Economic and Cultural Environment

In order to assess the present socio-economic and socio-cultural conditions of the Project area, a social survey was conducted.

In the Project area, four villages were visited and 33 persons were interviewed during the EIA. The age of the persons interviewed ranged from 20-60 years wherein 19 male and 13 female were interviewed.

There was one Dargah/Shrine in the project area named as Baba Halim Shah which is approximately 150 years old. People celebrate a festival in Baba Halim Shah Shrine on 2nd July of every year.

Punjabi and Saraiki are most spoken languages in Sargodha district followed by some Urdu speaking and very few people speak Pashtu.

The most common and generally used male dress is shalwar and a long shirt (Qameez) and Dohti. The ladies also wearing shalwar and the long shirt both of light and fancy colors along with a headscarf (dopatta).

The people in the project area being illiterate, work mostly as tenants and earn wages by harvesting crops and fruit cultivated lands; the area is suitable for agriculture. People are also engaged with business and small workshops. A small proportion of the population is engaged with brick kiln as labour.

The main Rabi crops are wheat, barley, gram, oil-seeds, and masoor and Kharif crops include cotton, sugarcane, rice, bajra, maize, mung, moth and mash. In addition to these main crops there are subsidiary crops known as Zaid Rabi and Zaid Kharif in which tobacco, Vegetables, fodder and toria. Citrus is the main production in Bhalwal tehsil, many citrus processing units are installed in the project area.

The availability of basic amenities of life to community living in the Project area is indicator of its socio-economic condition.

Public Consultation

Public consultations were held with the project proponent, government agencies, NGOs (secondary stakeholder) and local communities (primary stakeholders) during the field visits.

The important stakeholders consulted include District Wildlife Officer Sargodha, the Divisional Forest Officer Sargodha, Program Coordinator IUCN, Islamabad, Head of WWF Islamabad, Inspector General of Forest Islamabad, General Manager Noon sugar Mills LTD Bhalwal and Project Director Mona Reclamation Experimental Project.

The outcome of these consultations have been used in the EIA for the understanding of the project area environment, expectations of different stakeholder groups, key sensitivities and proponent's expected obligations. Generally, the people living in the project area are in favor of the project and they hope that this project will open new employment opportunities and prosperity in the area.

Physical Environment

Impacts:

Soil may be contaminated as a result of fuel/oils/chemical spillage and leakage, and inappropriate waste (solid as well as liquid) disposal.

It is estimated that 300 workers will be employed for construction of the project. Ground water will be used as a water source for the camp, to minimize the water related conflicts with the local communities. Construction camp will produce sewerage which if not treated properly will impact on the water resources. Most of the construction machinery will be having diesel engines, which will generate noise and exhaust emissions.

Construction machinery and project vehicles will release exhaust emissions, containing Carbon Monoxide (CO), Oxides of Sulfur (SO_x), Oxides of Nitrogen (NO_x) and Particulate Matter (PM). These emissions can deteriorate the ambient air quality in the immediate vicinity of the project site. Furthermore, construction activities such as excavation, land leveling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions.

Mitigations Measures:

Soil contamination by asphalt and other obnoxious materials will be minimized by placing all containers in caissons or dumped into temporary pits lined with impervious liners to avoid contamination of soil/ground water from leachate. Proper solid waste management plan will be developed by the Contractor and implemented to avoid the litter and any other waste problems.

Adequate number of solid waste containers will for storage and will be transported to the designated site for disposal. The contractor will instruct their staff not to throw any of the waste and other scrape materials into canals in order to avoid contamination of water resources.

Septic Tank with soakage pit will also be provided for disposal of sewerage from the camp site. Periodic tuning of vehicles will be made mandatory to reduce the emissions of NO_x, CO and PM₁₀.

For the construction machinery generating noise level in excess of the prescribed NEQS limits, effective control measures will be adopted by the Contractor in order to avoid inconvenience to the adjoining community due to noise, smoke and fugitive dust.

Biological Environment

Impacts:

The project area is mostly barren but has some natural vegetation cover. The site preparation and construction activities may necessitate removal of the natural vegetation from the areas where road, culverts and other buildings will be

constructed. Damage and/or loss of vegetation would include elimination of trees (mainly Kikar), and clearing of other indigenous and introduced species, as well as undergrowth comprising bushes, grass, etc.

The project site is located at Bhalwal, which provides habitat for wildlife. The loss of natural vegetation discussed above, and other project activities will potentially have adverse impacts on the faunal resources and habitats of the area as well. There is a game reserve near project area in Nabi Shah Lake but outside the project site.

Mitigations Measures:

A Plantation Plan has been developed for the project which will result in habitat restoration and ecological improvement. Noise control measures will be enforced during the construction phase such as provision of silencers on heavy construction vehicles.

It is further recommended that activities, which are expected to generate high noise, will be executed during the day time only. Furthermore, over speeding of vehicles will be prohibited and construction machinery, vehicles and equipment should remain confined within their designated areas of movement to avoid and minimize any accidental killing of fauna.

Wastes of the camp will be properly disposed off to prevent the chances of its attraction by wild animals, which may prove hazardous for them. Hunting, poaching and harassing of wild animals and birds should be strictly prohibited and contractor should be held responsible for any such act of his workers. Dust may be avoided by frequent water sprinkling.

Socio-Economic Environment

Impacts:

The population residing in the Project area will get more employment opportunities which will improve their socio-economic conditions. During the construction phase, general mobility of the population using the road in and around the Project area will be hindered causing traffic congestion. Construction activities, particularly excavation and movement of haul trucks and machinery may prove dangerous for the safety of the workers as well as for the residents. The Contractor should be aware of the health/safety conditions of their workers, e.g. staff while working on high rise columns may slip and get injured. Fall from the side slopes in an excavated area can be another reason for the injury.

Mitigations Measures:

Temporarily, the Contractor will select specific timings for heavy machinery operation so as to cause least disturbance to the adjoining community by considering their peak movement hours. Haul-trucks carrying concrete, aggregate and sand fill materials will be kept covered with tarpaulin to control the dust pollution, in provision of safety measures, first aid kits, emergency vehicles, etc., at the work place. Contractor will have a full time Environmental officer at the Project site.

Proper arrangement in the form of alternative routes on the Project site during construction phase will be made to ensure that the mobility of the community is not disturbed.

Positive Impacts of the project

The operation of the Bhalwal Industrial Estate, Sargodha will accelerate the business activity in the area and will provide employment to locals that will have positive impact on the local economy thereby increasing the quality of life. In addition the establishment of industrial estate will accelerate the export of citrus from the region which will further increase in business of the area.

Cumulative Impacts of the Project

The Report recommends that there is a need that District and Provincial Government of Punjab should issue policy guidelines to the future development of the adjoining area to ensure that no haphazard housing colonies are allowed on Bhalwal-Bhera Road without conducting IEE/EIA, and keeping in view of the potential increase in the traffic, it is recommended that dualisation of Bhalwal-Bhera Road should be carried out.

Environmental Management Plan

For effective implementation and management of mitigation measures, an Environmental Management Plan has been prepared. The EMP provides a delivery mechanism to address potential impacts of project activities, to enhance project benefits and to introduce standards of good practice in all project activities.

Environmental sensitivities and impacts, as well as the associated mitigation plan have been addressed in the EMP. The proponent will ensure that the project staff will be adequately trained in HSE sensitivities and operational management procedures, so that all levels of staff effectively contribute to impact prevention and mitigation at all times.

An Environmental Management Plan (EMP), providing:

- A systematic approach to ensure that mitigation strategies prepared in this EIA are implemented during project activities.
- An appropriate monitoring plan is device to ensuring strict adherence to the environmental mitigation and control measures.
- A waste management plan, identifying the most suitable waste disposal and pollution control options throughout the project lifecycle.

The cost estimates for Environmental Monitoring of the Project during construction phase is Rs 1.58 m. The Plantation management plan is made for effective tree plantation and to reduce deforestation in project area by planting 506 saplings and Total cost of plantation on 1 acre land for the first year is estimated to be Rs 0.154 m.

Conclusion and Recommendations

It is concluded that there is a need for an industrial estate in Northern Punjab for establishment of industries in Sargodha District. Bhalwal Industrial Estate Sargodha Project will accelerate Socio-economic development and create job opportunities in Sargodha district.

The Bhalwal Industrial Estate Sargodha site has been examined with respect to the Pakistan Environmental Protection Agency guidelines for industrial estate and found to be in line with the criteria developed.

The EIA has identified potential impacts that are likely to arise during pre-construction, construction and operational phases of the project. For the effective implementation and management of the mitigation measures an Environmental Management Plan (EMP) has been prepared.

The PIE will ensure that the implementation of all phases of the project are in line with the EIA report and Environmental Management Plan. The industries, to be established at the estate, will be subjected to the basic provisions related to pollution control under the Pakistan Environmental Protection Act of 1997.

On the basis of the overall impact assessment and more specifically, nature and magnitude of the residual environmental impacts identified during the EIA, it is concluded that Project is likely to cause a few adverse environmental impacts during its construction phase as well as limited negative impacts during its operational phases, that could be prevented provided the proposed activities are carried out as mentioned in this EIA report, and the mitigation measures included in this report are completely and effectively implemented.

Table of Contents

1	Introduction	19
1.1	The Project.....	19
1.2	The Proponent	19
1.3	Environmental Impact Assessment	19
1.4	EIA Approach and Methodology.....	21
1.4.1	Approach	21
1.4.2	EIA Methodology.....	22
1.4.3	Organization of the Report	23
2	Policy, Legal and Administrative Framework.....	25
2.1	Introduction	25
2.2	National Conservation Strategy.....	25
2.3	Biodiversity Action Plan.....	25
2.4	National Environmental Policy, 2005.....	25
2.5	Laws and Regulations.....	26
2.5.1	Pakistan Environmental Protection Act, 1997.....	26
2.5.2	Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000	26
2.6	National Environmental Quality Standards (NEQS), 2000	26
2.6.1	NEQS for Liquid Effluent.....	27
2.6.2	NEQS for Gaseous Emission	28
2.6.3	NEQS for Vehicular Emission	29
2.6.4	NEQS for Drinking Water, 2010	29
2.6.5	NEQS for Ambient Air and Noise, 2010.....	31
2.7	Industrial Building Regulations of Punjab Industrial Estates.....	31
2.8	Antiquity Act, 1975	32
2.9	The Cutting of Trees (Prohibition Act), 1975	33
2.10	The Protection of Trees and Bush wood Act, 1949	33
2.11	The Local Government Ordinance, 2001.....	33
2.12	Pakistan Penal Code, 1860.....	33
2.13	Land acquisition Act, 1894.....	33
2.14	Institutional Set Up	34
2.15	Environmental Guidelines.....	34
2.15.1	Environmental Protection Agency's Environmental Guidelines.....	34
2.15.2	Guidelines for the Preparation of IEE/EIA Reports	34
2.15.3	World Bank Environmental Guidelines	35
2.15.4	ADB Guidelines.....	35
2.16	Obligation under International Treaties	35
2.17	Implication of Legislations to the Project	35
3	Description of the Project	37
3.1	Introduction	37
3.2	Objective of the Project.....	37

3.3	Statement of Need	37
3.4	Location of the Project.....	41
3.5	Description of the Project	41
3.5.1	Types of industries	44
3.5.2	Design Parameters	44
3.5.3	Land Acquisition.....	46
3.5.4	Project's Cost.....	46
3.5.5	Time Schedule	46
3.6	Project Phases.....	48
3.6.1	Pre-construction/Design Phase	48
3.6.2	Construction Phase.....	48
3.6.3	Operational Phase	51
3.7	Project Alternative Considered.....	51
3.7.1	Concept Plan 1	51
3.7.2	Concept Plan 2	52
3.7.3	Concept Plan 3	52
3.7.4	The Estimated Cost of Plans.....	52
3.7.5	The selected Plan	53
4	Existing Environment	57
4.1	Introduction	57
4.2	Project Area	57
4.3	Physical Environment	57
4.3.1	Topography.....	57
4.3.2	Geology and Soils.....	58
4.3.3	Soil Analysis of the Project Site.....	58
4.3.4	Minerals	61
4.3.5	Land Use	61
4.3.6	Surface water.....	61
4.3.7	Water Quality of the Project area	62
4.3.8	Climate.....	65
4.3.9	Ambient Air Quality	67
4.3.10	Noise and Vibration.....	71
4.3.11	Traffic and Transportation	73
4.4	Biological Environment.....	78
4.4.1	Flora	78
4.4.2	Fauna	79
4.5	Socio-cultural Environment.....	83
4.5.1	Population.....	83
4.5.2	Age Structure, Sex Ratio of Project Area	83
4.5.3	Religion Ratio in Project Area	83
4.5.4	Languages.....	84
4.5.5	Tribal Distribution	84
4.5.6	Dress in the Project area.....	84
4.5.7	Main Occupation of the Project area	84

4.5.8	Agriculture.....	85
4.5.9	Other Facilities of Life	85
5	Consultation with Stakeholders	88
5.1	Introduction	88
5.2	Objectives of Consultation	88
5.3	Meeting held with Stakeholders	88
5.3.1	District Wildlife Officer Sargodha.....	89
5.3.2	Mr. Nasar Hayat.....	89
5.3.3	Divisional Forest Officer Sargodha.....	89
5.3.4	Program Coordinator IUCN, Islamabad.....	90
5.3.5	Head of WWF, Islamabad	90
5.3.6	Inspector General of Forests. Islamabad.....	90
5.3.7	General Manager Noon Sugar Mill Ltd Bhalwal.....	91
5.3.8	Project Director Mona Reclamation Experimental Project	91
5.3.9	DCO District Sargodha.....	92
5.4	Community Consultations	92
6	Impact Assessment and Mitigation Measures	95
6.1	Introduction	95
6.2	Environmental Screening of the Project	95
6.3	Pre-Construction Impacts	99
6.3.1	Project Siting Impacts	99
6.3.2	Project Site, Land Use design	99
6.3.3	Visual Impact	102
6.3.4	Cumulative Impacts.....	103
6.4	Construction Phase Impacts	103
6.4.1	Soil Degradation	104
6.4.2	Air Quality Deterioration	105
6.4.3	Surface and Ground Water Contamination.....	106
6.4.4	Loss of Vegetation	107
6.4.5	Damage to Wildlife	109
6.4.6	Land Acquisition.....	110
6.4.7	Traffic Congestion.....	111
6.4.8	Noise and Vibration.....	111
6.4.9	Safety Hazards, Public Health and Nuisance	112
6.4.10	Damage to Infrastructure	114
6.4.11	Gender Issues.....	114
6.4.12	Sites of Archaeological or Historical Significance	115
6.5	Operational Phase Impacts.....	115
6.5.1	Damage to Flora and Fauna	116
6.5.2	Soil Contamination.....	116
6.5.3	Surface and Ground Water Contamination.....	118
6.5.4	Traffic Congestion.....	118
6.5.5	Safety Hazard, Public Health and Nuisance	119
6.6	Positive Impacts of the project.....	119

7	Environmental Management Plan.....	121
7.1	Introduction	121
7.2	Environmental Management Plan.....	121
7.3	Purpose and Objectives of EMP	121
7.4	Structure of the EMP	121
7.5	Management Approach	122
7.5.1	Pre-Construction and Construction Phase	122
7.5.2	Operation Phase	122
7.6	Organizational Structure and Responsibilities.....	122
7.6.1	Primary Responsibilities	122
7.6.2	Field Management and Quality Control	123
7.6.3	Approvals.....	123
7.6.4	Contractual Provisions	123
7.7	Impact Mitigation and Management Matrix	123
7.8	Change Management Plan	143
7.9	Post Project Environmental Monitoring.....	143
7.10	Communication and documentation.....	143
7.11	Training Programme.....	143
7.12	Objectives	143
7.13	Roles and Responsibilities	144
7.14	Training Programme.....	144
7.15	Training Log.....	144
7.16	Training Needs Assessment.....	144
7.17	Plantation Plan.....	144
7.18	Disaster Management Plan	146
7.18.1	Aim and purpose.....	146
7.18.2	Legislative requirements	146
7.18.3	BIE Flood Disaster Plan	146
7.19	General Recommendations	151
8	Conclusions and Recommendations	152
8.1	Introduction	152
8.2	Conclusions.....	152
8.3	The major conclusions of the EIA are:.....	152
8.4	Recommendations.....	153
9	References	156
	Annexure–A: Persons consulted during the study	157
	Annexure–B: List of Fauna of the Project Area	159
	Annexure–C: List of Flora in the Project Area	161
	Annexure–D: Filled Socio Economic Survey Performa’s.....	162

List of Tables

Table 1.1: Name and Addresses of Proponents Representative and Consultant.....	21
Table 2.1: NEQS for Liquid Effluent Discharge.....	27
Table 2.2: NEQS for Gaseous Emission	28
Table 2.3: NEQS for Vehicular Emission.....	29
Table 2.4: NEQS for drinking water quality.....	30
Table 2.5: NEQS for Ambient Air.....	31
Table 2.6: NEQS for Noise.....	31
Table 3.1: Industries located in selected cities of Punjab	38
Table 3.2: Area analysis of Bhalwal Industrial Estate Sargodha Project.....	42
Table 3.3: Characteristics of influent of Bhalwal Industrial Estate Sargodha	45
Table 3.4: Estimated Cost of the Industrial Estate, Bhalwal.....	46
Table 3.5: Time Schedule for construction of Bhalwal Industrial Estate Sargodha Project ..	47
Table 3.6: Contractor staff during construction phase of the project.....	51
Table 3.7: Estimated cost for concept plans.....	53
Table 4.1: Analysis of surface water quality parameters.....	63
Table 4.2: Analysis of ground water quality parameters	64
Table 4.3: Microbial Analysis of Ground water	64
Table 4.4: Climate data for Sargodha (1960-2012)	65
Table 4.5: Meteorological data of Bhalwal Industrial Estate Site, Sargodha District	66
Table 4.6: Ambient Air Monitoring at Industrial Estate BHALWAL	68
Table 4.7: Average obtained concentration of priority pollutants	71
Table 4.8: Noise monitoring at the project site	72
Table 4.9: Traffic Count at Industrial Estate BHALWAL.....	74
Table 4.10: Population of villages affected by the Project	83
Table 4.11: Overview of socio-economic survey	83
Table 4.12: Tribal Distribution of Project Area	84
Table 4.13: Shows sources of drinking water in the Project area.	86
Table 4.14: Electricity and gas availability in the Project area	86
Table 6.1: Impact Characterization.....	96
Table 6.2: Environmental Screening Matrix (Unmitigated).....	97
Table 6.3: Comparison of Land Use of Bhalwal Industrial Estate Sargodha with Pak EPA guidelines.....	101
Table 6.4: Industries Performance against Pollution Loads.....	101
Table 7.1: Impacts Mitigation and Management Matrix for Bhalwal Industrial Estate Sargodha Project	124
Table 7.2: Cost Estimates for Environmental Monitoring of the Project	139
Table 7.3: Environmental Monitoring Plan during construction phase for Bhalwal Industrial Estate Sargodha Project	140
Table 7.4: Environmental Monitoring Plan during operational phase for Bhalwal Industrial Estate Sargodha Project	142
Table 7.5: Cost Estimates for Plantation (1 acre land).....	146
Table 8.1: Impact Matrix – Residual Impacts (Mitigated)	154

List of Figures

Figure 1.1: Key Location of the Project	20
Figure 3.1: Industrial Estates in Punjab	40
Figure 3.2: Layout Plan of Bhalwal Industrial Estate, Sargodha, Punjab	43
Figure 3.3: Concept plan Option-1 of Bhalwal Industrial Estate, Sargodha, Punjab.....	54
Figure 3.4: Concept plan Option-2 of Bhalwal Industrial Estate, Sargodha, Punjab.....	55
Figure 3.5: Conceptual Option-3 for Bhalwal Industrial Estate Project.....	56
Figure 4.1: A view of the Project area of Bhalwal Industrial Estate Sargodha Project.....	60
Figure 4.2: CO concentration during 24 hour monitoring	69
Figure 4.3: NO _x concentrations during 24 hour monitoring	69
Figure 4.4: NO concentration during 24 hour monitoring	70
Figure 4.5: NO ₂ concentration during 24 hour monitoring	70
Figure 4.6: SO ₂ concentration during 24 hour monitoring	71
Figure 4.7: Noise monitoring at the project site	73
Figure 4.8: Flora of the project area	80
Figure 4.9: Fauna of the project area	81
Figure 4.10: Bhalwal Industrial Estate and Nabi Shah Lake	82
Figure 4.11: Socio-economic setting of the Bhalwal	87
Figure 5.1: Public Consultation with Primary and Secondary Stakeholders.....	94

List of Abbreviations

ADB	Asian Development Bank
BIE	Bhalwal Industrial Estate
BOD	Biological Oxygen Demand
CETP	Combined Effluent Treatment Plant
CO	Carbon Mono Oxide
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
D.Com	Diploma of Commerce
E	East
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPD	Environmental Protection Department
IEE	Initial Environmental Examination
Govt.	Government
G T Road	Grand Trunk Road
Mgt. Sc.	Management Sciences
MPN	Most Probable Number
N	North
NaCl	Sodium Chloride
NCS	National Conservation Strategy
NE	North-East
NEQS	National Environment Quality Standards
NOC	No Objection Certificate
No.s	Numbers
NOx	Nitrogen Oxides
Pak-EPA	Pakistan Environmental Protection Agency
PEPA	Pakistan Environmental Protection Act 1997
PEPC	Pakistan Environmental Protection Council
PSQCA	Pakistan Standards Quality Control Authority

PM	Particulate Matter
Pvt.	Private
S	South
PIE	Punjab Industrial Estates Development and Management Company
SE	South-East
SOx	Sulphur Oxides
Sr. No.	Serial Number
SW	South-West
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UNEP	United Nations Environment Programme
W	West
WAPDA	Water and Power Development Authority
WB	World Bank
WHO	World Health Organization

List of Units

%	Percent (age)
°C	Degree centigrade
cm	Centi meter
dB (A)	Decibel
ft²	Square foot
ft³	Cubic foot
Km	Kilo meter
Km/h	Kilometer/hour
m	Meter
m²	Square meter
m³	Cubic meter
MT	Metric Ton

1 Introduction

1.1 The Project

Punjab Industrial Estate Development and Management Company (PIE) has planned the establishment of Bhalwal Industrial Estate Sargodha Project. The key location map of the Project is provided in **Figure 1.1**.

In order to comply with the regulatory requirement of Pakistan Environmental Protection Act (PEPA, 1997), Punjab Industrial Estate Development and Management Company (PIE) has acquired the services of M/s EA Consulting Pvt Ltd. as project Consultants.

This report provides an overview of Project description, alternatives considered, baseline environmental conditions, identification and assessment of potential impacts, mitigation measures and environmental management plan.

1.2 The Proponent

The Government of Punjab has set up PIE to achieve orderly, planned and rapid industrialization of Punjab by developing a chain of industrial estates in a dynamic and innovative manner, this aims at providing turnkey solutions to the problems by prospective entrepreneurs.

The objective of establishing PIE is providing quality infrastructure; ensure efficient, cost effective and sustainable management of industrial estates; and to enact on “One Window Operation” by providing utilities and services to industrial estates.

The PIE is led by private sector so that it can be more flexible, able to respond to the changing environment and designed to be financially self-sustainable in order to maintain desired impetus or developmental works.

The PIE has successfully launched and completed Industrial Estates at Sundar, Rahim Yar Khan and Kot Lakhpat with the participation of private sector and encouraged by the previous experience, intends to launch a new Industrial Estate in Bhalwal located in the center and sugar cane producing area.

1.3 Environmental Impact Assessment

According to the Pakistan Environmental Protection Act, 1997, Section 12 (1): “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 an adverse environmental effects an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof. “Under the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2000”, Industrial Estates in Schedule II, List of projects requiring an EIA. Therefore, an Environmental Impact Assessment of Bhalwal Industrial Estate Sargodha has to be carried out.

Figure 1.1: Key Location of the Project

1.4 Aims and Objectives of the EIA

The aims and objectives of the EIA of Bhalwal Industrial Estate Sargodha are as follows:

- Develop the baseline environmental conditions of the project area.
- Identification of all significant impacts that may require detailed assessment.
- Consultation with the community to be affected by the Project.
- Identification and assessment of all major and minor impacts during Pre-Construction, Construction and Operation phases
- Evaluating those impacts;
- To propose mitigation measures in order to minimize, eliminate or compensate the potential adverse impacts of the Project that are identified during assessment.
- Preparation of Environmental Management Plan (EMP)
- Preparation of an Environmental Impact Assessment (EIA) report for submission to the Environmental Protection Agency Punjab.

In case of further details or clarifications regarding this EIA, please contact the proponent's representative or the consultant at the addresses provided in the **Table 1.1.**

Table 1.1: Name and Addresses of Proponents Representative and Consultant

Proponent's Representative	Consultant
Punjab Industrial Estates Development and Management Company Commercial Area (North) Sundar Industrial Estate, Raiwind Road, Lahore. Tel: 042-35297203-6 info@pie.com.pk	EA Consulting Pvt. Ltd Al 9, 15th Lane, OFF Kh-e-Hilal, DHA 7, Karachi 75500 Pabx: 021 111 111 584 Fax: 021 351825 Email: tayyab.syed@eaworld.com
Mr Naveed Mushtaq Gill General Manager Technical	Mr Syed Muhammad Tayyab Principal Engineer (Transp. Engg. & Management)

1.4 EIA Approach and Methodology

1.4.1 Approach

The approach for conducting EIA of Bhalwal Industrial Estate Sargodha is to follow the requirement of Pakistan Environmental Protection Agency's (Review of IEE/EIA), Regulations 2000.

The Consultant engaged a team of experts for conducting EIA study, which included the following persons:

- Engr. Muhammad Tayyab, Principal Engineer

- Engr. Saadat Ali, Environmental Advisor/Team Leader
- Engr. Sabah Iqbal, Environmental Engineer
- Engr. Warda Ajaz, Environmental Engineer
- Dr Ali Gohar, Flora and Fauna Expert

1.4.2 EIA Methodology

Kick off Meeting with the client: The Consultant team held a kick off meeting with PIE technical staff at the start of the EIA study.

Collection of secondary data: The consultant team obtained published secondary data of Bhalwal Tehsil and Sargodha District that included:

Physical conditions - including topography, geology, soils, surface and groundwater resources and climate:

Ecological resources - including flora and fauna:

Human and economic development – including settlements, socio-economic conditions, infrastructure and land use;

Heritage aspects – including sites of cultural, archaeological or historical significance

The secondary data was also collected which provided a detailed insight into the biological environment of the area which included work conducted by International INGOs i.e., IUCN, WWF-P, as well as Forest and Wildlife Departments of GoP.

Information on all secondary data sources consulted during the EIA study is provided in **Annexure-1**.

Collection of primary data and field visit: The EIA team visited the Project area for collection of base line data. The baseline data of the Project site for ambient air quality, noise, surface and ground water resources was collected. The analyses were carried out by SGS Pakistan (Private) Limited, Karachi.

Biological Data Collection: Primary data for flora and fauna was collected at different sampling locations. Sampling locations were randomly selected, ensuring that sufficient locations are sampled to observe maximum number of vegetation and faunal species.

The faunal field data collection included incidental sightings and plot searches for birds, small mammals and reptiles.

Analysis of alternatives: The EIA report gives the details of three alternatives conceptual plans which were considered during the detailed design stage of the Project.

Public consultation: Public consultations were held with the major stakeholders including meetings World Wide Fund (WWF), International Union for Conservation of Nature (IUCN), Industrialists, MONA, Wildlife and Forest Departments of

Government of Punjab, and the communities living around Bhalwal Industrial Estate Sargodha Project area to obtain and document their views/concerns. The information obtained from the local communities was used to identify concerns and issues that have been subsequently mentioned and addressed in the EIA report.

During public consultation with the community, a total of four villages were visited and 33 males and females were interviewed. The Rapid Social Appraisal (RSA) method was applied to discover the facts, empirically verifiable observations or verifying the old facts, on the prevailing socio-economic and cultural conditions of the Project area. A list of persons met during EIA study is provided in **Annexure 2**.

Review of Legislative Requirements: The information on all legislation pertaining to the Project was reviewed and a synopsis of all relevant laws has been narrated in the report.

Impacts Assessment: The identification of impacts is a key activity in the environmental assessment process, which is based on the professional judgment of our experienced team on the basis of national and international guidelines. Impacts were identified for methodical consideration of likely or possible significant effects on environment because of Bhalwal Industrial Estate Sargodha. The objective of this task was to assess the risks associated with these impacts.

Evaluation of Impacts: Each impact identified was evaluated against its significance in terms of its severity and likelihood of its occurrence. The impact evaluation process prioritized each potential impact and screened out insignificant or inconsequential impacts. The significance of the impacts was then assessed in terms of the effects on the natural ecosystem. The evaluation of the significant impacts thus formed the basis for development of environmental mitigation, management and monitoring plans.

Identification of Mitigation Measures: The objective of identification of mitigation measures was to identify practices, technologies or activities that would prevent or minimize all significant environmental impacts and propose physical and procedural controls to ensure that mitigation is effective. On the basis of the impact evaluation performed, changes or improved practices were suggested where applicable, in the planned activities, to prevent and control unacceptable adverse impacts resulting from normal or extreme events.

Development of Environmental Management Plan: An EMP has been developed for effective implementation of the recommended mitigation measures. The EMP includes controls to minimize the identified impacts, and monitoring program to monitor residual impacts, if any, during the construction and operational phases of the Project. The EMP also lays down procedures to be followed during the operational phase of the Project. The EMP also identifies roles and responsibilities of all concerned personnel during the Project's construction and operational phases.

1.4.3 Organization of the Report

This report has been structured in the following manner:

Chapter 1 (*Introduction*) provides an overall introduction to the project and impact assessment methodology.

Chapter 2 (*Legal Framework*) describes the regulatory framework of Pakistan on environment and its implications on the project.

Chapter 3 (*Project Description*) provides the description of the proposed project, its layout plan and associated activities, raw material details and utility requirement.

Chapter 4 (*Existing 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 land of project area and surroundings.

Chapter 5 (*Public Consultation*) this chapter describes details of discussions held with primary and secondary stakeholders.

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 using the matrix method.

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.

Chapter 8 (*Conclusion*) summarizes the report and presents its conclusions.

The last Chapter is followed by the references and series of **Annexes** that provide supporting information.

2 Policy, Legal and Administrative Framework

2.1 Introduction

The enactment of comprehensive legislation on the environment, covering multiple areas of concern, is an ongoing phenomenon in Pakistan. The basic policy and legislative framework for the protection of the environment and overall biodiversity in the country is now in place. The detailed rules, regulations and guidelines required for the implementation of the policies and enforcement of legislation are also in place.

The Bhalwal Industrial Estate Sargodha Project has been assessed in compliance of existing legal framework on the environment in Pakistan as described henceforth.

2.2 National Conservation Strategy

The National Conservation Strategy is the first policy document that pledged to balance Pakistan's economic development with the conservation of natural resources. It is the underlying goal of this document that all economic and statutory development in the country should be such that it does not conflict with the interests of nature conservation. The Pakistan Environmental Protection Act, 1997 is the basic legislative tool empowering the government to frame rules and regulations for the protection of the environment. NCS covers 14 cover areas and environment is also included.

The policy, laws, regulations and standards relevant to the Bhalwal Industrial Estate Sargodha Projecting the context of environmental protection are described in the following sections.

2.3 Biodiversity Action Plan

Pakistan has ratified on 5th June 1992 to the Convention on Biological Diversity, and is thereby obligated to develop a National Strategy for the Conservation and management of Biodiversity in the country. The Government of Pakistan has constituted a Biodiversity Working Group under the auspices of the Ministry of Environment to develop a Biodiversity Action Plan for the country. After an extensive consultative exercise, a draft Action Plan has been developed. The Plan, which has been designed to complement the National Conservation Strategy (NCS) and the proposed provincial conservation strategies, identifies the causes of biodiversity loss in Pakistan and suggests a series of proposals for action to conserve biodiversity in the country.

2.4 National Environmental Policy, 2005

The National Environment Policy (NEP) aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development. In NEP, the further sectorial guidelines, Energy Efficiency

and Renewable directly related to building energy code for newly constructed buildings were introduced.

2.5 Laws and Regulations

2.5.1 Pakistan Environmental Protection Act, 1997

The Pakistan Environmental Protection Act, 1997 (the Act) is the basic legislative tool. The Act is applicable to a broad range of issues and extends to air, water, soil, marine and noise pollution, as well as the import and handling of hazardous waste. The discharge or emission of any effluent, waste, air pollutant or noise in an amount, concentration or level in excess of the National Environmental Quality Standards (NEQS) specified by the Pakistan Environmental Protection Agency (Pak EPA), and penalties have been prescribed for those contravening the provisions of the Act. The powers of the Federal and Provincial Environmental Protection Agencies (EPAs), established under the Pakistan Environmental Protection Act 1997, have also been 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.

The requirement for environmental assessment is laid out in Section 12 (1) of the Act. The section 12(6) of the act states that this provision is applicable only to such categories of Projects as provided in Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2000.

2.5.2 Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000

The Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 (the Regulations) prepared by the Pakistan Environmental Protection Agency under the powers conferred upon it by the Act, provide the necessary details on preparation, submission and review of the IEE and the EIA. Categorization of Projects for IEE and EIA is one of the main components of the Regulations. Projects have been classified on the basis of expected degree of adverse environmental impacts. Project types listed in Schedule-I are designated as potentially less damaging to the environment and those listed in Schedule-II as having potentially serious adverse effects. Schedule-I Projects require an IEE to be conducted, provided they are not located in environmentally sensitive areas. For the schedule-II Projects, conducting an EIA is necessary.

2.6 National Environmental Quality Standards (NEQS), 2000

The National Environmental Quality Standards (NEQS), 2000 specify the following standards:

- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged into inland waters, sewage treatment facilities, and the sea (three separate sets of numbers)

- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources
- Maximum allowable concentration of pollutants (02 parameters) in gaseous emissions from vehicle exhaust and noise emission from vehicles.
- Maximum allowable noise levels from vehicles.

These standards also apply to the gaseous emissions and liquid effluents generated by generator, process waste etc. The standards for vehicles will apply during the construction as well as operation phase of the project. Standards for air quality have not been prescribed as yet.

2.6.1 NEQS for Liquid Effluent

The National Environmental Quality Standards (NEQS) for discharge of effluent from industry are presented in **Table 2.1**.

Table 2.1: NEQS for Liquid Effluent Discharge

Parameters	Existing Standards	Revised Standards		
		Into Inland Waters	Into Sewage Treatment	Into Sea
Temperature	40°C	≤3°C	≤3°C	≤3°C
pH Value	6-10	6-9	6-9	6-9
Biological Oxygen Demand (BOD) ₅	80	80	250	80
Chemical Oxygen Demand (COC)	150	150	400	400
Total Suspended Solids (TSS)	150	200	400	200
Total Dissolved Solids (TDS)	3500	3500	3500	3500
Grease & Oil	10	10	10	10
Phenolic Compounds (as phenol)	0.1	0.1	0.3	0.3
Chlorides (as Cl')	1000	1000	1000	SC
Fluoride (as F')	20	10	10	10
Cyanide (CN') total	2	1.0	1.0	1.0
An-ionic Detergents (as MBAs)	20	2.0	20	20
Sulphate (SO'')	600	600	1000	SC
Sulphide (S')	1.0	1.0	1.0	1.0
Ammonia (NH ³)	40	40	40	40
Pesticides	0.15	0.15	0.15	0.15
Cadmium	0.1	0.1	0.1	0.1
Chromium (trivalent & hexavalent)	1.0	1.0	1.0	1.0
Copper	1.0	1.0	1.0	1.0
Lead	0.5	0.5	0.5	0.5
Mercury	0.01	0.01	0.01	0.01

Parameters	Existing Standards	Revised Standards		
		Into Inland Waters	Into Sewage Treatment	Into Sea
Selenium	0.5	0.5	0.5	0.5
Nickel	1.0	1.0	1.0	1.0
Silver	1.0	1.0	1.0	1.0
Total Toxic Metals	2.0	2.0	2.0	2.0
Zinc	5.0	5.0	5.0	5.0
Arsenic	1.0	1.0	1.0	1.0
Barium	1.5	1.5	1.5	1.5
Iron	2.0	8.0	8.0	8.0
Manganese	1.5	1.5	1.5	1.5
Boron	6.0	6.0	6.0	6.0
Chlorine	1.0	1.0	1.0	1.0

Source: NEQS, Pakistan Environmental Protection Agency

2.6.2 NEQS for Gaseous Emission

The National Environmental Quality Standards (NEQS) for permissible limits of gaseous emission from industry are presented in **Table 2.2**.

Table 2.2: NEQS for Gaseous Emission

Parameter	Source of Emission	Existing Standards	Revised Standards
Smoke	Smoke opacity not to exceed	40% or 2 Ringlemann Scale	40% or 2 Ringlemann Scale or equivalent smoke number
Particulate Matter	Boilers & Furnaces:		
	Oil Fired	200	300
	Coal Fired	500	500
	Cement Kilns	200	300
	Grinding, crushing, clinker coolers and related processes, metallurgical processes, converters, blast furnaces and cupolas	500	500
Hydrogen Chloride	Any	400	400
Chlorine	Any	150	150
Hydrogen Fluoride	Any	150	150
Hydrogen Sulphide	Any	10	10

Parameter	Source of Emission	Existing Standards	Revised Standards
Sulphur Oxides	Sulfuric Acid/sulphonic Acid Plants	400	5000
	Other Plants except power plants operating an oil and coal	400	1700
Carbon Monoxide	Any	800	800
Lead	Any	50	50
Mercury	Any	10	10
Cadmium	Any	20	20
Arsenic	Any	20	20
Copper	Any	50	50
Antimony	Any	20	20
Zinc	Any	200	200
Oxides of Nitrogen	Nitric Acid Manufacturing Unit	400	3000
	Other plants except power plants operation on oil or coal:	400	400
	Gas fired	-	600
	Oil fired	-	1200
	Coal fired	-	1200

Source: NEQS, Pakistan Environmental Protection Agency

2.6.3 NEQS for Vehicular Emission

The National Environmental Quality Standards (NEQS) for permissible limits of exhaust emissions from vehicles are presented in **Table 2.3**.

Table 2.3: NEQS for Vehicular Emission

Parameters	Standards (Maximum permissible limits)	Measuring Method
Smoke	40% or 2 on the Ringleman Scale During engine acceleration mode	To be compared with Ringleman chart at a distance of 6 meters or more
Carbon Monoxide	Emission Standards: New Vehicle = 4.5%	Under idling conditions: non-dispersive infrared detection through gas analyzer.
	Used Vehicle = 6%	
Noise	85 db (A)	Sound meter at 7.5 meter from the source

Source: NEQS Pakistan Environmental Protection Agency

2.6.4 NEQS for Drinking Water, 2010

The National Environmental Quality Standards (NEQS) for drinking water quality, 2010 are presented in **Table 2.4**.

Table 2.4: NEQS for drinking water quality

Parameter	Standard values for Pakistan	WHO standards
Physical		
Color	≤ 15 TCU	≤ 15 TCU
Taste	Non acceptable	Non acceptable
Odour	Non acceptable	Non acceptable
Turbidity	< 5 NTU	< 5 NTU
Total hardness	< 500 mg/L	---
TDS	<1000	<1000
pH	6.5- 8.5	6.5- 8.5
Chemical		
Essential Organic	Mg/Litre	Mg/Litre
Aluminium	≤ 0.2	0.2
Antimony	≤ 0.005	0.02
Arsenic	≤ 0.05	0.01
Barium	0.7	0.7
Boron	0.3	0.3
Cadmium	0.01	0.003
Chloride	≤ 250	250
Chromium	≤ 0.05	0.05
Copper	2	2
Toxic Inorganic		mg/Litre
Cyanide	≤ 0.05	0.07
Flouride	≤ 1.5	1.5
Lead	≤ 0.05	0.01
Manganese	≤ 0.5	0.5
Mercury	≤ 0.001	0.001
Nickel	≤ 0.02	0.02
Nitrate	≤ 50	50
Nitrite	≤ 3	3
Zinc	5	3
Organic		
Pesticides mg/L		PSQCA No.4639-2004.page No 4 Table No. 3serial No. 20-58
Phenolic Compounds		<0.002
Polynuclear aromatic hydrocarbons		0.01
Radioactive		
Alpha emitters bq/L	0.1	0.1
Beta emitters	1	1

Source: NEQS Pakistan Environmental Protection Agency

2.6.5 NEQS for Ambient Air and Noise, 2010

The National Environmental Quality Standards (NEQS) for Ambient Air and Noise, 2010 are presented in **Table 2.5** and **2.6**.

Table 2.5: NEQS for Ambient Air

Pollutants	Time Weighted Average	Concentration in Ambient Air (ug/m ³)	
		Effective from 1 st July, 2010	Effective from 1 st January, 2013
Sulphur Dioxide	Annual Average* 24 hrs**	80 120	80 120
oxides of Nitrogen (NO)	Annual Average* 24 hrs**	40 40	40 40
O ₃	1 hour	180	130
Suspended	Annual Average*	400	360
Particulate Matter	24 hours	550	500
Lead	Annual Average* 24 hrs**	1.5 2	1 1.5
Carbon monoxide	8 hours	5mg/m ³	5mg/m ³

** Annual Arithmetic mean of minimum 40 measurements in a year taken twice a week 24 hourly at uniform interval

* 24 hourly /8 hourly values should be met 98 % of the year, 2 % of time, it may exceed.

Source: NEQS Pakistan Environmental Protection Agency

Table 2.6: NEQS for Noise

Category of Area/ Zone	Effective from 1 st July, 2010		Effective from 1 st July, 2012	
	Limits in dB(A) Leq			
	Day time	Night time	Day time	Night time
Residential area	65	50	55	45
Commercial area	70	60	65	55
Industrial area	80	75	75	65
Silence area	55	45	50	45

Source: NEQS Pakistan Environmental Protection Agency

2.7 Industrial Building Regulations of Punjab Industrial Estates

These By-Laws may be called Punjab Industrial Estate Building By-Laws and shall come into force as and when notified by PIE from September 2007. These By-laws shall be applicable within areas acquired or to be acquired by PIE in the estate. The design and construction of buildings in the estate shall be in conformity with these Building By-Laws. The industrial plots shall only be used for industrial purpose and will not be used directly or indirectly for residential or any other purpose which contravenes with the industrial uses. The PIE or any person authorized in this behalf shall have power shall have power to make amendments, alternations, or additions in these By-Laws or relax any of its provisions.

- The ground to be covered by the building shall be reasonably free from any material that might damage the building or affect its stability, including vegetable matter, topsoil and preexisting foundations.
- For the purpose of this requirement “containment” means any substance which is or may become harmful to persons or buildings including substances which are corrosive, explosive, flammable, radioactive or toxic.
- A wide range of solid, liquid and gaseous containments can arise on the sites; especially in those that have had a previous industrial use. In particular, the burial of biodegradable waste in landfill can give rise to land filled gas. Sites with a generally rural use such as agriculture or forestry may be containment by pesticides, fertilizers, fuel and oils and decaying matter of biological origin.

Compliance to design codes

The structural design of buildings shall meet the requirements of the specified or latest editions of the following design codes.

- Uniform Building Code, 1997 Edition, International Conference of Building Officials, USA
- International Buildings Code, 2000 Edition, International Code Council, USA
- Building code of Pakistan
- Building Code Requirement for structural concrete (ACT 318-99) and Commentary (ACT 318 R-99), American Concrete Institute, USA.

Sanitation and drainage

On every plot, there shall be paved surface drains for disposal of surplus water. These surface drains shall be regularly flushed at least once a day. No obnoxious sewerage shall be connected with sewerage system of the estate. The pumping system for the sewerage shall be connected with sewerage system of the estate or any other arrangements approved by PIE. Industrial wastes or effluents shall be pretreated to a level as approved by PIE and NEQS standards of Pakistan, before disposal into sewerage system or any other arrangements provided. Minimum pre-treatment will be in the form of an approval size/shape of a solid Retention Tank/septic tank.

Solid Waste Storage

Every plot shall have adequate means of storing solid waste for a minimum of 24 hours generation. Waste treatment plants and disposal works shall be provided in accordance with design and construction requirements of industries department and Environmental Protection Agency (EPA). Waste treatment plant and disposal station shall not be constructed in the mandatory open spaces.

2.8 Antiquity Act, 1975

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The act is designed to protect antiquities from destruction, theft, negligence, unlawful

excavation, trade and export. 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 law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain articles of archaeological significance.

Under the Act, the Project proponents are obligated to:

- Ensure that no activity is undertaken in the proximity of a protected antiquity, and
- If during the course of the Project an archaeological discovery is made, it should be reported to the Department of Archaeology, Government of Pakistan.

2.9 The Cutting of Trees (Prohibition Act), 1975

Section 3 of this Act states “No person shall, without the prior written approval of the local formation commander or an officer authorized by him in this behalf, cut fell or damage or cause to cut, fell or damage any tree.”

2.10 The Protection of Trees and Bush wood Act, 1949

This Act prohibits cutting or chopping of trees and bush wood without permission of the Forest Department.

2.11 The Local Government Ordinance, 2001

A schedule 4 and 8 of this Ordinance pertains to environmental pollution. Under the Ordinance, the local councils are authorized to restrict Projects causing pollution to air, water or land. They may also initiate schemes for improving the environment.

2.12 Pakistan Penal Code, 1860

This outlines the penalties for violations concerning pollution of air, water bodies and land. Sections 272 and 273 of this Act deal with the adulteration of food or drink. Noise pollution has been covered in Section 268, which defines and recognizes noise as a public nuisance. “A person is guilty of a public nuisance who does any act or is guilty of an illegal omission which causes any common injury, danger or annoyance to the public or to the people in general who dwell or occupy property in the vicinity, or which must necessarily cause injury, obstruction, danger or annoyance to persons who may have occasion to use any public right.”

2.13 Land acquisition Act, 1894

The land acquisition act of 1894 was created with the expressed purpose of facilitating the government’s acquisition of privately held land for public purposes. The word “public purpose”, as defined in the act, refers to the acquisition of land for putting up educational institutions or schemes such as housing, health or slum

clearance, apart from the Projects for rural planning or formation of sites. The word "government" refers to the central government if the purpose for acquisition is for the union and for all other purposes it refers to the state government. It is not necessary that all the acquisition has to be initiated by the government alone. Local authorities, societies registered under the societies registration act, 1860 and co-operative societies established under the co-operative societies act can also acquire the land for developmental activities through the government.

2.14 Institutional Set Up

The apex environmental body in the country is the Pakistan Environmental Protection Council (PEPC), presided by the Chief Executive of the Country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and environmental tribunals.

The EPAs were first established under the 1983 Environmental Protection Ordinance; the PEPA 1997 further strengthened their powers. The EPAs have been empowered to receive and review the environmental assessment reports (IEEs and EIAs) of the Projects, and provide their approval (or otherwise).

The Bhalwal Industrial Estate Sargodha Project is located in Sargodha. Therefore, the EIA report will be submitted to PEPA for obtaining environmental approval for the Project.

2.15 Environmental Guidelines

Three sets of guidelines, the Pak-EPA's Environmental Guidelines, the World Bank Environmental Guidelines, and ADB Environmental Guidelines are reviewed here.

2.15.1 Environmental Protection Agency's Environmental Guidelines

The Pak EPA has prepared a set of guidelines for conducting environmental assessments. The package of regulations, of which the guidelines form a part, includes the PEPA 1997 and the NEQS. The guidelines themselves are listed below:

- Guidelines for the Preparation and Review of Environmental Reports,
- Guidelines for public consultation,
- Guidelines for Sensitive and Critical Areas, Sectorial Guidelines.

It is stated in the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 that the EIA or IEE must be prepared, to the extent practicable, in accordance with the Pakistan Environmental Protection Agency guidelines.

2.15.2 Guidelines for the Preparation of IEE/EIA Reports

The GoP has also framed guidelines for the preparation of EIA of Projects in various developmental sectors.

2.15.3 World Bank Environmental Guidelines

The principal World Bank publications that contain environmental guidelines are as follows:

- Pollution Prevention and Abatement handbook 1998: Towards Cleaner Production, (WB/UNIDO/UNEP, 1999).
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectorial issues, (WB, 1991).

2.15.4 ADB Guidelines

The principle ADB guidelines relevant to this Project are the Environmental Assessment Guidelines (ADB, 2003). The guidelines has two parts; the first providing an overview of the environmental assessment requirements and procedures, and the second, the technical guidelines. In addition, the guidelines include Rapid Environmental Assessment checklists for different sectors, contents and templates of the EIAs as well as IEEs.

2.16 Obligation under International Treaties

Pakistan is a signatory to various international treaties and conventions on the conservation of the environment and wildlife protection. The country is obliged to adhere to the commitments specified in these treaties. The Convention of Biological Diversity (CBD) 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 programs 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.

The Convention on the Conservation of Migratory species of Wild Animals, 1979 requires countries to take action to avoid endangering migratory species, where the term migratory species refers to species of wild animals of which significant proportions cyclically and predictably cross one or more national jurisdictional boundaries.

The parties are also required to promote or cooperate with research into migratory species. Under the international plant protection convention, 1951, Pakistan is required to take steps to ensure the protection of certain plant species that face the extinction threat. Pakistan signed and ratified on a number of international agreements and Convention and bound to implement them in its territory

2.17 Implication of Legislations to the Project

The implication of the above mentioned legislations to the pre-construction, construction and operation of Bhalwal Industrial Estate Sargodha Project would be as follows:

The PIE being the proponent of the project shall ensure that during pre-construction and construction phases of the project are in line with the EIA report and Environmental Management Plan is implemented.

During operation phase, the industrial units at Bhalwal Industrial Estate Sargodha will be subjected to four basic provisions relating to pollution control under the PEPA 97 are contained in section 11, 13, 14, 15, 16 and 17 (7) as follows:

- Section 11, prohibits discharge or emission of any effluent or waste or air pollutant or noise in excess of the NEQS, or the established ambient standards for air, water or land.
- Section 13, prohibits of hazardous wastes.
- Section 14, prohibits the handling of hazardous substance except under license or in accordance with provision of any local law or international agreement.
- Section 15, prohibits operation of motor vehicles for each air pollutant or noise is being emitted in excess of the NEQS or the established ambient standard.
- Under section 16 of PEPA, the Director General of the agency can issue EPO.
- Section 17 (7), the Director General, EPA may be imposed administrative penalty.

3 Description of the Project

3.1 Introduction

Punjab Industrial Estates Development and Management Company (PIE) intend to implement Bhalwal Industrial Estate Sargodha Project. This Chapter provides a description of the project, location, its salient features, components and various phases.

3.2 Objective of the Project

The main objective of Bhalwal Industrial Estate Sargodha Project is to provide developed plots to the interested entrepreneurs, for establishment of industries for the economic development of Sargodha district and to develop an industrial estate where issues of industrialists are handled and solved through 'One Window' operation.

3.3 Statement of Need

Pakistan has tremendous potential for industrial growth and export through value addition to its agricultural production. Lack of facilities and infrastructure, and under-developed entrepreneurship especially of small and medium scale, has been a constraint in the realization of their full potential, for agro-industries. Shortage of serviced land and facilitation especially for small and medium entrepreneur has been a constraint in utilization of full potential.

Experience in the country and elsewhere strongly indicates that industries thrive better when established in a planned environment of an industrial estate. The benefits of an industrial estate include:

- Structured platform available to set up industries
- Developed infrastructure available
- Support services/utilities provided at one location
- Availability of skilled/unskilled manpower
- Relatively secure environment
- Easy to comply with environmental regulations

Punjab economy is mainly agricultural, although industry makes a substantial contribution. The province is playing a leading role in agricultural production. It contributes about 68% to the annual food grain production in the country. 51 million acres of land is cultivated and another 9.05 million acres is lying as cultivable waste in different parts of the province.

Cotton and rice are important cash crops that contribute substantially to the national exchequer. Attaining self-sufficiency in agriculture has shifted the focus of the strategies made towards small and medium farming, stress on barani areas, farms-

to-market roads, electrification for tube-wells and control of water logging and salinity.

Punjab also has more than 48 thousand industrial units. The small and cottage industries are in abundance. According to Punjab Board of Investment and Trade, there are 20,134 industrial units, employing 2.3 million in 13 cities of Punjab. The Central Punjab has a maximum concentration of industries, i.e. Lahore has 41 % of industries mainly comprising of small light engineering units; Sialkot has 36% of industries comprising of sports goods, surgical instruments and cutlery goods whereas, Sargodha has only 1.74% of industries comprising of citrus and as such there is a need to spread the industrial base from Central Punjab to the North. **Table 3.1** provides data of industries with employees located in selected cities of Punjab. The **Figure 3.1** shows the Industrial Estates located in Punjab.

Table 3.1: Industries located in selected cities of Punjab

District	Industries	Employees	% Industries
Lahore			
Auto Parts	610	200,000	41.47
Foundry	600	10,000	
Plastics	90	1,500	
PVC Pipes	250	3,000	
Printing	2,000	50,000	
Publishing	150	30,000	
Publishing	150	30,000	
Garment	4,500	250,000	
Sialkot			
Sports Goods	4,500	60,000	35.81
Surgical Equipment	1,900	150,000	
Sports Wear	310	10,000	
Leather Garments	500	21,300	
Multan			
Handloom	423	3,300	4.29
Bed linen	160	10,000	
Mangos	280	250,000	
Okara and Sahiwal			
Potato	450	240,000	3.87
Dairy	330	800,000	
Gujranwala			
Ceramic Sanitary	100	3,500	3.38
Electrical Home Appliances	280	4,000	
Cutlery	300	5,000	

District	Industries	Employees	% Industries
Gujrat			
Wooden Furniture	350	8,000	3.03
Electric Fans	260	10,000	
Faisalabad			
Light Engineering	220	2,700	2.36
Textile Processing	255	35,000	
Kasur			
Tanneries	237	2,300	1.75
Flowers	115	3,000	
Sargodha			
Electrical Fittings	150	100,000	1.74
Citrus processing	200	30,000	
Rawalpindi			
Marble and Granite	200	2,000	1.29
Pharmaceutical	60	4,000	
Bahawalpur and Rahim Yar Khan			
Cotton Ginning	204	6,700	1.01
G Total	20,134	2,335,300	100.00

Source: Punjab Board of Investment and Trade 2012

Pakistan is the sixth largest producer of Kinow (Mandarin) and oranges in the world, with a production of 2.1 million tons. Pakistan is also the largest producer of “Citrus Reticula”, a variety of Kinow. This unique variety of citrus is indigenous to this part of the world. According to an estimate, approximately 95% of the total Kinow produced all over the world is grown in Pakistan. During 2008-09, a total of US\$237 million of horticultural were exported from Pakistan, out of which 25% were of Kinow.

Citrus fruit is grown in all four provinces of Pakistan but Punjab produces over 97% of the crop because of its favorable growing conditions and adequate water, whereas Sargodha’s share is 50%.

The importance of establishment of modern industrial parks/estates cannot be over emphasized in the present era of economic recession when we need to generate economic activities and create employment opportunities.

There is a need for industrial estates in Northern Pakistan for establishment of industries for socio-economic development of Sargodha District.

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Final Report

3.4 Location of the Project

Bhalwal is located in Sargodha District, surrounded by rich agricultural land irrigated by Upper Jhelum Canal. The area is a major producer of citrus and sugar cane and offers good potential for agro based industries.

It has good connectivity with adjoining hinterland, major markets and Urban Centres including Lahore, Faisalabad, Sargodha and Gujarat, etc.

The Industrial Estate is being built in Bhalwal Tehsil of Sargodha District. This area is surrounded by citrus farms and is the best place, for the setting up of a processing plant for citrus fruits. There is a strong need for a state of the art industrial estate at Bhalwal, Sargodha.

The Bhalwal Industrial Estate BIE, is located at Tehsil Bhalwal (Latitude 32°18'27.17" N & Longitude 72°53'5.89" E) in Sargodha District. The project site is located on Bhalwal – Bhera Road about 4 Km away from Bhalwal Town and 36 Km from Sargodha. The site is accessible from the Lahore-Islamabad Motorway from Salam Interchange (16 Km) or Bhera Interchange (19 Km). The railroad connection is through Bhalwal Railway Station at a distance of five kilometer from the site.

3.5 Description of the Project

The BIE will be established at 426 acres, in which 410 acres of cultivated /barani land has been acquired whereas about 16 acres is further being acquired. The layout of BIE is presented in **Figure 3.2**.

The site is in irregular shape having zigzag boundary. Northwestern part of the site is a low lying area that experiences ponding over a large area. Some water logged area in the North- east was found to be draining on the low lying area, creating a large pond.

The drainage from North-east in the site has now been blocked and the ponding area has now been planned for reclamation purpose. For the purposes of master planning the ponding area has been assumed as “reclaimed” and “fit” for development. Presently, the whole project site is dry though the water table was observed to be as high as around one foot.

Bhalwal Industrial Estate Sargodha will have following facilities:

- Industrial plots of 0.5, 1 and 2 acres
- Warehousing and cold storage
- Utilities i.e., Grid station, Water works, Roads, Pumping station, Combined Effluent Treatment Plant, Truck Stand, Security Offices and visitors parking.
- Common Facilities i.e., Mosque, Central Park, Shopping area with food outlets, Administrative offices of BIE; including one-window-hall, Maintenance department, Fire station, Business Centre; including offices of producers association(s), display hall for local products, banks, insurance company, convenience stores, clearing/forwarding agents, PTCL etc. .

The **Table 3.2** shows land distribution of Bhalwal Industrial Estate Sargodha Project.

Table 3.2: Area analysis of Bhalwal Industrial Estate Sargodha Project

Description	Acres	%
Industrial Plots	300.50	71
Administrative and commercial buildings	17.28	4
Utilities	13.50	3
Roads	94.72	22
Total	426.00	100

The design of Bhalwal Industrial Estate Sargodha Project consists of two main components i.e. Land reclamation, and Master planning and infrastructure. The details are as follows:

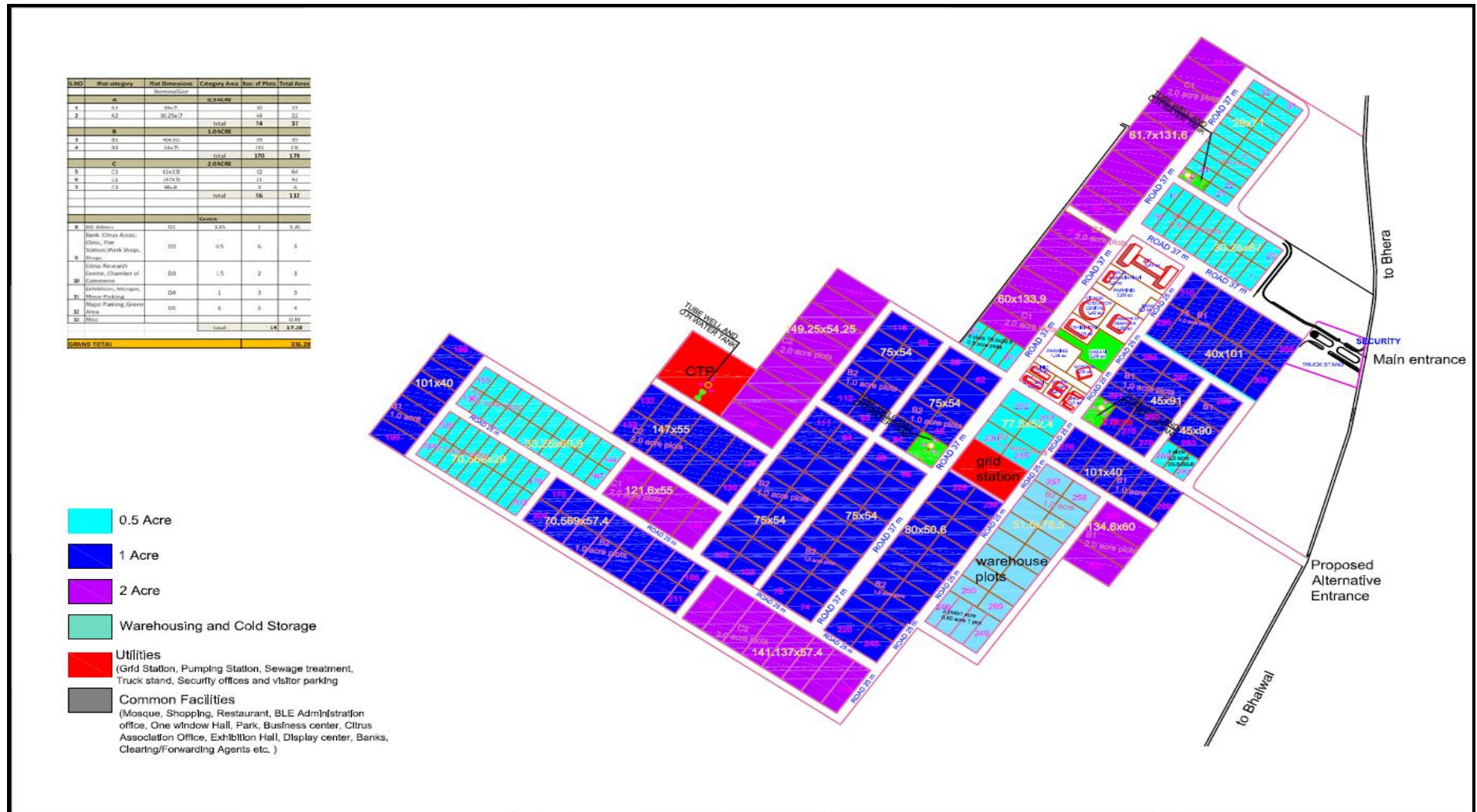
Land Reclamation

- Preliminary Design including Reconnaissance Survey, Ground water supply, Geotechnical Investigation, Proposed Land Reclamation work options and methodology, and estimated cost of Land Reclamation work.
- Detailed Design including detailed survey, ground water and sub soil
- Preparation of BOQs and Tender documents with specifications and construction drawings

Master Planning and infrastructure

- Preparation of preliminary layout plan of the estate
- Detailed master planning including design of Road, Sewerage, Drainage, Water supply; including provision for fire-fighting, electrification, waste water treatment, solid waste collection and disposal system and waste structures.
- Preparation of Environmental Impact Assessment (EIA) for approval of Environmental Protection Department (EPD)
- Preparation of BOQs and Tender documents with specification and construction drawings

Figure 3.2: Layout Plan of Bhalwal Industrial Estate, Sargodha, Punjab



Source: Punjab industrial Estate

EA Consulting Pvt. Ltd
Final ReportDescription of the Project
Page 43 of 166

3.5.1 Types of industries

In view of the potential of the area and input from the stakeholders, the following types of industries accommodated in Bhalwal Industrial Estate:

- Citrus Processing
- Juices, Jams and Marmalade
- Food Processing
- Dairy and Milk
- Flour Mills
- Oil Mills
- Cold Storage
- Warehouses
- Handicraft and Furniture
- Engineering
- Pharmaceutical
- Sugar Mill
- Textile Mill

3.5.2 Design Parameters

Bhalwal Industrial Estate will have following design parameters.

Roads

- Main Road Row 120 feet, Dual Carriageway
- Feeder Roads Row 80 feet, Dual Carriageway
- Access Roads Row 66 feet, Dual Carriageway
- Pavement: Rigid pavement (RCC)
- Flexible pavement (Asphalt)

Water Supply

- Source: Tube wells, 3 each at four Locations
- Distribution of water by OH Tanks 4, 70,000 gallons Capacity
- Pipe Size 75 mm Ø, 100 mm Ø, 150 mm Ø, 200 mm Ø
- Pipe: model - I uPVC Pipe
- model – II PE Pipe

Sewerage

- Underground Sewerage network with Sewage Treatment Plant. Final treated effluent will be drained to Nabi Shah Lake.
- Pipe Sizes: 200 mm Ø, 250 mm Ø, 300 mm Ø, 350 mm Ø, 400 mm Ø, 500 mm Ø, 550 mm Ø, 600 mm Ø, 650 mm Ø
- Pipe Materials: UPVC + RCC + RCC

Drainage

- Separate storm water drainage system with disposal in Nabi Shah Lake.
- Pipe Sizes: 300 mm Ø, 400 mm Ø, 500 mm Ø, 600 mm Ø, 800 mm Ø, 900 mm Ø, 1200 mm Ø
- Pipe Materials: RCC drains + RCC pipes.

Combined Effluent Treatment Plant

The combined Effluent Treatment Plant will be constructed at Bhalwal Industrial Estate Sargodha. The maximum daily average flow of influent is estimated to be 2.5 MGD.

The Combined Effluent Treatment Plant will be based on following influent parameters:

Table 3.3: Characteristics of influent of Bhalwal Industrial Estate Sargodha

Parameter	Units
BOD	375 mg/L
COD	750 mg/L
TSS	325 mg/L

The effluent from Combined Effluent Treatment Plant will meet the NEQS requirement of Pakistan for discharge into public water bodies. The PIE has reserved a plot for Combined Effluent Treatment Plant.

The CETP could only be designed when at least 50 to 60 % of the industries are operational and technical (characteristic and discharge) data for its design is available.

Solid Waste Collection and Disposal System

All the industries located at Bhalwal Industrial Estate will have primary storage of their waste inside their plot as per PIE Bye-Laws. The estate will design and implement Solid Waste Collection and Transportation System which will be comprised of i.e., recyclable, biodegradable, non-biodegradable and hazardous wastes. The recycling and biodegradable waste will be given to their respective contractors for further processing. The non-biodegradable will be disposed off at the exiting disposal sites at Sargodha and hazardous industrial materials will be disposed off in accordance with their standard disposal protocols.

3.5.3 Land Acquisition

The site measuring about 426 acres is in irregular shape having zigzag boundary. The land acquisition process is still in progress however, so far the land acquired is about 410 acres which is in the possession of the PIE while about 16 acres is further being acquired.

3.5.4 Project's Cost

The total estimated cost of Bhalwal Industrial Estate Sargodha is approximately Rs 3 billion as given in **Table 3.4**.

Table 3.4: Estimated Cost of the Industrial Estate, Bhalwal

Description	Amount in Rs Billion
Warehousing and cold storage	
Utilities i.e., grid station, Water works, Roads, Pumping station Combined Effluent Treatment Plant, Truck Stand, Security Offices and visitors parking.	
Common Facilities i.e., Mosque, Shopping, Restaurant, BIE Administrative office, one window hall, Park, Business centre, Citrus Association Office, Exhibition Hall, Display centre, Banks, Clearing and Forwarding Agents offices etc.	3.0
Total	3.0

Source: Punjab Industrial Estate

3.5.5 Time Schedule

Bhalwal Industrial Estate Sargodha Project will be constructed by PIE in a period of 6 months the time schedule of the project is given in the **Table 3.5**.

Table 3.5: Time Schedule for construction of Bhalwal Industrial Estate Sargodha Project

No	Activities	Activity Duration	Tentative Construction Schedule																	
		Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Detailed Engineering design	3	■	■	■															
2	Earthwork	3			■	■	■													
3	Construction of utilities	12				■	■	■	■	■	■	■	■	■	■	■	■			
4	Construction of Common Facilities	12						■	■	■	■	■	■	■	■	■	■	■	■	
5	Hand over to PIE	1																		■

Source: Punjab industrial Estate

3.6 Project Phases

The construction of Bhalwal Industrial Estate would be implemented in three phases i.e. Pre-construction/ design, Construction and Operational.

3.6.1 Pre-construction/Design Phase

During pre-construction/design phase, PIE has hired a consultant for land reclamation and master planning of infrastructure of Bhalwal Industrial Estate.

- The preliminary design of land reclamation Reconnaissance Survey, Ground water study and Geotechnical Investigation will be carried out. The land reclamation work options and methodologies for its implementation, along with the cost estimates will be worked out. After the approval of preliminary design of land reclamation works, a detailed survey and, ground water and sub soil investigations will be carried out.
- The detailed design of land reclamation works including BOQs and, tender documents with specifications and construction drawings, will be prepared.

The design of Master Planning and infrastructure development of Bhalwal Industrial Estate is comprised of preparation of preliminary layout plan, detailed master planning including design of Road, Sewerage, Drainage, Water supply including provision for fire-fighting, electrification, Combined Effluent Treatment Plant, solid waste collection and disposal system, and waste structures.

- The detailed design of Master Planning and Infrastructure development works of Bhalwal Industrial Estate including BOQs and, tender documents with specifications and construction drawings will be prepared.

Once the detailed design of land reclamation works and infrastructure development of Bhalwal Industrial Estate is available then the tender documents for construction works will be prepared. The PIE will float the tender for works and a contractor will be selected on the basis of experience, expertise and available resources to carry out the quality work.

3.6.2 Construction Phase

a - Contractor Mobilization

This component involves transportation of construction machinery and equipment to the project site, and establishment of the contractor's camp and office. The contractor camp site will be selected within the boundary of the estate.

The equipment and machinery will be brought to the project site through Bhalwal Bhera road. The camp site facilities of the contractor include site office, temporary residence for workers and areas for equipment and installation materials.

b - Site Preparation

Usually this activity involves operation of heavy earth- moving machinery and substantial land clearing, leveling and grading, as well as cutting and filling activities.

Although, the land for the estate is flat and will be designed in a manner to minimize these operations, which will be built on the existing contours, to the extent technically possible.

The first task during this activity is to demarcate the road alignment and other bench marks, with the help of drawings prepared during the design phase of the project. Once the, demarking is complete, the land will be cleared and prepared for subsequent construction activities. The whole purpose is to maintain the harmony of the area during construction phase.

c - Construction Activities

The construction activities will be carried out using the conventional methodology and sequence of work. The activities will include excavation, roads, culverts, water supply system, masonry work, carpentry, wiring, piping and plumbing, flooring, painting and instillation of fixtures. Other activities will include the laying of cables, construction of sanitary sewerage system, junction boxes and providing connections to the individual buildings. Supervision of this whole activity will be carried out by the PIE staff and the Engineering consultant.

d - Staffing

Construction crews will the responsibility of the civil contractor and its petty contractor. It is estimated that a maximum of 300 personnel will be working at site at a given time during peak construction period. These will essentially include masons, carpenters, electricians, painters, plumbers and general labour. For unskilled employment, preference will be given to local residents of Chak 14, Chak 13, Chak 11 and Chak 13 Rajgan.

e - Construction Machinery

The following construction machinery is expected to be present at the project site:

- Dozer
- Well drilling machines
- Concrete Mixing plant
- Water tanker
- Water pumps
- Diesel generator
- Vehicles for personnel movement
- Compactors
- Road rollers
- Concrete mixer plants
- Asphalt mixing plants

Exact quantity of the above-mentioned equipment and vehicles will vary depending upon the work schedule. But movement of all machinery will be restricted during day time.

f - Construction Material

The construction material will include cement, sand, crush, bricks, steel bars, paint, piping material, electrical material and finishing material. Most materials will be procured from Sargodha, Bhera and Lahore. The Bills of Quantities of the material will depend upon the construction activities.

g - Traffic Load during Mobilization (and Demobilization) of the Contractor

All of the contractor's equipment and vehicles will be transported to the site via Islamabad Lahore Motorway through Bhera and Makhdom Interchanges via Bhalwal Bhera Road.

h - Traffic Load for Construction Materials Supplies

It is estimated that on average 20 truckloads per day will bring construction materials to the project site during peak construction period. The condition of the Bhalwal Bhera Road is good and as such larger trucks can be used.

i - Other Resources

The appropriate sources of various construction materials will be identified by the Engineering Consultant during detailed design phase of the Project.

Water: During the construction phase, maximum of about 30,000 gallons per day of water will be required during peak construction period for construction activities and human consumption. The water is available near the project site.

Fuels: For the construction equipment and vehicle, diesel will be required. It is estimated that the peak consumption of diesel would be 10, 000 liters per day. The diesel will be procured from the nearby petrol pumps and brought to the project site.

Electricity: Temporary connections will be obtained from FESCO.

Camp Supplies: Camp supplies can be procured from Bhera, Sargodha and Lahore.

Contractor staff: During construction phase, the contractor will engage a staff of 300 for construction activities. The **Table 3.6** shows the break down.

Table 3.6: Contractor staff during construction phase of the project

Description	Nos.
Managerial	5
Clerical	10
Technical/Professional	10
Skilled workers	75
Un-skilled and others	200
Total	300

3.6.3 Operational Phase

The PIE will manage the operation phase of the project with the provision of a dedicated management team.

Maintenance

The PIE will carry out periodic maintenance works of Bhalwal Industrial Estate during its operational phase.

3.7 Project Alternative Considered

The Project Consultant has prepared three Concept Plan options to firm up the directions for further work on plan formulation as hereunder:

3.7.1 Concept Plan 1

The main entrance has been provided from the newly acquired area near Janazgah. The entrance road will be 120 feet wide and will make a connection with the existing Bhera Road with attractively designed T-Junction with a monument in the central island.

The gate will be located at the end of T-Junction with security office on the North side and parking on the South side. A properly designed gate structure will be provided at the entrance. The truck stand with parking area, food outlets, workshops, is located close to the entrance and next to the security office, Common Facilities area is in longitudinal configuration with the BIE administrative office, the making vista with the main entrance and mosque and the parks to make vista with second entrance at Jinnah colony. Modular plots of 0.5 and 1 acre have been provided on the Eastern side and 2 acres plots have been provided on the Western side. The warehousing area which is expected to be quieter and less polluting is provided next to the existing settlement of Chak 13 SB.

The total saleable area of this option is above 70% which will be fine-tuned during the detail planning when the location of water works, overhead tanks and sewerage pumping stations etc. will be precisely known.

The Option 1 follows a curvilinear road network which creates a softer layout pattern and looks more pleasing. The **Figure 3.3** represents concept plan option-1.

3.7.2 Concept Plan 2

Maintaining the same common features of option, this option includes the two entrances and location of common facilities, in the centre. It follows graphical design of straight road and T-Junctions avoiding through roads and cross-roads. The location of warehouse and cold storages is in the South-west corner closer to the existing settlement.

The location of smaller plots and larger plots has been reversed on the exemption that industries on larger plots will generate more waste water which can be disposed off through the existing drain in the earlier stages, until the Combined Effluent Treatment plant is commissioned.

The total saleable area of this option is above 77% which will be fastened during the detail planning when the location of water works, overhead tanks and sewerage pumping stations etc. will be precisely known. The Option-2 is based on a more orthogonal network design with a loose grid iron pattern. The **Figure 3.4** represents concept plan Option-2

3.7.3 Concept Plan 3

The Option-3 has same common feature, as Option-1 and Option-2 but the plan configuration is the mix of grid iron pattern and curvilinear pattern. The main difference is that, the common facilities and utilities are all grouped together in the central with block of smaller plots and larger plots located in flanks on the East and West of the central area. This is expected to increase the function efficiency of the common facilities.

The total saleable area of this option is above 70% which will be fastened during the detail planning when the location of water works, overhead tanks and sewerage pumping stations etc. will be precisely known.

The Option-3 is a graphical combination of the above two options but functionally is quite different. The **Figure 3.5** represents concept plan Option-3.

3.7.4 The Estimated Cost of Plans

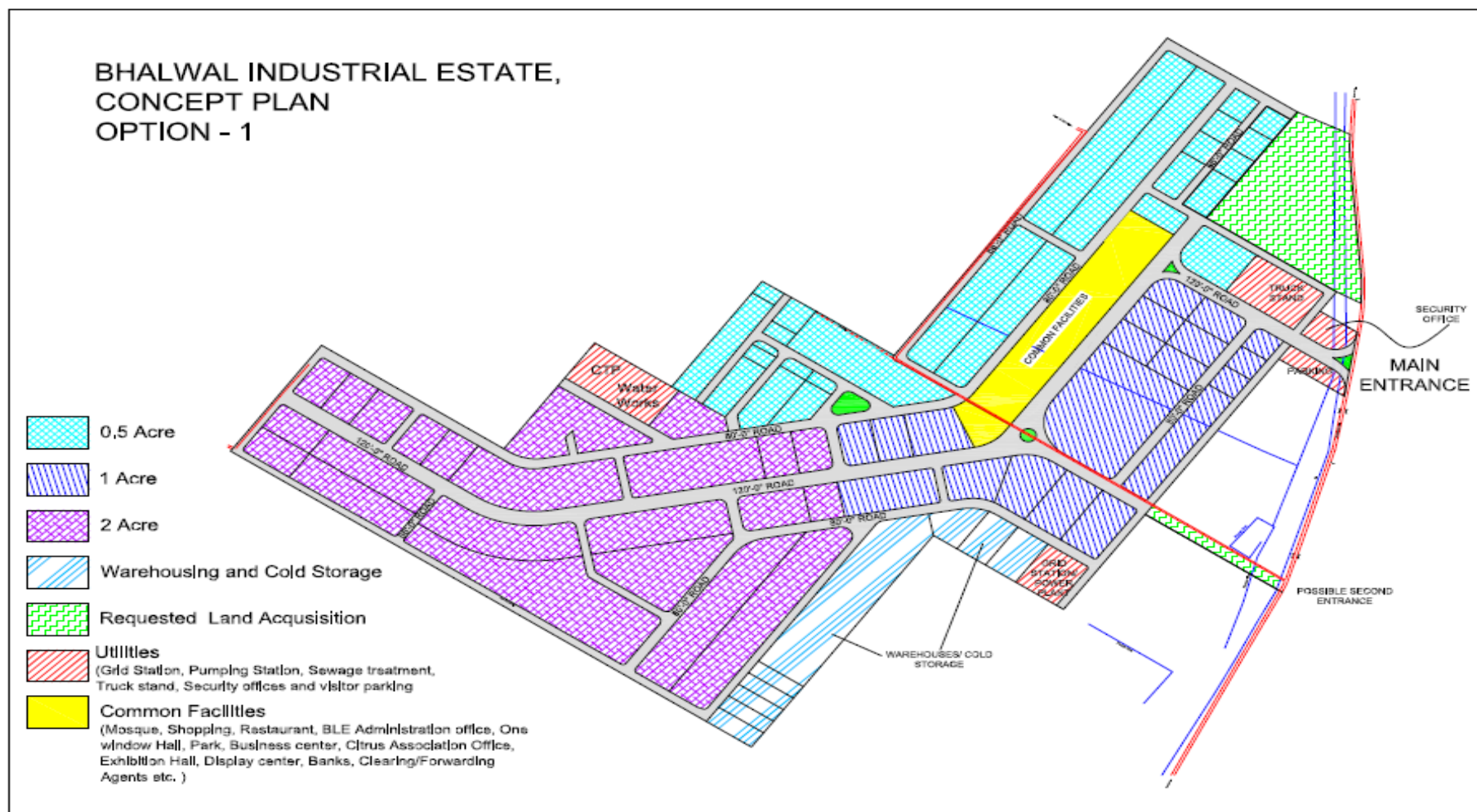
The estimated cost for three concept plans in Pak rupees for per acre is given in **Table 3.7**

Table 3.7: Estimated cost for concept plans

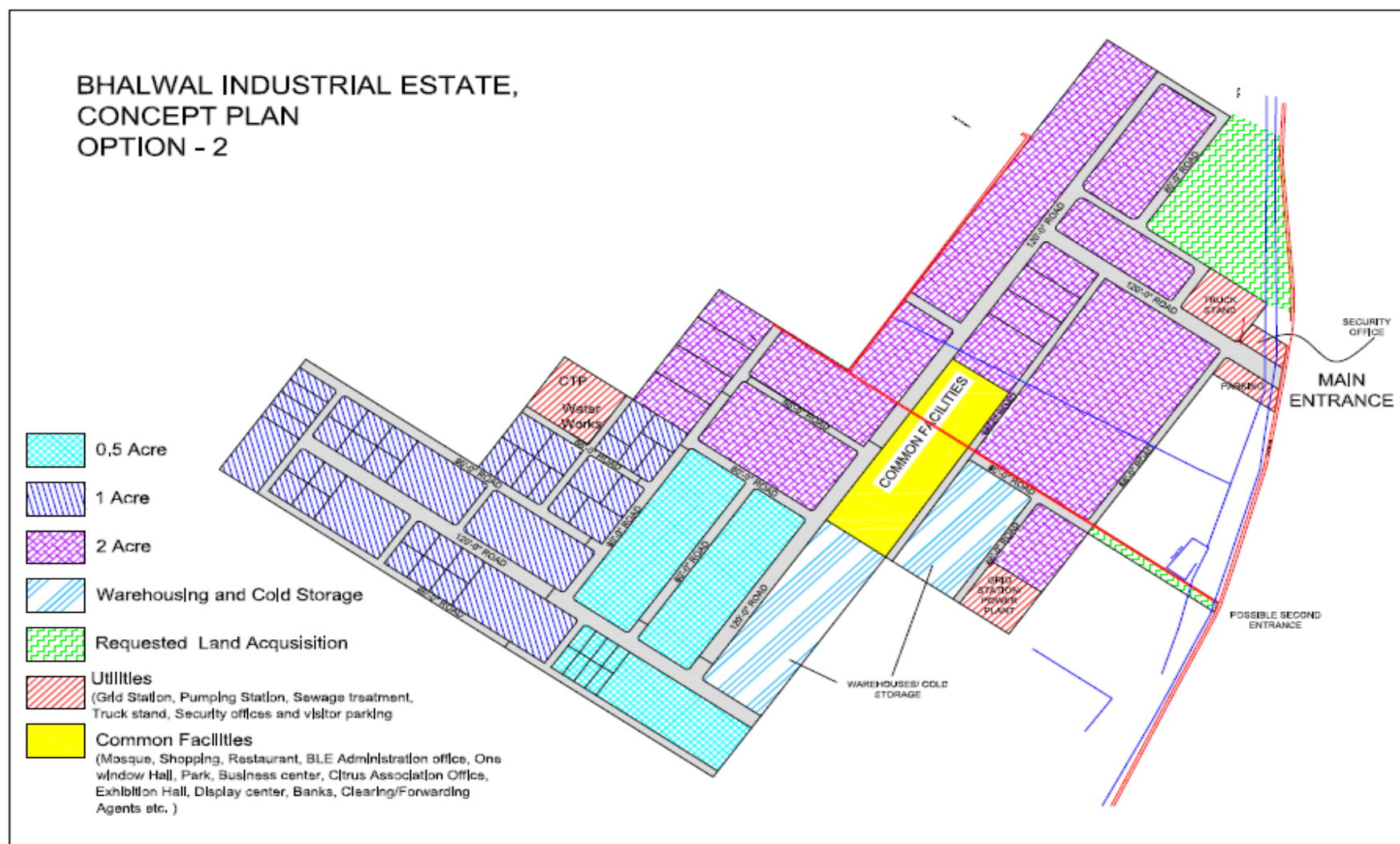
Activity		Cost per acre (Rs)		
		Option-1	Option-2	Option-3
Road construction	Rigid Pavement	3,114,479	2,832,827	2,903,615
	Flexible Pavement	1,786,820	1,604,345	1,664,853
Electrification		2.05 million	1.96 million	0.75 million
Development		316	347	314

3.7.5 The selected Plan

The selected plan is concept plan option-2 which has grid iron pattern of roads in the estate. This concept plan is better than other two proposed plans as it has proper distribution of plots and other facilities; there location is good and easily accessible through main road and other roads. The estimated cost plan also shows the affectivity of Option-2, in terms of environment and economically friendly plan. The **Figure 3.4** represents concept plan Option-2.

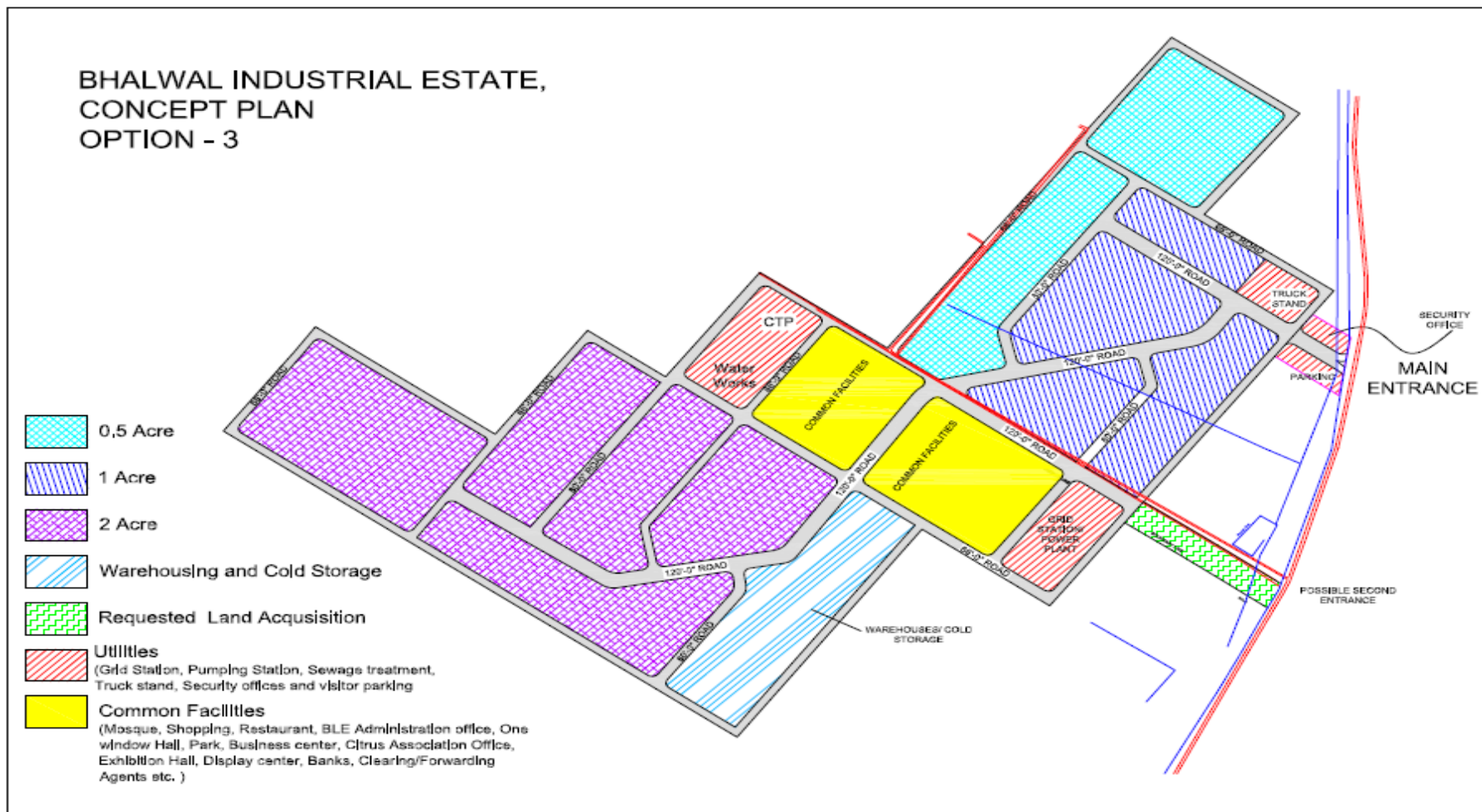
Figure 3.3: Concept plan Option-1 of Bhalwal Industrial Estate, Sargodha, Punjab

Source: Punjab industrial Estate

Figure 3.4: Concept plan Option-2 of Bhalwal Industrial Estate, Sargodha, Punjab

Source: Punjab industrial Estate

Figure 3.5: Conceptual Option-3 for Bhalwal Industrial Estate Project



Source: Punjab industrial Estate

4 Existing Environment

4.1 Introduction

The environmental and socioeconomic baseline defines the prevailing environmental and socioeconomic settings of the project area and surroundings. The project area in this document is defined as 'the areas where the project related activities to be carried which include the proposed project site and surroundings and the areas that can interact with the project's positive and negative externalities in the long run'. The environmental impact of any activity or process will be assessed on the basis of a deviation from the baseline or normal situation.

The project site is located in district Sargodha. The district derives its name from the headquarters town of Sargodha which is a combination of the words "Sar and Godha". "Sar", a Hindi word means a water pond while "Godha" was the name of the Hindu Faqir who lived near that pond. Upon the introduction of canal system in this area the settlements around the pond grew in importance and came to be called Sargodha after the pond and the name of the Hindu Faqir. The pond was later on filled up and is now included in the area of the district headquarters hospital Sargodha.

4.2 Project Area

The district lies from 31° -34' to 32°-36' North latitudes and 72°-10' to 73°-18' East longitudes. The district is bounded on the North by Jhelum district, on the East by Chenab River beyond which lies the districts of Mandi Bah-ud-Din and Hafizabad, on the South by Jhang district and on the West by Khushab district, separating the two districts by the river Jhelum.

The total area of the district is 5,854 square kilometers comprising five tehsils viz Sargodha, Bhalwal, Sillanwali, Shahpur and Sahiwal. It has one metropolitan corporation, two municipal committees, ten town committees and one cantonment contributing 24.1 per cent of total population of the district. There are 832 villages in the district. The **Figure 4.1** shows view of the project area of Bhalwal Industrial Estate Sargodha Project.

4.3 Physical Environment

The physical environment includes the abiotic component of the environment on which biological life is dependent to survive. The environmental indicators that substantiate the physical environment within the project area are explained below:

4.3.1 Topography

The whole of Sargodha district is plain and lies between 150-200 meters above the sea level. The Jhelum river crosses this plain at the extreme West of the district while the Chenab at the extreme East of it. The land away from the river Chenab and

the Jhelum is higher than that near the two rivers. The land between the two rivers is known as Chej Doab.

The topography of the project site is flat having average elevation of 195.2 m and slope of 1%. Lower Jhelum Canal flows from the North-east of the project site and small canal flows from South to East of the project site.

4.3.2 Geology and Soils

The Sargodha district is a part of West Indus basin that has gradually been filled up by alluvium brought by the Indus and its tributaries from the North.

The alluvial deposit is generally more than 300 meters thick and extends down to several hundred meters at places. Towards the South of Sargodha this alluvium is locally interrupted by rock outcrops of a buried hill range known as Karana hill.

This is a range of Precambrian age which is known on Dehbi Shahpur ridge. The land occupying the area has their origin between late Pleistocene and recent time. Consequently, three major geographical surfaces have been recognized. The youngest and the West are recent flood plains where deposition of fresh sediments is going on or has stopped only recently. The middle surface belongs to early and middle Holocene age. The recent and the sub recent flood plains are collectively called Jhelum flood plains. The highest and oldest (old river terrace) is most probably of Pleistocene age and comprises the highest strip of land locally known as Karana bar.

4.3.3 Soil Analysis of the Project Site

For evaluation of physical and engineering characteristics of the sub-soils, selected disturbed soil samples were tested in the laboratory. The laboratory testing was carried out at Berkeley Associates Testing Laboratory Facility, Lahore. The following laboratory tests were performed on selected soil samples.

- Particle size distribution
- Atterberg's limits
- Modified Proctor Compaction
- Chemical analyses of soil samples

Particle Size Distribution

For classifying the subsurface soils, thirty soil samples were subjected to sieve analyses during these studies. These samples were further subjected to hydrometer analyses. The sieve analyses were performed in accordance with the procedures specified in ASTM D 422, with sample preparation by ASTM D 2217 (wet preparation method), Procedure B. The hydrometer analyses were carried out in accordance with procedure specified in ASTM D 422. Results of sieve and hydrometer analyses were plotted in the form of gradation curves.

Atterberg's Limits

For evaluating plasticity characteristics of cohesive soils, liquid and plastic limit tests were performed on thirty (30) soil samples. The tests were performed as specified in ASTM Designation D 4318. All the liquid limit tests were performed with at least three trials.

Modified Proctor Tests

In order to determine the moisture-density relationships of subgrade soils at site, eight (08) Modified Proctor compaction tests were carried out on the composite bulk samples recovered from the test pits.

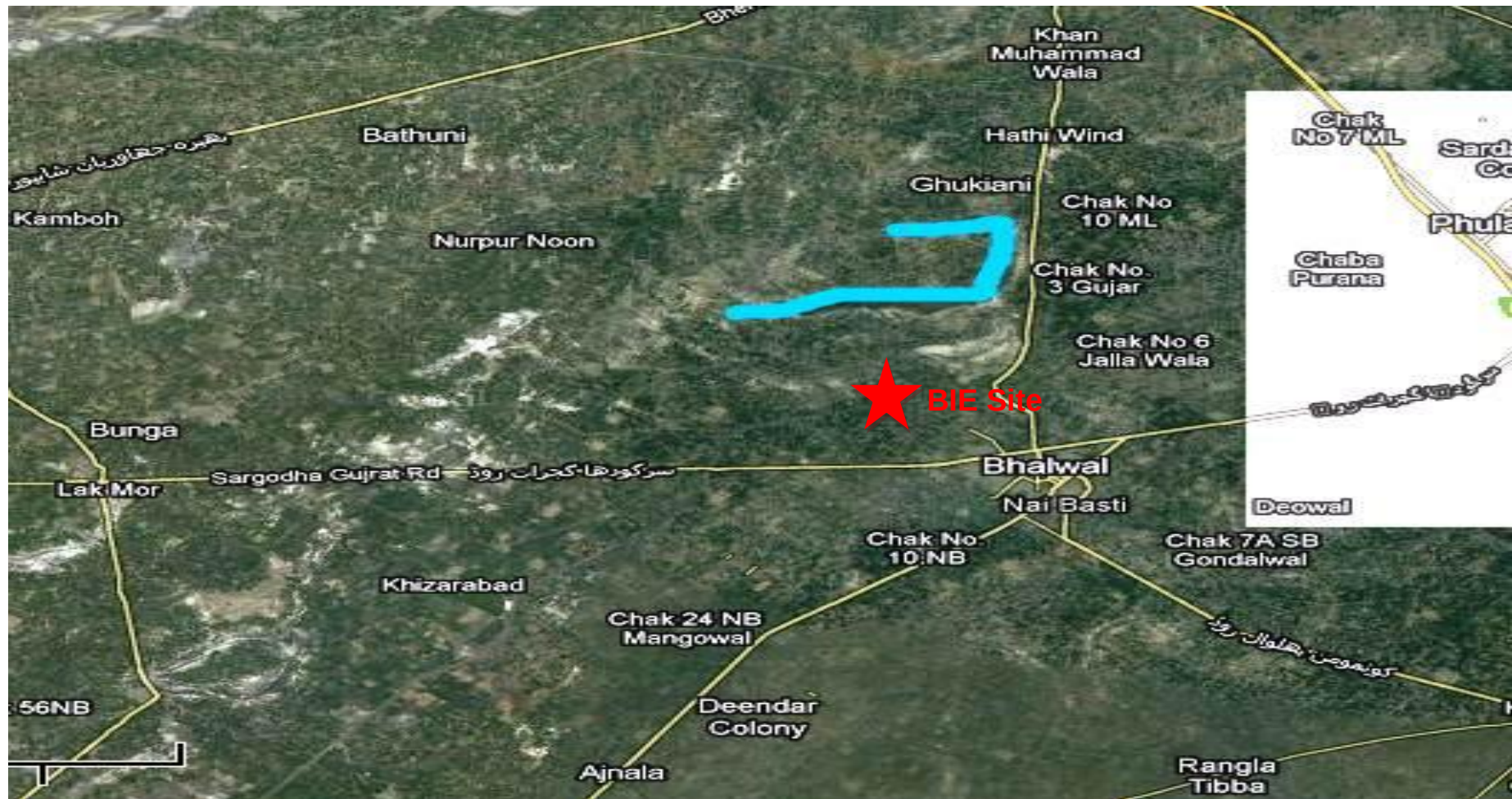
Chemical Analyses

In order to determine the chemical characteristics of the subsoil, four selected soil samples were tested for estimation of chemical composition.

Sulphate Content: The sulphate content of the tested soil samples ranges from 0.165% to 0.206%

Chloride Content: The chloride content of the tested soil samples ranges from 0.080% to 0.100%

Organic Content: The organic content of the tested soil samples ranges from 1.250% to 1.400%.

Figure 4.1: A view of the Project area of Bhalwal Industrial Estate Sargodha Project

Source: Punjab industrial Estate

4.3.4 Minerals

After creation of Khushab district Sargodha district is virtually left with no minerals. Ordinary stone and sand are the only minerals available. Ordinary stone is quarried from Karana hills range near Shaheenabad. A number of stone crushers have come up all along the Sargodha-Chiniot road. The area has emerged as a big market for stones and stone crushing business. Every day hundreds of trucks and tractor trailers are engaged in carrying crush stone to various parts of the country for construction.

4.3.5 Land Use

Bhalwal is an old but fairly planned city based on the grid iron street pattern. The territory of city is surrounded by planned Chak. Noon Sugar mill is the largest industry in Bhalwal, which is situated along the Sargodha Road. Noor Dairies is the second sizable economic activity of Bhalwal, which is located on the same road.

Being a planned city, most of the institutional buildings including the Telephone Exchange, Civil Courts, and Administrative Offices etc. are all located in the center of the city, which may be called as Institutional Zone together with the commercial Zone which is also located in the city center. These zones divide the whole city into two parts in a V-shape. Additionally, Bhalwal has linear commercial corridors along major arteries. The city has only one graveyard. The main Fruit Market is located along Lahore-Sargodha Road. A Canal is passing through the city and an Open Drain traverses the boundary of Bhalwal city.

The project site is situated between Chak 11, 14, 13 and Chak 13 Rajgan village of Bhalwal. The area is almost barren and looks like a mini desert due to flooding during the monsoon season.

4.3.6 Surface water

Rivers

The Chenab River, locally known as the Chanhani, which forms the East-Southern boundary of the district, for a distance of 24 kilometers must at some comparatively recent period, flowed considerably to the West of its present bed. The deposit left by the annual floods of the Chenab are usually very sandy and much inferior to the silt brought down by the Jhelum and some other rivers flowing in Punjab. New alluvium has to worth cultivating and odd land is apt to deteriorate. Since the opening of the lower Chenab Canal, with its weir at Khanki, practically the river discharge is diverted.

On descending the Northern edge of the Bar, a bank some 3.1 or 4.6 meters high known as the Danda, there is the valley of the Jhelum, a tract somewhat similar in the character to the valley of the Chenab, but much more fertile, better cultivated, better wooded and more thickly inhabited, owing no doubt to the richer quality of the alluvial silt annually brought down by the Jhelum. This river, the Vedasta and Hydaspes of the ancients is now locally known as the Jhelum or Vehat, the latter

name being more common towards the South of the district. It rises in Kashmir and debouches from the Hills at the town of Jhelum from which it takes its name. It then flows South West for about 160 kilometers as far as the town of Shahpur, where it takes a sharp turn and flows almost direct South to its junction with the Chenab. In winters, the river shrinks into a narrow channel, sometimes not more than 61 meters wide with a normal minimum discharge of about 255 cubic meters per second.

Lakes and Marshes

Only two lakes are situated in the districts which are called Nabi Shah lake Bhalwal Sub-division and Bud lake in Sargodha Sub-Division.

Marshes are situated in Mari and Dera Joor in Sargodha Sub-Division and Sillanwali Sub-Division. In Bhalwal Sub-Division Marshes are situated in Chak 11, Fatehabad Sher Muhammad Wala. Budnala of Yoda Jhawarian and Wagowal are marshy areas in Shahpur Sub-Division. The project site lies near Nabi Shah Lake.

4.3.7 Water Quality of the Project area

In order to examine the water quality of the area, water samples from different locations were collected and analyzed. Following is the brief description of methodology adapted for water sampling and analysis. Water sampling was carried out for following sources:

- Ground Water
- Surface Water

The sampling and analysis was carried out by SGS Pakistan in accordance to the internationally recognized methods including APHA and UESPA recognized methods.

Surface Water

One surface water samples were taken from lower Jhelum Canal. The sampling was carried out under standard procedures and protocols, the analytical trait of which is included as **Table 4.1**.

Table 4.1: Analysis of surface water quality parameters
(Date 19-07-12, Lower Jhelum Canal)

No	Parameters	Method	Unit	LDL	Test Results
1	Temperature (At the time of sample collection)	-	-		21.0
2	PH @ 28.1 C	Based on APHA-4500 H ⁺ B	mg/L	0.1	7.71
3	Biochemical Oxygen Demand (BOD5) @ 20 C	Based on ASTM 5210	mg/L	5.0	9.0
4	Chemical Oxygen Demand (COD)	Based on APHA-5220 D	mg/L	5.0	23.0
5	Total suspended solids (TSS)	Based on APHA-2540 D	mg/L	5.0	51.0
6	Total suspended solids (TDS)	Based on APHA-2540 C	mg/L	5.0	143.0
7	Grease & Oil	Based on USEPA-1664	mg/L	1.0	0.333
8	Phenolic comp. (As phenol	Base4d on APHA-5530 D	mg/L	0.01	0.043
9	Sulphate (SO ⁴)	Base4d on APHA-4500-SO ⁴ C	mg/L	5.0	7.203
10	Sulphide (S)	Base4d on APHA-4500 S ² D	mg/L	0.1	< 0.1
11	Chlorine	Base4d on APHA-4500 Cl G	mg/L	0.1	< 0.1
12	Fluoride (F)	Base4d on APHA-4500 F-C	mg/L	0.01	0.0236
13	Cyanide (CN)	Base4d on APHA-4500 CN F	mg/L	0.01	< 0.01
14	Anionic Detergents (As MBAS)	Base4d on APHA-5540 c	mg/L	0.1	< 0.1
15	Chloride (Cl)	Base4d on APHA-4500 Cl B	mg/L	0.5	5.9
16	Ammonia (NH ³)	Based on APHA-4500 NH ³ B	mg/L	0.1	< 0.1

LDL: Lowest Detection Limit
≤ Equal or Less Than

-: Not Defined

<: Less Than

Ground Water

Ground water is available in the project area and depth of water table ranges from 20 to 80 ft. Analysis of the ground water quality parameters is given in the **Table 4.2**.

Table 4.2: Analysis of ground water quality parameters
(Date of Sampling: 19-07-12, Chak # 14, Bhalwal, District Sargodha)

No	Parameters	Method	Unit	LDL	Test Results	Limits as per NEQS
1	PH @ 28.1 C	Base4d on APHA-4500+B	-	0.1	7.27	6.50 – 8.50
2	Total Dissolved Solids (TDS)	Based on APHA-2540 C	mg/L	5.0	748.0	< 1000.0
3	Color	Visual	-	-	Colorless	≤ 15 TCU
4	Odor	In-house / Organoleptic	-	-	Colorless	-
5	Taste	In-house / Organoleptic	-	-	Tasteless	-
6	Turbidity	Based on APHA-4500 B	NTU	0.2	< 0.2	< 5.0
7	Chlorine	Based on APHA-4500-CI G	mg/L	0.1	< 0.1	0.5 – 1.5
8	Nitrates (NO ³)	Based on APHA-4500 NO ³ D	mg/L	0.003	21.028	≤ 50.00
9	Nitrates (NO ²)	Based on APHA-4500 NO ² B	mg/L	0.01	< 0.01	≤ 3.0
10	Phenolic comp. (As phenol)	Based on APHA-5530 D	mg/L	0.01	0.0645	-

LDL: Lowest Detection Limit -: Not Defined <: Less Than
 ≤ Equal or Less Than

Table 4.3: Microbial Analysis of Ground water
(Date of Sampling: 19-07-12, Chak # 14, Bhalwal, District Sargodha)

No	Parameters	Procedure	Permissible Limits	Results
1	Total Coli Forms	APHA: 9222 B	0/100 ml	30
2	Faecal Coli Forms (E.Coli)	APHA: 9222 D	0/100 ml	Absent

Source: SGS Pakistan PVT (LTD)

WHO/USEPA Guidelines for drinking water states that Total or faecal coliforms must be absent or not tolerable in portable water. But the results shows that ground water of the project area shows Total coliform count of 30 which should not be present. While coliforms are themselves not normally causes of serious illness, they are easy to culture and their presence is used to indicate that other pathogenic organisms of faecal origin may be present. Faecal pathogens include bacteria, viruses, or protozoa and many multicellular parasites.

4.3.8 Climate

The Sargodha district has extremes of climate. May, June and July are the hottest months when the mean maximum and minimum temperatures are 39 degree centigrade and 25 degree centigrade respectively. December, January and February are the coldest months. During this period temperature maximum and minimum temperatures are 21 degrees centigrade and 6 degree centigrade respectively. Most the rainfall is the months of July, August and September, East to South-West. The hill gets more rain than the plains.

The **Table 4.4** showing the mean maximum and minimum temperatures and the precipitation recorded at Sargodha is given below while **Table 4.5** shows the Meteorological data of Bhalwal Industrial Estate Site, Sargodha District.

Table 4.4: Climate data for Sargodha (1960-2012)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	20 (68)	22 (72)	26 (79)	32 (90)	38 (100)	39 (102)	38 (100)	37 (99)	36 (97)	32 (90)	26 (79)	22 (72)	30.6 (87.1)
Average low °C (°F)	8 (46)	11 (52)	15.5 (59.9)	19 (66)	25 (77)	27 (81)	26 (79)	26 (79)	25 (77)	20 (68)	14 (57)	9 (48)	18.8 (65.8)
Precipitation mm (inches)	18 (0.71)	36 (1.42)	24 (0.94)	13 (0.51)	17 (0.67)	48 (1.89)	82 (3.23)	87 (3.43)	43 (1.69)	9 (0.35)	11 (0.43)	12 (0.47)	400 (15.75)
Avg. precipitation days (≥ 1.0 mm)	5	4	5	4	3	3	7	7	4	1	1	1	45

Source: Pportal.punjab.gov.pk

Table 4.5: Meteorological data of Bhalwal Industrial Estate Site, Sargodha District
(Date of Sampling: 18-19 July 2012)

Time	Temperature	Wind Direction	Wind Speed	Humidity	Pressure (mm of Hg)
	°C		m/s	%	
12:00	33	E	2.7	51	739.1
13:00	34	E	2.2	51	738.1
14:00	40	NE	7.2	41	748.1
15:00	41	NE	7.2	41	747.4
16:00	41	NE	6.7	42	746.7
17:00	39	NE	5.4	48	745.9
18:00	38	NE	7.2	54	745.6
19:00	37	NE	5.4	58	744.9
20:00	36	NE	8.0	67	746.3
21:00	35	NE	8.5	65	746.1
22:00	34	NE	7.2	64	745.2
23:00	32	NE	8.9	64	745.6
24:00	32	NE	6.2	63	745.9
01:00	30	NE	7.0	62	745.5
02:00	29	NE	6.2	62	746.1
03:00	30	NE	9.1	61	746.2
04:00	29	NE	2.7	58	745.3
05:00	28	NE	3.9	60	741.5
06:00	28	NE	4.5	49	744.3
07:00	31	NE	4.1	40	744.5
08:00	31	NE	3.5	45	744.5
09:00	30	NE	5.6	56	741.6
10:00	30	NE	5.9	60	743.6
11:00	30	NE	5.0	61	743.2

Source: SGS Pakistan (Pvt.) Ltd Karachi

Rainfall

Most of the rainfall occurs in the months of July, August and September, although some winter rain also occurs. The rainfall decreases as one goes from the Eastern and Northern part of the district, westwards. The average rainfall is about 30.4 centimeters but in 1960 the total recorded was 38.1 centimeters. There is a tendency for the rainfall to increase with the expansion of cultivation and vegetation. The winter rain falls mostly in January and February

Earthquakes

Earthquakes are not frequent. Shocks are felt occasionally, but they are very slight.

Cyclones

No regular cyclones pass over the district. Dust storms are common in summer, and some of them are of very considerable force, carrying away trees and thatched roofs before them. But on the whole, they are not very destructive. There is no record of un-usually severe dust storms. They begin early in April and continue more or less regularly until the rains set in.

Wind Storms

The wind-storms are not uncommon in this district. Strong wind continues to blow during the year, carrying away particles of sand other dust clouds before them.

Locusts

Locusts and swarms frequently visit the district, causing damage to the crops but no swarm of unusual intensity has been reported recently.

Hailstorms

Hailstorms are sometimes met with during February and March. Hailstones, as large and as hard as golf balls, sometimes fall in large quantity, and all the crops within the range of their course are totally destroyed.

4.3.9 Ambient Air Quality

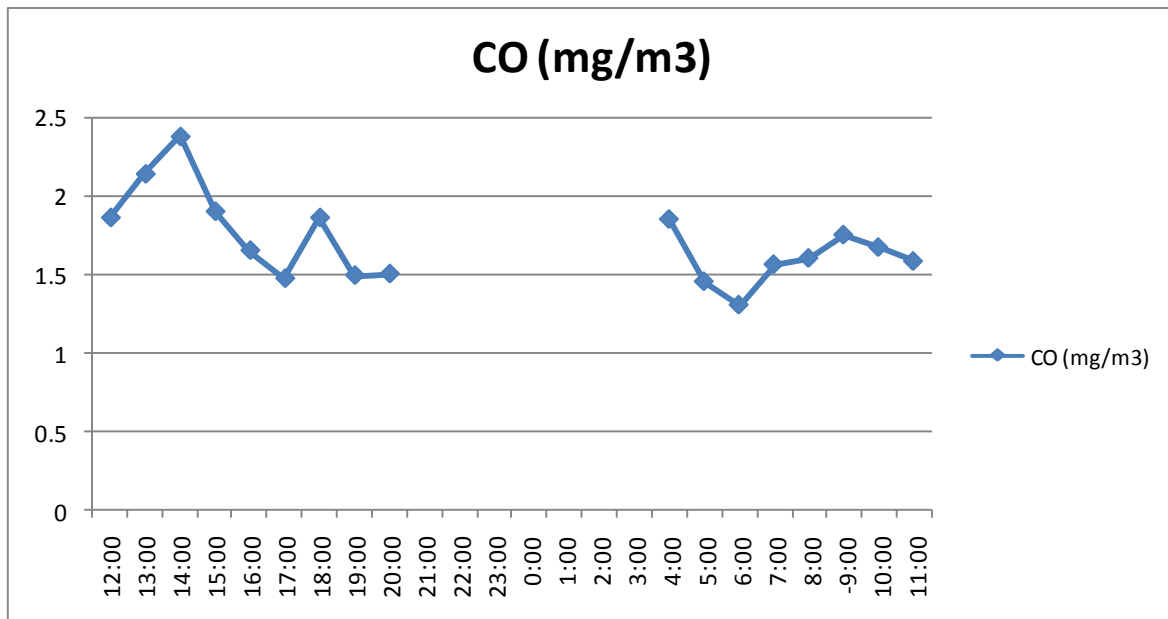
There are no major anthropogenic sources of air pollution in the project area. There are limited emissions from households and traffic. The ambient air quality analysis was carried out at the project site. The results of ambient air quality monitored for 24 hours are given in **Table 4.6**.

The average concentration of carbon monoxide CO for 8 hours according to NEQS should not exceed from 5 mg/m^3 and that of one hour should be in the range of 10 mg/m^3 . The value obtained at monitoring site for 24 hours average was 1.70 mg/m^3 .

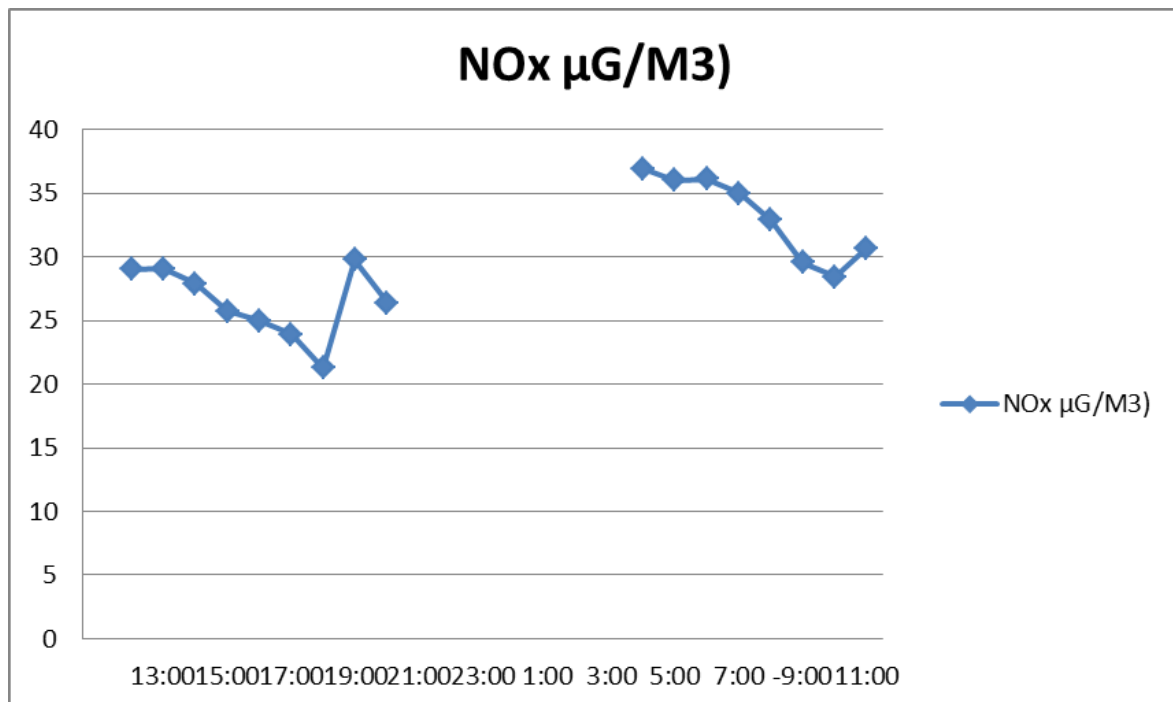
Figures 4.2 to 4.6 shows prevailing concentration of CO, NO_x, NO, NO₂ and SO₂ at the project site during 24 hour monitoring respectively.

Table 4.6: Ambient Air Monitoring at Industrial Estate BHALWAL

No	Time	CO (mg/m ³)	NO _x μG/M ³)	N ^o μG/M ³)	NO ² μG/M ³)	SO ² μG/M ³)
1	12:00	1.86	29.01	8.60	20.41	4.73
2	13:00	2.14	29.05	8.90	20.15	2.83
3	14:00	2.38	27.89	8.54	19.35	2.83
4	15:00	1.90	25.76	6.46	19.30	2.27
5	16:00	1.65	24.98	5.59	19.39	2.02
6	17:00	1.47	23.89	5.68	18.21	1.6
7	18:00	1.86	21.28	4.88	16.40	1.11
8	19:00	1.49	29.78	4.90	24.88	1.90
9	20:00	1.50	26.39	3.44	22.90	1.27
10	21:00	Data Mission Because of Rain				
11	22:00					
12	23:00					
13	24:00					
14	1:00					
15	2:00					
16	3:00					
17	4:00	1.85	36.91	6.76	30.15	1.97
18	5:00	1.45	36.03	6.89	29.14	1.80
19	6:00	1.30	36.14	6.70	29.44	1.63
20	7:00	1.56	35.0	5.40	29.60	1.70
21	8:00	1.60	32.9	5.36	27.54	1.88
22	-9:00	1.75	29.53	4.20	25.33	1.60
23	10:00	1.67	28.41	4.20	24.21	1.57
24	11:00	1.58	30.67	4.31	26.36	1.49
Average		1.70	29.62	5.93	23.69	2.01

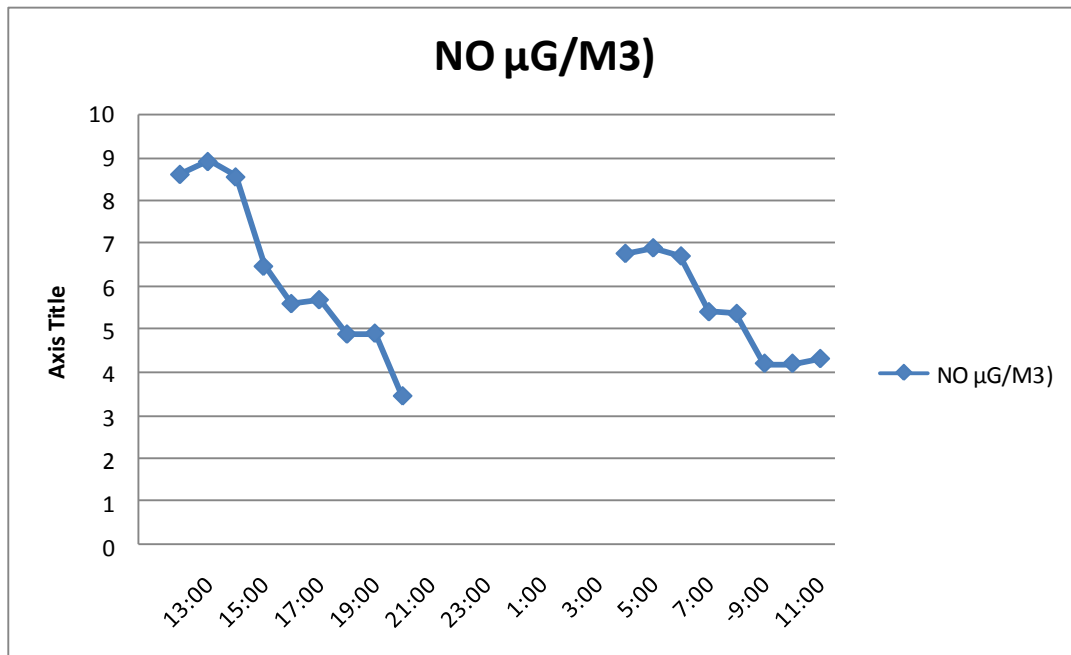
Figure 4.2: CO concentration during 24 hour monitoring

The standard value mentioned in NEQS for nitrogen dioxide NO₂ is 80 µg/m³ and average concentrations for nitrogen dioxide measured during 24 hour monitoring was found 23.69 µg/m³.

Figure 4.3: NO_x concentrations during 24 hour monitoring

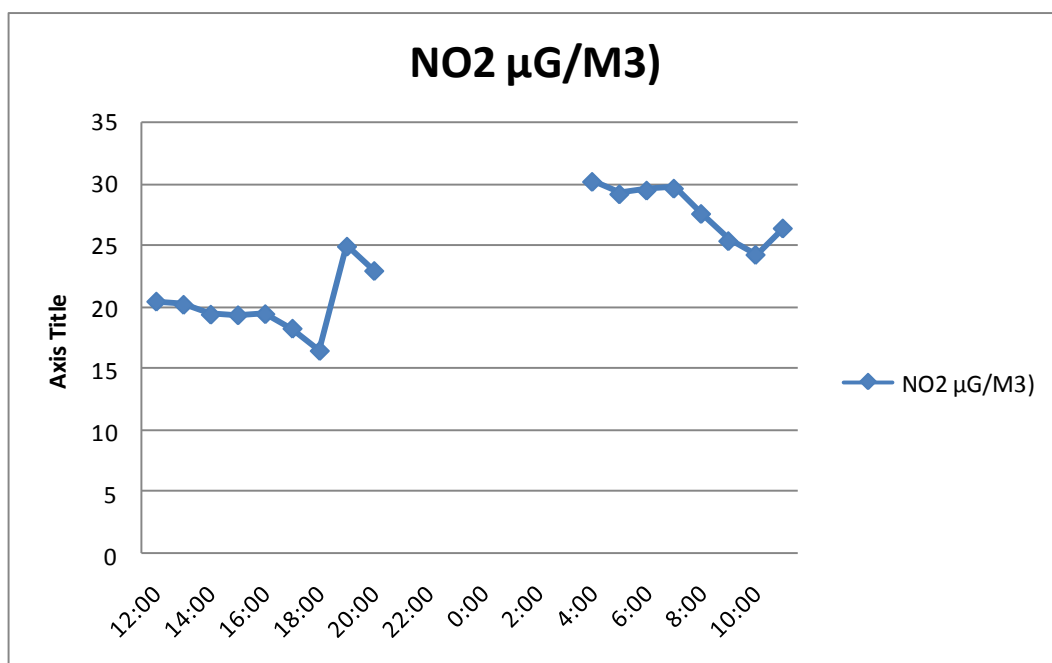
The standard value mentioned in NEQS for nitrogen oxide NO and average concentration of nitrogen oxide NO measured during 24 hours monitoring was found a $5.93 \mu\text{g}/\text{m}^3$.

Figure 4.4: NO concentration during 24 hour monitoring



The standard value mentioned in NEQS for nitrogen dioxide NO_2 is $80 \mu\text{g}/\text{m}^3$ and average concentrations of nitrogen dioxide NO_2 measured during 24 hour monitoring was found $23.69 \mu\text{g}/\text{m}^3$.

Figure 4.5: NO_2 concentration during 24 hour monitoring



According to standard the 24 hour concentration of sulphur dioxide SO_2 in ambient air should not exceed from $120 \mu\text{g}/\text{m}^3$ while concentration obtained during monitoring was found at $2.01 \mu\text{g}/\text{m}^3$.

Figure 4.6: SO_2 concentration during 24 hour monitoring

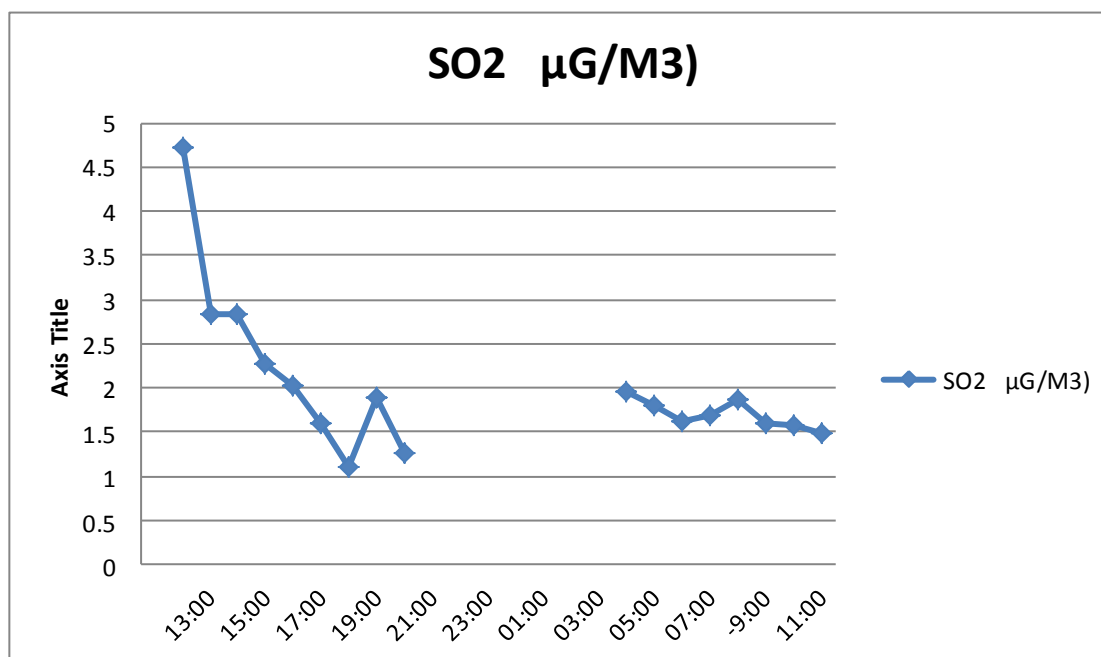


Table 4.7: Average obtained concentration of priority pollutants

Parameter	Unit	Duration	LDL	Average Obtained Concentration
Nitrogen Dioxide (NO_2)	($\mu\text{g}/\text{m}^3$)	24 Hours	0.01	23.69
Nitrogen Oxide (NO)	($\mu\text{g}/\text{m}^3$)	24 Hours	0.01	5.93
Sulfur Dioxide (SO_2)	($\mu\text{g}/\text{m}^3$)	24 Hours	0.01	2.01
Carbon Monoxide (CO)	($\mu\text{g}/\text{m}^3$)	24 Hours	1.00	1.70
Particulate Matter (PM_{10})	($\mu\text{g}/\text{m}^3$)	24 Hours	2.00	176.11

Source: SGS Pakistan (Pvt.) Ltd

The analysis of ambient air monitoring shows that the criteria parameters of ambient air quality, like Nitrogen Oxides (NO_x), Oxides of Sulphur (SO_x), and Carbon monoxide (CO), in the area are well within the acceptable limits.

4.3.10 Noise and Vibration

The project area is peaceful in early morning and night time. The voices of birds are heard during sun rise and sun set. However movement of vehicles on Bhalwal Bhera road increases the noise level to maximum in peak hours of day in which most of the people travel for jobs and business. Despite of heavy traffic the noise level of the

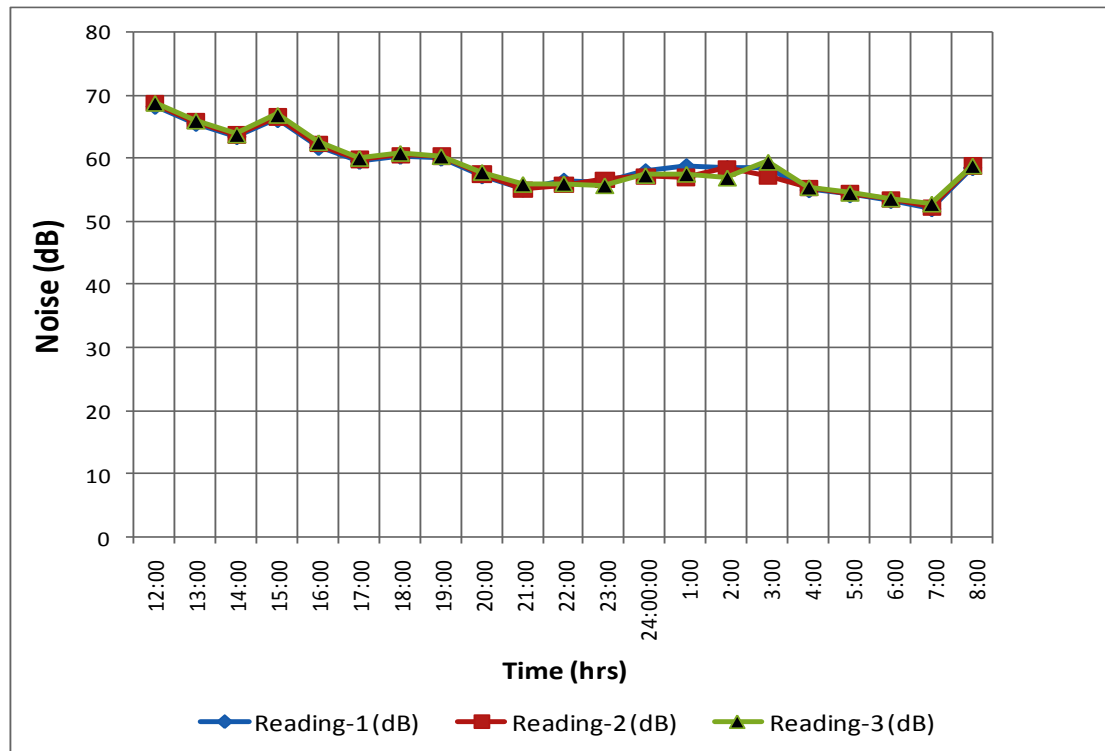
project site does not exceed 80dB. The noise levels were monitored at the Project site for 24 hours and results are given in **Table 4.8**.

Table 4.8: Noise monitoring at the project site

No	Time	Reading-1 (dB)	Reading-2 (dB)	Reading-3 (dB)
1	12:00	68.3	68.7	68.8
2	13:00	65.6	65.9	66.0
3	14:00	63.5	63.7	63.8
4	15:00	66.2	66.6	66.9
5	16:00	61.8	62.3	62.6
6	17:00	59.6	59.9	60.1
7	18:00	60.4	60.5	60.9
8	19:00	60.1	60.4	60.4
9	20:00	57.3	57.5	57.9
10	21:00	55.2	55.1	56.0
11	22:00	56.5	55.8	56.1
12	23:00	56.1	56.6	55.8
13	24:00	58.0	57.2	57.4
14	1:00	58.8	57.0	57.6
15	2:00	58.5	58.5	57.0
16	3:00	58.4	57.2	59.5
17	4:00	55.1	55.4	55.5
18	5:00	54.3	54.5	54.6
19	6:00	53.4	53.6	53.7
20	7:00	52.1	52.3	52.9
21	8:00	58.6	58.8	58.9

Source: SGS Pakistan (Pvt.) Ltd

The Noise level monitoring was conducted at same site where ambient quality was monitored and found in range of 52.1 – 68.8 dB

Figure 4.7: Noise monitoring at the project site

4.3.11 Traffic and Transportation

Bhalwal-Bhera Road is a single carriageway rural road with metaled width of sixteen feet. So far the traffic on the road is very light but the traffic generated by the Bhalwal Industrial Estate will require its dualisation.

A traffic count was made of vehicles passing near the entrance of the Bhalwal Industrial Estate from 0600hr to 2100hr. The details of traffic count are given in the **Table 4.9**.

Table 4.9: Traffic Count at Industrial Estate BHALWAL

Incoming from BHALWAL to Bhera	0600 h to 0900 h	0900 h to 1200 h	1200 h to 1500 h	1500 h to 1800 h	1800 h to 2100 h	Total
Large vehicles (trucks, buses, tractor trolleys, minibuses)	123	133	122	117	128	623
Medium sized vehicles (Suzuki pickups, cars, jeeps, taxis)	254	266	235	242	233	1230
Small vehicles (Rickshaws, motorcycles)	274	262	296	297	197	1326
Slow Vehicles (Animal driven carts and tongas)	67	60	44	71	53	295
Total (A)	718	721	697	727	611	3474
Large vehicles (trucks, buses, tractor trolleys, minibuses)	187	180	210	149	128	854
Medium sized vehicles (Suzuki pickups, cars, jeeps, taxis)	249	301	358	267	228	1403
Small vehicles (Rickshaws, motorcycles)	257	362	287	288	213	1407
Slow Vehicles (Animal driven carts and tongas)	58	60	138	72	112	440
Total (B)	751	903	993	776	681	4104

Source: PPI Field Data, 7th July 2012

The traffic count shows that a total of 3,474 vehicles going from Bhalwal to Bhera and 4,104 vehicles going from Bhera to Bhalwal by Bhalwal Bhera Road in a day which shows that average 2.63 vehicles passes every minute which show a medium traffic.

The Project Area



A view of PIE office at project site



A view of mosque in Chak 11



General preview of BIE site



General preview of Project site



Sign Board on Bhalwal Road for Project location



Preview of Chak 13 near to project site

Project area



Shrine of Baba Halim Shah near project site



Nabi Shah Lake near project site



Tube well in chak 11



Solid waste collection in Chak 13



Main Bazar Bhalwal



Tube well Water in Chak 11

Baseline Data Collection



Ambient air quality monitoring a project site



Data collection at project site



Noise quality monitoring at project site



Data collection at citrus unit



Data Collection at project site



Data collection at Bhalwal

4.4 Biological Environment

4.4.1 Flora

The characteristic trees and shrubs of the district are the van (*Selvadora abeoides*), Kari (*Salsola fostids*), jand (*prosopis spicigera*) and malla (*Zizypluys nummularia*), together forming the jungle with which the uncultivated land are generally covered. The van or jal (*Salvadora obeoides*), with the leaves something like the mistletoe, often forms a dense bush.

In the riverine the most numerous trees are the Kikar (*Acacia arabicva*) and Thali (*Dalbergia sisoo*), which are very largely grown especially on cultivated land. The shirin or Sirin (*Albizzia lebbek*), with its fragrant flowers and rusting pods is found chiefly along the roadsides. The Uksh or Kash or Fareash (*Tamarix articulate*), with its gnarled trunk and needle like leaves, is fairly common and does not require so much moisture as most other trees. The Ber (*Zizyphus jujube*) is very common on the roads and in the fields, and its fruit is much appreciated. In the neighborhood of wells many be seen the sohanjna (*Morings ptergosperma*) with its rocky bark, pollard head and bunches of white flowers, the Lasura (*Cordia myxe*), with its right flowers and edible fruit, the mulberry or toot (*Morus alba*), the fruit of which also is much appreciated. The date-palm or Khajji (*Phonenix dactylifera*) is common only in a few places on the river Jhelum, and especially at Sada Kamboh, above shahpur and at Majhoka and Kahi near the Jhang border.

The area selected for the Bhalwal Industrial Estate is situated between Chak 11, Chak 13, Chak 14 and Chak 13 Rajgan village of Bhalwal. The area is almost barren and looks like a mini desert due to flooding during the monsoon season. Flooding occurs due to rising of water table and flooding from the surrounding areas. Major part of the area remains inundated from August to February. Salinity and overgrazing during late spring are other causes of denudation and absence of flora.

There are three palm trees and 16 other trees in the vicinity of project boundary. During the field visit, few plants of Sarkenda (*sachrum* spp), lawn grass (*Cynodon dactylon*), Dhab grass (*desmostachya bipinnata*) and sedges (in the depressions) could be seen at the project site. The details of flora of the project area are given in the **Figure 4.7**

However, the following indigenous flora could is found in the surrounding localities:

Prosopis juliflora (mesquet), *Acacia nilotica* (kikar), *Acacia modesta*, *Dalbergia sissoo* (shisham), *Ficus religiosa* (peepal) *Albizzia lebbek* (sirin), *Tamarix articulate* (frash), *Morus alba* (shetoot), *Zizyphus jujube* (ber), *Zizyphus nummularia* (ber), and shrubs like: *Euphorbia caducifolia*, *Salsola foetida*, *Salvadoraspp*, and *Calotropis aphhylla* (ok), etc. Whereas a limited number of *Melia azadricha* (bakain), *bottle brush*, *bombox ceiba* (bamboo) and *seme I* are also found in the habitations. Common grasses are: *Sachrum* spp, *Cynodon dactylon*, *Heterpog contortu*, *desmostachya bipinnata*.

4.4.2 Fauna

Wolves are common in the Sargodha district. Jackals are numerous everywhere, and do considerable damage to the crops, especially to maize and sugarcane. Foxes and wild cats also thrive in the district.

Among the birds Chikor and Sissi are very common. They grey partridges are found in many places but the black only here and there in the riverine. Ducks of many kinds are found on the river and on their ponds in the jungle. The real shoveller and smaller kind of poachers come early and stay late in winter. The mallard, like the geese, turn up with the colder weather and some birds like the red-crested pochard are seen usually at the end of the season only. Snipe and bittern are not very common. The hoobara bustard (*Hoobara macqueenii*) arrives before the sand grouse in fair numbers. The lesser bustard (*Otis tetrax*) is occasionally seen, and on rare occasions the Tog or great Indian bustard (*Eupodite enwardsi*) may be seen, but seldom shot. Allied to the hoobara is the lesser stone plover (*Oedipodites crepitans*), which lives in the same country. Quail come with the cranes at the end of August, in large numbers but in the night. They are almost the forest to come and the last to leave.

The details of fauna of the project area are given in the **Figure 4.8**. The following wildlife is found in the project area:

Mammals: Wild boar. Jackals, red fox, hares and rates.

b. **Birds:** Myna, house crows, sparrows, partridges, owl, quail, hoopoes, red vented bulbul, doves, eagles, kites, pigeons, bustards. Whereas the migratory birds include; water fowls, ducks, long legged buzzard, oriental white backed vulture, and cranes.

c. **Reptiles and amphibians:** turtles, lizards and snakes and toads

Game Reserve

A game reserve in Nabi Shah Lake near project site is present; it was established by the Government of Punjab covering area of 1674 acres and lies at a distance of about 2km, North of Project site. This area is declared as Game Reserve for all wild birds and animals for a period of five years on 09.02.2009.

The game reserve operates yearly from September to January especially during high monsoon years. Lots of birds and wildlife comes to Nabi Shah Lake and leave during end of the season i.e., January when the lake starts to become dry.

The project site of Bhalwal Industrial Estate Sargodha Project is outside the perimeters of Nabi Shah Lake at a distance of 2-4 km. A map showing location of the Bhalwal Industrial Estate and Nabi Shah Lake is provided in **Figure 4.9**.

Figure 4.8: Flora of the project area



A view of Palm tree near project site



A view of kikar at project site



Eucalyptus tree near project site



A view of Citrus trees near project site



Tree near Project site



Tree near project site

Figure 4.9: Fauna of the project area



Bird near project site



Bulbul at project site



Bird near project site



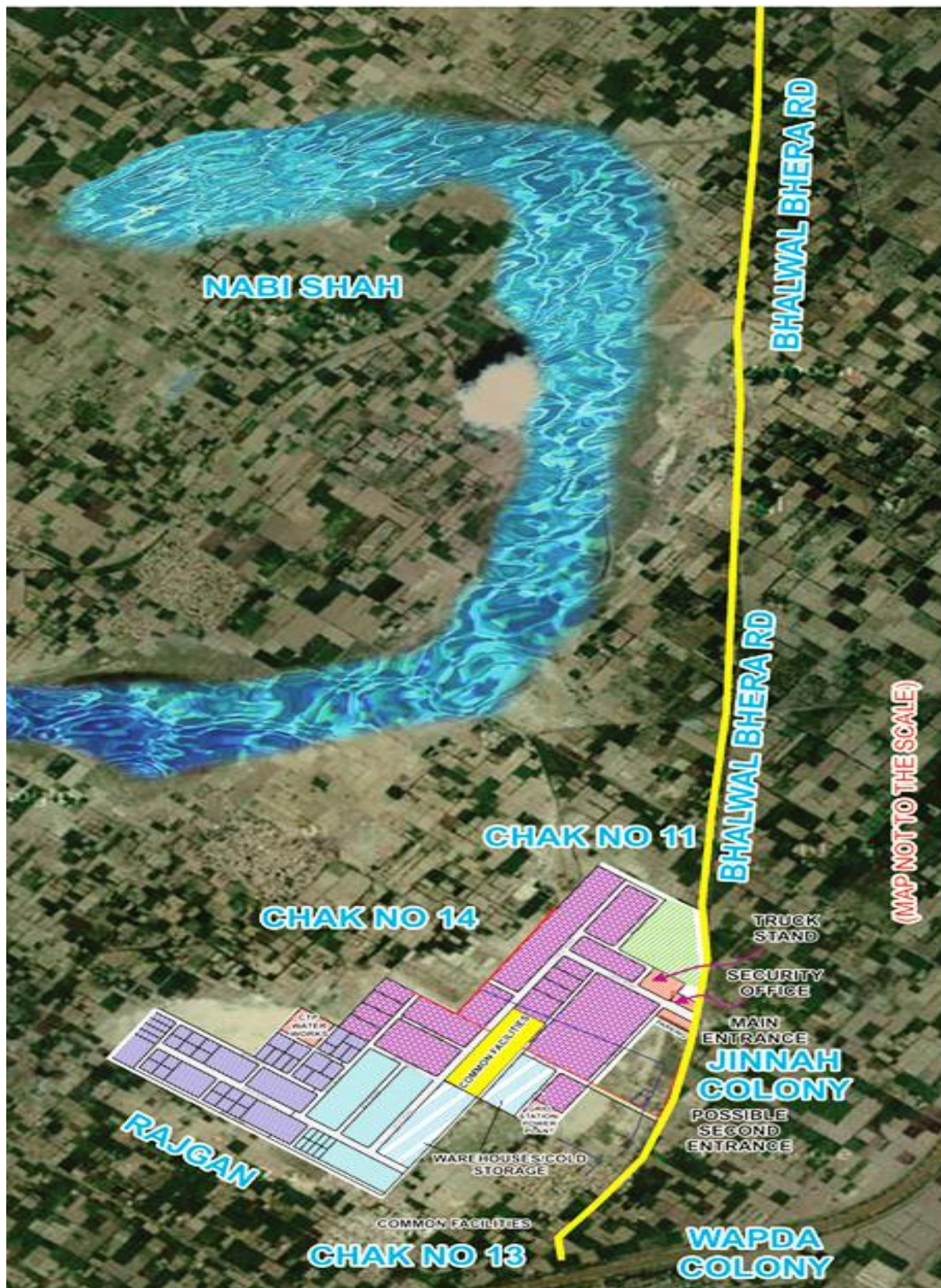
Cattles grazing near project site



Buffalo near Project site



Donkey near project site

Figure 4.10: Bhalwal Industrial Estate and Nabi Shah Lake

Source: PIE

4.5 Socio-cultural Environment

In order to assess the present socio-economic and socio-cultural conditions of local population of the Project area, a social survey was conducted. **Figure 4.10** Shown the socio cultural environment of project area.

4.5.1 Population

The villages were selected on the basis of their likelihood of getting any direct positive or negative impacts due to the project. The villages that were surveyed are Chak 11, Chak 13, Chak14 and Chak13 Rajgan. The **Table 4.10** shows the estimated population of villages and household number of each village visited.

Table 4.10: Population of villages affected by the Project

No	Village Name	Estimated Household	Estimated population
1	Chak 11	550	3,850
2	Chak 13	650	4,550
3	Chak 14	700	4,900
4	Chak 13 Rajgan	400	2,800
Total		2,300	16,100

Source: Estimated by PPI team

4.5.2 Age Structure, Sex Ratio of Project Area

In the Project area, four villages were visited and 33 persons were interviewed during the EIA. The interviews ages ranged from between 20-60 years wherein 19 male and 13 female were interviewed. Gender wise table represented under. The **Table 4.11** gives an overview of age structure, sex ratio in the Project area.

Table 4.11: Overview of socio-economic survey

No	Village Name	Gender		
		Male	Female	Age
1	Chak 11	3	3	22-50
2	Chak 13	3	3	20-30
3	Chak 14	6	6	20-60
4	Chak 13 Rajgan	7	1	22-35
Total		19	13	22-60

Source: Estimated by PPI team

4.5.3 Religion Ratio in Project Area

Punjabi society is structured around complex temporal and spiritual leadership dynamics. Tribal leadership in Punjab largely derives from temporal power, spiritual power, or from a combination of these. The spiritual power is either institutionalized

through claiming direct descent from Mohammad (PBUH), the Holy Prophet of Islam, or from a Sufi saint.

The custom of visiting Dargah (shrine) of saint is common among the Muslims and Non-Muslims. According to faith the people visit the Dargah during the time of trouble and misfortune and pray for safety and relief from the worldly affairs/problems. It is therefore the main cause that Pirs, Sayeds, Shaikhs are considered here as Mushed among uneducated masses.

There was one local non-significant Dargah/Shrine in the project area named as Baba Halim Shah which is approximately 150 years old. People celebrate a festival in Baba Halim Shah Shrine on 2nd July of every year.

4.5.4 Languages

Punjabi and Saraiki are most spoken languages in Sargodha district followed by Urdu speaking and very few people speak Phastu.

4.5.5 Tribal Distribution

The main tribes in the project area are Ranjahs, Gondals, Rajputs, dudhi, Sheikh, Khoda, Awan, Doder, Kokhar, and Pohar; based on the data collected from the sampled communities the key tribes of the sampled communities are presented in **Table 4.12**.

Table 4.12: Tribal Distribution of Project Area

No	Village Name	Major Tribes
1	Chak 14	Dudhi,Awan,Doder
2	Chak 13	Skeikh, Khoda
3	Chak 11	Pohar,Khokar,Gondals
4	Chak 13 Rajgan	Rajputs, Ranjahs,

Source: Estimated by PPI team

4.5.6 Dress in the Project area

The most common and generally used male dress is shalwar and a long shirt (Qameez) and Dohti. However, on festival and special occasions this dress is of better quality and is worn by waist coat and others adorable. The Western dress trouser and shirt can be seen rarely but among educated persons and student.

The ladies wear is also shalwar and the long shirt both of light and fancy colors along with a headscarf (dopatta). Gharara and sari are also worn by the ladies on special occasions.

4.5.7 Main Occupation of the Project area

The people in the project area being illiterate use to work as tenants and earn wages by harvesting crops and fruit cultivated lands; the area is suitable for agriculture.

People are also engaged with business and small workshops. A small proportion of the population is engaged with brick kiln as labour.

4.5.8 Agriculture

The main crops during Rabi are wheat, barley, gram, oil-seeds, and masoor and in Kharif cotton, sugarcane, rice, bajar, Maize, Mung, moth and mash. In addition to these main crops there are subsidiary crops known as Zaid Rabi and Zaid Kharif in which tobacco, Vegetables, fodder, toria

4.5.9 Other Facilities of Life

The availability of basic amenities of life to community living in the Project area is indicator of its socio-economic condition. Some of the people in villages are living in harsh condition and does not have access to the basic amenities of life. The results of survey, conducted regarding the facilities, in the Project area are as follows;

Road Access: All four villages have direct access to metal road however road conditions in villages are not good.

Health Facilities: Health facilities and infrastructure is quite inadequate in the project area. There is a high incidence of infant and maternal death in rural areas which can be prevented by providing basic health facilities at the community level. There is a government hospital in Bhalwal. Several private hospitals and clinics have also been established in Bhalwal.

One Basic Health Unit (BHU) has been established in Bhalwal near to the project area at distance of approximately 3km. However this BHU do not have any emergency facility. All the villages visit this BHU in case of emergency.

Major diseases in the area include respiratory infections, skin disease, suspected malaria, acute diarrhea, unexplained fever, acute watery diarrhea, malaria and Typhoid.

Education Facility: There are few primary and middle school in the villages near project area. Each village has at least one Government primary school GPS for boys and girls. However there was only one middle school in Chak 13 new Abadi.

Source of Drinking Water: The villages use hand pump and lower Jhelum canal water for drinking purpose. Chak 14 and Chak 13 villages use Hand pump water for drinking purpose however water in Chak 14 is salty taste. Chak 13 Rajgan and Chak 11 villagers use lower Jhelum canal water as well as hand pump water for drinking purpose and water is sweet taste. Water is available at approximately 20ft from the surface. **Table 4.13** shows sources of drinking water nearby project area.

Table 4.13: Shows sources of drinking water in the Project area.

No	Village Name	Source of drinking water	
		Hand Pump	Canal
1	Chak 11	√	√
2	Chak 13	√	—
3	Chak 14	√	—
4	Chak 13 Rajgan	√	√

Source: Estimated by PPI team

Gas Availability: None of the villages has gas supply. In other villages people use wood or gas cylinder as fuel. The **Table 4.14** shows electricity and gas availability in the Project area.

Table 4.14: Electricity and gas availability in the Project area

Village	Electricity	Sui Gas
Chak 11	√	—
Chak 13	√	—
Chak 14	√	—
Chak 13 Rajgan	√	—

Source: Estimated by PPI team

Religious Sites: The mosques and /or madrassas are present in 4 villages of the Project area.

Archaeological Sites:

There is no site of archaeological, cultural, historical and religious significance (graveyard, shrine, mosque, archaeological site) within 1,000 meters of the Project.

However, there was one local insignificant Dargah/Shrine in the project area named as Baba Halim Shah which is approximately 150 years old. People celebrate a festival in Baba Halim Shah Shrine on 2nd July of every year. The estate will be made in such a way that the shrine will not be disturbed.

Figure 4.11: Socio-economic setting of the Bhalwal

Govt Boys High School at Bhalwal



Basic Health unit at Bhalwal



Govt Girls High School at Bhalwal



Forest Complex at Bhalwal



Zakria educational institute of computer college at Bhalwal



A view of main bazar Bhalwal

5 Consultation with Stakeholders

5.1 Introduction

Bhalwal Industrial Estate Sargodha Project will impact local environment of the area as well as community living in and around the Project area.

Consultations were held with different stakeholders and community to discuss different aspects of the Project, including expected impacts on the physical, biological, and socio-economic environment of the Project area. The filled socio economic survey performs are attached as Annexure D.

This chapter provides details about consultation carried out with stockholders as well as community affected by the Project.

5.2 Objectives of Consultation

Public consultation plays a vital role in studying the effects of the Project on all the stakeholders and in the successful implementation and execution of the Projects and its activities. Public involvement is a compulsory feature of environmental impact assessment, which leads to better and more acceptable decision-making.

The main objectives of the consultation process are:

- Information dissemination, education, and liaison,
- Identification of problems and needs,
- Collaborative problem solving,
- Reaction, comments and feedback on Project,
- Documenting mitigation measures proposed by the stakeholders.

5.3 Meeting held with Stakeholders

All the stakeholders were given maximum project information verbally and were shown map of the area in detail. Different aspects of the project were discussed with stakeholders on establishment of Bhalwal Industrial Estate and expected impacts on the physical, biological, and socio economic environment of the project area. Stakeholders concern regarding various project aspects, existing environment, and impacts of industrial estate were noted and addressed in the EIA study.

Proceedings of the meeting with District Wildlife Officer Sargodha, the Divisional Forest Officer Sargodha, Program Coordinator IUCN, Islamabad, Head of WWF Islamabad, Inspector General of Forest Islamabad, General Manager Noon sugar Mills LTD Bhalwal, Project Director Mona Reclamation Experimental Project are given below.

5.3.1 District Wildlife Officer Sargodha

5.3.2 Mr. Nasar Hayat

The environmental specialist from PPI paid a customary visit to Mr. Nasar Hayat at his office. The project and the activities involved were explained to him with the help of map. Furthermore, he expressed certain concerns and suggested some action regarding the project, which are discussed as follows:

Comments:

- He appreciated the efforts of PPI for conducting stakeholder consultation meetings and also informed of other planned and on-going development activities in the area.
- The area selected for the Industrial Estate has been notified as Game Reserve, where game birds come during late autumn to spring and 2 permits are issued annually for shooting of water fowls.
- If the government intends to convert the area into an Industrial Estate, it has to be de-notified.
- Industries, in general, create pollution but it is crucial to know what types of industries will be establish to understand the nature impact on the biological environment
- In any case a proper system for disposal of industrial waste is crucial and proper drainage is imperative
- Physical, biological and socioeconomic aspects of the project area should be covered in detail in the EIA report as the data pertaining to the area is limited.
- Independent consultants should monitor the activities during the execution of the project and report EMP non-conformances to Punjab EPA.

5.3.3 Divisional Forest Officer Sargodha

Mr. Ghaffar Khan

Comments:

- The proposed activities should be planned in the manner to avoid causing any disturbance to the environment.
- Since there is salinity and area suffers from flooding, we have a limited choice of tree species for planting.
- A proper drainage system is necessary for planting trees to avoid water logging and stagnation.
- To overcome salinity problem big pits of 1 x 1 meter should be dug and filled with saline less soils mixed with compost.
- To avoid water stagnation mound planting should be done
- The Forest Department has plant nurseries and can supply saplings on the government rates

5.3.4 Program Coordinator IUCN, Islamabad

Mr. Hamid Surfaraz

Comments:

- He appreciated the stakeholder consultation process and made following suggestions
- IUCN provides technical support to government on formulation of strategies and policies and their capacity building on demand thus it is up to government to decide on whether it wants to retain the area as Game Reserve or an Industrial Estate.
- Industries, in most cases, create harm for biological environment therefore, environment friendly industries should be chosen for the area
- There are models that despite industries the biological environment can be maintained through proper system of solid and wastewater disposals and drainage systems.
- In any case the government should follow the international laws and abide by the national laws promulgated for protected areas.

5.3.5 Head of WWF, Islamabad

Dr. Ghulam Akbar

Comments:

- He expressed satisfaction that TOR of the study cover the environmental aspects associated with the proposed activities.
- He suggested that field survey should be conducted to gather primary data on physical, biological and socioeconomic environment as appropriate for the impact assessment.
- WWF will play its role if any department violates the rules formulated by the state.
- The industrial estate Bhalwal must treat the effluent prior to discharge in Nabi Shah Lake.
- The industrial estate should adopt proper mitigation measures to avoid air pollution.
- Industrialist should sign an undertaking that they will comply with environmental laws.

5.3.6 Inspector General of Forests. Islamabad

Mr. Nasir Mehmood

Comments:

- Industries are harmful for the biological environment in that area particularly

- The Punjab government should follow the national and international laws of protected areas.
- If the government de-notifies the area and declares as an Industrial Estate still strict measures would be needed to mitigate pollution.

5.3.7 General Manager Noon Sugar Mill Ltd Bhalwal

Engr Ehsan Ahmad

Comments:

- He appreciated the stakeholder consultation process.
- The industrial estate will help in development of the area.
- Facilities should be provided by the government for the treatment of effluent at the estate.
- In the particular case of Bhalwal Industrial Estate, land has been acquired easily as it was not an agricultural land.
- The industrial estate will accelerate development of the area and will be a source of employment and businesses opportunities.
- There should also be a vocational training center.
- For local population of the area so that so they can get proper training and get better employment.
-

5.3.8 Project Director Mona Reclamation Experimental Project

Engr Tanveer Ahmad Laghari

Comments

- He appreciated the stakeholder consultation process
- For industrial development, agencies with regulatory powers or responsibilities in relation to planning control, roads and traffic, waste disposal, discharge limits to fresh waters, emissions to air, historic monuments, and conservation of natural resources must be consulted.
- Proper reclamation of land should be done prior to construction of project because the project land is saline and can damage the industrial building if the reclamation is not done in time.
- Proper surface and sub-surface drainage should be provided.

5.3.9 DCO District Sargodha

Mr. Azmat Mahmood

Comments

- There is a long outstanding demand from industrialist for a state of art industrial Estate in Sargodha.
- He fully supports the establishment of Bhalwal Industrial Estate which will boost economic activities in Sargodha.

5.4 Community Consultations

A series of roadside and focus group discussions were carried out with local communities in the Project area to find out their opinion about the Project. Both male and female respondents were included in the consultation process. During the roadside and focused group discussion, the communities were informed about the salient features of the Project, its location, and its activities.

No major concern regarding the proposed operation was raised during the community consultations. People welcomed the idea of upcoming industrial estate activities sensing a relative increase in the localized economy and employments. The main concerns common to most communities are listed hereunder:

- Local villagers should be given priority during employment process for various construction-related works and activities.
- Quota for the local employment should be increased.
- The people living in adjoining villages should be provided access to the Industrial Estate.
- There should not be any interference/disturbance to women fetching water from wells, collecting firewood, grazing livestock and working in the fields.
- Increased traffic should not jeopardize the safety of the communities.
- The noise level should be kept to the minimal so that the local livestock does not get frightened and run away.
- It will also lead to providing other facilities for the residents of area; such as hospitals and high schools to the far away villages.
- They foresee the development of the area with provision of Sui gas supply and network of Telecommunication to locals.
- Majority of the people were of the opinion that the construction work should be started and completed as soon as possible.
- People emphasized that the proper mitigation measures should be implemented to control the water and solid waste pollution.
- Local people said that their privacy would be observed during construction and operational phases of the Project.

- The community emphasized that as water availability is a major concern in the Project area, so water conservation techniques should be considered. Equipment such as special showerheads, toilet system and rainwater harvesting systems should be installed at household level to conserve water.
- The Project can disturb the bio diversity and ecology of the area, thus proper mitigation measures should be taken.
- People emphasized that the proper mitigation measures should be implemented to control the water and solid waste pollution.
- Overall idea of the Bhalwal Industrial Estate Sargodha Project was appreciated by whole of the communities residing in the Project area and its vicinities.

Figure 5.1: Public Consultation with Primary and Secondary Stakeholders



Public consultation at Chak 13



Public consultation at Chak 13 Rajgan



Public consultations at Chak 11



Public consultation at Chak 13



Stakeholder consultation at Noon Sugar Mills Bhalwal



Stakeholder Consultation at DFO Bhalwal

6 Impact Assessment and Mitigation Measures

6.1 Introduction

This section discusses the potential environmental and social impacts of the proposed activities, predicts the magnitude of the impact, assesses significance, recommends mitigation measures to minimize adverse impacts, and identifies the residual impacts of the project

6.2 Environmental Screening of the Project

During the environmental impact assessment process, the predicated impacts will be characterized. Various aspects of the impact characterization include:

- Nature (direct/indirect)
- Duration of impact (short term, medium term, long term)
- Geographical extent (local, regional)
- Timing (project phase)
- Reversibility of impact (reversible/irreversible)
- Likelihood of the impact (certain, likely, unlikely)
- Impact consequence severity (severe, moderate, mild)
- Signification of impact (High, medium, low).

The above aspects of environmental characterization are defined in **Table 6.1**.

For the Bhalwal Industrial Estate Sargodha Project, an environmental screening matrix was developed, as part of the present EIA, focusing on the potential environmental impacts of the project during pre-construction, construction and operation phases. The matrix examines interaction of the project activities with various components of the environment. The impacts are broadly classified as physical, biological and socio-cultural, and then each of these broad categories were further divided into different aspects. The potential impacts thus predicated are characterized as follows:

- High negative (adverse) impacts,
- Low negative impact,
- Insignificant impact,
- High positive (beneficial) impacts,
- Low positive impact, and
- No impact.

The environmental screening matrix (unmitigated) is provided in **Table 6.2**.

Table 6.1: Impact Characterization

Categories	Characteristics
Nature	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 impact	Short-term: lasting only for the duration of the project such as noise from the construction activities. Medium-term: lasting for a period of few months to a year the project before naturally reverting to the original condition such as loss of vegetation due to clearing of campsite, contamination of soil or water by fuels or oil. Long term: lasting for period much greater than medium term impact before naturally reverting to the original condition such as loss of soil due to soil erosion.
Geographical extent	Local, regional (spatial dimension)
Timing	Construction and Operation
Reversibility of impact	Reversible: when a receptor resumes its pre-project condition Irreversible: when a receptor does not or cannot resume its pre-project condition
Like hood of the impact	Almost Certain: Impact expected to occur under most circumstances Likely: Impact will probably occur under most circumstances Possibly: Impact may possibly occur at some time Unlikely: Impact could occur at some time Rare: Impact may occur but only under exceptional circumstances
Impact consequence severity	Major: When an activity causes irreversible damage to a unique environmental feature; causes a decline in abundance or change in distribution over more than one generation of an entire population of species of flora or fauna; has long-term effects (period of years) on socioeconomic activities of significance or regional level. Moderate: When an activity causes long-term (period of years), reversible damage to a unique environmental feature; causes reversible damage or change in abundance or distribution over one generation of a population of flora or fauna; has short-term effects (period of months) on socioeconomic activities of significance on regional level. Minor: When an activity causes short-term (period of few months) reversible damage to an environmental feature; sight reversible damage to a few species of flora or faun within a population over a short period; has short term (period of months) effects on socioeconomic activities of local significance. Negligible: When no measurable damage to physical, socioeconomic, or biological environment above the existing level of public concern; and conformance with legislative of statutory requirements.
Significance of impact	Categorized as High, Medium, or Low Based on the consequence, likelihood, reversibility, geographical extent, and duration; level of public concern; and conformance with legislative of statutory requirements.

Table 6.2: Environmental Screening Matrix (Unmitigated)

	Soil Degradation	Air Quality Deterioration	Surface and Ground Water	Loss of vegetation	Damage to Wildlife	Traffic Congestion	Noise and vibration	Safety Hazard	Damage to Infrastructure	Gender Issues	Historical Archaeological Sites
Project Siting											
Visual Impacts	N	N	N	N	N	N	N	N	N	N	N
Cumulative Impacts	-2	0	-2	-2	-2	-2	-1	0	-1	N	N
Construction Phase											
Land acquisition	N	N	N	N	N	N	N	N	N	N	N
Contractor Mobilization	0	-1	0	N	-1	-2	-2	-1	-1	0	N
Construction Camp Establishment	-1	-1	-1	-2	-2	0	-1	-1	0	0	N
Construction Camp Operation	0	-1	-1	-1	-1	-1	-1	-1	0	-1	N
Site Preparation	-2	-1	-2	-2	-1	0	-2	-1	0	-1	N
Construction of Roads	-1	-1	-1	0	-1	0	-2	-1	0	0	N
Laying of Services	-1	-1	-1	-1	-1	0	-1	-1	0	0	N
Construction of Buildings	-1	-1	-1	0	-1	0	-1	-1	0	0	N
Construction Materials Supply	-1	-1	N	0	-1	-2	-1	-1	-1	0	N
Construction Crew Transportation	0	-1	N	0	-1	-2	-1	-1	-1	0	N
Solid Waste Disposal	-2	-1	-2	-1	-2	N	N	0	N	0	N
Waste Effluents Disposal	0	-1	-2	0	-1	N	N	-1	-1	0	N

	Soil Degradation	Air Quality Deterioration	Surface and Ground Water	Loss of vegetation	Damage to Wildlife	Traffic Congestion	Noise and vibration	Safety Hazard	Damage to Infrastructure	Gender Issues	Historical Archaeological Sites
Demobilization of Contractors	0	-1	0	0	-1	-2	-1	-1	-1	0	N
Operation Phase											
Operation of Bhalwal Industrial Estate	N	-1	0	-2	-2	0	-1	0	0	0	N
Solid Waste Disposal	-2	-1	-2	-1	-2	N	N	0	N	0	N
Effluents Disposal	-2	-1	-2	-1	-2	N	N	0	N	0	N

Key: -2: High negative impact; -1: Low negative impact; 0: insignificant/negligible negative; +1: low positive impact; +2: High positive impact, N: no impact.

Subsequent to the characterization, appropriate mitigation measures were identified, in order to minimize if not completely eliminate the adverse impact associated with project activities. Finally, residual impacts were identified.

The impact characterization of the predicated impacts, mitigation measures and residual impacts are discussed below.

6.3 Pre-Construction Impacts

6.3.1 Project Siting Impacts

The impacts associated with the project siting are those which relate to its location at Bhalwal. These impacts are different from those which are associated with the project's construction and operation phases, in the sense that the construction and operation impacts are associated with the activities such as land clearing, waste disposal, whereas the sitting impacts relate to the mere presence of a facility at the given location.

For the proposed project, the following three aspects of the project sitting were considered:

- Project land use and design
- Visual Impacts (aesthetic value)
- Cumulative impacts

6.3.2 Project Site, Land Use design

The project site, land use and design should meet the criteria developed by Pakistan Environmental Protection Agency for establishment of Industrial Estates in Pakistan.

The unmitigated impact associated with the locating the project at an unsuitable location or its land use design does not meet the minimum requirement are characterized as follows.

- Nature: Direct
- Duration: Long term
- Geo extent: Local
- Reversibility: Irreversible
- Likelihood: Possibly
- Consequence: Severe
- Impact significance: High.

Mitigation Measures

Project site: Bhalwal Industrial Estate Sargodha generally meets the criteria developed by Pakistan Environmental Protection Agency's guidelines for establishment of industrial estates as follows:

- The project site is not located on the prime agricultural land rather located on barren land.
- The project site is located 2-4 km from Nabi Shah Lake which is a game reserve. The Forest, Wildlife and Fisheries Department of the Government of Punjab on 13th February 2009 declared that the Nabi Shah Lake having an area of 1,674 acres shall continue to exist as Game Reserve for all wild birds/animals for a period of 5 years with effect from 9 February 2009.

The game reserve operates yearly from September to January particularly during monsoon season. A lot of birds and wildlife comes to Nabi Shah Lake and depart during end of the season i.e., January when the lake starts to become dry. However, with the passage of time, the area of Nabi Shah Lake has been reduced up to 40%.

The Project consists of two components i.e., Master Planning of Industrial Estate and Land Reclamation. The land reclamation plan for the Project site will be implemented during construction phase. This will further reduce the area of Nabi Shah Lake.

The implementation of the project will be completed in a period of 18 months and by that time the Game Reserve status of Nabi Shah Lake will expire.

Therefore, the project site is not located within 25 km of any ecologically or otherwise sensitive area, including religious and historical places and archaeological monuments, National Parks and sanctuaries except Nabi Shah Lake whom status of Game Reserve will expire before start of operation of Bhalwal Industrial Estate.

- The project site is not within 25 km of any major settlements having a population of more than 3 million.

Therefore, the project do meet the sitting criteria of Pakistan Environmental Protection Agency for establishing an industrial estates in Pakistan.

Land Use: The Pakistan Environmental Protection Agency guidelines for industrial estates have stipulated a land use of an estate.

Bhalwal Industrial Estate Sargodha is being established at an area of 426 acres, out of which 300.5 acres are allocated for industrial plots, 17.28 acres for administrative and common buildings, 33.50 acres for utilities and 94.72 acres for roads and green area.

The comparison of land use of Bhalwal Industrial Estate Sargodha with the Pak EPA guidelines is shown in **Table 6.3**.

Table 6.3: Comparison of Land Use of Bhalwal Industrial Estate Sargodha with Pak EPA guidelines

Category	Pak EPA %	Bhalwal Industrial Estate Sargodha %
Factory Plots	60-65	71
Roads	Up to 20	25
Open Space – Green Area	Up to 20	
Administrative and other buildings	5-10	4
Total	100	100

Source: Appendix II - Sectorial guidelines for Environmental reports – Industrial Estates, Pak EPA

From the above comparison, it is evident that the existing land use of Bhalwal Industrial Estate Sargodha does meet the land use criteria developed by Pak EPA for establishment of an industrial estate in Pakistan.

Design: The PIE has designed of the industrial estate for 13 types of small and medium sized industries. The **Table 6.4** shows performance of various industries against their pollution loads.

Table 6.4: Industries Performance against Pollution Loads

Industrial Zone	Noise pollution	Air emission	Liquid waste	Solid waste	Hazardous solid waste
Citrus Processing			X	X	
Juices, Jams and Marmalade			X	X	
Food Processing			X	X	
Dairy and Milk			X	X	
Flour Mills			X	X	
Oil Mills	X		X	X	
Cold Storages			X	X	
Warehouses			X	X	
Handicraft and Furniture	X	X		X	
Engineering	X			X	
Pharmaceuticals			X	X	X
Sugar Mills		X	X	X	
Textile Mills		X	X	X	

The individual industries to be established at the Bhalwal Industrial Estate Sargodha will have to treat their air, wastewater, solid waste and noise pollution to meet the NEQS requirement of Pakistan.

All the industries located at Bhalwal Industrial Estate will have primary storage of their waste inside their plot as per PIE Bye-Laws. The estate will design and

implement Solid Waste Collection and Transportation System which will be comprised of i.e., recyclable, biodegradable, non-biodegradable and hazardous wastes. The recycling and biodegradable waste will be given to their respective contractors for further processing. The non-biodegradable will be disposed off at the exiting disposal sites at Sargodha and hazardous industrial materials will be disposed off in accordance with their standard disposal protocols.

All industrial units generating wastewater will install primary treatment plants in their respective industrial units. The effluent will be treated at the Combined Effluent Treatment Plant to be established at Bhalwal Industrial Estate. A piece of land for Combined Effluent Treatment Plant has already been allocated. The effluent of Combined Effluent Treatment Plant will meet NEQS of Pakistan for discharge of effluent to public water bodies.

The air polluting industries will install scrubbers in order to comply with the NEQS requirement for air emissions.

The PIE will encourage waste minimization techniques to reduce quantity of receiving waters. This can include:

- Recycling of water from one process and one industry to another inside the estate;
- Design systems that recycle water repeatedly for the same purpose i.e., cooling towers.

6.3.3 Visual Impact

The project will be able to maintain much of its natural landscape and vegetation, particularly in and around the project site. This natural landscape has an aesthetic value, although not very significant importance, but indeed is a valuable asset of the area. The project can potentially damage the natural landscape and visual look will be impacted.

The unmitigated impact associated with the aesthetic value of the area is characterized as follows:

- | | |
|------------------------|--------------|
| ■ Nature: | Direct |
| ■ Duration: | Long term |
| ■ Geo extent: | Local |
| ■ Reversibility: | Irreversible |
| ■ Likelihood: | Possibly |
| ■ Consequence: | Severe |
| ■ Impact significance: | High. |

Mitigation Measures

For the project, the visual impacts have been minimized at different levels, as described below.

- First of all, the design of the industrial estate will be adopted in a manner that minimizes the changes in the topography, landscape and damage to the natural vegetation.
- There will be a green belt along the entire road network at the estate. A plantation plan has been proposed for the estate which will be implemented.

Residual Impacts

As a result of the above mitigation measures, the visual impact of the project will be greatly reduced. There will be some residual impact; however, its significance is expected to be low.

6.3.4 Cumulative Impacts

There is a general apprehension that the project will become a precedent, and will open ways for further development in the area. In particular housing schemes for labour and staff may be proposed in the area in future. Such projects would then lead to:

- Large scale land clearing,
- De-vegetation,
- Damaged habitat
- Increased threat to wildlife
- Increased load on the natural resources of the area, and
- Population influx.

Mitigation Measures

Although the impacts of the industrial estate have been addressed in this EIA on individual basis, the mitigation measures proposed do not address the cumulative impacts. In the opinion of the Consultant, this issue should be addressed at the policy issue, and the district and provincial Government should issue policy guidelines in this respect. One of the tools available for such kind of environmental assessment is the Strategic Environmental Assessment (SEA).

In particular, such policy guidelines should ensure that;

- No haphazard housing colonies or industrial units are allowed on Bhalwal-Bhera Road without conducting IEE/EIA.
- Keeping in view of the potential increase in the traffic, it is recommended that dualisation of Bhalwal-Bhera Road should be carried out.

In addition to the above, such planning should also address the issues which result into additional pressures on the natural resources of the project area.

6.4 Construction Phase Impacts

Construction phase is likely to be the most significant part of the project with respect to environmental considerations, since most of the impacts are likely to take place

during this period. Various construction activities will invariably create environmental disturbances, which may have impacts on the biological resources of the area and nearby communities. Major potential impacts on physical, biological and socio-cultural environment of the area include the following:

- **Physical Environment**
 - Soil degradation
 - Air quality deterioration
 - Surface and Ground Water Contamination
- **Biological Environment**
 - Loss of vegetation
 - Damage to Wildlife
- **Socio-Cultural Environment**
 - Land Acquisition
 - Traffic congestion
 - Noise and vibration
 - Safety hazards, Public health and Nuisance Issues
 - Damage to infrastructure
 - Gender Issues
 - Sites of Archaeological or Historical Significances

These impacts and their respective mitigation measures are discussed below:

6.4.1 Soil Degradation

The soil-related issues include soil erosion, slope stability, and soil contamination. These may be caused by the land clearing, leveling and grading, excavation and filling, construction activities and maintenance of equipment/vehicles. In general, the estate is being planned in a manner that the road, industrial plots and other infrastructure is arranged in accordance with the existing contours, thus minimizing the need for leveling and grading.

Soil may be contaminated as a result of fuel/oils/chemical spillage and leakage, and inappropriate waste (solid as well as liquid) disposal.

Extraction of stone and gravel from the area may potentially lead to soil erosion especially nearby canal.

The unmitigated impacts related to soil erosion and contaminations are characterized below.

- Nature: Direct
- Duration: Long term
- Geo extent: Local
- Reversibility: Irreversible
- Likelihood: Certain
- Consequence: Moderate
- Impact significance: High.

Mitigation Measures

The followings mitigation measures will minimize the soil erosion and contamination:

- Land clearing, leveling and grading be minimized, and carried out in a manner to minimize any risk of soil erosion.
- Excavated slopes will not be left untreated/unattended for long durations. Appropriate slope stabilization measures will be taken as per the design (i.e. Stone pitching). Temporary measures, such as construction of temporary walls reinforced with brick lining bordering the construction areas to contain debris and spoil, will also be undertaken to avoid soil erosion and water contamination.
- The stone and gravel will not be extracted from the areas around Nabi Shah Lake.
- Vehicles and equipment will not be repaired at the project site. If unavoidable, impervious sheathing will be used to avoid soil any water contamination.
- For the domestic sewage from the contractor's camp, septic tanks and soaking pits will be constructed having adequate capacity. Waste oils will be collected in drums and sold to the recycling contractors.
- The recyclable waste from the project site (such as card board, drums, broken/used parts, etc.) should be sold to recycling contractors. The hazardous waste should be kept separate and handled according to the nature of the waste.
- Domestic solid waste will be disposed in a manner that does not cause soil contamination (one of the options available is to dispose the recyclable material, and the remaining waste at a suitable location).

Residual Impacts

Appropriate construction practices and management actions as listed above will greatly minimize the soil erosion and contamination. The significance of the residual impacts is therefore expected to be 'low'.

6.4.2 Air Quality Deterioration

Construction machinery and project vehicles will release exhaust emissions, containing Carbon Monoxide (CO), Oxides of Sulfur (SO_x), Oxides of Nitrogen (NO_x) and Particulate Matter (PM). These emissions can deteriorate the ambient air quality in the immediate vicinity of the project site. Furthermore, construction activities such

as excavation, land leveling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions.

The unmitigated impacts related to air quality deterioration are characterized below.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Likely
- Consequence: Minor
- Impact significance: Medium.

Mitigation Measures

The following mitigation measures will minimize the hazardous emissions and their impacts:

- Construction machinery and vehicles will be kept in good working condition and properly tuned, in order to minimize the exhaust emissions.
- Fugitive dust emissions will be minimized by spraying water on soil, where required and appropriate.
- The use of vapor recovery system will be encouraged where applicable, to control losses of the volatile organic compounds(VOCs) from storage tanks to achieve 90 to 100 percent recovery
- The use of low nitrogen oxide (NOx) burners in combustion system will be encouraged.
- Plants should be encouraged to use fuel with low sulfur content
- A sulfur recovery system will be employed, if feasible, in large facilities when the hydrogen sulfide concentration in the tail gases exceeds 230mgINm³

Residual Impacts

The above measures will reduce the magnitude of the adverse impacts on the ambient air quality. The significance of the residual impacts on the air quality is expected to be low.

6.4.3 Surface and Ground Water Contamination

The project activities that can contaminate soil may also contaminate the surface water and groundwater. These include.

- Solid waste disposal
- Effluents disposal
- Equipment/vehicles maintenance
- Spillage/leakage of fuels, oils and chemicals

The unmitigated impacts of the proposed construction activities on the water resources of the area characterized below.

- Nature: Direct and indirect
- Duration: Short to medium term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Likely
- Consequence: Major
- Impact significance: High.

Mitigation Measures

- Storage of the liquid fuels and chemicals should be in areas where there is a provision for containment of spills.
- Cooling water should generally be recycled
- Sewage effluent should be segregated from wastewater containing heavy metals
- Waste water should be treated prior to discharge in Nabi Shah Lake. The effluents will meet the NEQS requirement for discharge into the public bodies.

The mitigation measures recommended to forestall soil contamination will also prevent surface and groundwater contamination.

Residual Measure

If the recommended mitigation measures are effectively employed, the residual impacts of the project activities on the water resources of the area will be negligible.

6.4.4 Loss of Vegetation

The project area is mostly barren and has some natural vegetation cover. The site preparation and construction activities may necessitate removal of the natural vegetation from the areas where road, culverts and other buildings will be constructed. Damage and/or loss of vegetation would include elimination of trees, and clearing of other indigenous and introduced species, as well as undergrowth comprising bushes, grass, etc.

There are three palm trees and 16 other trees within the project boundary. The PIE to take utmost care to avoid cutting of these trees, and pledge to realign the road, and adjust the location of buildings, if required, in case of any trees coming in the way.

The Construction crew can also indulge in tree/shrub cutting to obtain fuel wood.

The unmitigated impacts of the proposed activities on the floral resources of the area are characterized below.

- Nature: Direct
- Duration: Medium to long term
- Geo extent: Local
- Reversibility: Irreversible (reversible in medium to long term)
- Likelihood: Certain
- Consequence: Severe
- Impact significance: High.

Mitigation Measures

The follows mitigation measures will further minimize any negative impacts on the floral resources of the area:

- Endeavors will be made to compensate the loss by enhancing the environment, through plantation of trees and ornamental plants.
- A plantation plan of appropriate trees /bushes will be raised within the open available spaces and along roads. Ornamental trees, bushes and climbers have been included to improve the scenic and aesthetic value of the estate. A mixture of shady trees with heavy foliage will be required to counter the air and noise pollution, possibly along the roads.
- Selection of species to be planted may not be strictly confined to the proposed plantation plan, as local factors such as available quantity of irrigation water and edaphic limitations will also govern the choice of plants. It is further recommended that a small nursery may be established in estate, to provide planting stock wherever demand arises.
- All preventive measures will be adopted to control the spillover of chemicals and other effluents on the ground to protect soil fauna and ensure microbial activity in accordance with NEQS promulgated under Environmental Protection Act 1997.
- Cutting of trees and other natural vegetation will be minimized as far as possible through astute planning.
- A record will be maintained for any tree cutting.
- If cutting of trees is unavoidable, tree plantation of local species will be undertaken at appropriate location. The number of trees thus planted will be at least five times the ones that are cut. The trees to be planted should be an appropriate mix of fast and slow growing trees.
- The construction crew will be provided with LPG as cooking (and heating, if required) fuel. Use of fuel wood will not be allowed.

Residual Impact

The proposed tree plantation will take some time to grow and mature, there will be therefore some reduction of trees and natural vegetation in the area. However, no vegetation will be possible on the built-up area. This impact cannot be fully mitigated, and the residual impact would be medium; at least in the medium term. In the longer

run, however, the planted trees and vegetation will more than compensate for any vegetation loss.

6.4.5 Damage to Wildlife

The project site is located at Bhalwal; a wildlife habitat. The loss of natural vegetation as discussed above and the other project activities will have potential adverse impacts on the faunal resources and habitats of the area as well. There is a game reserve near the project area in Nabi Shah Lake. The industrial effluent will be treated and then discharged into Nabi Shah Lake. If NEQS for waste water treatment are not checked regularly this may damage wildlife. In addition the noise from industries will disturb the birds' routine. Migratory birds will also stop visiting Nabi Shah Lake due to noise from industries.

The unmitigated impacts of the proposed activities on the faunal resources of the area are characterized below.

- Nature: Direct
- Duration: Medium to long term
- Geo extent: Local
- Reversibility: Irreversible (reversible in medium to long term)
- Likelihood: Certain
- Consequence: Severe
- Impact significance: High.

Mitigation Measures

- The measures to prevent soil and water contamination will forestall any adverse impact on the faunal resources of the area.
- Solid waste from the contractor's camp and construction waste will not be left in the open and be disposed off properly.
- The measures to restore natural vegetation loss in the area will benefit the area's fauna as well.
- The project staff will not be allowed to indulge in any hunting or trapping activities.
- Night time construction works not be undertaken.
- Illumination levels at the site will be minimized, as far as possible.
- Appropriate diffusers will be used to restrict the illumination within the project site.
- Blasting will not be undertaken at the site for excavation purposes.

Residual Impact

Despite the above mitigation measures, there will be some residual impacts of the project on the faunal resources of the area. The significance of these residual impacts is expected to be medium.

6.4.6 Land Acquisition

The PIE will be established on 426 acres. A total of 410 acres of land has already been acquired and with possession. The PIE is in a process to acquire remaining land of 16 acres.

The unmitigated impacts related to the land acquisition for the proposed project are characterized as follows.

- Nature: Direct
- Duration: Medium to long term
- Geo extent: Local
- Reversibility: Irreversible
- Likelihood: Certain
- Consequence: Severe
- Impact significance: High.

Mitigation Measures

There is a need for appropriate compensation that should be paid to the land owners. The amount of compensation should be fixed according to the existing prices and land use.

The activities involved for this purpose would include:

- The Revenue Departments may determine a fair compensation for this land acquisition.
- Consultation and negotiation with the land owners regarding the compensation,
- Reaching an agreement for the compensation with the land-owners, and making the payment.
- Keeping complete documentary record of the entire process.

In addition to the above, employment and business opportunities should also be offered to the affected people. Furthermore, the community development initiative like provision of utility services, establishment of Vocational Training Centre and up-gradation of basic health facilities in Bhalwal should be supported by the PIE with the Government of Punjab. This will further decrease any social impacts of the project on the area, and in fact enhance the social value of the project.

Residual Impacts

The expectations of some of land owners may not be completely fulfilled even after the payment of a fair compensation. However, it is important to note that none of the land owners has taken their compensation so far, and as such there is a need to sort out this issue at the earliest. Hence, the significance of the residual impact will be high till it is resolved.

6.4.7 Traffic Congestion

Presently, the only access to the industrial estate is provided by the Bhalwal-Bhera Road which originates from the Motorway M2. The Bhalwal Industrial Estate Sargodha will potentially increase the traffic load on this road, thus adversely affecting its condition.

The vehicular traffic during the construction phase of the proposed project is expected to be 3-4 round trips during a day at peak construction period.

The unmitigated impacts associated with the vehicular traffic are provided below:

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Certain
- Consequence: Mild
- Impact significance: Medium

Mitigation Measures

- The project vehicles will avoid the peak vehicular traffic times (evenings, particularly during weekends).
- The contractor's vehicular traffic will be staggered as far as possible, to avoid traffic congestion especially at the entrance of Bhalwal-Bhera road.
- The number of trips will be minimized through astute planning.

Residual Impact

With the implementation of the above mitigation measures, the residual impacts of the project-related vehicular traffic on the existing Bhalwal-Bhera road will be negligible.

6.4.8 Noise and Vibration

Noise and vibration will be generated by the construction machinery and vehicles during construction activities. The houses close to the project site mainly in Chak 12, Chak 13, Chak 11 and Chak 13 Rajgan will be impacted by noise and vibration.

The unmitigated impacts related to the noise and vibrations caused by the project are characterized as follows.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible

- Likelihood: Certain
- Consequence: Moderate
- Impact significance: High.

Mitigation Measures

- Noise abatement measures should be achieved by well-designed, well operated and well maintained pollution control systems
- Construction equipment and vehicles will have exhaust mufflers (silencers) to minimize noise generation.
- Noise will be measured at the nearby houses. If found more than 55 dBA, appropriate sound reduction mechanism (such as a noise barrier) will be put in place.
- Construction activities will not be carried out during the night.
- Blasting will not be allowed as part of the proposed construction activities.

Residual Impact

With the implementation of above mitigation measures, the residual noise impact will be low to medium.

6.4.9 Safety Hazards, Public Health and Nuisance

The project being located close to the communities may pose some safety hazards to the local population living mainly near project site i.e. Chak14, Chak13 Chak11 and Chak13 Rajgan. Various project components/activities pose a varying degree of safety hazard to the local population. The construction machinery poses a hazard to the local population, particularly children; and increased vehicular traffic may pose safety hazards along the Bhalwal-Bhera road.

The public health issues related to the project location include: the possibility of contamination local drinking water resources, and dust emissions during the construction phase. The project area encompasses open grassland and isolated crop cultivated region. People living here are enjoying good health as they receive fresh vegetables and fruits. The anticipated health impacts are classified into the following categories:

Dust and Pollen Allergy: One of the main problems people are facing here is of dust and pollen allergy. Smoke exhaust from the brick lanes also leads to the problem of difficult breathing among the labour.

Eye and Respiratory Diseases: Construction workers may be susceptible to eye and respiratory diseases due to their routine exposure to dust and exhaust emissions on site. These effects could possibly be mitigated through routine health screening and training of contractor's employees.

Physical Injuries: Injuries could happen primarily by occupational-related accidents, animal bites, etc. Activities such as land clearing, tree felling, earthworks, and construction of facilities present various occupational hazards to the workers on site.

These risks can be mitigated through the provision of appropriate training and emergency response procedures.

Psychological Disorders: Some workers may suffer from depression and anxiety disorders due to working and accommodation conditions, and their relationship with fellow workers. The psychological wellbeing of some members of the communities may be affected due to disturbances created by the project activities. Mitigation measures for workers include the devotion to standards regarding working conditions.

Excessive illumination at the construction site may potentially cause light pollution, creating public nuisance.

The unmitigated impacts related to the safety hazards; public health and nuisance are characterized follows.

- | | |
|------------------------|----------------------|
| ■ Nature: | Direct and indirect |
| ■ Duration: | Short to medium term |
| ■ Geo extent: | Local |
| ■ Reversibility: | Reversible |
| ■ Likelihood: | Likely |
| ■ Consequence: | Major |
| ■ Impact significance: | High. |

Mitigation Measures

- Protected fencing will be fixed around the construction site. Unauthorized access within the construction area will not be allowed.
- The local community will be educated regarding the safety hazards at the site.
- The mitigation measures discussed under air quality deterioration, soil and water contamination will address the public health concerns as well.
- Defensive driving practices will be inculcated in the project drivers through trainings, posters and other similar measures.
- Vehicle speeds of 50 km/hr. at the project site will be implemented.
- Appropriate light diffusers and reflectors will be used, if required, to minimize the public nuisance caused by light pollution.

Residual Impacts

There will be a moderate level of residual impact of safety hazard associated with the vehicular traffic and construction activities.

The residual public health and nuisance issues will be quite negligible after the effective implementation of the mitigation measures.

6.4.10 Damage to Infrastructure

The construction activities and associated vehicular traffic may damage the existing infrastructures in the area, such as roads and culverts. These unmitigated impacts are characterized as follows.

- Nature: Indirect
- Duration: Medium term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Possibly
- Consequence: Moderate
- Impact significance: Medium.

Mitigation Measures

- The project vehicles will not be overloaded
- Infrastructure damaged by the project activities will be restored to original or better condition.

Residual Impact

- The residual impact on infrastructure will be low after the effective mitigation measures.

6.4.11 Gender Issues

The construction activities and vehicular traffic may cause some hindrance to women mobility in the area.

These unmitigated impacts are characterized as follows.

- Nature: Indirect
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Possibly
- Consequence: Moderate
- Impact significance: Medium.

Mitigation Measures

- Contractor's camp location will be decided in consultation with the PIE staff
- Construction crew will avoid entering the villages and settlements as much as possible.

- Moral code of conduct will be observed by the construction crew.

Residual Impacts

Despite the implementation of the above mitigation measures, there will be a moderate level of residual impact associated with the gender issues.

6.4.12 Sites of Archaeological or Historical Significance

There are no significant reported sites of archeological or historical significance at the land being acquired for the project at Bhalwal. However, in case any artifact of such significance is found during the construction activities, the Archeology Department, Government of Punjab, will be contacted. Whereas there is a local non-significant shrine named as Baba Halim Shah Shrine situated at project site.

6.5 Operational Phase Impacts

The Bhalwal Industrial Estate Sargodha operation activities will interact with different components of the environmental. This interaction may result into the following adverse impacts:

- Damage to flora and fauna
- Soil Contamination
- Surface and Ground Water Contamination
- Traffic congestion
- Safety hazards, public health and nuisance

However, the magnitude of some of the above impacts is likely to be higher as compared to the construction phase impacts.

To ensure harmony of the project with the environmental, the PIE will implement sound environmental management practices to effectively handle the basic environmental issues, including:

- Treatment of effluents from the industries as per NEQS requirement of Pakistan for discharge of effluent into water bodies.
- Hazardous and municipal waste management
- Landscaping and plantation
- Noise and other public nuisance abatement.
- Air quality management

The potential environmental impacts of the Bhalwal Industrial Estate Sargodha during operation phase are discussed below.

6.5.1 Damage to Flora and Fauna

The impacts of industrial estate on the natural vegetation of the area are likely to be comparatively less than those which would be encountered during the construction phase.

The potential impacts include cutting of trees by the estate for fuel wood.

Most of the potential impacts of the estate operation on the faunal resources are associated with the damage to the natural vegetation and habitat. In addition, the wildlife may be disturbed by noise, illumination, and mere presence of the people.

The unmitigated impacts of the estate operation on the biological resources of the area are characterized as follows.

- Nature: Direct and indirect
- Duration: Medium to long term
- Geo extent: Local
- Reversibility: Mostly irreversible (at least in the short term)
- Likelihood: Likely
- Consequence: Severe
- Impact significance: High.

Mitigation Measures

Most of the mitigation measures for protecting the biological resources during the construction phase would be applicable during the operation as well. The additional mitigation measures are:

- Cutting of trees and other natural vegetation at individual industrial plots by the entrepreneurs will be minimized as far as possible through industrial environmental awareness booklets to be prepared by the PIE.

Residual Impact

With the help of the mitigation measures listed above, the impact of the estate operation on the biological resources of the project area will be greatly reduced and the residual impacts are expected to be low to medium.

6.5.2 Soil Contamination

The soil may be contaminated as a consequence of inappropriate waste (solid as well as liquid) disposal at the estate or Combined Effluent Treatment Plant is not constructed by the PIE.

Their impacts are characterized as follows.

- Nature: Indirect
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Like
- Consequence: Major
- Impact significance: High.

Mitigation Measures

The mitigation measures recommended under above-mentioned sections apply to the operation phase of the project also. These essentially comprise of the following:

Effluent from industries

- All the wastewater polluting industries must construct Primary Treatment Plants.
- The PIE will transport the effluent from industries by underground pipe network rather than open drains.
- Properly designed Combined Effluent Treatment Plant will be installed in the estate to ensure that the requirement of NEQS of Pakistan is met for discharge of liquid effluent to water bodies.
- The PIE has already reserved a plot for the construction of Combined Effluent Treatment Plant.
- Wherever possible generation of sludge should be minimized and treated. It should be stabilize if toxic material is present.

Solid Waste

All the industries located at Bhalwal Industrial Estate will have primary storage of their waste inside their plot as per PIE Bye-Laws. The estate will design and implement Solid Waste Collection and Transportation System which will be comprised of i.e., recyclable, biodegradable, non-biodegradable and hazardous wastes. The recycling and biodegradable waste will be given to their respective contractors for further processing. The non-biodegradable will be disposed off at the exiting disposal sites at Sargodha and hazardous industrial materials will be disposed off in accordance with their standard disposal protocols.

Residual Impact

The residual impacts after the implementation of the above measures will be low if the PIE construct and operate Combined Effluent Treatment Plant and a Sanitary Landfill for Solid Waste Treatment and Disposal.

6.5.3 Surface and Ground Water Contamination

The nature of impact of the project's operation activities on the surface and ground water quality is expected to be quite similar to those predicated for the construction phase, except that the magnitude is likely to be larger, owing to the presence of industries at the estate.

The unmitigated impacts on the surface and groundwater resources of the area are characterized below.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Likely
- Consequence: Major
- Impact significance: High.

Mitigation Measures

The mitigation measured against soil contamination discussed above for the operation activities will forestall any possible water contamination as well.

Residual Impact

After the effective implementation of the above measures, the residual impacts of the operation of the estate on the water resources of the area will be negligible.

6.5.4 Traffic Congestion

The vehicular traffic associated with the estate operation is expected to be growing with the passage of time as industries starts production

The characterization of the unmitigated impacts associated with the vehicular traffic is provided below.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Certain
- Consequence: Mild
- Impact significance: Medium.

Mitigation Measures

- The vehicular traffic will be staggered as far as possible, to avoid traffic congestion.

- THE PIE should propose to the Government of Punjab for the dualization of Bhalwal Bhera Road for smooth and safe flow of traffic.

Residual Impact

The nature implementation of the above mitigation measures, the residual impacts of the project-related vehicular traffic on the existing road will be low.

6.5.5 Safety Hazard, Public Health and Nuisance

The nature impacts of the project's operation activities relating to safety hazards, public health and nuisance is expected to be quite similar to those predicated for the construction phase. These unmitigated impacts are characterized below.

- Nature: Direct and indirect
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Likely/possible
- Consequence: Moderate
- Impact significance: High to medium.

Mitigation Measures

The following mitigation measures will forestall any possible impact during the operation phase:

- The mitigation measures discussed under air quality deterioration, soil and water contamination will address the public health concerns as well.
- Appropriate waste disposal mechanisms will be implemented, as described earlier.
- Appropriate light diffusers and reflectors will be used where required to minimize the public nuisance caused by light pollution.
- Provision of firefighting arrangements at the estate
- Provision of emergency health facilities

Residual Impact

After the effective implementation of the above-mentioned measures, the residual impacts of the estate operation activities relating to safety hazards, public health and nuisance will be negligible.

6.6 Positive Impacts of the project

The operation of the Bhalwal Industrial Estate, Sargodha will accelerate the business activity in the area and will provide employment to locals that will have positive impact on the local economy thereby increasing the quality of life.

In addition the establishment of industrial estate will accelerate the export of citrus from the region which will further increase business in the area.

6.6.1 Social Benefits

BIE will be able to concentrate dedicated infrastructure in a delimited area to reduce the per-business expense of that infrastructure. Such infrastructure includes roadways, railroad sidings, ports, high-power electric supplies, high-end communications cables, large-volume water supplies, and high-volume gas lines.

6.6.2 Employment and Business Opportunities

The operation of the BIE, will accelerate the business activity in the area and will provide employment to locals that will have positive impact on the local economy thereby increasing the quality of life.

6.6.3 Import of Products

This Project will facilitate the production and import of the citrus products and other food goods grown in the Project area to national and international markets.

6.6.4 Other Benefits

- Increase government revenues.
- Reduce increasing ratios of poverty and regional disparities.
- Enhance the volumes of textiles production and exports in the days to come.
- It would increase province's role in national exports.
- Bhalwal is likely to be the first Special Economic Zone of Punjab/Pakistan.

7 Environmental Management Plan

7.1 Introduction

This chapter outlines the implementation mechanism for Environmental Management Plan (EMP) and defines the institutional arrangements required for the implementation of the plan. The EMP provides the implementation mechanism for the mitigation measures identified during the EIA.

7.2 Environmental Management Plan

The environmental management plan (EMP), one of the outcomes of the EIA, identifies key areas requiring attention during the project, in particular, (a) what is to be managed and monitored; (b) when and where; (c) by whom; (d) the expected cost for management; and (e) whom to report and follow up if there is an issue that may raise at any stage of the project. Based on these guiding principles, the EMP so prepared for the effective implementation and management of the mitigation measures and monitoring requirements, satisfies the requirement of the Pakistan's environmental regulations.

7.3 Purpose and Objectives of EMP

The Environmental Management Plan (EMP) will provide a delivery mechanism to address the adverse environmental impacts of Bhalwal Industrial Estate Sargodha Project during its execution and operation, to enhance project benefits and to introduce standards of best practices to be adopted for all phases of the project.

The primary objectives of the EMP are to:

- Facilitate the implementation of the earlier identified mitigation measures.
- Develop a proper monitoring mechanism and identify requisite monitoring parameters to confirm effectiveness of the proposed mitigation measures.
- Define the responsibilities of the project proponent PIE, engineers and contractors, and provide a means of effectively communicating environmental issues among them.

7.4 Structure of the EMP

The EMP consists of the following parts:

- Roles and Responsibilities (Management Approach)
- Impact Mitigation Management Matrix
- Environmental Monitoring Plan
- Change Management Plan
- Communication and documentation
- Training Programme

7.5 Management Approach

7.5.1 Pre-Construction and Construction Phase

Roles and Responsibilities of BIE

The overall responsibility for compliance with the Environmental Management Plan of Bhalwal Industrial Estate Sargodha Project rests with Punjab Industrial Estates Development and Management Company.

Roles and responsibilities of Engineers, Contractors/Sub-contractors

The contractors will carry out field activities as part of their contract agreement. The contractors will be responsible to implement various mitigation actions prescribed in the EIA report. The contractors will also be subject to certain liabilities under the environmental laws of Pakistan, and under their contracts with the PIE. Furthermore, the PIE will implement Environmental Monitoring Plan which has been prepared for the construction phase.

The Project Manager, Bhalwal Industrial Estate Sargodha Project will monitor the contractors and ensure implementation of the EMP and the EIA.

7.5.2 Operation Phase

The magnitude of environmental impacts during the operational phase will be significant therefore; the PIE will have to implement various mitigation actions as described in the EIA during operation phase. Furthermore, keeping in view of magnitude of environmental impact, an Environmental Monitoring Plan has been proposed.

7.6 Organizational Structure and Responsibilities

7.6.1 Primary Responsibilities

- The Director, Punjab Industrial Estates Development and Management Company or his representative will be over all responsible to ensure that EMP is properly implemented throughout the project.
- The Project Manager, Bhalwal Industrial Estate Sargodha Project, PIE will be responsible to supervise/ monitor and ensure the implementation of the EMP and the EIA.
- The PIE should establish an Environmental Protection Cell within the PIE which should look after the environmental issues of all industrial estates and ensure the implementation of remedial measures.
- The engineering contractor(s) will be responsible for the implementation of the EMP and EIA on the ground.

7.6.2 Field Management and Quality Control

Carrying out construction activities in an environmentally sound manner during the construction phase will be the responsibility of the Project Manager, Bhalwal Industrial Estate Sargodha Project. He will be responsible for implementing the IEE and EMP recommendations.

7.6.3 Approvals

The PIE and project contractor will have to obtain all the relevant clearances and necessary environmental approvals required by the Environmental Protection Agency, Punjab Pakistan.

7.6.4 Contractual Provisions

Adherence to the requirements of the EIA and EMP in terms of environmental mitigation will be required from all project contractors and thus EMP will form part of their contracts with The PIE. The contractor shall be responsible for implementing the mitigation measures and monitoring of various environmental parameters. The PIE shall monitor the contractor's performance with respect to EMP implementation.

7.7 Impact Mitigation and Management Matrix

An Impact Mitigation Management Matrix has been provided at **Table 7.1**. This matrix will be used as a management and monitoring tool for implementation of the mitigation measures required by the EIA. The matrix includes:

- The mitigation measures recommended in the EIA.
- The person/organization directly responsible for adhering to or executing the required mitigation measures.
- The parameters, which will be monitored to ensure compliance with the mitigation measures.
- The timing at which the mitigation or monitoring has to be carried out.

Table 7.1: Impacts Mitigation and Management Matrix for Bhalwal Industrial Estate Sargodha Project

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
Design and Pre-Construction Stage					
ALIGNMENT and SHOULDER WIDTH OPTIONS					
SAFETY					
Design of main and approach roads to standards with special reference to local dangers	Uneasy traffic flow, congestions.	Improve road geometry Provide markings for centre and edge lines and stop lines at junctions and bus stops All signs, markings and bridge plates must be refectories. Improve junction layouts In built-up areas, consider widening on one side of carriageway only, and explore possibility to incorporate service lane.	At the Project site	Engineering Consultant	PIE
STRUCTURES					
Cross-drainage and accessory structures	Flash flows may damage structures or cause drainage problems in urban areas	Adequately design cross-sections of drainage structures based on hydraulic studies, taking regional/local lessons learned into consideration All structures will be constructed with reasonable safety against seismic acceleration	At the Project site	Engineering Consultant	PIE

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
	Seismic activities may damage structures	Adequately design all structures based on material/ construction studies that take into account activities up to the seismic scales indicated in the seismic maps.	At the Project site	Engineering Consultant	PIE
ROADSIDE VEGETATION and PLANTATION					
Loss of vegetation	Loss of plants in an area with biodiversity	Incorporate technical design to minimize removal of plantation. Apply flexibility in decision as which side to be widened, or in reducing locally the shoulder width. Plan for compensatory planting program, i.e. plants of similar floral function, at least 1 m high. Discourage the introduction of exotic species or species with known environmental setbacks (e.g. <i>Eucalyptus spp</i>).	All along the Project site	Engineering Consultant	PIE
WILDLIFE and ADJACENT ECOLOGICAL SENSITIVE AREAS					
Disturbance to ecologically sensitive areas adjacent to or the near the estate	Accidents with wildlife	Incorporate cautionary signage to raise attention of people for wildlife protection in area at risk.	Disturbance to ecological sensitive areas adjacent or the near the estate	Engineering Consultant	PIE

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
MAINTAINING AIR QUALITY and NOISE LEVELS					
Increase of traffic intensity	Increase of air and noise pollution and associated health risks for roadside residents	Incorporate technical design features that enable continual traffic flux and avoid congestions (e.g. signboards, speed limits, speed bumpers, bays); Include design measures to prevent blockage of bus stands and carriageways by street vendors, particularly near villages. Consider noise barriers in sensitive areas	At the Project site	Engineering Consultant	PIE
Creation and burning of wastes at or near camp site	Air pollution associated with burning garbage	Disallow setting for worker camp , including waste dump sites, in distances closer than 5 km to any inhabited areas; Incorporate technical design features for refuse collection containers at sites that would minimize burning impacts; Devise plan for safe handling, storage and disposal of harmful materials.	At camp site	Engineering Consultant	PIE
SOIL and BORROW MATERIAL					
Excavation of earth from borrow areas	Change of soil characteristics; loss of topsoil; impact on agriculture	Agricultural areas will be avoided for burrowing of materials, confining to already defined borrow pits. Contractor needs to obtain approval from PPP Unit for excavation and for plan of rehabilitating the site after excavation.	Where applicable	Engineering Consultant	PIE

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
Acquisition of conglomerate and rocky sub-base material	Degradation of existing river beds, alteration of surface and groundwater regime, land-use conflicts	Excavation in farmlands, Riverbed and embankment vicinity will be prohibited.	Where applicable	Engineering Consultant	PIE
EXISTING PUBLIC UTILITIES					
Public utilities	Public utilities to be affected may create disruption of public services and economics	Timely notifications and consultations with respective agencies; All public utilities (e.g. water pipes, power/ telephone and Sui-gas lines) are likely to be impacted by the carriageway widening need be re-located well ahead work commencement.	Where applicable	Engineering Consultant	PIE
Construction STAGE					
CAMP SITE					
Site clearing and preparation, and re-installation work after contract completion	Loss of vegetation and assets on the selected land, and dissatisfaction on rehabilitation measures after completion	All efforts during the design phase should be made to minimize the removal of existing plantation at camp site. Contractor will provide plan for removal & rehabilitation of site upon completion Photographical and botanical inventory of vegetation before clearing the site Compensatory plantation to be scheduled when construction work near to end; for each tree removed new shall be planted	Through the construction site	Contractor	Engineering Consultant
Sanitation & waste disposal	Health risks to work force and	The Contractor will provide a proper waste management plan.	At waste collection and latrine sites of	Contractor	Independent Monitoring Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
facilities at camp	public if not properly managed	The sewerage system for the camp will be properly designed (pit latrines) and built so that no water pollution takes place.	camp		
CONSTRUCTION WORKS					
Work safety and hygienic conditions	Health risks if work conditions provide unsafe and/or unfavorable work conditions	Obligatory insurance against accidents to work labourers Providing basic medical training to specified work staff, and basic medical service and supplies to workers Layout plan for camp site, to be approved by the IEC indicating safety measures taken by the contractor, e.g. fire fighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents; Work safety measures and good workmanship practices are to be followed by the contractor to ensure no health risks for labourers; Protection devices (ear muffs) will be provided to the workers in the vicinity of high noise generating machines. Provision of adequate sanitation, washing, cooking and dormitory facilities, including light up to the satisfaction, approved by PPP Unit. Proper maintenance of facilities for workers will be monitored by the Independent Monitoring Consultant Regarding pest control measures in the camp.	Valid for entire construction area Throughout operation of work camp	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
Camp site security	Security hazards and related conflicts	Proper storage and fencing/locking of storage rooms containing hazardous material Employment of guard for storage rooms. Provision of adequate security against sabotage and petrol theft.	At Construction camp	Contractor	Engineering Consultant
Wages and Work Regulations	Inequities in wages, underpayment and gender-biased wages	The Contractor will agree to pre-defined minimum wages in Pakistan Women must receive wages equal to the wage paid to men for equal works Wages shall be made public to all workers Child labour will be strictly ruled out; Contractor has to respect local festivals and religious customs that would temporarily interfere with work performance; Sub-Contractors have to adhere to the same wage principles	Construction sites	Contractor	Engineering Consultant
Creation of construction waste material	Contamination of soil from construction wastes and quarry materials	All spoils will be disposed off as desired and the site will be restored back to its original conditions before handing over. Non-bituminous wastes from construction activities will be dumped in sites approved by the PPP Unit in line with the legal prescriptions for dumpsites, and covered with a layer of the conserved topsoil. Bituminous wastes will first be recycled if it is not possible then be disposed off in an identified dumping site.	All construction sites and entire Project area	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
Movement of vehicles in the construction site and along the haulage routes	Soil compaction and alteration of percolation and vegetation pattern; Damage to properties and utilities	Construction vehicles, machinery and equipment will move, or stationed in the designated ROW, to avoid unnecessary compaction of soil. Damages will be instantly repaired and/or compensated at Contractor's obligation Water and soil quality will be monitored as envisaged in the Environmental Monitoring Plan.	Throughout the Project site	Contractor	Engineering Consultant
Movement, maintenance and fuelling of construction vehicles	Contamination of soil and groundwater from fuel and lubricants	Slopes of embankment leading to water bodies will be modified and screened so that contaminants do not enter the water body Construction vehicles and equipment will be properly maintained and refuelled in such way that oil/diesel spillage does not contaminate the soil. Fuel storage and refuelling sites will be kept away from drainage channels. Oil and grease traps will be provided at fuelling locations, to prevent contamination of water. Unusable debris shall be dumped in nearest landfill sites. Waste oil and oil soaked cotton/ cloth shall be sold off to authorized vendors Water quality will be monitored as envisaged in the Environmental Monitoring Plan.	Throughout the Project alignment.	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
Embankment works: Excavation of earth, cutting operations, embanking, clearing of vegetations	Soil Erosion, Loss of vegetation and habitat	In areas with strong sheet flow, high embankments will be provided with chutes and drains to minimize soil erosion. Stone pitching and retaining walls will be made at high embankments in critical areas (> 40% gradient) As applicable and needed, plantation of grasses and shrubs will be carried out for slope protection. Soil erosion-checking measures such as the formation of sediment basins, slope drains, etc, will be carried out. Soil erosion along the road shall be visually checked as given in the environmental monitoring plan.	Where applicable	Contractor	Engineering Consultant
Borrow pit land lease agreement	Land disputes, Soil erosion, loss of potential crop land, loss of vegetation and landscape degradation	The Contractor must obtain any necessary permits for borrow pits from the competent authorities, including Provincial Highway Department, Government of Punjab.	Where applicable	Contractor	Engineering Consultant
Borrow pit excavation activities	Soil Erosion, damage to road embankment and public health risks	No excavations are allowed within 100 m to ROW In borrow pits the depth of the pit will be regulated so that the sides of the excavation will have a slope not steeper than 1: 4. Soil erosion along the borrow pit shall be regularly checked to prevent / mitigate impacts on adjacent lands. In case burrowed pits fill with water, measures shall be taken to prevent the creation of	All borrow sites in entire Project area	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
		mosquito-breeding sites.			
Provisions for rehabilitation of borrow pit	Soil Erosion, derelict land-uses, conflicts, visual sores in the landscape, public health risks due to development of mosquito-breeding pits	Abandoning borrow areas without proper rehabilitation measures will be disallowed. The Contractor's agreement with the landowner must determine the options and appropriate measures for rehabilitation of the borrow pit as approved by the Independent Consultant, such as reshaping the borrow site into a desired land-use plot (e.g. irrigation field, fishpond), re-plantation aiming at double amount of trees removed from the site.	All borrow sites in entire Project area	Contractor	Engineering Consultant
WATER					
Use of water for construction and consumption	Conflict with local water demand	The contractor will make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. For construction purposes, water shall be drawn from surface water bodies on priority and as available.	Throughout the Project Area	Contractor	Engineering Consultant
Earth- and stonework and other construction activities affecting water resources	Contamination of water due to construction waste	Construction work close to the streams or other water bodies will be avoided, especially during monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. Wastes must be collected, stored and taken to an approved disposal site.	Throughout the Project Area	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
AIR POLLUTION CONTROL					
Vehicular movement and running of machineries	Emission from construction vehicles and machinery, causing public health risks, nuisance and other impacts on the bio-physical environment	Diversion roads in built-up areas will be established and scheduled to minimize traffic congestion Diversion roads will be black-topped to prevent excessive dust development All temporary service and access roads will be regularly water-sprayed to minimize the dust generation: Schedules will be adjusted to actual needs, determined by the PPP Unit or Independent Monitoring Consultant. All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the NEQS. Air quality parameters will be monitored at determined sites and schedule determined by the PPP Unit or then by Consultant.	Include all diversions in populated areas of the three districts	Contractor	Engineering Consultant
Running of asphalt mix plants, crushers, etc.,	Dust generation from construction machineries causing health risks to operating workers, impact on bio-physical environment	Ensure precautions to reduce the level of dust emissions from, hot mix plants, crushers and batching plants will be taken up, e.g. providing them, as applicable, with protection canvasses and dust extraction units. Mixing equipment will be well sealed and equipped as per existing standards. Water will be sprayed on the lime/ cement and earth mixing sites. Work safety measures like dust masks shall be provided by the contractor to ensure no health risks for operators.	At sites of hot mix plant	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
NOISE CONTROL					
Running of construction machinery	Noise from vehicles, asphalt plants and equipment	The plant and equipment used for construction will strictly conform to noise standards specified in the NEQS. Vehicles and equipment used will be fitted as applicable, with silencers and properly maintained. In urban settlements, construction activities will be restricted to be carried out between 6 a.m and 8 p.m. In accordance with the Environmental Monitoring Plan, noise measurements will be carried out at locations and schedule specified to ensure the effectiveness of mitigation measures.	During construction	Contractor	Engineering Consultant
FAUNA and FLORA					
Access to sensitive areas and fragile ecosystem	Wildlife poaching, collection of wild plants, disturbance of ecosystem.	The use of fire wood for cooking and execution of works will be prohibited No open fires will be allowed Restoration of vegetated areas damaged Strict instructions from the Contractor to work staff (particularly the cooks) with respect to poaching local wildlife Patrolling and enforcement. A record should be maintained for tree cuttings. Cutting of tress and other natural vegetation will be minized as far as possible through astute planning including diversion of road at sensitive location.	Near sensitive areas	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
ROAD SAFETY and COMMUNITY LIFE					
Vehicular movement at construction sites and access/ service roads	Accident risks, particularly inflicting local communities who are not familiar with presence of heavy equipment	Timely public notification on planned construction work. Close consultation with local communities to identify optimal solutions for diversions to maintain community integrity & social links Seeking cooperation with local education facilities (school teachers) for road safety campaigns Provision of proper safety signage, particularly at urban areas and at sensitive/ accident-prone areas. Setting up speed limits in close consultation with the local stakeholders Ensure proper lighting at auxiliary facilities such as bus stands, taxi stands, passengers waiting sheds etc. If identified, consider guard rails at accident-prone stretches and sensitive locations (schools).	Throughout Project Road, particularly near the settlements and sensitive locations	Contractor	Engineering Consultant
SOCIAL BALANCE and PUBLIC RELATIONS					
Cultural differences between contractor and locals	Local residents may resist Contractor attitudes; Cultural clashes particularly when international	Timely and full public consultation and announcement of mobilizing equipment Establishment of formal links with affected communities, Plan for social grievance redress mechanisms including the Nazim and community leaders.	Project Area	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
	Contractor is engaged	Seek assistance from and cooperation with local NGOs			
Conflicts arising due to the mix of local & migratory job seekers	Social disturbance because of dissatisfaction with employing outsiders	Aim at obliging the Contractor to employ an agreed ratio (>75%) local community (unskilled) labour for construction works; An agreed minimum unskilled labour employment rate for women, at equal pay like men, will be negotiated at early stage.	Project Site	Contractor	Engineering Consultant
ARCHAEOLOGICAL SITES					
Encountering archaeological sites during earth works	Impacts of historically important sites and damage to fossils, arte-facts, tombs, structure etc, as defined in Antiquity Act, 1975	In case of detecting any archaeological artefact, structure, tomb etc., and the Contractor needs immediately halt all works at the find site and brief within shortest time possible the Archaeological Department in Sargodha. In the event of such finding, the Contractor has the duty to secure the site against any intrusion until the archaeological expert will decide on further action.	Throughout/ entire Project area, including borrow sites	Contractor	Engineering Consultant
OPERATIONAL STAGE					
WATER and SOILS					
Vehicular movement and industrial operations	Contamination from operation and spills etc	Wastewater will be treated prior to entering in Nabi Shah lake	Throughout the Project Area	Contractor	Engineering Consultant
AMBIENT AIR QUALITY					
Vehicular movement and industrial	Emission from industries causing public health risks,	Plantations as applicable and feasible under harsh climatic conditions; plants should be selected in accordance to their ability to	Adjoining villages and at sensitive spots along the road	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
operations	nuisance and other impacts on the bio-physical environment	absorb emissions Regular road maintenance to ensure good surface condition Speed limits in areas sensitive Monitoring air quality at defined schedule Regular vehicle check to control/ensure compliance with NEQS Enforcement and penalties against traffic rules violators			
NOISE LEVEL and VIBRATIONS					
Vehicular movement and industrial operations	noise pollution and vibrations from industries	Noise measurements will be carried out at locations and schedule specified by the Provincial Highway Department to ensure the effectiveness of mitigation measures, e.g. speed limits and noise control plantations at sensitive spots. According to monitoring results, additional sound barriers in form of trees and hedges will be discussed with the affected public and planted if agreed. Signs for sensitive zones (health centers / educational institutions etc.) will be headed to prohibit the use of pressure horns. Enforcement and penalties against rules violators.	As applicable at Sensitive spots along the road	Contractor	Engineering Consultant
FAUNA and FLORA					
Vehicular movement	Accidents with wildlife	Setting up speed limits. Provision of proper safety signage.	Throughout the Project site	Contractor	Engineering Consultant

Activities and Actions	Environmental Issue/ Component	Proposed Mitigation Measures	Approximate Location	Institutional Responsibilities for Implementing Mitigation Measures Implementation Supervision	
		Setting up speed limits Proper lighting arrangements at petrol stations, bus truck stops Display of signboards alerting drivers' attention on wildlife and environmental issues related to safe driving and wildlife encounters. Special education signboards at times when migratory birds tend to approach the highway; inform school masters			
Plantation	Maintenance of Flora	Monitoring of survival of trees at the rate of 75 % should be done in the first year of the operational phase and suitable mitigation measures should be taken to protect the trees Efforts will be made for proper maintenance of planted trees, shrubs and grasses to maintain greenery and aesthetics	Throughout Project area	Contractor	Engineering Consultant
ROAD SAFETY					
Vehicular movement	Accidents involving hazardous materials	In case of spillage, the report to relevant departments will be made. Efforts will be made to clean the spills of oil, toxic chemicals etc. as early as possible.	At any location where accident occurs	Contractor	Engineering Consultant
Vehicular movement	General road safety issues	Traffic management plan will be developed, especially along congested locations Traffic control measures including speed limits will be enforced	Throughout Project area	Contractor	Engineering Consultant

7.8 Environmental Monitoring Plan

Environmental Monitoring is normally undertaken during both the construction and operational phases to ensure the effectiveness of the proposed mitigation measures. In order to respond to unanticipated environmental concerns at an early stage and to determine the accuracy of impact, predictions are also required. Specific monitoring programs are outlined below as well as responsibilities for the collection and analysis of data and the reporting requirements.

The cost estimates for Environmental Monitoring of the Project during construction phase by an Independent Environmental Consultant is provided in **Table 7.4**.

Table 7.2: Cost Estimates for Environmental Monitoring of the Project

Description	Frequency	Unit Cost in Rs	Amount in Rs
Surface water and Ground Water parameter analysis	At the start of construction activities, Quarterly and at the end of the Project	18,000	252, 000
Ambient air quality and Noise monitoring		40,000	280,000
Fee of Independent Engineering Consultant		125,000	1,050,000
		Total	1,582,000

An Environmental Monitoring Plan during construction phase is provided in **Table 7.3** and an Environmental Monitoring Plan during operational phase is provided in **Table 7.4**.

Table 7.3: Environmental Monitoring Plan during construction phase for Bhalwal Industrial Estate Sargodha Project

Environmental Component	Parameters	Locations	Frequency	Standards	Implementation	Supervision
Air Quality	PM10, SOx, NOx, CO, dust, smoke	At the center of the estate	PM10, for continuous 8 hours, on quarterly basis	WHO/USEPA guidelines, NEQS	Independent Monitoring Consultant	PIE
Water Quality	pH, BOD, COD, TDS, TSS, DO, NHx, coliforms hardness, nitrate, hydrocarbon, Pb	Nearest surface water At nearest bore hole near Contractor's camp	Quarterly basis	WHO and NEQS	Independent Monitoring Consultant	PIE
Noise Levels	dBA	At the site where air quality analysis are carried out.	Twice in 8 hours at selected sites at 1 m, 7.5 m, 15 m, and 50 m from right-of way, Quarterly basis	EPA Ambient Noise standards	Independent Monitoring Consultant	PIE
Erosion	Visual inspection of erosion prevention measures and occurrence of erosion	Side slopes of the embankments and material storage sites	At the end of filling activity		Independent Monitoring Consultant	PIE
Solid waste from Contractor's camp	Visual checks to assess the situation.	At contractor's camp site	Once in a month	Monitoring that solid waste disposal off properly.	Independent Monitoring Consultant	PIE
Top soil conservation	Depth of top Soil	At all Project sites.	Beginning of earth filling works	USEPA guidelines	Independent Monitoring Consultant	PIE

Environmental Component	Parameters	Locations	Frequency	Standards	Implementation	Supervision
Hydrocarbon and chemical storage	Visual Inspection of storage facilities	Construction camps	Monthly	Monitoring that Chemicals should stored carefully	Independent Monitoring Consultant	PIE
Traffic Safety	Visual inspection to see whether proper traffic signs are placed and flag man for traffic management are placed	Roads	Monthly		Independent Monitoring Consultant	PIE
Health Safety of contractor staff	Visual checks to assess the situation.	Workers of the contractor	Once a month	Monitoring of the health and safety of workers	Independent Monitoring Consultant	PIE
Flora & Fauna	Visual checks to assess the situation.	All along the Right of Way of the Project	Once a month		Independent Monitoring Consultant	PIE
Plantation Plan implementation	Visual inspection of plant species survival rate and status of maintenance	(1) At sites where plantation was carried out (2) At site within right of-way	(1) One month after plantation (2) One year after plantation 1 month, 3 months, 6 months, and 12 months after Planting	75 % survival rate	Independent Monitoring Consultant	PIE

Table 7.4: Environmental Monitoring Plan during operational phase for Bhalwal Industrial Estate Sargodha Project

Environmental Component	Project Stage	Parameters	Locations	Frequency	Standards	Implementation	Supervision
Plantation Plan Implementation	Operation	Visual inspection of plant species survival rate and status of maintenance	At sites where plantation was carried out	(1) 2.5 years after plantation	75% survival rate	BIE	PIE
Safety and Traffic Rules Compliance	Operation	(1) Faulty, overloaded and speeding vehicles (2) Inspection of signage	All along Bhalwal Industrial Estate Sargodha Project with spot check at accident-prone black spots	Quarterly basis, for 3 years	To be determined	BIE	PIE

7.8 Change Management Plan

The EIA for Bhalwal Industrial Estate Sargodha Project recognizes that changes in the EMP may be required and therefore provides a Change Management Plan to manage such changes. Overall responsibility for the preparation of change management statements will lie with the Project Manager, PIE.

7.9 Post Project Environmental Monitoring

The Project Manager, PIE or his representative shall prepare a brief Post Project Environmental Monitoring Report describing the conduct of the actual operation, any changes from the operation for which approval was obtained, the degree to which the recommendations of the EIA were adhered to, any damages to the environment and the mitigation or compensation provided, and monitoring information.

7.10 Communication and documentation

Meetings

Two kinds of environmental meetings will take place during the Project:

- Kick-off meeting
- Monthly meetings

The purpose of the kick-off meeting will be to present the EMP to Project Staff and discuss its implementation.

A monthly meeting will be held during construction operations at the camp. The purpose of this meeting will be to discuss the conduct of the operation and environmental issues, and their management. The proceedings of the meeting will be recorded in the form of a monthly environmental report.

Reports

Environmental Monitoring Reports will be prepared on quarterly basis during construction phase of the Project.

7.11 Training Programme

Environmental training will form part of the environmental management system. The training will be directed towards raising the awareness of all personnel on key environmental issues related to the project activities and the importance of adopting mitigation measures to minimize these impacts.

7.12 Objectives

The key objective of training programme is to ensure that the requirements of the EMP are clearly understood and followed throughout the project. The training of the

staff will help in communicating environmental restrictions specified in the EIA and EMP.

7.13 Roles and Responsibilities

The contractors will be primarily responsible for providing environmental training to all project personnel on potential environmental issues of the project. The contractors will be responsible to arrange trainings and ensure the presence of the relevant staff.

7.14 Training Programme

The environmental awareness, EIA and EMP training will be carried out for key staff involved during different phases of the project.

7.15 Training Log

The project contractors will be required to maintain a training log that must include the following:

- Topic discussed.
- Date, Time and location.
- Trainer.
- Participants / Attendees.

7.16 Training Needs Assessment

In addition to the training specified in the training log, special/additional trainings will be provided during the project activity. The criteria to assess the need of such special training will be based on the following:

- When a specified percentage of staff is newly inducted in the project.
- When any non-compliance is repeatedly reported, refresher training will be organized addressing the particular issue.
- When any incident/accident of minor or major nature occurs
- Arrival of new contractor/sub-contractor
- Start of any new process/activity

7.17 Plantation Plan

At this stage it is not known that how much area would be available for planting trees thus the following planting plan and estimates are made for one acre land basis.

A. Soil working: No tree can survive in an area which remains waterlogged for 7 to 8 months and where salinity is high. Thus a proper drainage system is crucial for

planting trees. To overcome the problem of salinity, big pits of 1x1 should be dug and filled with soil that contains compost or high organic matter.

B. Selection of Species: To create a desirable biological environment, 3 planting strips would be advisable. Keeping in mind the salinity, flooding and the ornamental aspect, the following species are recommended

i. 1st Strip: Tall trees along the boundary: depending on the availability of land for planting one or two row of Eucalyptus, Shesham, Peepal, Sirin and Mulberry can be established.

ii. 2nd Strip: In the next row medium sized trees with spreading crowns like, Neem, Bakain, Jaman, and kachnar, alternated with of tall bores like: bamboo and dates or small trees of high ornamental value, like Tecoma, Pilken, Kachnar, Gravellia and Bottle brush, etc.

iii. Third Strip: Around building small sized ornamental trees/ shrub (like bottle brush Chinese shoe flower, lagustrum, kanir, Sukh chane, and weeping Ashok, etc) and fruit plants like Dates, Anar (pome granate), Citrus, Chiko, and Amroot (guava).

C. Spacing: For 1st and 2nd strip 3 m x 3 m spacing are recommended due to big size of trees, thus these strips will occupy 75% land (6 kanal out of an acre). Whereas spacing for small trees and shrubs would be 2m x 3m (3 m from row to row and 2 m for plant to plant)

D. Planting methods: As stated earlier, a proper drainage system is necessary prior to planting trees. Having installed the drainage system, small mounds of earth should be created in the low lying spots / depressions. In the rest of the land big sized planting pits should be dug.

E. Planting time: Planting should be carried out in the fall or early spring.

F. No of saplings for 1 acre land

i. 1st and 2nd strip will occupy 75% land (6 kanals) = 3035 sq.m = 337 saplings

ii. Strip 3 will occupy 25% land (2 kanals) = 1012 sq.m = 169 saplings

Total = 506

Table 7.5: Cost Estimates for Plantation (1 acre land)

Activity	Estimated Cost Plan	
	Per Sapling/ Plant	Total
Digging of pits, replacing saline soil and planting saplings	50 per sapling 506x 50	Rs 25,300
Cost of 337 big sized tree saplings	@Rs 10 per plant	Rs 3, 370
Cost of ornamental 85 tree saplings	@Rs 30 per plant 85 x 30	Rs 3, 370
Cost of 85 fruit sapling	@Rs 100 per plant = 85x100	Rs 8,500
Transportation and cost of maintenance of saplings (lump sum)		Rs 5,000
Tools and Implements (lump sum)		Rs 2,000
Wages for 1 guard/ gardener	@Rs 90000 per month for 1 year	Rs 108,000
Total cost of plantation on 1 acre land for the 1st year		Rs 154,720

7.18 Disaster Management Plan

A disaster is a natural or man-made (or technological) hazard resulting in an event of substantial extent causing significant physical damage or destruction, loss of life, or drastic change to the environment. A disaster can be defined as any tragic event stemming from events such as earthquakes, floods, catastrophic accidents, fires, or explosions. It is a phenomenon that can cause damage to life, property and destroy the economic, social and cultural life of people.

7.18.1 Aim and purpose

The Plan is a document describing the Disaster Risk Management Plan and approach to disaster operations in support of the guiding principles and objects of the Act.

All events, whether natural or caused by human acts or omissions, should be managed in accordance with the Plan. The Plan is supported by supplementary hazard specific plans, functional plans and disaster management guidelines.

7.18.2 Legislative requirements

The Act forms the legislative basis for disaster management activities across all levels of government in BIE in accordance with the Provincial Disaster Management Commissions and Provincial Disaster Management Authorities established in all provinces in accordance with the National Disaster Management Ordinance 2006.

National Disaster Management Authority (NDMA) has developed the guidelines on the planning process and outcome.

7.18.3 BIE Flood Disaster Plan

Pakistan is no stranger to floods or havocs they wreck, thanks to its geographical location. It falls in the arid zone with irregular rain pattern. The total area of Punjab Province is 51 million acres of which 7.7 million acres fall in the active flood zone. As

per 1998 Census, of the total population 14.5 million falling in the active flood zone. It has a tremendous water source in the shape of Indus River System which drains bulk of its fertile land.

BIE is located in lower Jhelum Canal area. The Jhelum River after flowing through Wular lake and collecting water from the Neelum and Kunhar rivers enters Punjab through Mangla Dam from where Upper Jhelum Canal originates to feed the Chenab River upstream Khanki Barrage. From Rasul Barrage on the Jhelum River, Rasul –Qadirabad Link and Lower Jhelum Canal are taken out. The JR then opens into the Chenab River at Trimu H/W, from where Trimu-Sidhnai Link, Haveli and Rangpur Canals are taken out.

This area falls under less and intermittent flood area but if flood comes it can affect the lower Jhelum canal area.

Preventive Action

Once the likelihood of a disaster is suspected, action has to be initiated to prevent a failure. Engineers responsible for preventive action should identify sources of repair of equipment, materials, labour and expertise for use during emergency.

Reporting Procedures

The level at which a situation will be termed a disaster shall be specified. This shall include the stage at which the surveillance requirements should be increased both in frequency and details. There is a need to notify the following information:

- Exit points for the public,
- Safety areas in the
- Nearest medical facilities.

Communication System

An efficient communication system is absolutely essential for the success of any disaster management plan. This has to be worked out in consultation with the BIE. More often, the entire communication system gets disrupted when a disaster occurs. The damage areas need to be clearly identified and provided with temporary and full proof communication system.

Emergency Action Committee

To ensure coordinated action, an Emergency Action Committee will be constituted. Emergency Action Committee will prepare the evacuation plan and procedures for implementation based on individual industries needs and facilities available. The plan should include:

- Demarcation of the areas to be evacuated with priorities,
- Safe area and shelters,
- Functions and responsibilities of various members, and
- Setting up of joint control action.

All personnel involved in the Emergency Action Plan should be thoroughly familiar with all the elements of the project site and their responsibilities. The staff at the site should be trained for problem detection, evaluation and emergency remedial measures. Individual responsibility to handle the segments in emergency plan must be allotted.

Success of an emergency plan depends on public participation, their response to warning notifications and timely action. Public has to be educated on the hazards and key role in disaster mitigation by helping in the rescue operations. It is essential to communicate by whom and how a declared emergency will be terminated. There should be proper notification to the public on de-alert signals regarding termination of the emergency. The notification should be clear so that the evacuees know precisely what to do when re-entering or approaching the affected areas.

Here are the steps some of which can be taken to avoid massive damage in any disaster especially flood.

Pre-Flood Arrangements

- I. *Coordination; collaboration and consultation:* The BIE identifies roles of officers that lead the activities and decisions at the State, district and local level.
- II. Across all levels of the BIE, effective management of any disaster relies on strong coordination arrangements; consultative decision making, collaboration and shared responsibility achieved through supporting relationships, trust and teamwork between individuals, agencies and the community.
- III. Evacuation of the marooned people to already selected safer places is planned. Relief camps should set up and roads are checked for pliability to ensure the supply of relief goods when needed. Rehearsals are made without creating false alarm. Everything is double checked and double ensured.
- IV. The joint teams of Irrigation Department, Pakistan Army and District Governments carry out the inspection of protection embankments, head works, barrages and breaching sections and submit their reports to the Relief Department.
- V. The relief equipment including boats, OBMs, life jackets, tents, blankets, and de-watering sets etc., owned by the Relief Department, should place at the disposal of the Army troops.

The Livestock Department according to the scheduled program completes its pre-flood vaccination in second week of May and they are under the obligation to keep ample dosages of these vaccines for use in case of any emergency and are also directed to keep sufficient quantity of fodder and animal feed as reserve stock.

An emergency Centre of Provincial Health Department should set up in the BIE main office

Food Department maintains sufficient stock of wheat at safer places near the flood prone areas.

All the concerned departments are mobilized to prepare a holistic all-encompassing Flood Disaster Management Plan to tackle any contingency arising out of floods. Nothing is left to chance or taken for granted. Every measure to be taken in case of any eventuality is well considered and well-rehearsed.

During-Flood Arrangements

- I. During floods many people get stranded and marooned in inundated areas and may have to be safely and immediately evacuated. The District Governments evacuate the flood affected to the pre-arranged safer areas with the help of Army.
- II. After evacuation, the flood victims are shifted to Relief Camps where they get food, medicines and temporary shelter.
- III. The Mobile Teams constituted by the Health and the Livestock Departments should come into operation immediately for the purposes of vaccination, inoculation, treatment and cure. The affectees should provide with the chlorine tablets to ensure the provision of safe drinking water. Cholera vaccination, anti-venom serum and other medical help are ensured. ORS is supplied regularly, and emergency beds are arranged in the hospitals. The cattle are also vaccinated.
- IV. Tents, blankets and de-watering sets should provide immediately. After temporarily ensconcing the affectees in the camps, the rehabilitation work including repair of roads and irrigation channels, and restoration of electricity, telecommunication and gas etc is started immediately so as to repatriate them to their home and hearth.

Post-Flood Arrangements

When the flood waters recede and the danger is sub-sided, the most difficult of all the flood-disaster management stages begins.

All the concerned departments coordinate for the restoration of services and the rehabilitation of the flood affectees. The roads and water channels should be opened and repaired on priority basis, because these are the life lines of the rural population. The Irrigation Department should get busy in replenishing the affected embankments and irrigation infrastructure.

The Relief Department oversees the working of the area administration in implementation of relief and rehabilitation schemes and the social Welfare Department coordinates the efforts of NGOs for re-settlement and rehabilitation of the affected people.

The Post-Flood Disaster Management is the most sensitive and arduous task and has to be implemented with patience and indulgence. This stage completes the Flood Disaster Management Plan.

Emergency Measures

The emergency measures are adopted to avoid any failure in the system such as lights, fire, means of escape, ventilation shafts etc. The aim of Emergency Action Plan is to identify areas, population and structures likely to be affected due to a catastrophic event of accident. The action plan should also include preventive action, notification, warning procedures and co-ordination among various relief authorities. These are discussed in following sections.

Emergency Lighting

The emergency lights operated on battery power should be provided at appropriate locations. The battery system should supply power to at least 25% of the lights at those locations for a period of 2 hours. Both the transformers need to be kept energized and should feed independently alternate rows of lights so that in case of failure of one transformer, there will not be complete darkness.

Prevention and Safety Measures

Fire prevention measures will be designed and implemented to minimize the risk of outbreak of fire by appropriate choice, location and installation of various materials and equipment. The potential sources of fire can be reduced by:

Fire Prevention

- Use of non-combustible or smoke retardant materials where possible,
- Provision of layout which permits ease of maintenance for equipment and its cleaning,
- Provision of special storage spaces for combustible materials such as paint and oil,
- Prohibition of smoking in fire prone areas,
- Provision of cigarette and litter bins, and
- Good housekeeping

Fire Alarm and Detection System

A complete fire detection system with equipment complying with the requirements of Fire Fighting Department of the BIE shall be provided throughout the project site and ancillary buildings to give visual and audible indication of alarm conditions actuated by the operation of break glass contact or fire sensors e.g. detector heads, linear heat detecting cables etc. The system shall be operated from 24 V DC Power sources.

Manually operated call points shall be provided at every hydrant and nose reel points, station head wall, tail wall and other locations. Alarm bells shall be installed in each plant room complex at both platform and concourse level and shall be clearly audible at all points in the room/area.

Beam detector or heat detector shall be installed at roof level, ceiling and floor cavity, whilst linear detecting cables shall be installed in under platform cable ducts and cable shafts.

Fire Control Measures

Control of the spread of fire and smoke will be achieved by containment of fire risk areas, planning for smoke extraction, and arrangement for smoke containment.

Visual and audible indication of alarm conditions actuated by the operation of break glass contact or fire sensors e.g. detector heads, linear heat detecting cables etc. The system shall be operated from 24 V DC Power sources.

Manually operated call points shall be provided at every hydrant and nose reel points, station head wall, tail wall and other locations. Alarm bells shall be installed in each plant room complex at both platform and concourse level and shall be clearly audible at all points in the room/area.

Beam detector or heat detector shall be installed at roof level, ceiling and floor cavity, whilst linear detecting cables shall be installed in under platform cable ducts and cable shafts.

Smoke probe units shall be installed in rooms/compartments. When an alarm point is operated, the fire pump shall start to operate automatically. A station fire control and indicating panel shall be provided and installed in the station controllers room, for the control, indication and monitoring of the whole detection and firefighting systems.

7.19 General Recommendations

Keeping in view the landscape of the Industrial Estate, it is recommended that a water pond should be created at one corner of the lowest end of the area and a strip of bushes and shrubs be established around the pond. The pond will create a habitat and attract migratory birds. Moreover, the pond will drain out an ample amount of water from the plantation and building subjected to flooding. The water can also be filtered/ treated for different uses.

8 Conclusions and Recommendations

8.1 Introduction

This Chapter presents the assessment of the possible environmental impacts of Bhalwal Industrial Estate Sargodha Project. The study presents the purpose of the EIA, the description of the site, the impacts of the project during and after implementation, the mitigation measures and residual impacts.

The EIA also includes the justification and detailed description of the project, with an evaluation of the potential impacts and effects on the environment including economic and social consequences. This Chapter describes the conclusion and recommendation of the EIA study of the project.

8.2 Conclusions

8.3 The major conclusions of the EIA are:

- The Bhalwal Industrial Estate Sargodha site was examined considering the Pakistan Environmental Protection Agency guidelines for industrial estate, and was found to be in line with the criteria developed.
- The project construction and operation activity can potentially impact the natural resources of the area. These adverse impacts can be largely reduced by implementing the appropriate mitigation measures which have been discussed in this report.
- The project siting is likely to result into some aesthetic issues which can be reduced with the help of astute planning.
- The base line data for ambient air, Surface and Ground water, noise has been established for the project site.
- The potential impacts during construction phase include loss of natural vegetation, increased threat to wildlife, increased traffic load on Bhalwal Bhera Road, soil erosion and contamination, water contamination, deterioration of ambient air quality caused by the exhaust emission and kicked up dust, noise pollution, damaged infrastructure, safety hazards and public health concerns for the nearby communities.
- The significant environmental management issues during operation phase include air pollution, effluent disposal, solid waste and noise pollutions, vehicular traffic.
- The mitigation measures have been identified in the Chapter 6 for impacts expected during the different phases of the project.
- Based on the recommended mitigation measures in Chapter 6, the impacts identified in Table 6.2 will be reduced with residual impacts having insignificant levels. Table 8.1 presents the assessment of the residual impacts (mitigated).

- On the basis of the overall impact assessment, more specifically, nature and magnitude of the residual environmental impacts identified during present EIA, it is concluded that Bhalwal Industrial Estate Sargodha Project is unlikely to cause any significant, lasting impacts on the social, physical and biological environment of the area, provided that the proposed activities are carried out as suggested in the report, and the mitigation measures recommended in this report are completely and effectively implemented.
- There are no remaining issues that warrant further investigation. This EIA is considered as adequate for the environmental and social justification of the project.

8.4 Recommendations

- A plantation plan has been proposed in the EIA report which will be developed and implemented for Bhalwal Industrial Estate Sargodha Project.
- The PIE should ensure that every industrial unit must keep a minimum of 10 % of their plot as green area.
- The PIE intends to construct open drains for transportation of effluents from industries up to the final disposal point. It is recommended that PIE should transport the effluent from industries up to the final disposal point through underground pipe network rather than open drains.
- The PIE will ensure that all wastewater polluting industries do install Primary Treatment Plant at the earliest.
- All the industries located at Bhalwal Industrial Estate will have primary storage of their waste inside their plot as per PIE Bye-Laws. The estate will design and implement Solid Waste Collection and Transportation System which will be comprised of i.e., recyclable, biodegradable, non-biodegradable and hazardous wastes. The recycling and biodegradable waste will be given to their respective contractors for further processing. The non-biodegradable will be disposed off at the exiting disposal sites at Sargodha and hazardous industrial materials will be disposed off in accordance with their standard disposal protocols.
- Regarding cumulative impacts of the project, there is a need that District and Provincial Government of Punjab should issue policy guidelines to the future development of the area to ensure that;
 - No haphazard housing societies or industrial units are allowed on Bhalwal Bhera Road without conducting IEE/EIA.
 - Keeping in view the potential increase in the traffic, the dualization of Bhalwal Bhera Road may be carried out, when feasible. However, in the meantime its Right of Way should be increased to cater for its future expansion.

Table 8.1: Impact Matrix – Residual Impacts (Mitigated)

	Soil Degradation	Air Quality Deterioration	Surface and Ground Water	Loss of Vegetation	Damage to Wildlife	Traffic Congestion	Noise and vibration	Safety Hazard	Damage to Infrastructure	Gender Issues	Historical Archaeological Sites
Project Siting											
Visual Impacts	N	N	N	N	N	N	N	N	N	N	N
Cumulative Impacts	Need to be addressed at policy level. An SIA should be carried out in the area to address cumulative impacts.										
Construction Phase											
Land acquisition	N	N	N	N	N	N	N	N	N	N	N
Contractor Mobilization	0	0	0	N	-1	-1	-1	0	0	0	N
Construction Camp Establishment	-1	0	0	-1	-1	0	0	0	0	0	N
Construction Camp Operation	0	0	0	0	-1	0	0	0	0	0	N
Site Preparation	-1	0	0	-1	-1	0	-1	0	0	0	N
Construction of Road	0	0	0	0	0	0	-1	-1	0	0	N
Laying of Services	0	0	0	0	0	0	-1	-1	0	0	N
Construction of Common Buildings	0	0	0	0	-1	0	-1	-1	0	0	N
Construction of Chalets	-1	0	-1	0	-1	0	-1	-1	0	0	N
Construction Materials Supply	0	0	N	0	-1	-1	-1	-1	0	0	N
Construction Crew Transportation	0	0	N	0	-1	-1	-1	-1	0	0	N
Solid Waste Disposal	-1	0	-1	-1	-1	N	N	0	N	0	N

	Soil Degradation	Air Quality Deterioration	Surface and Ground Water	Loss of Vegetation	Damage to Wildlife	Traffic Congestion	Noise and vibration	Safety Hazard	Damage to Infrastructure	Gender Issues	Historical Archaeological Sites
Waste Effluents Disposal	-1	0	-1	-1	-1	N	N	0	N	0	N
Demobilization of Contractors	0	0	0	0	-1	-1	-1	0	0	0	N
Operation Phase											
Operation of Bhalwal Industrial Estate	N	0	0	0	-1	0	0	0	0	0	N
Solid Waste Disposal	-1	0	-1	-1	-1						
Waste Effluents Disposal	-1	0	-1	-1	-1	N	N	0	N	0	N

Key: -2: High negative impact; -1: Low negative impact; 0: insignificant/negligible negative; +1: low positive impact; +2: High positive impact, N: no impact.

9 References

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Annexure–A: Persons consulted during the study

No	Name	Gender	Occupation	Village
1	Mr. Mazhar Abbas	Male	Farmer	Chak 14 North
2	Mr. Shabaan	Male	Farmer	Chak 14 North
3	Mr. Mohammad Nazir	Male	Farmer	Chak 14 North
4	Mr. Sana Ullah	Male	Student	Chak 14 North
5	Mr. Abdul Qam	Male	Farmer	Chak 14 North
6	Mr. Abdul Hafeez	Male	Police	Chak 14 North
7	Mrs Mussarat	Female	House wife	Chak 14 North
8	Mrs Sana Rehman	Female	House wife	Chak 14 North
9	Mrs Naseer	Female	House wife	Chak 14 North
10	Miss Marai Rehman	Female	Student	Chak 14 North
11	Mrs Bushra	Female	House wife	Chak 14 North
12	Mrs Sana Aziz	Female	House wife	Chak 14 North
13	Mrs Rahila	Female	House wife	Chak 11 - Adda
14	Mr. Sajjad Hussain	Male	Shop keeper	Chak 11 - Adda
15	Mr. Mukhtar Hussain	Male	Shop keeper	Chak 11 - Adda
16	Mr. Mohammad Yar	Male	Shop keeper	Chak 11 - Adda
17	Mrs Kalsoom	Female	House wife	Chak 11 - Adda
18	Mrs Maraim Bibi	Female	House wife	Chak 11 - Adda
19	Mr. Abdul Rauf	Male	Shop keeper	Chak 13 - Rajgaan
20	Mr Qabla-e- Abbass	Male	Shop keeper	Chak 13 - Rajgaan
21	Mrs Gulam Ruqaya	Female	House wife	Chak 13 - Rajgaan
22	Mrs Parveen	Female	House wife	Chak 13 - Rajgaan
23	Mrs Shehnaz	Female	House wife	Chak 13 - Rajgaan
24	Mr Azar Iqbal	Male	Student	Chak 13 - Rajgaan
25	Mr. Qaiser Iqbal	Male	Self Employed	Chak 13 New Abadi
26	Mr. Mirza Khan	Male	Shop keeper	Chak 13 New Abadi
27	Mr. Mushtaq Ahmed	Male	Farmer	Chak 13 New Abadi
28	Mr. Mohmmad Safdar	Male	Labourer	Chak 13 New Abadi
29	Mr. Mulzim Hussain	Male	Labourer	Chak 13 New Abadi
30	Mr. Mohammad Asif	Male	Labourer	Chak 13 New Abadi
31	Mr. Faisal	Male	Labourer	Chak 13 New Abad
32	Mrs Anwar Bibi	Female	House wife	Chak 13 New Abadi
33	Mr Afzal Ahmed	Male	Labour	Chak 13 New Abadi

No	Name	Gender	Occupation	Village
34	Mr. Nasar Hayat	Male	District Wildlife Officer	Sargodha
35	Mr. Ghaffar	Male	Divisional forest officer	Sargodha
36	Mr Hamid Srafraz	Male	Program Coordinator IUCN	Islamabad
37	Dr. Ghulam Akbar	Male	Head WWF	Islamabad
38	Mr Nasir Mehmood	Male	IG Forest	Islamabad
39	Engr. Ehsan	Male	GM Noon Sugar Mill Ltd	Bhalwal
40	Engr Tanveer Ahmad	Male	Project Director Mona Reclamation Experimental Project	Bhalwal

Annexure–B: List of Fauna of the Project Area

List of Birds

No.	Scientific Name	Common Name	Status			Occurrence		
			Abundant	Common	Less Common	Rare	Migratory	Resident
1	<i>Coturnix coturnix</i>	Common Quail		X				X
2	<i>Columba livia</i>	Pigeon		X				X
3	<i>Pycnonotus cafer</i>	Red vented, Bulbul			X			X
4	<i>Acridotheres ginginianus</i>	Myna		X				X
5	<i>Streptopelia decaocto</i>	Collared dove		X				X
6	<i>Corvus splendens</i>	House Crow	X					X
7	<i>Passer domesticus</i>	House Sparrow	X					X
8	<i>Acridotheres tristis</i>	Indian Myna		X				X
9	<i>Streptopelia senegalensis</i>	Little Brown Dove		X				X
10	<i>Ardeola grayii</i>	Paddy Bird/Indian Pond Heron			X			X
11	<i>Bubulcus ibis</i>	Cattle Egret			X			X
12	<i>Eudynamis scolopacea</i>	Common Koel			X		X	X

Source: PPI field data

List of Mammals

No.	Scientific Name	Common Name	Status			Occurrence		
			Abundant	Common	Less Common	Rare	Migratory	Resident
1	<i>Sus scrofa</i>	Indian Wild Boar		X				X
2	<i>Mus booduga</i>	Little Indian field mouse		X				X
3	<i>Mus musculus</i>	House mouse		X				X
4	<i>Rattus rattus</i>	Common Rat		X				X
5	<i>Mus musculus</i>	House mouse		X				X
6	<i>Rattus rattus</i>	Common Rat		X				X
7	<i>Canis aureus</i>	Asian Jackal		X				X
8	<i>Canis lupus</i>	Wolf		X				X
9	<i>Lepus nigricollis</i>	Indian Hare, Wild Hare		X				X
10	<i>Felis chaus</i>	Jungle Cat		X				X
11	<i>Rattus rattus</i>	Rat		X				

Source: PPI field data

List of Reptiles

No.	Scientific Name	Common Name	Status			Occurrence		
			Abundant	Common	Less Common	Rare	Migratory	Resident
1	<i>Calotes versicolor</i>	Garden Lizard		X				X
2	<i>Bufo stomaticus</i>				X			
3	<i>Uromastix hardwickii</i>			X				X
4	<i>Hemidactylus flaviviridis</i>				X			X
5	<i>Varanus bengalensis</i>	Indian Monitor		X				X

Source: PPI field data

Annexure-C: List of Flora in the Project Area

No.	Botanical Name	Local Name	Family	Life Form						
				Herb	Shrub	Grass	Tree	Sedge	Climber	Creeper
1	<i>Acacia nilotica</i>	Kikar	Mimosaceae				x			
2	<i>Acacia modesta, Dalbergia sissoo</i>	shisham	Malvaceae		x					
3	<i>Ficus religiosa</i>	peepal	Amaranthaceae	x						
4	<i>Tamarix articulata</i>	frash	Amaranthaceae	x						
5	<i>Albizia lebbek</i>	Shreen	Mimosaceae				x			
6	<i>Morus alba</i>	shahtoot	Papilionaceae	x						
7	<i>Zizyphus jujube</i>	beri	Poaceae			x				
8	<i>Zizyphus nummularia</i>	ber	Boraginaceae	x						
9	<i>Euphorbia caducifolia,</i>		Asteraceae	x						
10	<i>Salsola foetida</i>		Amaranthaceae	x						
11	<i>Calotropis aphhylla</i>	Oak	Meliaceae				x			

Source: PPI field data

Annexure–D: Filled Socio Economic Survey Performa's

EIA of Bhalwal Industrial Estate, Sargodha Socio-Economic Survey

Year: 2012No. : 01**1. Location/Settlement:**1.1 Village: Chak 141.2 Tehsil: Bhalwal1.3 District: Sargodha**2. Biographical Data :**2.1 Name: Sana Aziz2.2 Father's Name: Salahuddin2.3 Age: 272.4 Sex: F2.5 Caste : Dudhi

2.6 Marital Status:

☒ Married ☐ Single ☐ Widow ☐ Divorced

2.7 Literacy Status:

☒ Literate ☐ Illiterate

2.8 If literate:

☐ Primary ... ☐ Secondary ☐ Matric ☒ Bachelors ☐ Higher2.9 Occupation: ☐ Agricultural ☒ Non Agricultural out of country.2.10 Monthly Income: 35,000/-**3. Household:**3.1 Size of household: 5 (3 kids)3.2 How long have you lived in this area: Birth - Native

3.3 Ownership status of your house:

Self-owned: ☒ Rented: ☐

3.4 Type of construction of your house:

Pacca: ☒ Semi-pacca: ☐ Kacha: ☐3.5 Transport Sources: ☐ Motor Bike ☐ Car ... ☐ Other No. Bus

3.6 Which of the following facilities are available at your house:

Electricity: ☒ Water supply: ☒Gas: ☒ Telephone: ☒

4. Land Use:

- 4.1 Depth of Water Table (Feet): 28-30
- 4.2 Is any working Tube well present: ☒ Yes..... ☐ No
- 4.3 If yes, Type of Tube Well: ☒ Diesel Tube Well ☐ Electric Tube Well.....
- 4.4 Type of Vegetation in area: Barani
- 4.5 Orchards / Fruit Tree in area: Fruit trees -
Mangoes -

5. Project:

- 5.1 Do have information about Project: ☒ Yes..... ☐ No
- 5.2 Perception about Project:
Five.
- 5.3 Negative effects of Project:
- 5.4 Any Suggestion to improve Environment
Employment to local -

Interviewer Signature: Jabbar

EIA of Bhalwal Industrial Estate, Sargodha

Socio-Economic Survey

Year: 2012No. : 19**1. Location/Settlement:**

1.1 Village: Chak 13 Rajgan 1.2 Tehsil: Bhalwal
 1.3 District: Sargodha

2. Biographical Data :

2.1 Name: Ghulam Duqya
 2.2 Father's Name: G. Ali
 2.3 Age: 17-18 years 2.4 Sex: M
 2.5 Caste : Araen
 2.6 Marital Status:
 () Married () ☒ Single () Widow () Divorced
 2.7 Literacy Status:
 (☒) Literate () Illiterate
 2.8 If literate:
 () Primary ... () Secondary (☒) Matric () Bachelors () Higher
 2.9 Occupation: (☒) Agricultural () Non Agricultural
 2.10 Monthly Income: 30-40,000/-

3. Household:

3.1 Size of household: 7
 3.2 How long have you lived in this area: local- Native
 3.3 Ownership status of your house:
 Self-owned: ☒ Rented: _____
 3.4 Type of construction of your house:
 Pacca: _____ Semi-pacca: ☒ Kacha: _____
 3.5 Transport Sources: (☒) Motor Bike () Car ... () Other _____
 3.6 Which of the following facilities are available at your house:
 Electricity: ☒ Water supply: ☒
 Gas: ☒ Telephone: Mobile

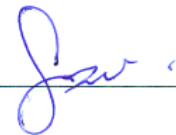
4. Land Use:

- 4.1 Depth of Water Table (Feet): 60-70
- 4.2 Is any working Tube well present: ☒ Yes..... ☐ No
- 4.3 If yes, Type of Tube Well: ☐ Diesel Tube Well ☒ Electric Tube Well.....
- 4.4 Type of Vegetation in area: Barani
- 4.5 Orchards / Fruit Tree in area: Mango, Shehtoot.

5. Project:

- 5.1 Do have information about Project: ☒ Yes..... ☐ No
- 5.2 Perception about Project: Positive
- 5.3 Negative effects of Project: Pollution will cause if SW is not Managed.
- 5.4 Any Suggestion to improve Environment increase the Employment opportunities for local

Interviewer Signature: _____





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