ENVIRONMENTAL IMPACT ASSESSMENT

TYRE MANUFACTURING INDUSTRY

EMC Pakistan Private Limited

ARMSTRONG

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Armstrong ZE Tyre Manufacturing Factory

Final Report
March, 2022
Ref: EIA/31/03/22

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Executive Summary

Armstrong ZE (Pvt.) Ltd. (hereinafter referred as Project Proponent) intends to establish Armstrong ZE Tyre Manufacturing Factory, Gharo, Karachi. The proponent has commissioned the services of EMC Pakistan (Pvt) Ltd to conduct the Environmental Impact Assessment (EIA) of the project.

M/s Armstrong ZE (Pvt.) Ltd. plans to set up an automobile manufacturing plant on 50.25 acres land located at Gharo – Keti Bunder Highway (N110), Sindh. Armstrong ZE (Pvt.) Ltd. is a tyre importer and supplier who is setting up their own tyre manufacturing industry in Pakistan. With over 50 years of experience in the tyre industry, the company has gained an immense understanding and expertise of not just tyres, but the automotive sector as a whole

Location of the Project within the Gharo at Gharo – Keti Bunder Highway (N110), Mirpursakro, Thatta, Sindh is shown in the figure below;

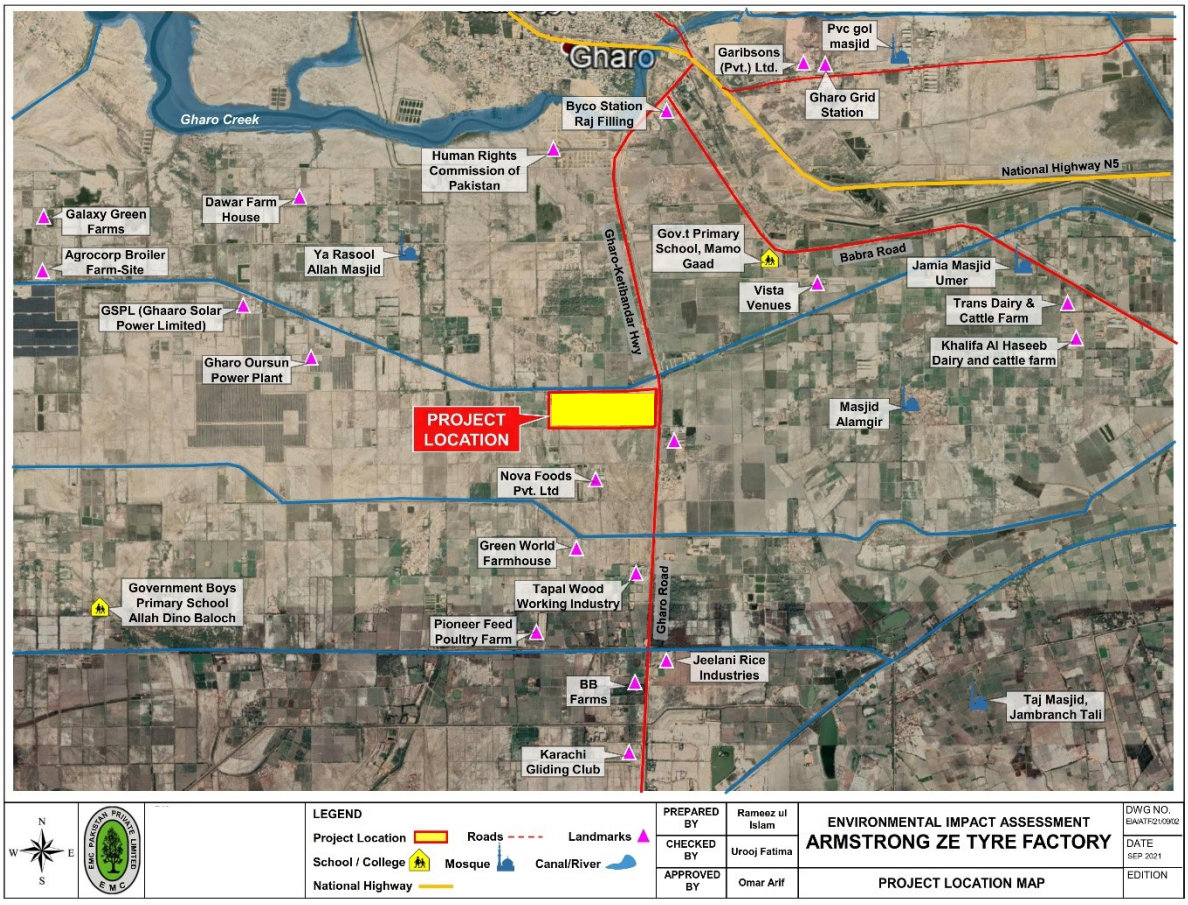

Figure Ex 1: Location Map of the Project

Being classified under Schedule III of the Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021, an Environmental Impact Assessment (EIA) of the project has been carried out to meet the environmental assessment requirements.

The manufacturing of tyres can potentially create a number of E&S risk issues. Most of these risks are associated with harmful substances, which are used during the manufacturing process as well as hazards arising from waste and emissions.

This EIA study was carried out to assess the environmental impacts during the siting, construction and operational phase Armstrong ZE Tyre Manufacturing Factory in Gharo, Thatta. The assessment was carried out according to the requirements of Sindh Environmental Protection Act 2014 and all applicable national & international standards.

The baseline environmental and socioeconomic information was collected from a variety of sources, including reports of previous studies, published literature, and field survey (primary information). The information collected was used to develop baseline conditions of project area with respect to the natural, socioeconomic, and cultural environments likely to be affected by the project.

The proposed project activities were reviewed, and an assessment made of the potential impact of these activities on the area's natural, socioeconomic, and cultural environments is also described in this report. Where appropriate, mitigation measures were recommended to keep the adverse environmental impact within the acceptable limits.

The findings of impact assessment and visual inspections of existing environment of the project area in the present scenario indicates following main impacts along with simultaneous relevant and appropriate mitigation measures:

- The majority of the emissions to air generated during tyre manufacturing plant are volatile organic compounds (VOCs) emitted finishing operations (mixing, applications, and drying). The emissions are primarily organic solvents. The project has provision for Installation of abatement technologies to minimize exposure to hazardous substances and to control the release of emissions, e.g., enclosure of equipment, use of appropriate ventilation with filters, gas balancing systems, cyclones, and wet or alkali scrubbers
- Inadequate control or accidental releases of hazardous substances on site or in transit may result in significant environmental impacts in relation to soil, groundwater and surface water contamination and occupational health and safety, e.g., disposal of empty drums and packaging of fuel and chemicals. Chemicals with different hazard symbols will not be stored together - clear guidance on the compatibility of different chemicals will be obtained from the Materials Safety Data Sheets (MSDS) which would be readily available from the manufacturer and on site. It will be ensured that the chemicals are stored in a dedicated, enclosed and secure facility with a roof and a paved/concrete floor. Chemical tanks will be completely contained within secondary containment such as bunding.
- There are several areas with a potential to contaminate waters via accidental discharge to drains and sewers or onto ground. Plant effluent and wastewater will be routed through Wastewater treatment plant before discharging into allocated sewer.
- Solid wastes may arise from several sources during tyre manufacturing and the majority of wastes by volume result from packaging - reusable or disposable. Reusable packaging covers metal racks, bins and containers and disposable packaging covers wood pallets, cardboard, plastic, polystyrene and polythene film. All hazardous and non-hazardous wastes will be disposed of through EPA approved contractor.
- Tyre manufacturing plants use energy throughout the plants for many different end-uses. The main energy types used on-site are electricity, steam, gas and

compressed air. The proponent is committed to monitor and target energy usage and implement behavioral change programmes.

- Chemicals involved in the motor vehicle assembly may have a wide range of hazardous effects, including being toxins, carcinogens or highly corrosive upon skin contact. Direct skin and eye exposure to and/or inhalation of hazardous chemicals can result in health impacts for workers. Prolonged exposure over years can induce chronic health effects. Prior to the commencement project, the Environment, Health and Safety (EHS) specialists will develop Occupational Health and Safety Plan (OHSP).
- Tyre manufacturing plant can be noisy work places due to the high level of use of machinery. Transport of products by road may also generate noise. The proponent will ensure provision of personal protective equipment (PPE) that is fit for the task to prevent injury and maintain hygiene standards. Staff will be trained in the correct selection, use and maintenance of PPE, and put in place measures to encourage/ mandate its use. Enclose noisy machines to isolate people from the noise where practicable.
- Project site has no sensitive areas such as protected sites including wildlife sanctuaries, game reserves or national parks, or any archaeological, historical or cultural heritage in its neighborhood; as such its siting would have no sensitivity in this regard.

Screening of potential impacts suggests that the construction and Operation of Armstrong ZE Tyre Manufacturing Factory, on adoption of the suggested mitigation measures, be an environmentally acceptable proposition and will be an add-on in the production capacity of the facility. Careful implementation of the Environmental Management Plan (EMP) will ensure that the environmental impacts are proportionally managed and minimized and the project proponent meets all statutory requirements. There are two essential recommendations that need to be followed to ensure that the environmental impacts of the project are successfully mitigated. The proponent shall ensure that:

- All mitigation, compensation and enhancement measures proposed in this EIA report are implemented in full, as described in the document;
- The Environmental Management Plan is implemented in letter and spirit.

It is recommended that the EIA be approved with the condition that recommendations given in the EIA and NOC will be duly followed by the proponent.

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Annexures

1 Introduction

1.1 General

This report, prepared as per the guidelines of the Sindh Environmental Protection Agency, will serve to identify the Environmental Impacts associated with the construction and operation of the proposed tyre manufacturing facility, along with a robust description on environmental practices and precautions that the Proponent may undertake to mitigate the identified environmental impacts.

To play their role in fulfilling these requirements, Armstrong ZE (The Proponent) intends to establish a facility to manufacture and supply an important requirement for the transportation industry: tyres, where the proposed tyre manufacturing plant will be located along the Gharo - Keti Bunder Highway in Mirpursakro, Thatta, Sindh.

1.2 Project Overview

Spread over an area of 50.25 acres along the Gharo – Keti Bunder Highway, the proposed Armstrong ZE tyre manufacturing facility will fulfill a growing demand of tires for the increased automobile production and circulation throughout the country.

The facility has been designed to accommodate all necessary machinery and processes to ensure tyre production of international standards and quality, including raw material storage, processing areas, finished goods storage and display areas, along with loading docks and transportation centers for further distribution of produced goods. Segregated areas have also been designed and provided throughout the facility for materials that may require specialized and secluded conditions for storage e.g., chemicals.

The facility has also adequately proposed and will provide separate areas for administrative areas, workers accommodation, a canteen, recreation halls, prayer areas, watch towers on the 4 corners of the project site, and greenbelts in all open areas throughout.

The location of the project, along with nearby receptors and industries are discussed in the section below and depicted in Figure 1.1.

Table 1.1 - Current Status of Project Site

1.3 Project Objectives

With the advent of this project, Armstrong ZE aims to achieve the objective of fulfilling a growing demand of providing locally produced tyres of international quality throughout the country for different vehicles and reducing the dependency on importing tyres.

The specific objectives of the project can be summarized as:

- To provide local communities with tyres of international standards and quality at a fraction of the price by producing locally
- To reduce dependency on imported tyres and thereby reducing the foreign capital being spent on imports
- To promote development in the transportation sector, one of the fastest growing sectors in Pakistan with plenty of room for further growth and development, contributing to the growth of GDP
- To provide employment to hundreds of skilled and unskilled workers through the establishment of the factory

1.4 Project Proponent

The facility being designed will carry the name of Armstrong ZE, where the ZE, stands for M/s “Zafar Enterprises”.

Based in Karachi but operating all over Pakistan, Zafar Enterprises is a well renowned importer and distributor of tyres from world renowned brands, where with 50 years in the tyre Industry, the company has gained an immense understanding and expertise of the entire automotive sector.

The company offers a diverse portfolio of brands, suitable for a variety of applications, including after sales services through periodical visits of their technical and commercial staff to their customers. The company deals in and supplies:

- Passenger Car Tyres
- Light Truck Tyres
- Truck and Bus Tyres and Tubes
- Off Road Tyres

Operating in the field for the time that they have, Zafar Enterprises is primed to establish and manufacture their own tyres through the proposed Armstrong ZE facility. Ancillary details of the company are provided below:

Table 1.2 - Proponent Details

Name of Facility	Armstrong ZE Tyre Manufacturing Facility
Name of Proponent	Armstrong ZE (Pvt) Limited
Address of Proponent	Suite 801-802, Fortune Center, Main Shahrah-e-Faisal, Block-6, PECHS, Karachi, Sindh
Address of Facility	Gharo-Keti Bunder Highway, Mirpursakro, Thatta, Sindh

Telephone Number	021-111-938-938
Email	info@zafarenterprises.com
Website	https://zafarenterprises.com/

1.4.1 Company Philosophy

One of the key maxims at Zafar Enterprises is Growing Together. The company strives to immerse their suppliers and customers in their growth process within the dynamic and ever-changing market of Pakistan. The company seeks to nurture their brands and create a strong footing in the market by offering customers a diverse product portfolio that fits a diverse set of needs.

1.5 Project Location

The Armstrong ZE Tyre Manufacturing Factory spread over an area of 50.25 acres, is located along the Gharo – Keti Bunder Highway, in Gharo, where the location of the proposed project is easily accessible by National Highway N-5. Major industrial units near the plant include Tapal Wood Working Industry, Jeelani Rice Industries, and others.

The nearest landmarks near the proposed project site are Daniyal Farms, Nova Foods Pvt. Ltd., Green World Farmhouse, etc. In the immediate north of the proposed project site, Khari Seer Distry runs along the northern boundary of the plot, which receives water from Jam Branch. Towards far west of the project site, Gharo Oursun Power Plant is also located. The detailed project location map is shown in Fig 1.1.

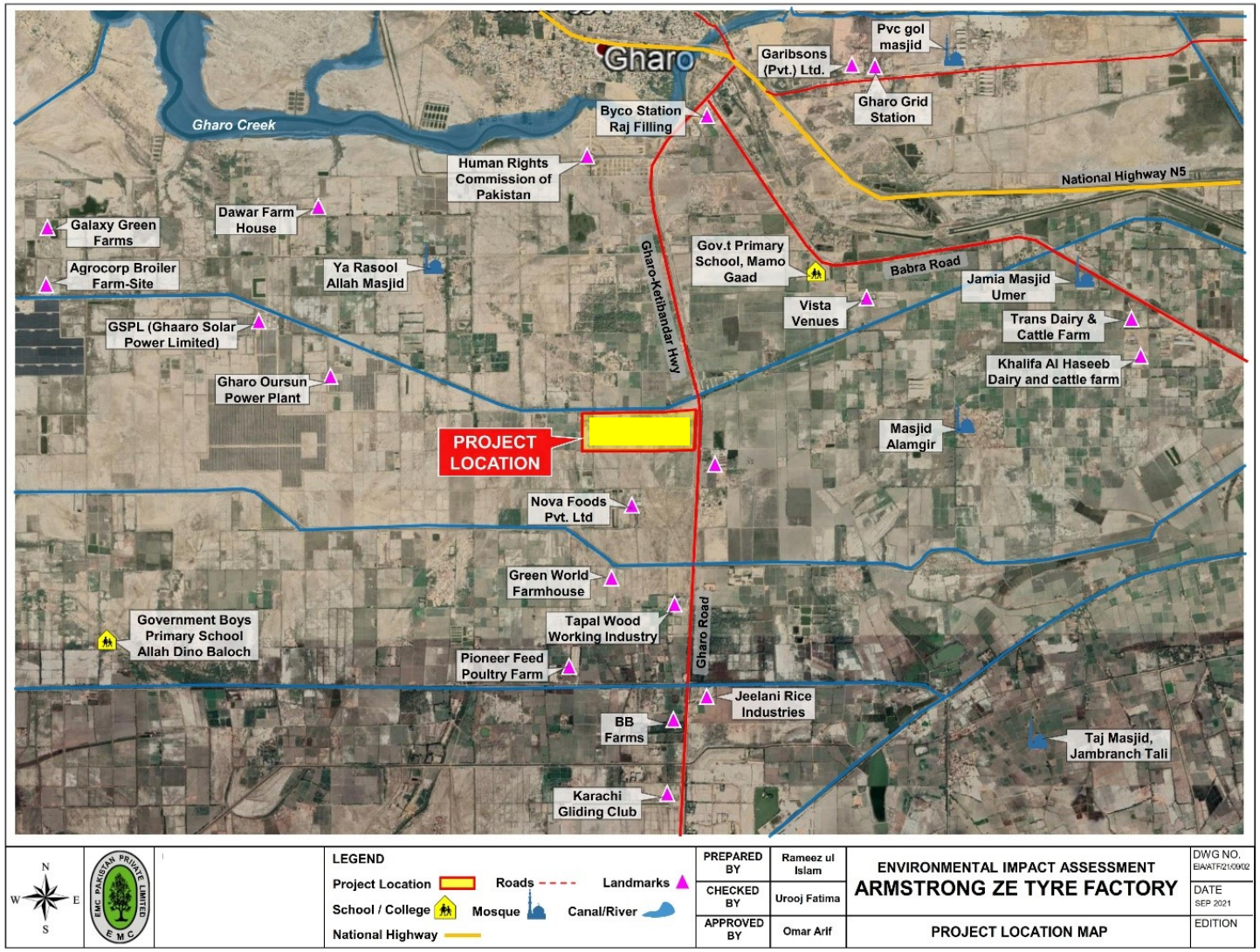
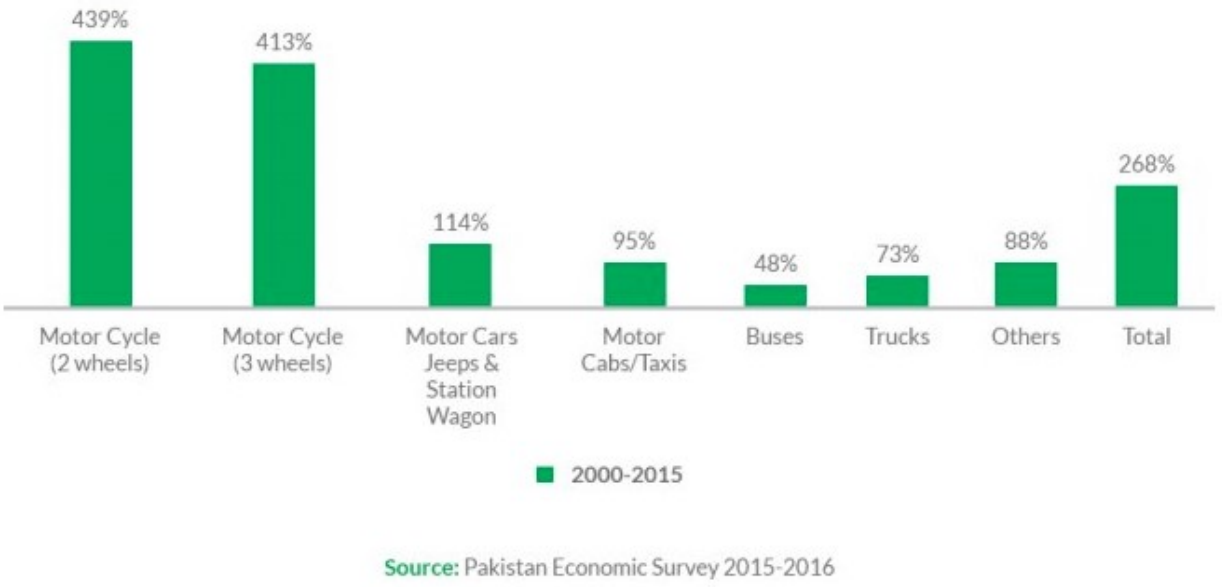


Figure 1.1: Project Location Map

1.6 Need for Project

The country has witnessed dramatic growth in the automotive sector, where not only is the country seeing a surge in vehicular movement on roads, but also an introduction of new foreign brands in local markets, adding to the options available for local consumers.

This is evident as a 2016 study by the Pakistan Economic Survey revealed that the number of registered motor vehicles in Pakistan increased by 268% in the years between 2000 and 2015, where during the same time, a depiction of which is provided below.



Source: Pakistan Economic Survey 2015-2016

Figure 1.2 - Percentage Growth in the Number of Registered Vehicles from 2000-2015

Subsequently, data obtained from the Pakistan Bureau of Statistics highlights that the number of registered vehicles in Pakistan in December 2018 was reported at over 5.9 million, whereas by December 2019, the number had increased to 6.2 million.

This increase in the number of vehicles present on roads has brought with it numerous issues, e.g., increased traffic congestion, delayed travel times, increased air and noise pollution, however, one problem that is not highlighted enough, is the shortfall in supply of quality tyres and the excessive smuggling that takes place to accommodate demand from all these vehicles.

An article published in April 2021 in local newspaper “The News”, when speaking on the same issue, claimed that the “Government is losing billions on tyre import”[1]. The article went on to explain that the annual consumption of tyres in Pakistan is at 10 million, of which 20% is met by locally manufactured tyres, 15% through imported

[1] https://www.thenews.com.pk/print/828122-govt-loses-billions-on-tyre-import

tyres, and the remaining 65% through smuggled tyres (due to unrealistic prices for imported tyres).

With the establishment of the Armstrong ZE tyre manufacturing industry, a boost can be provided to the local tyre supply, diminishing the dependency on imported tyres, and the rate of tyres being smuggled, along with providing a boost to the local GDP.

1.7 Basis of Study & Categorization of Project

The Environmental Impact Assessment (EIA) of the Armstrong ZE Tyre Manufacturing Facility has been carried out in compliance with the mandatory requirement of Section 17 of Sindh Environmental Protection Act (SEPA), 2014 which states:

"No Project shall commence construction or operation unless it has filed with the Agency an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) and has obtained from Agency approval in respect thereof. SEPA shall review the IEE & EIA and accord approval subject to such terms and conditions as it may prescribe or require."

To fulfill this requirement, an environmental assessment was carried out for the Armstrong ZE Tyre Manufacturing Facility, specifically an Environmental Impact Assessment, as mandated by the Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021:

SCHEDULE III - Projects requiring an EIA

Section (C) - Manufacturing and processing

Sub-Section (6) - Establishment of Industrial estates & Export processing zones

Therefore, the following EIA has been developed to evaluate the environmental impacts of the proposed tyre manufacturing plant under guidelines of the Sindh Environmental Protection Agency.

1.8 Scope of EIA Study

This Environmental Impact Assessment study aims to provide an understanding of the environmental conditions prevalent at the project location, and subsequently, an assessment of the impacts of the proposed development with respect to its siting on the existing physical, ecological, and socioeconomic environment. For impacts identified, mitigation measures are also advised to reduce the project's environmental footprint as much as possible. The main rationale of the EIA study is to make sure that:

- Any major undesirable impact on the environment (physical, ecological, and socioeconomic) during different phases i.e., construction, operation and decommissioning are identified,
- Adverse impacts, if any, are appropriately addressed and adequate mitigation measures are suggested for inclusion in the design, construction, and operation phases of the project,
- Severity of socioeconomic aspects is recognized,
- An Environmental Management and Monitoring Plan (EMMP) for sustainable development and operation of the project is devised.

This EIA report has appropriately recognized the environmental aspects and screened the potential impacts to make certain that the effects of proposed activities pertaining to construction and operation of the proposed manufacturing plant have been carefully assessed and mitigation measures properly planned & implemented to keep environmental impacts under permissible limits as prescribed by the Sindh Environmental Protection Act (SEPA), 2014.

1.9 Methodology Adopted for EIA

The Environmental Impact Assessment is based on a simple comparative evaluation approach. Initially, the environmental baseline or the profile of the project area was developed by gathering data, records, and information on the existing physical, ecological as well as socioeconomic environment. The same data was then projected or modelled for different phases of project, i.e., Design Stage (preconstruction), Construction Stage (includes Engineering, Procurement and Contracting (EPC)), and the Operation and Maintenance (O&M) Stages.

The changes expected in the critical environmental aspects e.g., in the ambient environmental parameters that may be significant, were also identified. This led to the identification and evaluation of major impacts, for which corresponding effective mitigation measures were provided. Lastly, the Environmental Management & Monitoring Plan (EMMP) to be implemented during the construction and operation phases, was framed.

This EIA study adopted the following methodology:

1.9.1 Scoping

A scoping exercise was undertaken to identify the potential issues that are to be considered in the environmental impact assessment. The scoping exercise included the following indispensable tasks:

- Data Compilation: A description of the activities relevant to this environmental assessment were compiled with the help of the Project proponent.
- Review of Published literature: All available published and unpublished information pertaining to the micro and macro environment of the study area was obtained and reviewed. It included earlier studies conducted in the project area, the environmental and social baseline and impact assessment studies conducted by different consultants in past. Secondary data was very helpful in understanding the issues that were identified by other consultants.
- Review of Applicable Legislation: Information on relevant legislation, regulations, guidelines, and standards was reviewed and compiled.
- Identification of potential impacts: The information collected in the above procedures was reviewed and potential environmental issues identified.
- Reconnaissance survey: An initial site visit was conducted to get an overview of site conditions and the surrounding areas.
- Stakeholder consultation: Stakeholder consultation was undertaken to document the concerns of the local community and other stakeholders to identify issues that may require additional assessment to address these concerns.

Stakeholder consultation was conducted during the survey with following objectives:

- To inform the Stakeholders, Communities and Project Affected Persons about the project
- To gather feedback from primary and secondary stakeholders of the project
- To identify relevant potential issues, including the socioeconomic impact of the project, and corresponding mitigation measures.

During the stakeholder consultation process for the project, the following key considerations were also focused on:

- Identification of sensitive receptors in the area
- Concerns of the residents (Project Affected Persons, if any)
- Institutional Stakeholders

1.9.2 Review of Legislation and Guidelines

National legislations, international agreements, environmental guidelines, and best industry practices were reviewed to set environmental standards that the proponent will be required to follow during different stages of the project. The Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021 were used to define the type of study.

The review of legislations included but not limited to the following:

- Policies and Legislation relevant to the project.
- Complementary legislation applicable to project for sustainable management of the environment covering land, water resources and water quality, atmospheric emissions.

1.9.3 Baseline Data Collection

Detailed environmental baseline surveys were conducted to collect primary data on the Project Area to help identify sensitive receptors. The primary data obtained was examined and compared with secondary data available from earlier environmental studies in the region. The scope of survey included collection of information on the following key aspects:

1. To confirm baseline data including Biophysical features of the Project Area including the following items with their seasonal variability:

▪ Climate and Rainfall	▪ Air Quality	▪ Noise Quality
▪ Topography	▪ Soil	▪ Geomorphology/Geology
▪ Hydrology	▪ Vegetation	▪ Agriculture
▪ Livestock	▪ Fauna	▪ Flora

2. To confirm baseline data including the Socio-Economic Environment of the Project Area including the following items with their seasonal variability

- Administrative Division
- Demography and Settlement
- Socio-Economic Activities
- Land use and National Resources Management in the Project area
- Existing Infrastructure and Social Services

3. To carry out preliminary groundwork investigations to have an overview of the project area, along with existing infrastructure socio-economic activities.

1.9.4 Screening of Project Alternatives

Possible project alternatives are screened for their practicality and viability. The reasons or justification for acceptance or refusal of any of the alternatives is discussed.

1.9.5 Identification of Aspects

Identification of environmental aspects and their significance is fundamentally important for the determination of severity of incidence of impacts at different stages of the project. This step is aimed at obtaining an inventory of the aspects. The aspects identified during this step cover all activities to determine those which have or can have significant impact on the environment.

1.9.6 Impact Assessment & EMMP

Environmental experts at EMC analyzed and assessed the anticipated impacts that are likely to arise due to the identified aspects. Each of the potential impacts identified during the scoping session was evaluated using the environmental, socioeconomic, and project information collected. In general, the impact assessment discussion covers the following aspects:

- Present baseline conditions
- Potential change in environmental parameters due to project
- Prediction of potential impacts
- Evaluation of the likelihood and significance of potential impacts
- Defining of mitigation measures to reduce impacts to as low as practicable
- Prediction of any residual impacts, including all long- and short-term, direct, and indirect, and beneficial and adverse impacts
- Monitoring of residual impacts.

An environmental management & monitoring plan (EMMP) was developed to oversee the environmental performance of the project and implementation of proposed mitigation measures. A monitoring plan has also been incorporated in the EMMP to monitor impact of all activities, the effectiveness of mitigation measures proposed, and to identify any residual impacts, along with their positive/negative changes in the physical, and socioeconomic environment.

1.9.7 Documentation & Review

This is the final step of the EIA study. The data generated for the study is compiled and examined by experts of the respective field. Sections of this report were prepared as the study progressed by EMC office staff in consultation with experts. The report was finally reviewed by the Team Leader, who analyzed the information, assessed the potential environmental impacts in the light of national and international guidelines, examined the alternatives in the light of observations on the field as well as meetings with the stakeholders, before finalizing the report in its present form.

1.10 Organization of the EIA Report

Section 1 (Introduction) – Introduces the project, along with defining the basis of the study being carried out.

Section 2 (Project Description) - Describes the project activities in detail, along with the technical aspects of the project.

Section 3 (Policy, Legal & Administrative Framework) - Briefly discusses existing national policy and relevant legislation for sustainable development and environmental protection, and then presents the legislative requirements that need to be followed while conducting the EIA.

Section 4 (Environmental and Social Baseline) - Documents in detail the existing physical, environmental, biological, and socioeconomic conditions at the microenvironment and macroenvironment of the Project Site.

Section 5 (Stakeholders Consultation) - Discusses in detail the methodology, procedure, and outcome of consultation with potential stakeholders of the Project.

Section 6 (Screening of Alternatives, Potential Impacts and Mitigation Measures) - Presents the project alternatives that were considered and the reasons for their selection or rejection are highlighted. It also presents an assessment of the Potential Environmental Impacts on the physical, biological, and socioeconomic environment, besides the measures required to mitigate the negative impacts.

Section 7 (Environmental Management & Monitoring Plan) - Presents the measures proposed for implementation of the environmental mitigation measures, and

Section 8 (Conclusion and Recommendations) - Summarizes the overall findings, conclusions, and further recommendations of this EIA Study.

1.11 Study Team

Armstrong ZE Pvt. Ltd. commissioned EMC Pakistan Private Limited for conducting the Environmental Impact Assessment (EIA) study of the Proposed Project to assess the likely environmental and social impacts that may result from Project activities and subsequently identify effective measures to mitigate potential negative impacts, if any. Consequently, the following team from EMC Pakistan conducted the study:

S. No.	Name	Position in the Team
1	Engr. Syed Nadeem Arif	Project Director
2	Mr. Muhammad Haseeb	Project Manager
3	Engr. Ahmed Zohair Siddiqui	Environmental Engineer
4	Khurram Shams Khan	Senior Sociologist
5	Syed M. Omar Arif	Environmental Engineer
6	Syeda Urooj Fatima	Environmental Scientist
7	Toufeeque Ahmed	Environmental Engineer
8	Wajai Kumar	Sociologist
9	Mr. Ehtisham Ahmed	Sociologist
10	Mr. Ather Adil	Environmental Monitor

2 Description of Project

M/s Armstrong ZE (Pvt.) Ltd. to set up Armstrong ZE Tyre Manufacturing Factory in Gharo city, opposite to Daniyal Farmhouse. For this purpose, 50.25 acres of land has been purchased with defined boundary walls. All land approvals are provided in the annexures.

2.1 Construction Phase

The proposed project will include installation and construction of tyre manufacturing setup which will require small scale construction and installation of basic facilities which may be used during the entire life cycle of the proposed project. Main activities would be leveling of land, construction of building structure, MEP (Mechanical, Electrical & Plumbing) work, and installation of manufacturing machinery/equipment, civil works and finishing.

2.2 Plant Details

Following are the main operational areas at the plant:

1. Mixing Hall
2. Clendering
3. Bead
4. Steel Belt Cutting
5. Body Ply Cutting
6. Inner Liner
7. Extrusion
8. Mold Shop
9. Storage Area
10. Curing
11. Warehouse
12. Boiler Room
13. Offices and Canteens
14. Fire Station
15. Refrigeration and Air Compression Stations
16. General Substation
17. Oil Depot
18. Manipulation and Pulling
19. Tube Extrusion
20. Desma and Lasting Hall
21. Processing Section
22. Sole and Rug Store
23. Leather Store
24. Synthetic Leather Store
25. Gusbi Hall
26. Claimable Material Store
27. Wastewater Treatment Plant
28. Finish Goods Display / Showroom
29. Mosque or Pray Area
30. Recreation Hall
31. Commercial / Market
32. Labor Accommodation
33. Covered Car Parking
34. Grassy Area, Internal Roads, Drains, etc.

2.3 Process Details

The Armstrong ZE is a tyre manufacturing company. Facility process includes mixing, calendering, extruding, cutting, beading, building, curing, and inspection leading to the final product storage.

2.4 Flow of Tyre Manufacturing Process

The schematic diagram shown in below figure will be the flow of processes at the proposed tyre manufacturing plant. Particulars of the sequential flow have been detailed below;

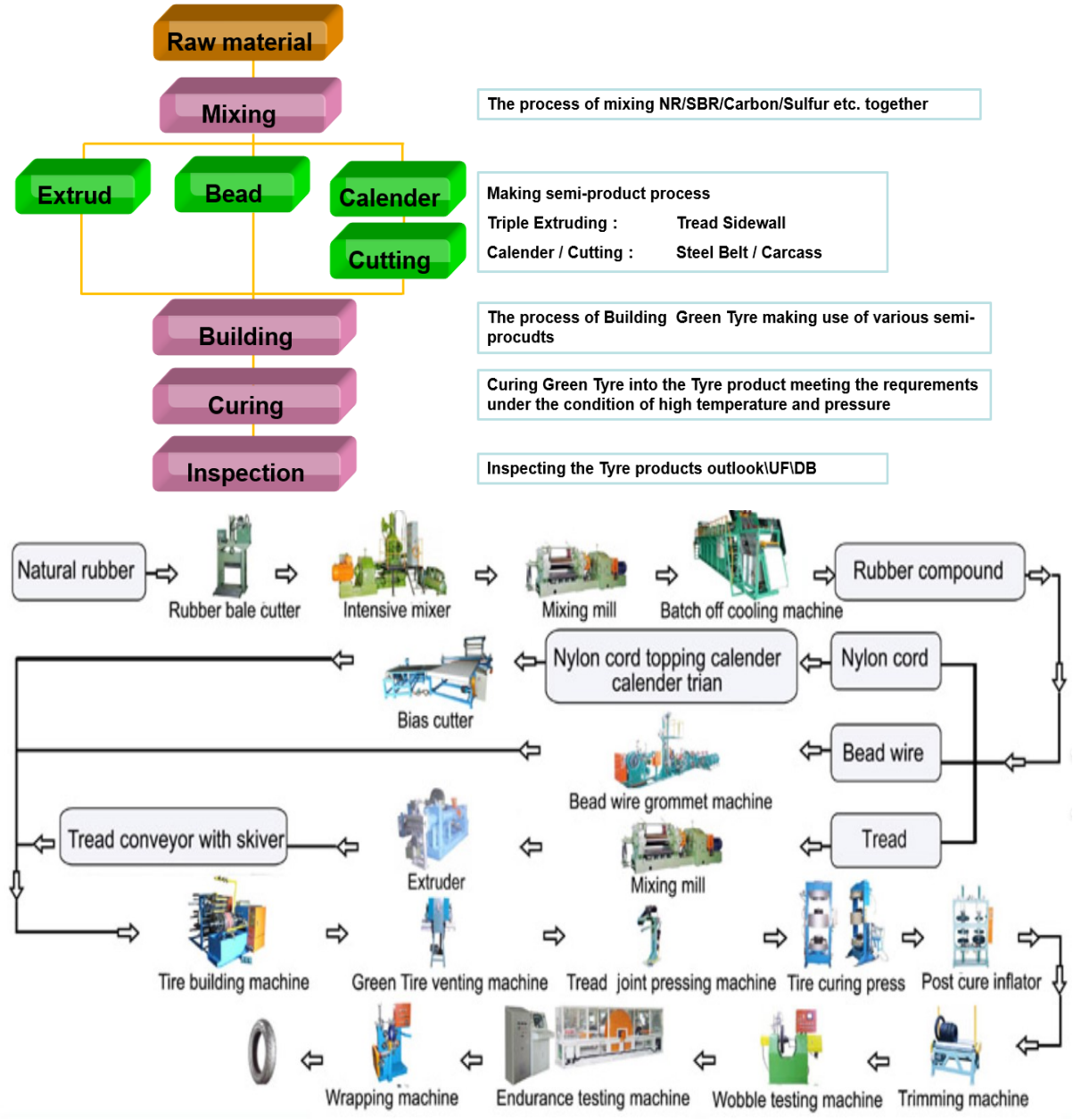


Figure 2.1: Passenger Car Radial (PCR) Tyre Production Process Flow

2.4.1 Mixing

CMB Mixer:

According to a certain standard proportion of CMB Compound, weighing CMB chemical and Rubber to be mixed into CMB compound.

Final Mixer:

According to a certain standard proportion of Final Compound, weighing CMB Compound and Final chemical to be mixed into Final compound for use of follow-up section.

Figure 2.2: A view of CMB Mixer

Figure 2.3: A view of Final Mixer

2.4.2 Calendering

The process of using the extrusion pressure of the roller of calender to cover the surface of textile fabric and steel cord with final compound to produce a certain specification of Carcass/ Steel Belt.

Figure 2.4: A view of Calender Section

Figure 2.5: A view of Calender Machine

Inner Linear Calender:

A process in which I/L Final Compound is made into a film with a certain section size and shape by using the extrusion force of the roller of the calender.

Figure 2.6: A view of Inner Linear Calender

2.4.3 Extruding

An example of extruding section is illustrated below:

Figure 2.7: A view of extruding section

Side Wall Extruder:

Side Wall is the area of extra-thick rubber that runs from the bead to the tread and gives your tyre its lateral stability. The process in which the side wall and rim cushion final compound are passed through the side wall extruder and the mouth plate to form side wall profile.

Tread Extruder:

Tread is the soft area of tyre where the rubber meets the road. The tread provides both cushioning and grip, and its design and compound determine many of tyre's most important performance features. The process in which Tread/ under Tread/ wing final compound are passed through the Tread extruder and the mouth plate to form Tread profile.

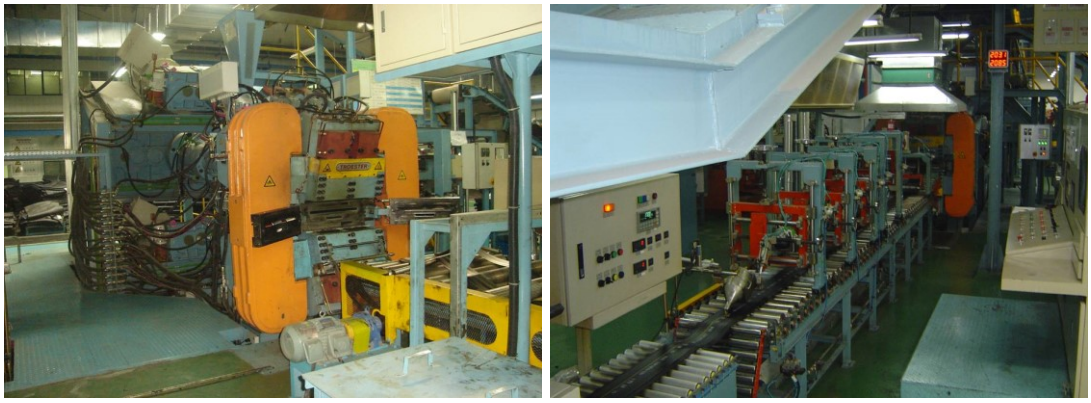


Figure 2.8: A view of (left) Side Wall Extruder and (right) Tread Extruder

2.4.4 Cutting

Steel belt Calendering (SBC)

According to the technological instructions, the steel Belt from the calendering section shall be cut into the certain semi-product with a certain width and Angle, then supplied to the Buiding section for use.

Figure 2.9: A view of SBC Machine

TRC

According to the technological instructions, the Carcass from the calendering section shall be cut into a certain semi-product at right angle and a certain width, and then supplied to the Buiding section for use.

Figure 2.10: A view of TRC Machine

2.4.5 Beading

Bead Machine

After the bead wire is evenly coated with Bead Final Compound, the bead wire is rolled into a certain bead according to the manufacturing instructions.

Figure 2.11: A view of Bead Machine

Bead Filler Machine

The operation of fitting the Bead filler formed by the extruder together with the bead.

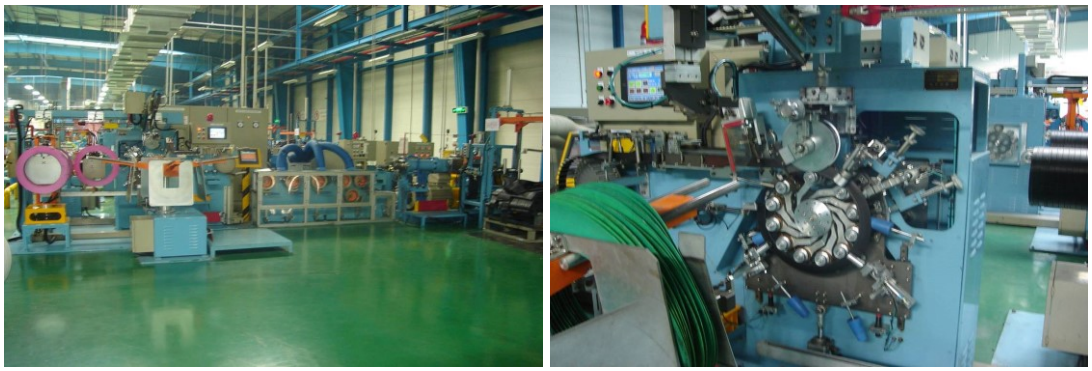


Figure 2.12: A view of Bead Filler Machine

2.4.6 Buiding

One-stage Buiding Machine

All semi-products from before buiding sections are built into G/T in accordance with certain standards and order on the one stage Buiding Machine. This machine is operated by one person with high degree of automation.

Two-stage Buiding Machine

All semi-products from before buiding sections are built into G/T in accordance with certain standards and order on the two-stage Buiding Machine. This machine should be operated by two person.

Figure 2.13: A view of One-Stage Buiding Machine

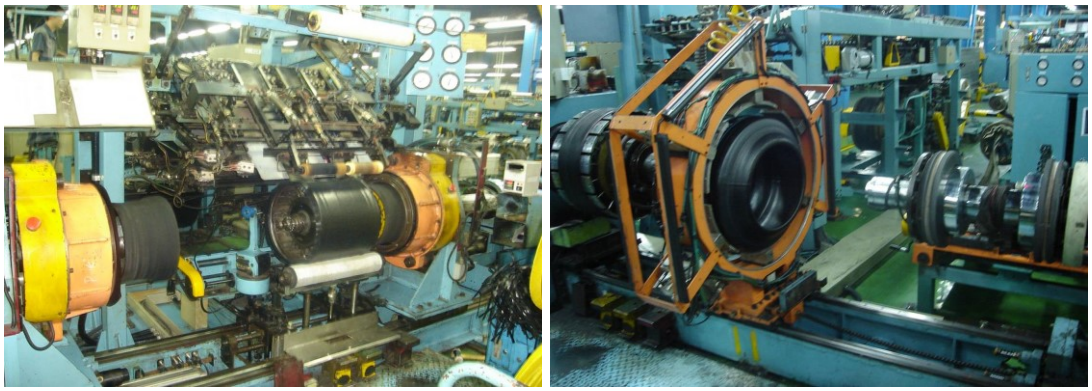


Figure 2.14: A view of Two-Stage Buiding Machine

2.4.7 Curing

The G/T from buiding section is placed in the corresponding MOLD, then curing into a tire with high elasticity and wear resistance through a certain time, temperature and pressure.

Figure 2.15: A view of Curing Machine

Trimming

Used for removing Tire vent and beautifying tires.

Sander

Used for grinding off the White sidewall covered black compound film to expose the white sidewall compound.

Figure 2.16: A view of Trimming (Left) and Sander (right)

2.4.8 Inspection

Inspecting the uniform distribution of the strength, size, and weight of a tire during a full rotation under a given load.

2.4.9 Storage

Tyre Product Storage

After passing the tire test, the tire product should be registered in and out storage from warehouse.

Figure 2.17: Uniformity Inspection Final Product Storage

2.5 Components of Tyre

Tyre is a composite structure consisting of many layers. They usually consist of

- Inner liner
- Body ply
- Side wall
- Beads, Apex
- Belt Package
- Tread
- Cushion Gum

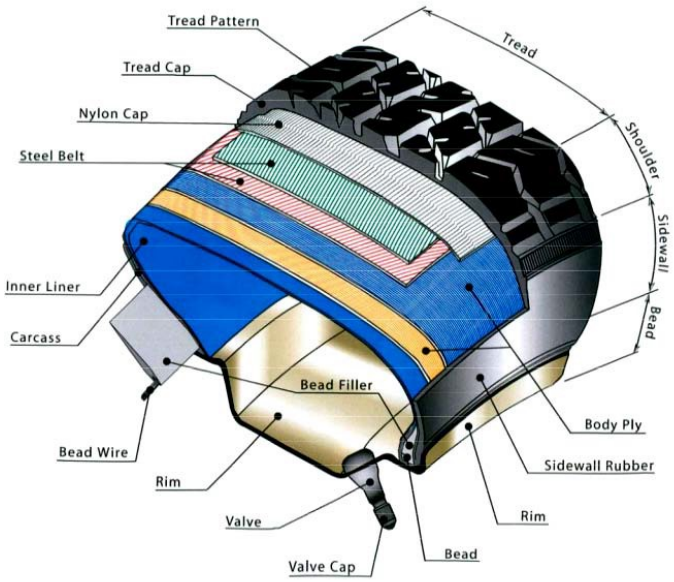


Figure 2.18: Schematic of the components of a tyre

2.5.1 Inner Liner

It is an extruded halobutyl rubber sheet compounded with additives that result in low air permeability. The inner liner assures that the tire will hold high-pressure air inside, without the air gradually diffusing through the rubber structure.

2.5.2 Body Ply

The body ply is a calendered sheet (two or more sheets are rolled together such that mechanically they are bonded) consisting of consecutive layers of rubber and reinforcing fabric.

They give the structural strength to the tyre. Passenger tyres typically have one or two body plies. Truck tires, off-road tires, and aircraft tires have progressively more plies. The fabric cords are highly flexible but relatively inelastic. The textile materials used are cotton in early years now replaced by rayon, nylon, kevlar, polyester.

2.5.3 Sidewalls

Sidewalls are non-reinforced extruded profiles with additives to give the sides of the tire good abrasion resistance and environmental resistance. Additives used in sidewall compounds include antioxidants and antiozonants to protect the tyre from decomposition when exposed to ultra violet light. Sidewall extrusions are nonsymmetrical and provide a thick rubber area to enable molding of raised letters and sidewall ornamentation.

2.5.4 Beads

Beads are bands of high tensile-strength steel wire encased in a rubber compound. Bead wire is coated with special alloys of bronze or brass. Coatings protect the steel from corrosion. Copper in the alloy and sulphur in the rubber cross-link to produce copper sulphide, which improves bonding of the bead to the rubber. Beads are inflexible and inelastic, and provide the mechanical strength to fit the tyre to the wheel. Bead rubber includes additives to maximize strength and toughness.

2.5.5 Apex

The apex is a triangular extruded profile that mates against the bead. The apex provides a cushion between the rigid bead and the flexible inner liner and body ply assembly. It is alternatively called as "filler" in literature and industry.

2.5.6 Belt Package

Belts are calendered sheets consisting of a layer of rubber, a layer of closely spaced steel cords, and a second layer of rubber. The steel cords are oriented radially in radial tire construction, and at opposing angles in bias tire construction. Belts give the tyre strength and dent resistance while allowing it to remain flexible. Passenger tires are usually made with two or three belts.

2.5.7 Tread

The tread is a thick extruded profile that surrounds the tire carcass and this is the layer which comes directly in contact with the. Tread compounds include additives to impart wear resistance and traction in addition to environmental resistance. Tread compound development is an exercise in compromise, as hard compounds have long wear

characteristics but poor traction whereas soft compounds have good traction but poor wear characteristics.

2.5.8 Cushion Gum

Many higher-performing tyre include an extruded component between the belt package and the tread to isolate the tread from mechanical wear from the steel belts.

2.6 Public Works

Public works will include the following equipment and their use:

Table 2.1: Public Works

Process	#	Device Name	PCS	Usefulness
Receiving and distribution	1	High Voltage Cabinet	80	Transformer, shunt
	2	Transformer	50	
	3	Power Distribution Cabine	400	
	4	Power cabinet	200	
	5	Mobile crane	1	Lifting heavy objects
	6	Cable		
Machining	7	Planer	1	Plane roughing
	8	slotting machine	1	Machining inner keyway
	9	Surface grinder	1	Plane finishing
	10	Large lathe	1	Machining outer circle, inner hole and thread
	11	Small lathe	1	
	12	Radial drilling machine	1	Turning hole, tapping
	13	Bench dril	1	
	14	End mill	1	External key slot, flat
	15	Horizontal milling	1	
	16	Wire cutting	1	Contour processing
	17	Sawing machine	1	Cutting
	18	Electric welding	6	Welding, thermal cutting
	19	Gas welding	3	
	20	Argon arc welding	2	
	21	Measuring tools		measure
	22	fixture		Clamping
	23	Cutting tools		Cutting tools
	24	Electric grinding wheel	2	Manual grinding
	25	Angle grinder	6	
	26	Electric hand drill	6	Manual drilling
	27	Magnetic drill	2	
	28	Hydraulic jack	4	lift
	29	Lifting platform	1	Climbing work
	30	Crossed platform	1	Scribing
	31	Universal dividing head	1	The work piece can be divided equally
	32	Fitter tools	1	Tools for daily maintenance
	33	Mobile crane	2	Lifting heavy objects
Original motion	34	Water pump		Water pressure rise
	35	Refrigeration unit	4	refrigeration
	36	Refrigeration unit	3	refrigeration
	37	Cooling tower	4	dissipate heat
	38	air conditioner	10	temperature control
	39	central air-conditioning	2	
	40	Boiler system	2	Supply steam

	41	Air compressor system	2	Supply of compressed air
	42	Fire water system	1	fire control
	43	Air tank	10个	Storage of compressed air
	44	Mobile crane	5	Lifting heavy objects
Nitrogen production system	45	Cold dryer	2	Dry compressed air
	46	PSA nitrogen generator	2	Separation of nitrogen
	47	Three stage filter	2	Remove impurities
	48	Air tank	5	Storage of compressed air
	49	Nitrogen booster pump	2	Increase nitrogen pressure
	50	Cryogenic liquid vaporizer	1个	Gas from liquid to gas
	51	Vacuum pump	2	Provide negative pressure
	52	Air compressor	2	Supply of compressed air
	53	Mobile crane	2	Lifting heavy objects
Spare parts warehouse	Storage of equipment components			
Network system	Internal network			
Piping	Internal network			

2.7 Machinery & Raw Materials

2.7.1 Raw materials

The main raw materials used in tyre manufacturing are:

- Natural Rubber
- Synthetic Rubber
- Polyester
- Nylon
- Steel Cord
- Carbon Black
- Bead Wire
- Oil
- Chemicals

2.7.2 Natural Rubber

Natural Rubber is an elastomer derived from latex, a milky colloid produced by some of the plants like *Hevea brasiliensis*. These plants produce latex when they are wounded as a healing mechanism. The latex is collected in a vessel and it is allowed to coagulate which gives you the solid rubber which can be further processed in to sheets. The coagulation process can be controlled by chemicals like Ammonia, Formic acid. Ammonia decelerates the coagulation process whereas Formic acid accelerates it. The purified natural rubber is same as polyisoprene.

2.7.3 Synthetic Rubber

Synthetic rubber can be made from the polymerization of a variety of monomers including isoprene (2-methyl-1,3-butadiene), 1,3-butadiene, chloroprene (2-chloro-1,3-butadiene), and isobutylene (methylpropene) with a small percentage of isoprene for

crosslinking. These and other monomers can be mixed in various desirable proportions to be copolymerized for a wide range of physical, mechanical, and chemical properties.

Various kinds of synthetic rubbers are used in the tyre components like Styrene-butadiene, Polybutadiene because of the relatively low materials cost, low heat-buildup properties respectively.

Halobutyl rubber is used for the tubeless inner liner compounds, because of its low air permeability. The halogen atoms provide a bond with the carcass compounds which are mainly natural rubber.

2.7.4 Carbon Black

Carbon black is a material produced by the incomplete combustion of heavy petroleum products such as coal tar, ethylene cracking tar etc., It is a form of amorphous carbon that has a high surface-area-to-volume ratio and significantly lower PAH (polycyclic aromatic hydrocarbon). It is used as a pigment and reinforcement filler in the tyre. It helps in conducting heat away from the tread and belt area of the tire, reducing thermal damage and increasing tire life. While a pure styrene-butadiene rubber has a tensile-strength of no more than 2.5MPa, and almost nonexistent abrasion resistance, compounding it with 50% of its weight of carbon black improves its tensile strength to 20MPa and considerable wear resistance. The black color of the tyre is due to carbon black, if we want to have any other color with the same reinforcing properties fumed silica is used.

2.7.5 Bead Wire

The beads are made from high-strength braided steel coated in rubber, and create an airtight seal between your tyre and the rim of the wheel.

2.7.6 Chemicals

Sulfur and other chemicals are also used in tires. Specific chemicals, when mixed with rubber and then heated, produce specific tire characteristics such as high friction (but low mileage) for a racing tire or high mileage (but lower friction) for a passenger car tire. Some chemicals keep the rubber flexible while it is being shaped into a tire while other chemicals protect the rubber from the ultraviolet radiation in sunshine.

2.7.7 Machines

List of core machines is as per Table below:

Table 2.2: List of Core Machines

S. No.		Device Name	PCS/ SET	Usefulness
Extruder	1	Open mill equipment	1	Blending, plasticizing, and sheeting of pressed rubber
	2	Dust removal equipment	1	Separate dust in flue gas
	3	Extruder line	1	Product the tread and sidewall
	4	placemat Finishing equipment	1	Tidy up the roll deviation and the discount cloth
	5	Offline scanning equipment	1	Scan tread and side wall thickness width and area out of tolerance

	6	Tread placemat	100	Curled tread products
	7	Tread tool	50	place the tread products
	8	Sw placemat	60	Curled sidewall products
	9	Sidewall tool	30	place the sidewall products
	10	tractor	1	Move the tread and sidewall to buiding
	11	Forklift truck	1	Handling rubber
Cutting	12	90 °Cutting equipment	1	Cut the calendered fiber cord
	13	Bp tool	60	place the bodyply products
	14	Bp placemat	60	Curled bodyply products
	15	Forklift truck	1	handling the calendered fiber cord
	16	Hoist	1	Load the calendered fiber cord
	17	tractor	1	Move the bodyply to buiding
	18	placemat Finishing equipment	1	Tidy up the roll deviation and the discount cloth
Inner Lining	19	sheeting Calendar	1	Product the innerliner and sheeting
	20	Il tool	60	place the innerliner products
	21	Il placemat	60	Curled innerliner products
	22	Hoist	1	Unload calendered film
	23	tractor	1	Move the innerliner to buiding
	24	placemat Finishing equipment	1	Tidy up the roll deviation and the discount cloth
Cutting	25	steel cord Cutting equipment	1	Cut the calendered steel cord
	26	SB tool	80	place the steelbelt products
	27	SB placemat	80	Curled steelbelt products
	28	Forklift truck	1	handling the calendered steel cord
	29	Hoist	1	Load the calendered steel cord
	30	tractor	1	Move the steelbelt to buiding
Cutting	31	JLB cord wide/narrow Cutting equipment	1/1	JLB cord wide/narrow Cutting
	32	JLB cord wide Cutting storage rack	1	Storage the JLB cord wide Cutting products
	33	JLB tool	10	Load the narrow cutting products
	34	JLB Scroll	60	Curled JLB products
	35	tractor	1	Move the JLB to buiding
	36	Tape sliter	1	tape cutting
	37	Hoist	2	Load the calendered JLB cord
Calender	38	Steel wire/cord calendering linkage	1	Calendering material production auxiliary line
	39	Steel wire/cord calender	1	Calendering material production equipment
	40	Spindle room	1	Calendered steel wire storage guide chamber
	41	Constant temperature and humidity equipment for spindle room	1	Temperature and humidity control of spindle chamber
	42	Large cloth finishing machine	1	Empty padding finishing prevents discounting

	43	Cooling room cooling air system	1	Cooling of spindle room and key equipment
	44	Storage rack for raw wire	1	Storage of calendered raw materials
	45	Calendered cord storage rack	1	Storage of calendered half products
	46	Electric hoist, 3TON	4	Calendering tooling and calendering material transfer
	47	hoist, 3 ton	1	Calendered material transfer
	48	Winding roll shaft	100	Calendered material winding
	49	The huge	100	Calendered material isolation
	50	Diesel forklift 3TON	1	Handling of calendered materials
Bead	51	Wrap the wire with the wire	1	Bare bead production
	52	Trigonometric adhesive laminating machine	3	Complete the bead production
	53	Bead circumference measuring instrument	1	Measure inner diameter of bead
	54	Bare tire ring storage car	25	Bare bead storage
	55	Complete the tyre storage car	50	Complete bead storage
	56	Complete the bead divider	10000	Complete tire isolation
	57	tractor	2	Transport of semi-products
	58	welding machine	1	Wire joint welding
Buiding	1	GT tool	500	Place the tyres
	2	one stage/two stage equipment	7	Product the tyres
	3	Tire Conveyor chain	1	Move tire to curing
	4	electric forklift truck	1	Change and move the tool
	5	One stage drum tool	7	Place the one stage drum tool
	6	Belt drum tool	7	Place the belt drum tool
Curing	7	Curing machine	30	Sulfide embryos
	8	Conveyor line	2	Tire transportation
	9	Mold preheater (two pieces of mold, movable mold)	2	Preheating mold
	10	Shave lanugo machine	2	Tire hair cleaning
	11	Dust removal equipment	1	Separate dust in flue gas
	12	Tire tool	100	Place the tyres
	13	Repair and check the conveyor line	1	Tire transportation
Inspection	14	Tyre repairman	3	Defective tire repair
	15	PCI repair machine	2	PCI defective repair
	16	Tyre heating box	1	Tyre heating

	17	Uniformity checking machine	3	Check the uniformity of tires
	18	Dynamic balance checking machine	3	Tire dynamic balance check
	19	Automatic tire insertion device	2	The wheel is automatically put in to check for uniformity and dynamic balance
	20	Holographic bubble tester	1	Check for air bubbles inside your tires
	21	X-ray machine	1	Check that the inside of the tire is normal
	22	White tire side grinding machine	1	The tire grinding
Warehouse	23	Tyre packing machine	2	Tire package
	24	Tyre holder	5000	Tire store

2.8 Equipment and Machinery List

Equipment list for each process is as follows:

Table 2.3: Equipment List

S. No.		Device Name	PCS/SET
Laboratory	1	Softening point measuring device	1
	2	rotational viscometer	1
	3	Electronic scales	5
	4	Electro-thermal constant-temperature dry box	2
	5	The horse boiling furnace	2
	P	Petroleum products aniline point tester	1
	7	Digital melting point meter	1
	8	Distilled water generator	1
	9	Electric thermostatic oscillating water tank	1
	10	Water circulation thermostat	1
	11	Sieve Shaker	1
	12	Bet	1
	13	Magnetic stirrer	2
	14	Washing sieve residue device	2
	15	Household refrigerator	1
	16	Sulfur content tester	1
	17	Carbon black humidity tester	1
	18	Adjustable temperature electric heating sleeve	1
	19	The centrifuge	1

	20	Rapid moisture tester	1
	21	DBP Absorption meter	1
	22	PH meter	1
	23	Glass apparatus (test kit)	1
	24	Rheometer	2
	25	Mooney viscometer	2
	26	Tensil testing machine	1
	27	Plate vulcanizing press	2
	28	Test mould (adhesive force of rubber, fiber and steel wire)	4
	29	Automatic hardness tester	1
	30	Automatic hydrometer (water method)	2
	31	Open mill(6 inch)	1
	32	Carbon black dispersion tester	1
	33	Digital thermometer (roller type, needle type)	1
	34	Banbury Mixer(1.6L)	1
	35	Yarn twist meter	1
	36	Heat aging test chamber	1
	37	DIN abrasion testing machine	1
	38	Steel wire torsion tester	1
	39	tensiometer	1
	40	Dry heat shrink meter	1
	41	Common normal micrometer	1
	42	Constant temperature and humidity test chamber	1
	43	Warewell plasticizer	1
	44	Slicing machine	1
	45	Thickness gauge	1
	46	Stiffness instrument	1
	47	RPA	1
	48	Tackness meter	1
	49	Fume hood	1
	50	purification system	1
Material Warehouse	51	Forklift truck	4
	52	Hoist	3
	53	loadometer	1
Mixing	54	Mixing line system	2
	55	Pallet	300
	56	Chemical car	60

	57	Dust system	2
	58	Rubber cutting machine	1
	59	Grasp Rubber machine	1
	60	Forklift truck	5
	61	Hoist	4
	62	Elevator	2
	63	Chemical weighing system	2
	64	weight	30
	65	weighing appliance	3

Table 2.4: Molding vulcanization

Process / Unit	Device Name	PCS/SET	Usefulness
Buiding	GT tool	500	Place the tyres
	one stage/two stage equipment	7	Product the tyres
	Tire Conveyor chain	1	Move tire to curing
	electric forklift truck	1	Change and move the tool
	One stage drum tool	7	Place the one stage drum tool
	Belt drum tool	7	Place the belt drum tool
Curing	Curing machine	30	Sulfide embryos
	Conveyor line	2	Tire transportation
	Mold preheater (two pieces of mold, movable mold)	2	Preheating mold
	Shave lanugo machine	2	Tire hair cleaning
	Dust removal equipment	1	Separate dust in flue gas
	Tire tool	100	Place the tyres
	Repair and check the conveyor line	1	Tire transportation
Inspection	Tyre repairman	3	Defective tire repair
	PCI repair machine	2	PCI defective repair
	Tyre heating box	1	Tyre heating
	Uniformity checking machine	3	Check the uniformity of tires
	Dynamic balance checking machine	3	Tire dynamic balance check
	Automatic tire insertion device	2	The wheel is automatically put in to check for uniformity and dynamic balance
	Holographic bubble tester	1	Check for air bubbles inside your tires
	X-ray machine	1	Check that the inside of the tire is normal
	White tire side grinding machine	1	The tire grinding
Warehouse	Tyre packing machine	2	Tire package

	Tyre holder	5000	Tire store

Table 2.5: Mold Laboratory

Unit	Device Name	PCS/SET	Usefulness
TTM	Tire Loader	1	Tire Loader & unloader
	Balancing machine	1	Tire Balance
	2-Position High speed endurance testing machine	1	High Speed & Endurance Test
	4-Position High speed endurance testing machine	1	High Speed & Endurance Test
	Bead Unseating & Plunger Testing machine	1	Bead Unseating & Plunger & Footprint Test
	Tire Sample wire cutting	1	Cut Sample
	Tire sample grinding machine	1	Grinding Sample
	Testing Rim	80	Rim for Testing
	Rim Storage Rack	3	Storing Testing Rim
	Testing Tire Storage Rack	4	Storing Testing Tire
	Sample Storage Rack	4	Storing Sample
Mold Shop	Mold	300	Mold for curing
	Mold Container	100	Mold Container for Curing
	Mold Tray	200	Leave with Mold
	Mold Storage Rack	16	Storing Mold
	Sandblasting clean machine	1	Clean Mold
	Cycle Plate Print Machine	1	Print DOT Number
	Hoist	3	Assemble the mold

Table 2.6: Boiler Details

Items	Content		Remarks
	10,000 pcs in phase I	The standby	
Boiler specification	Circulating fluidized bed coal boiler	Circulating fluidized bed coal boiler	At this stage, the environmental protection management adopts: boiler body + wet dust removal + chimney (using by Langma at this stage). Strict environmental protection in the next stage: increase desulfurization + denitration, and the cost is 50% of the initial investment
Boiler capacity	10T steam / hour	10T steam / hour	
Dust removal mode	Wet dedusting	Wet dedusting	

Daily coal consumption	33T/day		Coal: 5500 kcal
Boiler size / floor area	1 platform 35m*10m	1 platform 35m*10m	Plan 2 boiler spaces
Maximum emission / treatment capacity	30,000/m³/h		-
Coal yard area	800m²		10,000 PCS per day, in storage for about 20 days

2.9 Yearly Tyre Production Capacity

2.9.1 Raw Materials and Finished Products

The categories of tyre will be produced by the proposed tyre manufacturing plant including Passenger Car Tires, Light Truck and 4X4 Tires. Estimated tire Weight, Estimated R/M Consumed, Projected tire production, Raw material Consumed in KGS, and Finished Product in KGS is mentioned below.

Table 2.7 Production Capacity and Raw Materials used

Description	Estimated tire Weight	Estimated R/M Consumed	Projected tire production	Raw material Consumed in KGS	Finished Product in KGS
Passenger Car Tires	8.4	8.82	747,000	6,588,540	6,274,800
Light Truck	12.6	13.23	373,500	4,941,405	4,706,100
4X4 Tires	17.3	18.19	124,501	2,264,829	2,156,980
Total			**1,245,001**	**13,794,774**	**13,137,880**

2.10 Utilities and Support Services

2.10.1 Fire Fighting

The facility includes a fire protection system which comprises fire hose reel, manual call points, Push bar doors, fire hydrants, fire pump, foam trolleys and fire extinguishers. Firefighting team is trained and evacuation plan, list of emergency numbers and fire fighters is displayed in all relevant areas of the facility. Main Fire Assembly Point is located outside the building.

2.10.2 Water Supply and Consumption

The daily water consumption varies with the production. Generally, the estimated water usage is 77,500 gallons per day (approximately) and will be obtained by the local water supply sources in the area.

2.10.3 Electricity

The electricity requirement of the Armstrong ZE Tyre Manufacturing Factory facility is 5MW and 4 MW will be fulfilled by backup power generators. Estimates electricity requirement for production of per kg tyre is provided below.

2.10.4 Gas Supplies

Gas will be used in gas ovens, generators, hot water generators. Gas or steam consumption will be monitored and will be obtained by the local gas supply sources in the area.

Approvals for the utility provision have been obtained from the relevant authorities and provided in the annexures. Comprehensive estimates of the utilities required for per day tyre manufacturing in the proposed plant is provided below as per Pakistan Regional Economic Development Authority (REDA) guidelines.

Table 2.8 Estimated Utilities Requirement

Description	Annual Tyre Production (KG)	Per Day Tyre Production (5000 pcs/day accounting for 100 ton or ~10,000 KG)	Utilities Requirement		
			Steam (KG/day)	Electricity (KW/day)	Water (KG/day)
Passenger Car Tires	6274800	17191.23	34382.47	5157.37	3094.42
Light Truck	4706100	12893.42	25786.85	3868.03	2320.82
4X4 Tires	2156980	5909.53	11819.07	1772.86	1063.72

As per *Pakistan Regional Economic Development Authority (REDA):*
Per 10 KG of tyre production Steam requirement = 20 KG;
Per 10 KG of tyre production Electriciy requirement = 1.5 KW; and
Per 10 KG of tyre production Water requirement = 6 KG

2.11 Waste Disposal Methods

2.11.1 Waste Generation

Waste generated by production of tyres from the tyre production plant would be the 5% of the production capacity. Therefore, the estimated amount of total waste generation will be 656,894 kg per 13,137,880 kgs of final products.

The amount of waste generation from production of each of the tyre category is enlisted below:

Table 2.9 Production Waste

Description	Projected tire production	Raw material Consumed in KGS	Finished Product in KGS	Wastage 5%
Passenger Car Tires	747,000	6,588,540	6,274,800	313,740
Light Truck	373,500	4,941,405	4,706,100	235,305
4X4 Tires	124,501	2,264,829	2,156,980	107,849
Total	1,245,001	13,794,774	13,137,880	**656,894**

2.11.2 Wastewater Management

The facility generates wastewater in the form of sanitary wastewater, process wastewater. Wastewater effluent treatment plant is also proposed in the design. Monitoring of the wastewater is carried out on quarterly basis as per the SMART rules to check the quality of wastewater in relation to SEQS

The plant will generate liquid waste use of Chemicals in the Pre-treatment and finishing processes, the same will be treated through a dedicated Effluent Treatment Plant ("ETP") of an estimated capacity of 62,000-65,875 gallons per day. The design parameters of the WWTP to meet SEPA effluent discharge Standards are as follows:

1) BOD = 80 mg/L
2) COD = 150 mg/L
3) TSS= 150 mg/L
4) Ni= 2 mg/L
5) Mn = 2 mg/L
6) Zn= 5 mg/L
7) TDS = 1000 mg/L

The disposal of treated sludge will be made through SEPA approved 3rd Party Contractor for incretion at their premises. The below table summarizes the effluent and wastage which is expected from the Project. The project Proponent will take all necessary measures to ensure the proper disposal of all wastage and be an environmentally friendly corporate citizen in Gharo.

2.12 Cost and Duration of the Project

The cost of the project is 19 Billion PKR and it will be completed within 2 years (2022-2024).

2.13 Workforce Requirement

Tyre manufacturing Plant will have a real impact on employment opportunities and will generate direct employment for up to 800 people and will create multiple indirect jobs in downstream industries.

3 Policy, Legal, and Regulatory Framework

This chapter highlights the applicable laws, regulations, and guidelines regarding the environmental and social considerations in connection to proposed project. Provisions of many of the guidelines have been incorporated in the mitigation measures and the Environmental Management Plan (EMP) which has been formulated for the adequate management of environmental and social impacts.

The key legislations governing the current EIA study include:

1. **The Sindh Environmental Protection Act, 2014** - which was enacted with the objective of "protecting, conserving, rehabilitating and improving the environment for the prevention and control of pollution, and promotion of sustainable development".
2. **The Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021** – define the category of study required before commencement of project activities, based on the estimated level of impacts from project activities.
3. **The Sindh Environmental Quality Standards, 2015** – The governing limits and standards for acceptable environmental emissions from project activities during construction and operation phase.
4. Policies and laws on conservation of nature as outlined below:
    a. National Conservation Strategy, 1992
    b. Biodiversity Action Plan, 2000
    c. National Environmental Policy, 2005
    d. Sindh Environmental Protection Act, 2014

3.1 National Environmental Policies

3.1.1 National Conservation Strategy, 1992

The National Conservation Strategy (NCS) is the primary policy document of the Government of Pakistan (GoP) on national environmental issues. The policy was approved by the Federal Cabinet in March 1992, where it has also attained recognition by the international donor agencies, principally the World Bank.

The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas in order to preserve the country's environment.

A mid-term review of the achievements of the NCS in 2000 concluded that achievements under the NCS have been primarily awareness raising and institutional building rather than actual improvement to environment and natural resources and that the NCS was not designed and is not adequately focused as a national sustainable strategy (GoP, November 2000). The need therefore arose for a more focused National Environmental Action Plan (NEAP) required to bring about actual improvements in the state of the national environment with greater emphasis on poverty reduction and economic development in addition to environmental sustainability.

The National Environmental Action Plan was approved by the Pakistan Environmental Protection Council under the chairmanship of the President/ Chief Executive of Pakistan in February 2001. NEAP also constitutes the national environmental agenda, and its core

objective is to initiate actions that safeguard public health, promote sustainable livelihoods, and enhance the quality of life of the people of Pakistan.

The Government of Pakistan and United Nations Development Program (UNDP) have jointly initiated an umbrella support program called the National Environmental Action Plan-Support Program signed in October 2001 and implemented in 2002. The development objective supported by NEAP-SP is environmental sustainability and poverty reduction in the context of economic growth. The objective of new policy has total 171 guidelines on sectoral and cross sectoral issues. The objectives of new policy include assurance of sustainable development and safeguard of natural wealth of country. The following are the approved Sectoral Guidelines:

- Water Supply and Management.
- Air Quality and Noise.
- Waste Management.
- Forestry.
- Biodiversity and Protected Areas.
- Climate Change and Ozone Depletion.
- Energy Efficiency and Renewable.
- Agriculture and Livestock.
- Multilateral Environmental Agreements.

3.1.2 Mid-term Review of NCS: Key Findings

An overview of the key environmental issues facing Pakistan is as follows:

- Per capita water availability in Pakistan has been decreasing at an alarming rate. In 1951, the per capita availability was 5300 cubic meter which has now decreased to 1105 cubic meter just touching water scarcity level of 1000 cubic meter.
- Almost all freshwater resources are severely polluted due to discharge of untreated industrial and municipal wastes. Pollution of coastal waters due to waste discharges and oil spills coupled with reduced freshwater flows is resulting in declining fish yields.
- About 55 percent of population has access to a relatively safe drinking water source. Potable water quality, assessed against WHO standards, fails to meet all the specified criteria, confirming evidence of extremely high pollutant loads.
- Approximately 35 percent of population has access to adequate sanitation facilities.
- Air pollution is on the rise, especially in urban areas. Recent surveys conducted by Pakistan Environmental Protection Agency revealed presence of very high levels of suspended particulate matter (about 6 times higher than the World Health Organization's guidelines). 'Smog' also seriously affects almost entire Punjab during December and January every year.
- Noise pollution has become a serious issue in major urban centers.
- Of about 54,850 tons of solid waste generated daily in urban areas, less than 60 per cent is collected. No city in Pakistan has proper waste collection and disposal system for municipal, hazardous or healthcare wastes.
- The deforestation rate has been estimated at 0.2-0.5 percent per annum. Forest cover, which was 4.8 percent of total land area in 1992, could hardly be increased substantially despite all efforts.

- Degradation and encroachment of natural forests, rangelands and freshwater and marine ecosystems are resulting in loss of biodiversity. At least four mammal species, including tiger, swamp deer, lion and Indian one horned rhinoceros, are known to have become extinct from Pakistan while at least 10 ecosystems of value for the species richness and uniqueness of their floral and faunal communities are considered to be critically threatened.
- Desertification affects over 43 million hectares of land annually.
- Pakistan is a highly energy inefficient country. It uses approximately same amount of energy to generate 1 dollar of GNP as the USA.

The situation just mentioned is the result of several constraining factors including high population growth rate, prevailing poverty, unplanned urban and industrial expansion, insufficient emphasis on environmental protection in the government policies, lack of public awareness and education and above all the ailing economy which has caused deficiencies in institutional capacity and resources for effective environmental management.

The midterm review of the NCS led the Government of Pakistan (GOP) and United Nations Development Program (UNDP) to jointly initiate an umbrella support program called the National Environmental Action Plan-Support Program (NEAP-SP) that was signed in October 2001 and implemented in 2002. The development objective supported by NEAP-SP is environmental sustainability and poverty reduction in the context of economic growth. The primary objective of NEAP is to initiate actions and programs for achieving a state of environment that safeguards public health, promotes sustainable livelihood, and enhances the quality of life of the people in Pakistan. The NEAP identifies four primary areas, (1) Clean air (2) Clean water (3) Management of solid waste (4) Ecosystem management. The plan also presents five additional areas of concern (i) Management of fresh water resources (ii) Marine pollution (iii) Toxic and hazardous substances handling and disposal (iv) Energy conservation and management (v) Compliance with international treaties and protocol.

3.1.3 Biodiversity Action Plan, 2000

Pakistan signed the Convention on Biological Diversity in 1992 and it lead the government of Pakistan to constitute a Biodiversity Working Group, under the auspices of the Ministry of Environment, to develop a Biodiversity Action Plan for the country, which was completed after an extensive consultative exercise in 2000. The plan has been designed to complement the NCS. The proposed provincial conservation strategies identify the causes of biodiversity loss in Pakistan and suggest a series of proposals for action to conserve biodiversity in the country and Pakistan Environmental Protection Council (PEPC) approved the action plan. The steering committees were formed at the federal and provincial levels to implement the plan.

3.1.4 National Environmental Policy, 2005

The National Environmental Policy provides an overreaching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, and loss of biodiversity, desertification, natural disasters and climatic change.

It also gives direction for addressing the cross-sectional issues as well as the underlying causes of environmental degradation and meeting international obligations.

The National Environmental Policy, while recognizing the goals and objectives of the National Conservation Strategy, National Environmental Action Plan and other existing environment related national policies, strategies and action plans, provide broad guidelines to the Federal Government, Provincial Governments, Federally Administrated, Territories and Local Governments for addressing environmental concerns and ensuring effective management for their environmental resources. The National Environmental Policy aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development.

3.2 National and Provincial Legislation

3.2.1 18th Amendment to the Constitution of Pakistan and the Status of Sindh Environmental Protection Agency (SEPA)

Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The 'Federal list' covered the subjects over which the federal government had exclusive legislative power, while the 'Concurrent List' contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject. However, because of the 18th Amendment this subject is now in the exclusive domain of the provincial government. As a result, the Ministry of Environment at the federal level has been abolished. Its functions related to the national environmental management have been transferred to the provinces and the respective provincial environmental ministries and agencies. The international obligations in the context of environment will be managed by the ministry of climate change.

As a result, the Pakistan Environmental Protection Act, 1997 is no longer applicable to provinces and provinces now need to enact their own environmental protection acts at provincial level.

3.2.2 Sindh Environmental Protection Act, 2014

In March 2014, the Government of Sindh passed the Sindh Environmental Protection Act having 37 sections. The applicable sections of this act to this project are:

Section 11(1): Subject to the provisions of this Act and the rules and regulations, no person shall discharge or emit or allow the discharge or emission of any effluent, waste, pollutant, noise or any other matter that may cause or likely to cause pollution or adverse environmental effects, as defined in section 2 of this Act, in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards; or, where applicable, the standards established under Section 6(1)(g)(i); or direction issued under Section 17, 19, 20 and 21 of this Act; or any other direction issued, in general or particular, by the agency.

Section 11(2): All persons, in industrial or commercial or other operations, shall ensure compliance with the Environmental Quality Standards for ambient air, drinking water, noise or any other Standards established under section 6(1)(g)(i); shall maintain monitoring records for such compliances; shall make available these records to the authorized person for inspection; and shall report or communicate the record to the

Agency as required under any directions issued, notified or required under any rules and regulations.

Section 11(3): Monitoring and analysis under sub-section (1) and (2), shall be acceptable only when carried out by the Environmental Laboratory certified by the Agency as prescribed in the rules.

Section 12: No person shall import hazardous waste into Sindh province or its coastal, internal, territorial, or historical waters, except acquiring prior approval of the Agency.

Section 13: Subject to the provisions of this Act, no person shall import, generate, collect, consign, transport, treat, dispose of, store, handle or otherwise use or deal with any hazardous substance except- Handling of hazardous substances. (a) under a license issued by the Agency; or (b) in accordance with the provisions of any other law, rule, regulation, or notification for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement, or other instrument to which Government is a party.

Section 14: No person shall undertake any action which adversely affects the environment, or which leads to the pollution or impairment of damage to biodiversity, ecosystem, aesthetics or any damage to environment etc.

Section 15: This section deals with regulation of motor vehicles banning emission of air or noise pollutants being emitted from them in excess of allowable standards.

Section 17(1): No proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment and has obtained from the Agency approval in respect thereof.

The EIA of the proposed Project will be submitted to the Sindh Environmental Protection Agency (EPA) for approval and only after the issuance of NOC will the construction activity be commenced.

Section 21: Where agency is satisfied that the discharge or emission has occurred in violation of any provision of this act or rules etc. then it may, after giving an opportunity to person responsible, by order direct such person to take such measures within specified period. The agency under this section has been empowered to immediately stop, prevent or minimize emission, disposal etc. for remedying adverse environmental effects.

Section 22: The person who fails to comply with section 11, 17, 18 and 21 shall be punishable with a fine which may extend to five million rupees, to the damage caused to environment and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues. And, where a person convicted under sub-sections 1 & 2 had been previously convicted for any contravention of this Act, the Environmental Protection Tribunal (EPT) may, in addition to punishment, award imprisonment for a term that may extend up to three years, or order confiscation or closure of facility etc.

Section 23: Where any violation of this Act has been committed by any of employee of any corporate body, then, that employee shall be guilty of environmental pollution.

3.2.3 Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021

Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021 made in exercise of powers conferred under section 37 of the Act 2014 provide the necessary guidelines on the preparation, submission, & review of Environmental Assessments. The regulations categorize projects in three categories provided in Schedule I, II and III of the 2021 Regulations.

To fulfill this requirement, an environmental assessment was carried out for the Armstrong ZE Tyre Manufacturing Factory, specifically an Environmental Impact Assessment, as it is defined in Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021.

SCHEDULE III - Projects requiring an EIA

Section (C) - Manufacturing and processing

Sub-Section (6) - Establishment of Industrial estates & Export processing zones

Therefore, following EIA has been developed to evaluate the environmental impact of proposed tyre manufacturing plant under guidelines of Sindh Environmental Protection Act (SEPA), 2014.

3.2.4 Sindh Environmental Quality Standards (SEQS), 2016

In exercise of the powers conferred under clause (g) of sub-section (1) of section of 6 of the Sindh Environmental Protection Act, 2014, the Sindh Environmental Protection Agency, with the approval of the Sindh Environmental Protection Council, has established the standards for Industrial wastewater, Effluent, Domestic Sewerage, Industrial air emissions and Ambient air, Noise for vehicles, Air emissions for vehicles and Drinking water quality standards. Ambient Air standards are given in the table below.

Table 3.1: Sindh Environmental Quality Standards for Ambient Air

Pollutant	Time-weighted average	Concentration in Ambient Air	Method of measurement
Sulfur Dioxide (SO_2)	Annual Average*	80µg/m^3	Ultraviolet Fluorescence Method
	24 hours**	120µg/m^3	
Oxides of Nitrogen as (NO)	Annual Average*	40µg/m^3	Gas Phase Chemiluminescence
	24 hours**	40µg/m^3	
Oxides of Nitrogen as (NO2)	Annual Average*	40µg/m^3	Gas Phase Chemiluminescence
	24 hours**	80µg/m^3	
O3	1 hour	130µg/m^3	Non-dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	360µg/m^3	High volume Sampling, (Average flow rate not less than 1.1m3/minute)
	24 hours**	500µg/m^3	
	Annual Average*	120µg/m3	Â Ray absorption method

Respirable Particulate Matter (PM10)	24 hours**	150µgm3	
Respirable Particulate Matter (PM2.5)	Annual Average*	40µg/m3	Â Ray absorption method
	24 hours**	75µg/m3	
	1 hour	15µg/m3	
Lead (Pb)	Annual Average*	1µg/m3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5µg/m3	
Carbon Monoxide (CO)	8 hours**	5mg/m3	Non Dispersive Infra-Red (NDIR) method
	1 hour	10mg/m3	
***Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval. **24 hourly / 8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive**			

Table 3.2 shows the standards for motor vehicle noise.

Table 3.2: SEQS for motor vehicle noise

Parameter	Standards (maximum permissible limit)	Measuring method
Noise	85dB(A)	Sound-meter at 7.5meter from the source

Standards for noise are given below;

Table 3.3: SEQS for Noise

S. No	Category of Area/Zone	Limit in dB(A) Leq*	
		Day Time	**Night Time**
1	Residential Area (A)	55	45
2	Commercial Area (B)	65	55
3	Industrial (C)	75	65
4	Silence Zone (D)	50	45
Note: 1	Day time hours: 6.00 a. m to 10.00 p. m		
2	Night time hours: 10.00 p. m to 6.00 a. m		
3	Silence zone; Zone which are declared as such by competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.		
4	Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.		
***dB(A) Leq**	Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.		

The SEQS for effluents are shown in table 3.4;

Table 3.4: SEQS for Municipal and Liquid Industrial Effluents					
S. No	Parameter	Into Inland Waters	Into Sewage Treatment	Into Sea	Unit
1	Temperature or Temp. increase	<3	<3	<3	°C
2	pH value (H+)	6-9	6-9	6-9	
3	Biological Oxygen Demand $(BOD)_5$ at 20°C	80	250	80	mg/l
4	Chemical Oxygen Demand (COD)	150	400	400	mg/l
5	Total Suspended Solids (TSS)	200	400	200	mg/l
6	Total Dissolved Solids (TDS)	3500	3500	3500	mg/l
7	Oil and Grease	10	10	10	mg/l
8	Phenolic Compounds (as Phenol)	0.1	0.3	0.3	mg/l
9	Chloride (as Cl^-)	1000	1000	SC	mg/l
10	Fluoride (as F^-)	10	10	10	mg/l
11	Cyanide (as CN^-) total	1	1	1	mg/l
12	An-ionic detergents (as MBAS)	20	20	20	mg/l
13	Sulphate(SO_4^{2-})	600	1000	SC	mg/l
14	Sulphide (S^{2-})	1	1	1	mg/l
15	Ammonia (NH_3)	40	40	40	mg/l
16	Pesticides	0.15	0.15	0.15	mg/l
17	Cadmium	0.1	0.1	0.1	mg/l
18	Chromium (trivalent and hexavalent)	1	1	1	mg/l
19	Copper	1	1	1	mg/l
20	Lead	0.5	0.5	0.5	mg/l
21	Mercury	0.01	0.01	0.01	mg/l
22	Selenium	0.5	0.5	0.5	mg/l
23	Nickel	1	1	1	mg/l
24	Silver	1	1	1	mg/l
25	Total toxic metals	2	2	2	mg/l
26	Zinc	5	5	5	mg/l
27	Arsenic	1	1	1	mg/l
29	Iron	8	8	8	mg/l
30	Manganese	1.5	1.5	1.5	mg/l
31	Boron	6	6	6	mg/l

32	Chlorine	1	1	1	mg/l

Standards for drinking water are shown in table below;

Table 3.5: SEQS for drinking water

S.#	Properties/ Parameters	Standard Values for Pakistan	S.#	Properties / Parameters	Standard Values for Pakistan
	Bacterial			**Chemical Essential Inorganics (mg/liter)**	
1	All water intended for drinking (E.Coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	13	Aluminum (Al) mg/l	≤ 0.2
			4	Antimony (Sb)	≤ 0.005
2	Treated water Entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	5	Arsenic (As)	≤ 0.05
			6	Barium (Ba)	≤ 0.7
			7	Boron (B)	0.3
3	Treated water in the distribution system (E.coli or thermo tolerant coliform and total coliform bacteria)	Must not be Detectable in any 100-ml sample. In case of large supplies, where sufficient samples are examined, must not be resent in 95% of the samples taken throughout any 12-month period.	8	Cadmium (Cd)	0.01
			9	Chloride (Cl-)	< 250
			10	Chromium (Cr)	≤ 0.05
			11	Copper (Cu)	2
			Organic (mg/l)		
			12	Phenolic Compounds	< 0.0002
			Toxic Inorganics (mg/l)		
			13	Cyanide (CN)-	≤ 0.05
			14	Fluoride (F)	≤ 1.5
			15	Lead (Pb)	≤ 0.05
			16	Manganese (Mn)	≤ 0.5
Physical			17	Mercury (Hg)	≤ 0.001
4	Color	< 15 TCU	18	Nickel (Ni)	≤ 0.02
5	Taste	Non-objectionable/ Acceptable	19	Nitrate (NO_3)-	≤ 50
6	Odor	Non-objectionable/ Acceptable	20	Nitrite (NO_2)-	≤ 3
7	Turbidity	< 5 NTU	21	Selenium (Se)	≤ 0.01

8	Total Hardness as $CaCO_3$	< 500 mg/l	22	Residual Chlorine	0.2-0.5 At consumer end 0.5-1.5 at source
9	TDS	< 1000			
10	pH	6.5-8.5			
Radioactive					
11	Alpha Emitters bq/L	0.1	23	Zinc (Zn)	*5.0*
12	Beta Emitters	1			

3.2.5 Hazardous Substance Rule, 2014

These Rules were notified to streamline procedures for issuance of licenses to industries / businesses that deal with the use, transport, and handling of hazardous materials and generate hazardous waste. The rules also specify procedures to be adopted for import, transport, and disposal of hazardous waste; and identify two hundred and forty-three hazardous substances and synthetic chemicals.

3.2.6 Sindh Wildlife Protection, Preservation, Conservation, and Management Act, 2020

This Act provides for the preservation, protection, and conservation of wildlife by the formation and management of protected areas and prohibition of hunting of wildlife species declared protected under the Sindh Wildlife Protection Ordinance (2001). The ordinance also specifies three broad classifications of the protected areas: national parks, wildlife sanctuaries and game reserves. Activities such as hunting and breaking of land for mining are prohibited in national parks, as are removing vegetation or polluting water flowing through the park.

Wildlife sanctuaries are areas that have been set aside as undisturbed breeding grounds and cultivation and grazing is prohibited in the demarcated areas. Nobody is allowed to reside in a wildlife sanctuary and entrance for the public requires special approval. However, these restrictions may be relaxed for scientific purpose or betterment of the respective area on the discretion of the governing authority in exceptional circumstances. Game reserves are designated as areas where hunting or shooting is not allowed except under special permits.

Sindh Wildlife Department is responsible for protection of wildlife in the Province. The Department's concerns are limited to areas designated as game reserves, national parks and wildlife sanctuaries and to protecting species afforded protection under the law. So as long as the law is not being contravened they have no artificial interest in activities carried on outside game reserves, national parks and wildlife sanctuaries. The Department nevertheless has the powers to halt illegal activities outside the protected areas.

The project area does not fall inside or in the vicinity of any wildlife protected area.

3.2.7 Factories Act, 2015

The Sindh Factories Act, 2015, deals with any premises which falls in the category of a Factory i.e. where any manufacturing work is carried out employing ten or more persons. Inspectors, appointed under this act, are empowered to enforce the provisions of this Act.

Section 11(1) of the Act "Registration and Deregistration of Factory" states that:

'Provided also that the registration documents be supported by No Objection Certificates from Industries Department, approval of Sindh Environmental Protection Agency (SEPA) and any other document or forms in the prescribed manner.'

Chapter III of this Act titled "Health & Safety" comprising of Section 15-53, describes various Occupational Health and Safety measures that any Factory has to follow. The provisions of this chapter include clean working environment, arrangements for disposal of wastes and effluents on regular basis, provision of adequate ventilation, prevention from accumulation of dust and fumes generated during manufacturing process, avoidance of overcrowding and ensuring of sufficient lighting arrangements. This chapter also requires availability of amenities such as drinking water, canteen, safety against fire hazards and appointment of welfare officer and measures for prevention from diseases. This Act also prescribes penalties for violation of provisions of the Act.

The proponent will adhere to the applicable provisions of the act.

3.2.8 Sindh Factories Rules, 1975

These Rules provide for inspection of factory premises at any time by inspectors authorized under these rules. Section 13 &14 discusses health and safety requirements. Section 15, 16 & 17 requires that the working areas should be properly ventilated with tolerable levels of dust, fumes, and artificial humidification. Section 25 prescribes sound precautions against fire. Protection of persons attending machinery or boilers is also provided. Section 33-K provides precautions against dangerous fumes.

3.2.9 Land Acquisition Act, 1894

This act is generally used to establish the rights on the land being acquisitioned for public purposes. The LAA describes the detailed procedures for acquisition of private properties but does not appropriately cover resettlement and rehabilitation. Additionally, LAA 1984 treats land acquisition as a provincial subject, and allows each province to use it in different ways based on their own interpretation. Federal EPA prepared the National Resettlement Policy 2002, which described the ways relating to calculation of compensation, public participation and consultation, formulation of resettlement action plan, and provisions for transparency and accountability.

The proponent is the legal owner of the land, hence, there is no need for land acquisition nor applicability of this Act.

3.2.10 The Antiquities Act, 1975

The protection of cultural resources in Pakistan is ensured by the Antiquities Act of 1975. Section 22 specifically prohibits the execution of development schemes and new constructions in proximity to immovable antiquity. Notwithstanding anything contained in any other low for the time being in force, no development plan or scheme or new construction on, or within two hundred feet of, a protected immovable antiquity shall be undertaken or executed except with the approval of the Director.

The Act is designed to protect the antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GOP to prohibit excavation in any area that may contain articles of archaeological significance. The project site does not have any cultural sensitivity in the vicinity to require protection, hence, the provisions of this law therefore do not apply on the project.

3.2.11 The Forest Act, 1927

The Act is applicable to all regions of Pakistan. It includes procedures for constituting and managing various types of forests, such as reserved forests and protected forests.

The Act empowers the provincial forest departments to declare any forest area as reserved or protected. It also defines the duties of forest related public servants, and penalties of any infringement of the rules. The project is not a part of any protected or reserved forest, mentioned in Forest Act, 1927. In the microenvironment and immediate vicinity, no forest is located which might be affected due to project implementation. Nevertheless, measures for protection of vegetation and green areas in the surroundings will be adopted by the project management.

3.2.12 Sindh Cultural Heritage (Preservation) Act, 1994

The Sindh Cultural Heritage (Preservation) Act, 1994 is the provincial law for the protection of cultural heritage. Its objectives are like those of the Antiquity Act, 1975. The Act empowers the Antiquities Department to protect the cultural and heritage sites from any development /improvement work.

None of the sites protected under this law are found in the vicinity of project site. The project will therefore not influence the integrity of cultural heritage in the micro or macro-environment.

3.2.13 Pakistan Penal Code, 1860

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

3.2.14 The Sindh Irrigation Act, 1879 and the Canal and Drainage Act, 1873

This Sindh Irrigation Act covers the construction, maintenance, and regulation of canals for the supply of water and for the levy of rates of water supplied in the Province of Sindh. Canals are defined as channels, pipes and reservoirs constructed and maintained by the Government for the supply for storage of water. Under section 27 of the Act a person desiring to have a supply of water from a canal for purposes other than irrigation shall submit a written application to a Canal Officer who may, with the sanction of the Provincial Government give permission under special conditions. The Act under section 61 also prohibits the damaging, altering, enlarging, or obstructing the canals without proper authority. There is a freshwater canal passing in the vicinity on the north-western side of project area. Provisions of this Act will be duly considered during project implementation to prevent any damage to the canal.

3.2.15 Self-Monitoring and Reporting by Industry Rules, 2014

These rules classify the industrial units for monitoring and reporting their liquid effluent and gaseous emissions into three and two categories respectively. According to each category they define the priority parameters to be monitored and reported to SEPA according to a specific frequency based on working conditions. This monitoring and reporting is in addition to the monitoring conditions as required by the conditions of approval of EIA. The sampling for testing must be carried out according to Environmental Samples Rules, 2014 and be sent to SEPA certified environmental testing laboratories.

3.2.16 Pakistan Environmental Assessment Procedures, 1997

The Federal EPA has prepared a set of guidelines for conducting environmental and social assessments. The guidelines derive from much of the existing work done by international donor agencies and NGOs. The package of regulations, of which the environmental and social guidelines form a part, includes the PEPA 1997 and the NEQS. These guidelines are listed below followed by comments on their relevance to proposed project:

- Policy and Procedures for Filing, Review and Approval of Environmental Assessments, Pakistan Environmental Protection Agency, September 1997: These guidelines define the policy context and the administrative procedures that govern the environmental

assessment process from the project pre-feasibility stage to the approval of the environmental report. The section on administrative procedures has been superseded by the IEE-EIA Regulations, 2000.

- Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997: The guidelines on the preparation and review of environmental reports target project proponents and specify:
    - The nature of the information to be included in environmental reports
    - The minimum qualifications of the EIA conductors appointed
    - The need to incorporate suitable mitigation measures at every stage of project implementation
    - The need to specify monitoring procedures.
- The terms of reference for the reports are to be prepared by the project proponents themselves. The report must contain baseline data on the Study Area, detailed assessment thereof, and mitigation measures.
- Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May, 1997: These guidelines support the two guidelines mentioned above. They deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.
- Sectoral Guidelines for Environmental Reports: Housing estates and new Town developments: These guidelines are prepared to look specifically at the Environmental impacts resulting from constructing housing estates and townships in Pakistan. The guidelines examine the alternatives on site and technology and impacts on the social and physical environment, during the construction and operation phases of the project and devices proposals for mitigation measures.

  The EIA report submission and approval procedure is summarized below:

  a) Ten hardcopies of the EIA and two soft copies will be submitted together with a review fee and form included as Schedule V of the IEE-EIA Regulations.

  b) The EPA will conduct a preliminary scrutiny and reply within 10 days of the submittal of the report

     i. confirming completeness, or

     ii. asking for additional information, if needed, or

     iii. returning the report requiring additional studies, if necessary.

  c) If accepted, the EPA will set a date for public hearing and publish a notice in the print media. According to the law, a minimum of 15 day notice is required for the public hearing.

  d) The EPA will review the EIA taking into account the any public comments received during the hearing or otherwise.

  e) The EPA is required to make every effort to complete the EIA review process within four (04) months of the issue of confirmation of completeness under regulation 9.

f) The approval granted at the end of the review process, is valid for three years to start construction.

g) Once the project construction is complete, the proponent is required to submit a request to EPA for confirmation of compliance. An environmental management plan for the operation phase is to accompany the request.

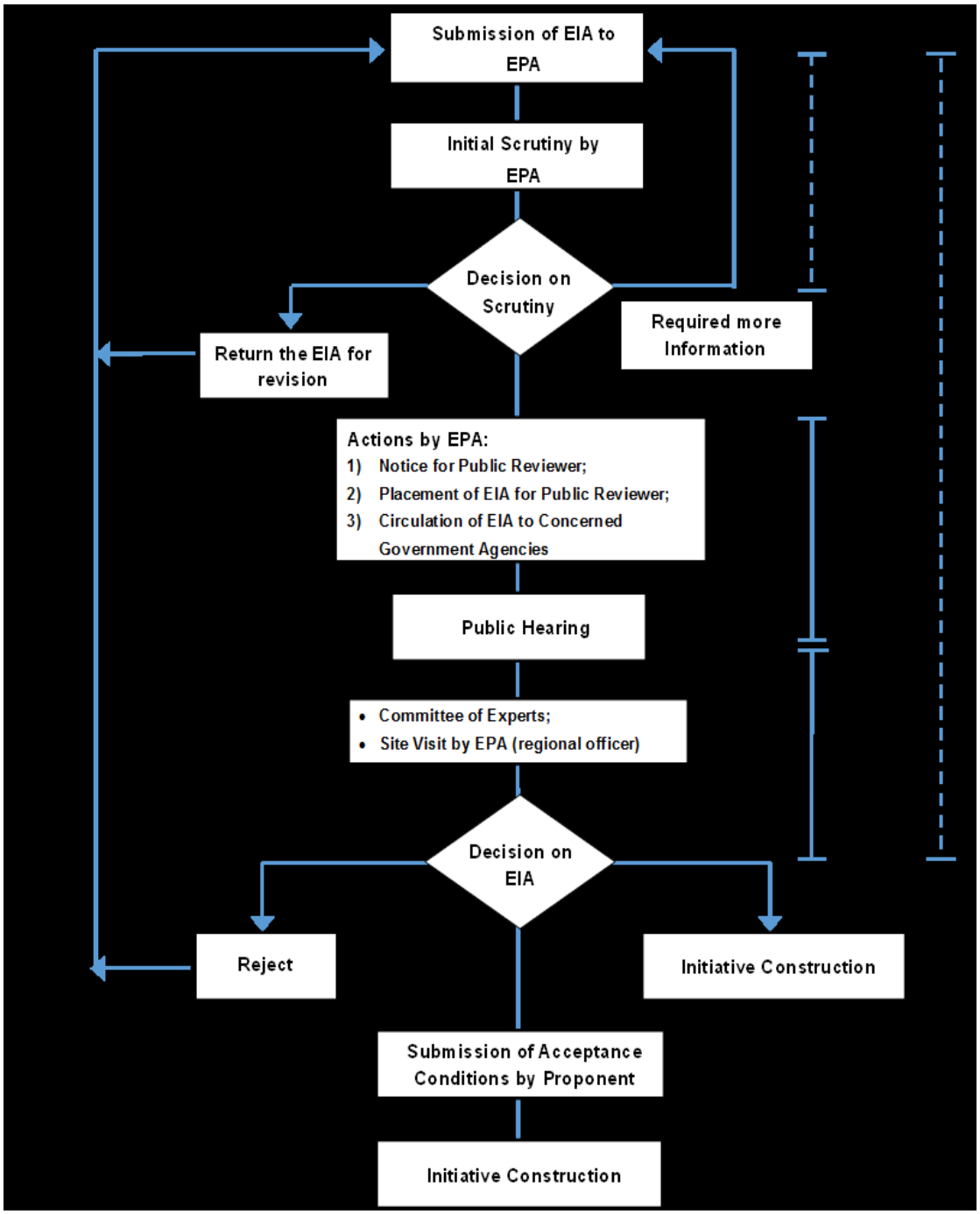


Figure 3.1 - EIA Review and Approval Procedure

3.2.17 Guidelines for Public Consultation

Public consultation is mandated under 2014 Act. Regulation 11 of the 2014 Regulations provides the general requirements whereas the sectoral guidelines indicating specific

assessment requirements are provided in the Guidelines for Public Consultation 1997 (the 'Guidelines'). These are summarized below:

Objectives of Public Involvement: 'To inform stakeholders about the proposed project, to provide an opportunity for those otherwise unrepresented to present their views and values, providing better transparency and accountability in decision making, creating a sense of ownership with the stakeholders'.

Stakeholders: 'People who may be directly or indirectly affected by a proposal will clearly be the focus of public involvement. Those who are directly affected may be project beneficiaries, those likely to be adversely affected, or other stakeholders. The identification of those indirectly affected is more difficult, and to some extent it will be a subjective judgment. For this reason, it is good practice to have a very wide definition of who should be involved and to include any person or group who thinks that they have an interest. Sometimes it may be necessary to consult with a representative from a particular interest group. In such cases the choice of representative should be left to the group itself. Consultation should include not only those likely to be affected, positively or negatively, by the outcome of a proposal, but should also include those who can affect the outcome of a proposal'.

Mechanism of consultations: 'Provide sufficient relevant information in a form that is easily understood by non-experts (without being simplistic or insulting), allow sufficient time for stakeholders to read, discuss, consider the information and its implications and to present their views, responses should be provided to issues and problems raised or comments made by stakeholders, selection of venues and timings of events should encourage maximum attendance'.

Timing and Frequency: Planning for the public consultation program needs to begin at a very early stage; ideally it should commence at the screening stage of the proposal and continue throughout the EIA process.

Consultation Tools: Some specific consultation tools that can be used for conducting consultations include focus group meetings, needs assessment, semi-structured interviews; village meetings & workshops.

Other Important Considerations: The development of a public involvement program would typically involve consideration of the following issues: objectives of the proposal and the study; identification of stakeholders; identification of appropriate techniques to consult with the stakeholders; identification of approaches to ensure feedback to involved stakeholders; and mechanisms to ensure stakeholders' consideration are considered'.

As above, the Guidelines for Public Consultation introduces effective ways to inform the contents of the project to the public during the planning stage and that eventually consensus building toward the implementation of project is reached. However, there are instances where in middle of a project on direction of tribunal or court environmental assessment carried out with public consultation.

Incorporating public involvement into the stages of environmental assessment is explained in the guidelines that public consultation meeting must be carried out after the works on "developing options and assessing and mitigating impacts" for comments and assessment.

3.2.18 Sindh Prohibition of Child Employment Act, 2017

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines, or any other hazardous employment. In accordance with this Article, the Prohibition of Child Employment Act (PCEA) 2017 disallows the child labour in Sindh. The PCEA defines a child as a person who has not completed his/her fourteenth years of age, and an adolescent means a person who has completed fourteenth year of age but has not completed eighteenth years of his age. No child shall be employed or permitted to work in any establishment including construction, but an adolescent can be employed or permitted to work under strict guidelines provided in the PCEA and rules. An adolescent shall not be employed in any hazardous work included in the schedule to the PCEA.

3.2.19 Sindh Solid Waste Management Board Act, 2014

The SSWMB Act, 2014 was enacted to establish a Board for collection and disposal of all solid waste, to arrange effective delivery of sanitation services, to provide pollution free environment and to deal with other relevant matters. The Board established under the Act headed by the Chief Minister constitutes of thirteen other ex officio members of other relevant departments. Some of the salient features and functions of the Board are; it has the right over the solid waste related issues, assets, funds and liabilities of the Councils and shall possess sole rights on all kinds of solid waste within the limits of all Councils established under the Local Government Act 2013, it has the authority to grant permission to individuals, institutions industries, factories, workshops, furnaces, compost making and power generation from the solid waste, for segregation of the recyclable material from the waste, collection, treatment, sale and purchase, recycling or disposal of any kinds of waste.

3.2.20 Sindh Drinking Water Policy, 2017

The Public Health Engineering & Rural Development Department, Government of Sindh, with the approval of Chief Minister Sindh issue the drinking water policy on 3rd May 2017.

Principles: The main principles of Sindh Drinking Water Policy, adopted from the National Drinking Water policy 2009, and aligned with the Sustainable Development Goals, are as follows:

- Access to safely managed drinking water is a fundamental right of every citizen and that it is the responsibility of the Government to ensure its provision to all citizens,
- Water allocation for drinking purpose shall be given priority over other uses,
- To ensure equitable access, special attention shall be given to removing the existing disparities in coverage of safe drinking water and for addressing the needs of the poor and the vulnerable on priority basis.
- Recognizing that inadequate and unsafe water supply and sanitation are a major cause of diarrhea and nutritional deficiency in children, which consequently contribute towards child mortality. Safely managed drinking water supply and sanitation shall be integrated in health, nutrition, and school health programs.
- Access shall be increased to high quality nutrition-sensitive services, including access to water, sanitation facilities, and hygiene.

- Key hygiene actions (safe drinking water, hand washing with soap, safe disposal of excreta, food hygiene) shall be integrated as essential components in all nutrition programs.
- Realizing the fact that access and availability of safe drinking water affects all aspects of life of a citizen, a multi sectorial approach, involving different departments of the government, shall be adopted to address the issues related to safe drinking water. Being cognizant of the fact that women are the main providers of domestic water supply and maintainers of hygienic household environment, their participations in planning, implementation, monitoring and operation & maintenance of water supply systems shall be ensured, and WASH shall be integrated in maternal and neonatal health programs.
- Responsibilities and resources shall be delegated to local authorities to enable them to discharge their assigned functions regarding provision of safe water supply.
- A supportive policy framework shall be developed that encourages alternate options through private provision, public private partnerships, the role of NGOs and community organizations.
- The execution of component-sharing model for government programs and projects shall be promoted to ensure financial sustainability and community and private sector involvement in development and O&M.
- Low-cost technologies in water and sanitation, that are easy and cost-effective to maintain shall be developed and used.

Goals and Objectives:

Overall Goal: The goal of the Sindh Drinking Water Policy is to improve the quality of life of people of Sindh by reducing morbidity and mortality caused by water-borne diseases through provision of safely managed and potable drinking water to the entire population that is located on premises, available when needed, and free from contamination, affordable and of sufficient quantity, and in a way, that is efficient, equitable and sustainable.

Objectives:

- Introduce legislative measures and regulations to create an enabling framework for safely managed drinking water supply, regulation of water usage, extraction, treatment, transportation, and distribution.
- Ensure that all drinking water resources, and supply systems are protected with community involvement.
- Develop district level drinking water availability plans for urban and rural areas to ensure improved planning for equitable access.
- Enhance the coverage of safely managed drinking water supply in the province to achieve the Sustainable Development Goals (SDGs) targets of universal access.
- Develop criteria for installation of new drinking water supply schemes and ensure that all new schemes are safely managed, rationalized, and constructed through need-based criteria so that all areas and communities are served.
- Develop standardized service delivery models for both urban and rural drinking water supply schemes to improve efficiency, cost-effectiveness, monitoring & sustainability.

- Develop mechanisms for reuse, recycle and recharge of wastewater for other municipal and productive uses.
- Ensure that all drinking water supply systems are designed and constructed in line with the national drinking water quality standards and all municipal discharges comply with National Environment Quality Standards (NEQS).
- Install water treatment plants at existing drinking water supply schemes where required and incorporate water treatment facilities in all new drinking water supply schemes.
- Ensure development of water safety plans for all drinking water supply systems.
- Develop and sustain regular drinking water quality monitoring & surveillance, and institute mechanisms for remedial action.
- Increase public awareness about water borne and water related diseases (including polio), nutrition and hygiene, and enhance the role of communities for household water treatment/storage, water safety and conservation, and safe hygiene practices.
- Ensure that drinking water supply projects are nutrition sensitive and integrated in health, nutrition, and school health programs.
- Institutionalize Water, Sanitation & Hygiene (WASH) in schools (infrastructure and 3 starts) and introduce curricular change to incorporate health, nutrition and hygiene and improve safe water and sanitation practices among school children.
- Institute adaptation measures and disaster risk reduction and mitigation strategies to minimize the impact of climate events on drinking water supply system.

3.2.21 Sindh Sanitation Policy, 2017

The goal of the Provincial Sanitation policy is to ensure that the entire population of Sindh has access to a safely managed sanitation service and sanitary environment that is also nutrition-sensitive and hygienic. The motto of the policy was ‘Saaf Suthro Sindh’ (Neat and Clean Sindh). The Policy sets targets to achieve its motto. For instance, eradication of Open Defecation from Sindh Province by 2025, while 70% villages of 13 high priority districts achieve the status of open defecation free by 2020; create and develop wastewater treatment mechanisms to cover 75% of urban areas and 40% in rural areas by 2025 and implement integrated solid waste management with 100% coverage in urban areas and 60% in rural areas of Sindh by 2025. A WASH behavior changes, and communication strategy has also been developed for sustainable and safe hygiene environment by 2025 to enhance the living standards of the people of Sindh.

3.2.22 Building Code of Pakistan, Fire Safety Provisions 2016

The Building Code of Pakistan-Fire Safety Provisions-2016 provide rules for fire prevention, life safety in relation to fire and fire protection of building and structures as prescribed. All the federal and provincial governments, organizations, authorities, both public and private are mandated to adopt and implement Building Code of Pakistan-Fire Safety Provisions-2016, as notified. Any construction and modification of buildings in violation of Building Code of Pakistan (Fire Safety Provisions-2016) shall be considered as violation of professional engineering works as specified under clause (xxv) of section 2 of the Act.

The implementation and enforcement of this byelaw shall vest with the Authority Having Jurisdiction (AHJ) within their respective jurisdictions and circles as follow:

1) Building Control, Housing and Development Authorities
2) District Administration
3) Tehsil or Town Administration
4) Municipal Administration
5) Station Headquarters (Army, Air Force and Navy)
6) Cantonment Administration
7) Union Council Administration
8) Autonomous Bodies
9) Industrial Estates
10) Directorates of Civil Defense
11) Export Processing Zones
12) Other Federal/Provincial Authorities as and when notified.

This Byelaw shall come into force upon being notified and all the concerned AHJs shall implement the same immediately in the prescribed manner.

All relevant AHJs shall ensure compliance and implementations of this Code and accordingly adopt or amend their relevant regulations, Byelaws or rules as the need be.

This Byelaw shall apply to both new and existing buildings.

a. Buildings permitted for construction after the adoption of these Provisions shall comply with the provisions stated herein for new buildings forthwith.
b. Existing buildings constructed prior to adoption of these provisions shall comply with the provisions stated herein as soon as possible but not later than three years of notification of these provisions; and
c. Minimum fire protection requirements such as provision of fire alarm and detection system, fire extinguishers, emergency response plans and fire drills shall however be in place as soon as possible but not later than one year of notification of these provisions.

Any person who fails to comply with this Byelaw or fails to carry out an order made pursuant to these provisions, or violates any condition attached to a permit, approval, or certificate shall be subject to the penalties in accordance with the regulations of AHJ.

3.2.23 The Sindh Occupational Safety and Health Act, 2017

The Sindh Occupational Safety and Health Bill 2017 has been approved by the Provincial Assembly of Sindh (Ref. Sindh Bill No. 27 of 2017) and enacted as the Sindh Occupational Safety and health Act, 2017. The Act makes provision for Occupational Safety and Health conditions at all workplaces for the protection of persons at workplaces against risk of injury arising out of the activities at workplaces and the promotion of safe, healthy, and decent working environment adapted to the physical, physiological, and psychological needs of all persons at work. The Sindh Occupational Safety and Health Rules, 2019 have also been framed under the act.

3.3 International Conventions and Guidelines

3.3.1 IUCN Red List

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

- Endangered: species that are sent to be facing a very high risk of extinction in the wild in the near future, reduction of 50% or more either in the last 10 years or over the last three generations, survive only in small numbers, or have very small populations.
- Vulnerable in Decline: species that are seen to be facing a risk of extinction in the wild, having apparent reductions of 20% or more in the last 10 years or three generations.
- Vulnerable: species that are seen to be facing a high risk of extinction in the wild, but not necessarily experiencing recent reduction in population size.
- Lower Risk: species that are seen to be facing a risk of extinction that is lesser in extent that for any of the above categories.
- Data Deficient: species that may be at risk of extinction in the wild but at the present time there is insufficient information available to make a firm decision about its status.

No species as listed in IUCN red list were found at the project site during the survey.

3.3.2 The Convention on Biological Diversity, 1992

The Convention on Biological Diversity was adopted during the Earth Summit of 1992 at Rio de Janerio. 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 promoting their sustainable use.

3.3.3 The Convention of Conservation of Migratory Species of Wild Animals, 1979

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979, requires countries to take action to avoid endangering migratory species. The term “migratory species” refer to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. These parties are also required to promote or co-operate with other countries in matters of research on migratory species.

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

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

3.3.4 The Convention on Wetlands of International Importance, Ramsar 1971

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

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

3.3.5 Convention on International Trade in Endangered Species of Wildlife Fauna and Flora

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

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

4 Environmental and Social Baseline

This section details the physical, biological, and socioeconomic environmental conditions of the microenvironment and macroenvironment of the project area. Discussion on the natural environment covers the area's physical and meteorological features, including geology, water resources, climate, and air quality. Overview of vegetation, wildlife and natural habitats are included in the ecological section.

4.1 The Macro-environment: District Thatta

The proposed project is in Gharo, Mirpursakro Taluka of District Thatta. The project is planned in the environs of multiple farms, mills, small to medium scale industries and agricultural land facing the main Gharo - Keti Bunder Highway (N110). The project site can be easily accessed through National Highway (N-5) in the south, via Gharo - Keti Bunder Highway (N110). The major settlements in macro-environment of the project site are Lait Village, Satellite Town Gharo, Jokhio village, and Katiyar village. The farms nearby the project site include the Pioneer Feed Poultry Farm, Galaxy Green Farms, and Twin Lake Farm amongst various other small farms.

4.2 The Microenvironment of the Project

The project is in the northern side of the sub district Mirpursakro in Gharo, along the main Gharo - Keti Bunder Highway (N110), also known as Gharo Road. The nearest landmarks near the proposed project site are the Daniyal Farms, Nova Foods Pvt. Ltd., Green World Farmhouse. In the immediate north of the proposed project site, Khari Seer Distry runs along the northern boundary of the plot, which receives water from Jam Branch. Towards, far west of the project site, Gharo Oursun Power Plant is located.

Existing Topography of the Project Site



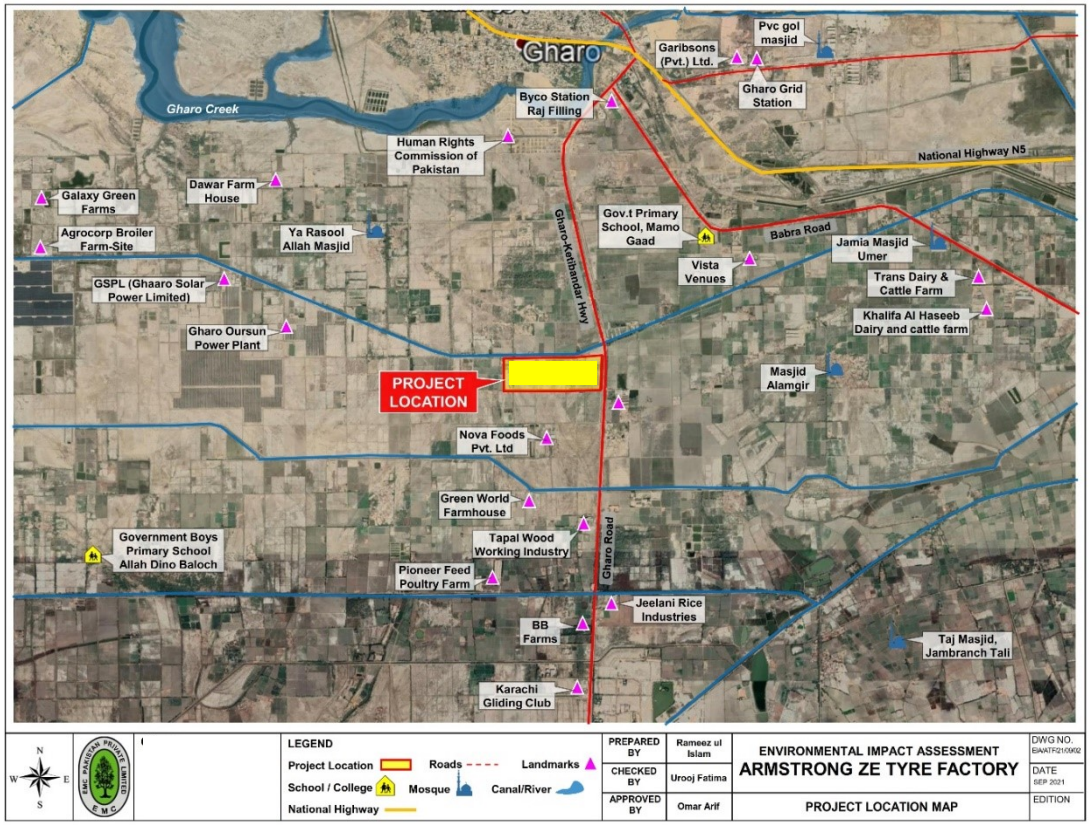



Figure 4.1: Location Map of the Project

4.3 Physical Environment

4.3.1. Meteorology and Climate

The climate of the microenvironment can be classified as arid, moderate, hot, and humid typical of subtropical coastal areas under the influence of monsoons. The mild winter is restricted to the December-February period.

The summer extends from April to October, which overlaps the short spells of the main rainy season during July-August. The weather tends to be very humid during May-June and September and pleasant during July to August and November to March.

The coastal area of the Indus delta is largely influenced by the subtropical monsoon regime. The strong southwest monsoon period prevails from May to September while the weak northeast monsoon period is restricted to the period between December to January. The period between the two monsoons is transitional or calm period with winds of variable speed

and direction. The weather during the inter-monsoon periods is uncertain and short spells of dust storm, dry weather, or a humid cool breeze may prevail for short durations.

4.3.2. Temperature

In Thatta, the summers are sweltering, muggy, arid, and windy; the winters are short, comfortable, and dry; and it is mostly clear year-round. Over the course of the year, the annual maximum temperature typically varies from 32.5°C to 33.5°C observing the highest temperature during April to June. Minimum temperatures was observed ranging from 19.9 to 21.1 °C.

A study conducted in 2020 reported that minimum and maximum temperature in Thatta are significantly increasing while concluding that minimum temperature may replace the maximum temperature in the region in coming years, while maximum temperature is expected to be further escalated than its upper limit[2].

Table 4.1 - Mean Monthly Maximum Temperature (Degrees Celsius)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	27.2	29.6	33.1	34.6	35.1	34.9	32.2	32.3	33.1	36.0	33.5	30.4	32.7
2002	27.0	28.2	33.3	35.4	35.6	35.1	32.2	31.6	31.4	36.5	32.7	28.1	32.3
2003	27.6	28.5	32.4	36.6	35.7	34.9	34.1	32.6	32.5	37.0	32.2	28.3	32.7
2004	26.6	29.9	36.2	35.4	36.8	35.6	33.8	32.7	32.8	33.7	33.1	29.4	33.0
2005	24.9	26.3	31.5	35.3	35.4	36.0	33.2	32.2	34.2	35.2	33.1	28.4	32.1
2006	26.0	31.3	31.8	34.0	34.6	35.3	33.8	31.0	34.2	35.0	33.4	26.3	32.2
2007	26.9	29.4	31.4	37.7	36.0	36.4	N/A	N/A	N/A	N/A	N/A	N/A	33.0
2008	24.4	26.9	34.3	34.4	33.9	35.1	33.5	31.9	34.7	35.5	32.5	27.2	32.0
2009	26.2	29.8	33.0	36.0	36.8	35.7	34.5	33.0	32.8	35.9	33.0	28.6	32.9
2010	27.5	29.2	34	35.7	36.5	34.7	34.6	33.2	34.5	35.9	32.7	28	33.0
2011	26.9	28.5	33.2	35.8	35.3	35.3	34.2	32.8	32.9	N/A	N/A	N/A	N/A
2012	25.7	26.9	31.7	35.1	35.5	34.6	33.2	32.7	33.2	35.0	32.7	28.2	32.0
2013	26.7	28.0	33.3	34.0	35.1	36.5	33.8	32.1	33.0	35.7	32.3	28.3	32.4
2014	25.5	28.0	31.7	35.1	35.9	36.5	34.0	33.7	33.8	36.3	32.9	28.7	32.7
2015	26.3	28.9	31.5	35.9	36.0	37.7	34.1	32.3	34.6	35.8	33.0	28.6	32.9
2016	27.8	30.3	33.3	34.7	35.7	36.1	33.6	33.0	32.9	34.0	33.3	31.0	33.0
2017	25.4	30.2	32.8	35.5	36.2	36.3	33.1	33.8	33.4	36.6	32.3	28.2	32.8
2018	28.5	30.4	34.4	36.2	38.7	35.4	33.8	31.9	32.6	36.8	33.8	28.2	33.4
2019	26.3	26.8	31.3	35.4	36.0	37.2	34.7	32.5	35.7	35.8	31.5	27.1	32.5
2020	24.3	30.1	31.2	36.2	36.6	37.3	36.7	34.6	35.0	36.2	31.4	28.1	33.1

[2] Fatima, S. U., Khan, M. A., Majeed, R., Mahmood, N., & Sulman, N. (2020). Variation in Climatological Regimes in Coastal-Rural Districts of Sindh, Pakistan. *International Journal of Biology and Biotechnology*, 18(3), 485-497.

2021	24.8	30.7	34.7	37.9	37.7	36.6	34.8	32.8	35.5	34.3	32.2	25.8	33.1
Source: Pakistan Meteorological Department													

Table 4.2 - Mean Monthly Minimum Temperature (Degrees Celsius)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	11.5	14.9	19.6	23.8	28.1	29.0	27.1	26.5	25.9	24.4	18.6	15.8	22.1
2002	12.8	13.8	19.5	23.9	27.0	28.2	29.6	25.6	24.8	22.5	17.7	14.9	21.7
2003	12.7	16.9	19.8	24.2	26.5	28.2	23.6	27.0	25.3	20.9	15.2	12.0	21.0
2004	12.9	14.5	19.1	24.8	27.3	28.8	27.5	26.3	25.3	22.4	18.0	15.4	21.9
2005	12.3	11.3	20.3	23.0	26.4	28.3	27.2	26.6	26.6	22.9	18.9	13.0	21.4
2006	11.7	18.1	19.6	24.5	27.5	28.5	28.3	26.3	26.8	25.7	19.4	14.0	22.5
2007	13.0	17.3	19.7	24.7	27.6	28.6	N/A	N/A	N/A	N/A	N/A	N/A	21.8
2008	10.1	11.1	19.6	24.0	27.3	29.1	27.9	26.8	26.6	23.8	17.6	14.9	21.6
2009	14.7	16.5	20.8	23.8	27.6	28.7	28.1	27.5	26.5	22.6	17.0	13.9	22.3
2010	12.2	14.7	21.3	25.1	28	28.2	28.3	27.2	25.8	23.9	17.4	11.1	21.9
2011	11	14.5	19.7	23.1	27.1	28.8	27.8	28.6	26.5	N/A	N/A	N/A	N/A
2012	11.2	11.9	19.1	24.5	27.2	28.0	27.9	26.9	26.4	22.7	18.6	14.2	21.5
2013	11.6	15.1	19.2	24.2	27.1	29.3	28.0	26.6	25.5	25.4	18.1	13.0	21.9
2014	9.9	13.1	18.9	24.4	27.0	29.2	28.3	27.1	26.8	23.3	19.5	13.1	21.7
2015	12.6	16.4	19.2	25.7	27.7	29.8	28.4	26.9	26.3	24.9	18.6	12.6	22.4
2016	14.8	14.9	21.7	24.6	27.9	27.9	28.1	27.1	26.4	24.0	17.1	15.5	22.5
2017	12.5	18.2	20.3	24.4	27.8	29.2	27.7	27.0	26.2	23.5	16.8	13.0	22.2
2018	12.9	15.8	20.9	25.3	27.7	28.8	28.1	26.3	25.5	23.0	19.3	13.1	22.2
2019	13.3	15.3	19.0	24.0	26.6	28.9	28.1	26.8	27.2	24.0	19.4	13.7	22.2
2020	10.8	15.3	19.1	24.7	27.7	29.7	29.4	28.1	27.3	22.7	16.0	12.5	21.9
Source: Pakistan Meteorological Department													

4.3.3. Precipitation

From July to September the district receives the monsoon rains and mean annual precipitation during 2014-2018 was observed between 32.6 to 231.3 mm. During precipitation period the southern half of the district or its coastal/delta zone receives more rains than the northern half of the district. The district remains dry during rest of the months and receives minimal rainfall.

Table 4.3: Monthly Amount Of Precipitation (mm)

THATTA													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2014	0.0	0.0	0.0	0.0	0.0	0.0	7.0	13.9	8.8	0.0	10.1	0.0	39.8
2015	0.0	0.0	3.8	0.0	15.8	10.7	93.6	0.0	41.0	0.0	0.0	0.0	164.9
2016	0.0	0.0	0.0	0.0	0.0	6.3	1.2	123.8	0.0	0.0	0.0	0.0	131.3

2017	2.8	TRACE	0.0	0.0	0.0	48.4	79.8	85.3	15.0	0.0	0.0	0.0	231.3
2018	0.0	0.0	0.0	0.0	0.0	24.7	5.9	2.0	0.0	0.0	0.0	0.0	32.6
2021	0.0	0.0	0.0	0.0	0.0	66.0	0.0	120.0	9.0	0.0	0.0	13.0	208.0

4.3.4. Wind speed and Direction

The average hourly wind speed in Thatta experiences extreme seasonal variation over the course of the year. The windier part of the year lasts for 5.0 months, from May to September.

Table 4.4: MEAN MONTHLY WIND SPEED AT 1200 UTC (Knots)

THATTA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2014	0.3	3.3	3.4	0.5	0.7	0.8	0.7	0.6	0.7	3.1	2.5	2.0	1.6
2015	0.3	4.5	0.4	6.0	8.0	6.3	10.0	8.0	6.4	4.9	3.0	2.2	5.0
2016	3.1	3.1	5.0	7.5	10.5	8.9	9.8	7.5	10.0	5.0	2.4	2.5	6.3
2017	4.4	4.1	5.1	8.5	10.4	7.3	0.8	6.7	5.5	4.4	2.9	4.5	5.4
2018	0.3	0.3	4.9	0.6	0.8	7.9	8.1	7.3	7.3	3.3	2.7	2.9	3.9
2021	2.5	2.4	4.3	4.6	6.8	6.9	7.4	7.4	3.9	3.4	2.7	3.3	4.6

The predominant average hourly wind direction in Thatta varies throughout the year. The wind is most often from the west. The wind is most often from the north from November to February.

Table 4.5: MEAN MONTHLY WIND DIRECTION AT 1200 UTC

THATTA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	N45E	N27E	N45W	S32W	S46W	S45W	S65W	S42W	S60W	S27W	N11E	N60E
2015	N18E	N45W	S72W	S43W	S49W	S41W	S63W	S46W	S47W	S62W	N43E	N47E
2016	S45W	N60E	S41W	S60W	S34W	S45W	S70W	S76W	S68W	S56W	S45W	N3E
2017	N43E	N27E	S62W	S53W	S63W	S40W	S70W	S59W	S54W	S43W	N5E	N36E
2018	N53E	N55E	S76W	S56W	S65W	S40W	S52W	S54W	S56W	S41W	N21E	N51E
2021	N40E	S63W	S47W	S55W	S50W	S47W	S55W	S46W	S66W	S43W	N50E	N25E

4.3.5. Humidity

Thatta experiences extreme seasonal variation in the perceived humidity. The muggier period of the year lasts for 6 months, from April to October, during which time the comfort level is muggy, oppressive, or miserable. The muggiest day of the year is August, with muggy conditions.

Table 4.6: MEAN MONTHLY RELATIVE HUMIDITY (MEAN) AT 1200 UTC (%)

THATTA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2014	28.0	25.0	30.0	37.0	49.0	57.0	59.0	60.0	58.0	33.0	36.0	28.0	41.7
2015	37.0	38.0	31.0	41.0	53.0	51.0	66.0	65.0	53.0	41.0	30.0	26.0	44.3
2016	40.0	20.0	24.0	44.0	54.0	56.0	61.0	71.0	60.0	53.0	29.0	34.0	45.5
2017	36.0	25.0	29.0	35.0	50.0	55.0	68.0	65.0	60.0	38.0	28.0	26.0	42.9
2018	28.0	31.0	27.0	35.0	41.0	57.0	61.0	64.0	59.0	33.0	29.0	31.0	41.3
2021	29.8	30.4	33.4	34.6	45.4	54.5	63.8	62.4	66.2	43.9	27.5	34.1	43.8

4.3.6. Storms

High heat content of the Arabian Sea that is adjacent to the extensive heat zone of Pakistan usually upsets the heat balance and hence the water-balance of the region, particularly

because it is the destination of windstorms. Tropical cyclones generally develop over Arabian Sea in low latitude i.e. 5-20 degrees north and dissipate after they move over land. The maximum frequency of tropical cyclone formation occurs in April, May and June and in the October-November period. The month of June receives least tropical cyclones in the region. About 76% of tropical cyclones in Karachi approach from the south through the east.

Tropical cyclones that come near the proximity of Karachi are generally weakened. The one that came near the coastal area on May 12, 1999 changed its direction and hit the coastal area of Badin, however Karachi was safe from this cyclone as it is located in the peripheral area and only rain showers of moderate intensity were recorded. The June 6, 2010 cyclone 03A, nick named Phet had landed on the coast of Oman and had lost its intensity. Moving in clockwise direction it poured heavy rains on Gwadar and Pasni. The rain bearing winds moved along the coastline towards Karachi. It touched Karachi only tangentially and brought 100 mm rainfall two days before it landed south of Thatta District.

The recent tropical cyclone of June, 2014 that hit the Oman had impact similar to June, 2007 cyclone, it also caused flooding and heavy rainfall in coastal belt of Balochistan and Badin & Thatta districts of Sindh, while Karachi remained safe from its impact.

Very Severe Cyclonic Storm Nilofar was the strongest tropical cyclone of 2014 within the North Indian Ocean and the strongest storm to form over the Arabian Sea since Phet in 2010. Nilofar originated from a low pressure area in the Arabian Sea that intensified into a depression on October 25. By October 31, Nilofar was reported to have weakened into a well-marked low pressure area.

Thatta, Badin and Mirpurkhas received heavy rainfall with high winds and dust storm due to cyclonic storm Takutae during May 2021.

On 30th September 2021, severe Cyclonic Storm Shaheen, a tropical cyclone that originated from the remnants of Cyclonic Storm Gulab, had peripheral effect be on Thatta, Badin, Mirpurkhas, Tharparkar, Umerkot, and Sanghar districts in the form of high winds and intermittent rainfall.

4.3.7. Geological settings of Macro Environment

Geologically, Thatta is formed of volcanic and sedimentary rocks of quaternary and tertiary and has the same composition as that of the Indus plain and the eastern desert zone of Pakistan containing the deserts of Cholistan, Nara and Thar. The soils are silt, clayey wet and saline. The natural vegetation found in the district can be divided into two categories-mangroves in the coastal or delta zone, and tropical thorns in the rest of the district. In terms of use, the lands in the district can be divided into five major categories; lands not available or fit for agriculture, those under arable agriculture, forests, rough grazing lands and areas under human settlements. River Indus bisecting the district from north to southwest, Kohistan or hill zone in the north and North West, areas put under year round cultivation along river Indus through canals and tube wells, and coastal belt and delta area, are four broader topographical divisions of Thatta. Keenjhar Lake is another important physical feature and surface water resource of the district. District Thatta possesses a diversity of environmental features and resources since it carries all the environmental features of the province. The district has desert, hills/gravel rocks, rangelands, water bodies, delta, tidal flats, creeks, lakes, mangrove and riverine forests and irrigated agricultural lands.

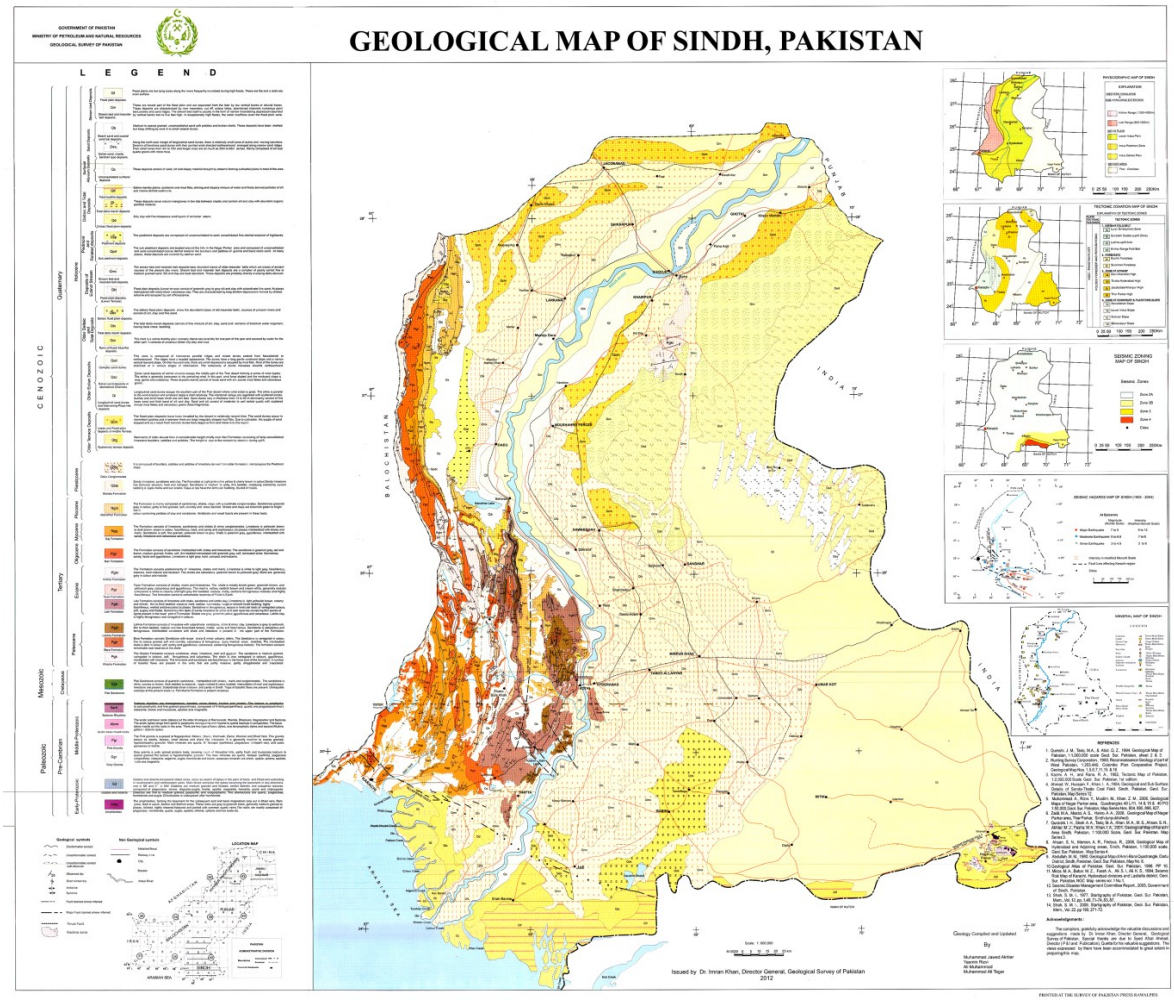


Figure 4.2: Geological map of Sindh

4.3.8. Soil

The project area has mainly loamy and clayey soil as found in the coastal areas of Sindh. The soil of project may also be classified as mainly loamy saline and part gravelly. At certain parts of the project area, the soil is strongly calcareous (moderately alkaline) and some part is strongly saline. Soil composition includes deposition of pebbles, loosely packed cobbles, stones, and fine to course sand.

Soil Investigation at Project Site

The program of subsurface investigation at the project site consisted of executing 41 boreholes. The boring was accomplished by rotary method.

Subsoil investigation has revealed that top 1.0m consist of fill material. This is underlain by medium dense, silty SAND, sandy SILT deposits. This is followed by dense to very dense, fine to coarse SAND and sandy SILT deposits that continue upto the investigated depth of 20.0 m.

Major subsurface deposits can be described as follows:

- Brownish gray, medium den se, sandy SILT
- Grayish brown, medium dense. silty SAND / sandy SILT
- Brown/Grayish brown, dense to very dense, fine to coarse SAND
- Gray / Brown, dense to very, silty SAND / sandy SILT

Groundwater Table

The position of groundwater table for each borehole is presented in the annexures as Geotechnical Soil Investigation Report. The depth of groundwater at project site generally ranges from 1.38m to 1.62m.

4.3.9. Seismicity

According to a map created by the Pakistan Meteorological Department, the country is divided into 4 zones based on expected ground acceleration. The areas surrounding Quetta, those along the Makran coast and parts of the NWFP, and also along the Afghan border fall in Zone 4. The rest of the NWFP lies in Zone 3, with the exception of southern parts of this province, which lie in Zone 2. The remaining parts of the country lie in Zone 2. According to this classification the project area falls in Zone 2.

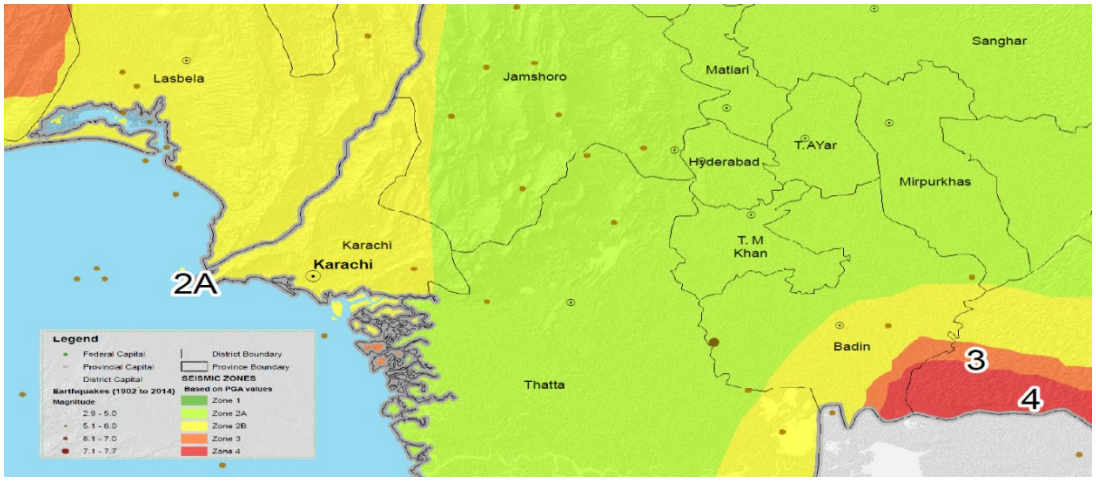


Figure 4.3: Seismic Zones of Karachi and Thatta

4.3.10. Hydrology

Surface Water Hydrology

Within the macro-environment of subdistrict Mirpursakro, Gharo Creek is located in the far western side of the project site.

In the immediate north of the proposed project site, Khari Seer Distry runs along the northern boundary of the plot, which receives water from Jam Branch. Other irrigation canals nearby project site are Palijani Minor and Malkah Wah.

A view of Khari Seer Distry (*Pahreen Nahar*) and Gharo-Keti Bunder Hwy (N110) crossing over it

Groundwater Hydrology

The southern Sindh province of Pakistan adjoins the Arabian Sea coast where drinking water quality is deteriorating due to the dumping of industrial and urban waste and use of agrochemicals and yet has limited freshwater resources. The groundwater quality is badly affected by salinity, arsenic, fluoride and microbial pollution, which further deteriorates in low-lying, deltaic and floodplains of Sindh. In these areas, people mostly depend on the groundwater for drinking and irrigation purpose because of low precipitation and reduced flow of Indus River. In the coastal areas, seawater intrusion further degrades the quality of groundwater. The contamination in groundwater in most of the areas of the Thatta district is due to seawater intrusion, as seawater contains many trace metals.

Locals in the project area supplement their water supplies by extracting groundwater through wells and tube wells. The quality of groundwater varies from sweet to brackish in the project area.

4.3.11. Solid Waste Management

Updated and proper data is not found on the current situation of Solid waste management system in district Thatta. Like some other major districts of Sindh, District Thatta also has no proper solid waste management system, while indiscriminate dumping and open burning of waste is a common practice. It is responsibility of the municipal authorities to collect and dispose of solid waste but they had failed to perform their job because of the lack of the required machinery, capacity, expertise and mismanagement[3].

4.3.12. Ambient Air Quality

Air monitoring setup was installed at the monitoring locations at project site to collect ambient air quality data. Pollutants being monitored included NOX, SO2, CO, CO2,

[3] https://reliefweb.int/sites/reliefweb.int/files/resources/PESA-DP-Thatta-Sindh.pdf

O3, SPM, PM2.5, and PM10. The results of monitoring of the ambient air quality are shown in Table Below:

Table 4.3: SEQS Parameters

Date	Time	CO ($\mu g/m^3$)	NO ($\mu g/m^3$)	NO2 ($\mu g/m^3$)	SO2 ($\mu g/m^3$)	PM 10 ($\mu g/m^3$)	PM 2.5 ($\mu g/m^3$)	SPM ($\mu g/m^3$)	Lead ($\mu g/m3$)
03.04.2021	11:00	0.07	10.5	16.2	20.5	58	12	202	BDL
03.04.2021	12:00		12.4	17.4	23.4	62	15	205	BDL
03.04.2021	13:00		14.0	21.2	20.2	65	21	212	BDL
03.04.2021	14:00	0.05	09.9	19.6	22.3	81	36	218	BDL
03.04.2021	15:00		08.5	15.4	24.4	92	41	225	BDL
03.04.2021	16:00		10.2	13.9	26.9	81	33	229	BDL
03.04.2021	17:00	0.08	12.4	15.3	31.5	79	29	235	BDL
03.04.2021	18:00		14.6	10.8	30.9	62	28	234	BDL
03.04.2021	19:00		16.3	11.4	30.0	56	20	231	BDL
03.04.2021	20:00	0.04	18.4	10.2	29.4	52	15	224	BDL
03.04.2021	21:00		15.8	10.9	24.3	45	12	219	BDL
03.04.2021	22:00		14.7	13.0	21.4	38	17	210	BDL
03.04.2021	23:00	0.03	12.2	08.4	18.6	37	12	201	BDL
04.04.2021	00:00		12.1	09.0	14.4	30	11	192	BDL
04.04.2021	01:00		08.4	10.2	12.8	32	13	181	BDL
04.04.2021	02:00	0.02	06.8	11.4	16.2	42	10	176	BDL
04.04.2021	03:00		05.3	12.3	18.5	44	10	170	BDL
04.04.2021	04:00		09.5	14.6	20.3	46	11	186	BDL
04.04.2021	05:00	0.05	10.8	16.7	21.4	52	08	198	BDL
04.04.2021	06:00		11.3	12.5	23.3	53	12	201	BDL
04.04.2021	07:00		13.5	14.6	24.2	64	10	213	BDL
04.04.2021	08:00	0.06	12.2	15.4	20.5	73	13	220	BDL
04.04.2021	09:00		10.6	16.7	18.5	81	12	225	BDL
04.04.2021	10:00		12.8	17.6	20.2	86	15	226	BDL
Minimum		0.02	05.3	08.5	12.8	30	08	170	BDL
Maximum		0.08	18.4	21.2	31.5	92	41	234	BDL
Average		0.05	11.8	13.9	22.2	58.7	17.3	209.7	BDL
SEQS		**5**	**40**	**80**	**120**	**150**	**75**	**500**	**1.5**
LDL-Limits		0.01	0.1	0.1	0.1	10	2.5	1.0	0.01

4.3.13. Ambient Noise Quality

Noise level monitoring at the project was also carried out. The observations of the noise level monitoring are shown in the table below.

Table 4.4: Noise Level Test Report					
S. No.	LOCATION/SOURCE	SEQS Limits: 65dB(A) Noise Level Readings			
		Min	Max	AVG	Mean
1	Front Side Right Corner	48.4	65.4	56.9	SEQS Limits : 75dB(A)
2	Front Side Right Corner	50.5	66.0	58.2	
3	Back Side Right Corner	45.8	55.3	50.5	
4	Backside Left Corner	46.2	57.4	51.8	
5	Near Road Side	62.8	73.4	68.1	

Ambient Air and Noise Quality Monitoring

4.3.14. Land Use

The present site land is a barren, flat tract with sparse vegetation. The apparent soils of the area are medium dense, silty SAND, sandy SILT deposits. This is followed by dense to very dense, fine to coarse SAND and sandy SILT deposits. The vegetative growth in this area is limited to short grasses, shrubs and scrubs along with a few drought resistant trees.

The land use of the immediate macro environment i.e. along the Gharo-Keti Bunder Highway, can be divided into the following four types:

- Agricultural Land
- Small stores (dairy farms, auto repair shops, restaurants, etc.)
- Large factories or buildings surrounded by fences

- Fuel stations
- Development zones or vacant lots

4.3.15. Traffic Conditions

Once the operation phase of the tyre manufacturing facility commences, manufactured tyres will be transported to the Karachi city and to the destinations upcountry. The principal road they will be using in the first place will be the Ghoro – Keti Bunder Highway (Mirpursakro Road) and the National Highway (N5). The National Highway starting from the Karachi Port area passes through the Central Business District and the airport and crosses the Malir River at Quaidabad. It carries heavy traffic on the way to the extent that Quaidabad is among the 10 most travelled destinations in Karachi with 822,321 vehicles passing through the corridor each day[4].

Roads along the proposed project site

Ghoro – Keti Bunder Highway (Mirpursakro Road)

4.4 Biological Environment

The microenvironment of the project area is located in the vicinity of Gharo creek and coastal highway, where summers are very hot, winters are very mild, humidity in summer is high being located in coastal zone and monsoon rainfall is scanty and sporadic.

4.4.1. Flora of Project Area

Ecological surveys were conducted in and around the project alignment to check the current ecological status of the project site and its immediate surroundings. The land use of the microenvironment is agriculture and saline barren lands. The vegetation mostly comprises of various species of grass, bushes, shrubs and few specie of cactus and other thorny plant. Very few species of trees are present in and around the project area, that include Coconut, *Conocorpus erectus* etc. these trees are in very small number and widely spaced. The native/indigenous flora of the site is given in below list, however, few species such as *Capparis aphylla*, *Euphorbia caducifolia*, *Calotropis procera, Prosopis juliflora* and *Salvadora oleoides* are predominantly found in the microenvironment. No cutting of trees is envisaged during construction as mature trees are not present at project site.

[4] Environmental Management Consultants – Environmental Impact Assessment for KEE, 2007

Table 4.5: List of Floral specie found in the microenvironment		
S. No	Botanical Name	Local Name
Trees and Shrubs		
1.	*Capparis aphyla*	Kirir
2.	*Salvadora oleoides*	Khabar
3.	*Acacia Senegal*	Kunbhat
4.	*Prosopis cineraria*	Kandi
5.	*Prosopis juliflora*	Mesquit, devi
6.	*Tecoma undulata*	Lohiro
7.	*Euphorbia caudicifolia*	Thuar
8.	*Tamarix aphylla*	Lai
9.	*Ziziphus nummularia*	Ber
10.	*Acacia nilotica*	Babur
Grass		
1.	*Aristida adscenciones*	Lumb
2.	*Aristida funiculate*	Lumb
3.	*Cenchrus biflorus*	Bhurt
4.	*Cenchrus ciliarus*	Dhaman
5.	*Chrysopogon aucheri*	Putar
6.	*Cymbopogon jawarncusa*	Poi
7.	*Desmostachya bipinnata*	Dubh
8.	*Dicanthium annulatum*	
9.	*Lasiurus sindicus*	Sain
10.	*Lasiurus hirsutus*	
11.	*Leersa spp.*	

Onsite Flora




4.4.2. Fauna of Project Area

Due to sparse vegetation and increased interventions of human the abode and population of the wild species have shrunk considerably. Wild animal of various family

which were once commonly seen, have moved to areas where the human interventions are minimum.

Below is the list of faunal specie native to the micro and macro-environment:

Table 4.6: List of Mammals		
S No.	Scientific name	Common name
Large Mammal		
1.	*Canis aureus*	Asiatic Jackal
2.	*Sus Scrofa*	Indian Wild Boar
3.	*Felis chaus*	Jungle Cat
4.	*Manis crassicaudata*	Indian Pangolin
5.	*Herpestes Javanica*	Small Indian Mongoose
Small Mammals		
1.	*Funambulus pennant*	Palm Squirrel
2.	*Ratus norvegicus*	Screw Rat
3.	*Mus musculus*	House Mouse
4.	*Tetra Indica*	Indian Gebril
5.	*Meriones hurrianae*	Indian Desert Jird
6.	*Gerbillus nanus*	Balochistan Gerbil

Table 4.7: List of birds		
S. No.	**Scientific name**	**Common name**
1.	*Milvus migrans*	Common Kite
2.	*Francolinus francolinus*	Black Partridge
3.	*Ardeola grayii*	Indian Pond Heron
4.	*Bubulcus ibis*	Cattle Egret
5.	*Egretta garzetta*	Little Egret
6.	*Egretta gularis*	Reef Heron
7.	*Centropus sinensis*	Crow Pheasant
8.	*Psittacula krameri*	Rose Ringed Parakeet
9.	*Galerida cristata*	Crested lark
10.	*Acridotheres tristis*	Indian Myna

4.5 Socio-Economic Baseline

4.5.1 Overview

The social baseline chapter provides a comprehensive review of the socio-economic conditions of the project area. This socio-economic profile is based on a literature review and several primary data gathering activities including site visits, sample socio-economic survey of stakeholders in the area and consultations with primary and secondary stakeholders. This social baseline provides an overview of the socio-economic conditions of the people who reside and work in the project vicinity. It also includes an assessment of public utilities and social services (education and health facilities) in the area concerning the proposed construction and operation of Armstrong ZE Tyre Factory.

International best practice for EIA studies demands an alignment of the proposed project components with the applicable Sustainable Development Goals (SDGs) adopted by all UN Member States in 2015. The SDGs provide broad universal targets for reducing poverty, environmental degradation, injustice and important pillars of social upheaval that must be achieved by 2030. In March 2017, the global indicator framework was developed and agreed upon by the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) to monitor progress towards the achievement of these indicators. Moreover, all member states, including Pakistan have developed national indicators linked to the global targets that provide the basis for a national effort of monitoring progress towards fulfilment of the

indicators. The proposed project should be aligned with Goal 11 of the SDGs that requires all essential steps be taken to ensure development that is socially acceptable and environmentally sound.

The socio-economic baseline data in this chapter identifies the existing socio-economic trends in the area and the potential impacts of the project providing the basis for the development of a Social Management Plan. The social baseline is divided into macro and microenvironment of the project area. The macro-environment encompasses District Thatta of Sindh. The discussion on macro environment covers the administrative setup, demography, education and health profile of the area. The immediate neighborhood of the project area is considered to be the micro-environment of the project and covers land use, education, health and utilities profile of the area.

4.5.2 Macro-environment: District Thatta

4.5.2.1 Administrative Context

District Thatta is situated at a distance of 98 Kilometers in the east of Karachi Division on the National Highway. The district is surrounded on the north and northwest by Jamshoro district, on the east by Hyderabad, Tando Muhammad Khan and Sujawal district. The total area of the district is 8,570sq km. The northern part of the district is known as "Kohistan" connected with a Kirthar range of mountains. Thatta District is comprised of four main talukas including Ghorabari, Keti Bunder, Mirpursakro and Thatta. The proposed project is located in Gharo, Mirpursakro Taluka of District Thatta.

4.5.2.2 Demography

According to the latest national census of 2017, there are a total of 982,138 people in District Thatta. The district saw an average annual growth of 2.63% between the 1998 and 2017 census. The sex ratio in District Thatta is 108.68, whereas the males are 52% and females are 48%, with an insignificant number of transgenders. The following table shows the demographic details of Thatta according to the 2017 census. Moreover, the dominant rural lifestyle is evident from the fact that nearly 82% of the population resides in rural areas.

Table 4.8: Population Census Results 2017 – Thatta

Administrative Units		Population 2017				Population 1998	Sex Ratio 2017	1998-2017 Average Annual Growth Rate
		Male	Female	Trans-gender	All Sexes			
Thatta	Total	510,143	471,958	37	982,138	599,492	108.68	2.63
	Rural	419,243	386,402	17	805,662	535,788	108.90	2.17
	Urban	90,900	85,556	20	176,476	63,704	106.25	5.5

Source: PBS- 2017 Census Final Results

4.5.2.3 Ethnicity and Culture

Sindhi is the major language of the district, although Urdu is also spoken and understood. Islam is the major religion of this district representing 96.2% of the population followed by Hinduism (2.89%) and Christianity (0.18%). Caste system is very strong in this region. Majority of the population of Thatta district belongs to indigenous Sindhi clans including

Jokhio, Palijo, Sheerazi, Soomro, Sammo, Syed, Memon, Khoja and Mirbahar are the main tribes of Thatta district.

This district has a rich heritage of ancient Sindhi and Arabian culture. Both can be seen in the architect and culture of this district. Thatta's Jamia Masjid known as Shah Jehan Masjid is a masterpiece. It was built on the orders of the Mughal Emperor, Shah Jehan, who gifted it to the people of Thatta. Its construction started in 1644 and was completed in 1647. Makli hills, also known as Makli graveyard, are one of the largest necropolises in the world, with a diameter of approximately 8 kilometers. These hills are supposed to be the burial place of some 125,000 sufi saints. The graveyard is located on the outskirts of Thatta city.

The following table show the gender wise population of Gharo Tapedar Circle according to the 2017 census conducted by Pakistan Bureau of Statistics.

Table 4.9: Gender wise Population Gharo TC - 2017

Taluka	Gharo TC	Total	Male	Female	Transgender
Mirpur Sakro	Urban	36,799	19,109	17,688	2
	Rural	58,994	30,739	28,254	1
	Total	95,793	49,848	45,942	3

Source: PBS- 2017 Census (TC = Tapedar Circle)

4.5.2.4 Livelihood

Agriculture and fisheries are the two major sources of employment for the people of district Thatta. In addition to that, there is a substantial number of landless people who own and manage livestock or are engaged in the non-farm sectors. According to a study conducted by Asian Development Bank, 79% of the population of district Thatta is poor. The incidence of poverty is negatively correlated with land ownership. Landowners are usually non-poor.

There are about 30 industrial units established in the district. Apart from the sugar mills, all the larger industrial units are located in Dhabeji and Gharo mouzas adjacent to Karachi. Most of the labour force working in these units is non-local and generally belongs to Karachi. The industrial units of the district include sugar mills (5), textile mills (9), paper mills (2), flour mill (3) salt works, ice factory (2), etc. In addition, crushed stones from the Makli Hills and Kohistan are supplied to the Pakistan Steel Mill and the Thatta Cement Factory. There are also large coal deposits in Thatta Taluka. Recent addition to the industrial units is the car manufacturing plant near Budho Talpur, belonging to the Deevan Group, adjacent to the Deewan Sugar Mills.

The Government of Sindh has allocated 1530 acres of land to establish Dhabeji Special Economic Zone (DSEZ) in Thatta near Dhabeji. Dhabeji has certain locational advantages including easy access to Port Qasim enabling raw material import and finished goods export without incurring major inland transportation costs and saving time. Dhabeji SEZ would open new vistas of development and prosperity in Sindh by starting economic activities and creating a large number of employment opportunities for the local people. The project will generate over 50,000 job opportunities for the skilled and unskilled youth. After the establishment of Dhabeji Special Economic Zone in near future Dictrict Thatta will become an important district with regards to industrial development.

4.5.2.5 Education Profile

According to Sindh Education Profile 2016-17 published by Reform Support Unit, Sindh Education & Literacy Department, the average enrolment rate in public schools for school going aged females in the province is 39% and 61% for males. The total number of males

enrolled at secondary level of education is 505,561 while the total number of females is 350,281. The enrolment of males decreased to 224,280 and number of females to 123,409 at the higher secondary level.

The total number of students enrolled in public schools of Thatta district is 77,303 according to Sindh Education Profile 2016-17. At the secondary level the total number of students enrolled is 12,356 out of which only 3995 are females. The average enrolment rate in Thatta is 59% with 60% for males and 57% for females (Access to Education in Sindh, 2015, Manzil Pakistan Report). The gender disparity in enrolment in Thatta is not as large as in other districts of Sindh. According to the report published by Manzil Pakistan, only 77% of the schools in the district are functional and basic facilities such as toilets, boundary walls and electricity are not available in most schools.

The following table shows the literacy rate of the population of Thatta Distict, starting from the age of ten years and older populace

Table 4.10: Literacy Ratio Population (10 years age and above)

District	Total	Male	Female	Transgender
Thatta	27.88	35.46	19.63	16.22
Rural	23.58	31.15	15.27	17.65
Urban	46.77	54.63	38.12	15.00

Source: PBS- 2017 Final Census Result

4.5.2.6 Health Profile

According to the Health Profile of Sindh 2016, there are 648 hospitals in the province with a total capacity of 30,126 beds. Additionally, there are 800 BHUs and 133 RHCs in the province with a total capacity of 3318 beds. The doctor to population ratio in the province is 1 doctor for 3159 people. In comparison with Sindh, there are only 8 hospitals in the entire district of Thatta with a total capacity of 300 beds. Additionally, there are 22 BHUs and 6 RHCs in the district with a total capacity of 124 beds. (Health Profile of Sindh 2016) The doctor to population ratio in the district is 1 doctor for 5859 people, showing that the health personnel in the district are inadequate to serve the population of entire district. According to PESA report for district Thatta 2014, 44% (Male 44%: Female 43%) of the children aged 12-23 months have received full immunization

Table 4.11: Comparison of Sindh and District Thatta Health Care Facilities

District/Province	HEALTH UNIT/CENTRE	NO. OF UNITS	NO. OF BEDS
SINDH	BHUs	800	1615
	RHCs	133	1703
	TOTAL	933	3318
THATTA DISTRICT	BHUs	22	44
	RHCs	6	80
	TOTAL	28	124

Source: Sindh Health Profile 2016-17 (GoS)

4.5.3 Micro Environment

In the micro-environment of the proposed project, the project is located on Gharo-Keti Bunder Highway (N110). Shehzad Farm House is located adjacent to the site while

Daniyal Farm House is facing across the road. The nearby villages include Jokia Goth (5km), Samo Goth (5km), Yameen Khaskheli Goth (5km), Kakran Goth (6km), Chachmera Goth (7km) and Lait Village (8km). The commercial interests in the area include Karachi Gliding Club (1km), Daniyal Farm House (300m), Shahzad Cattle Farm (100m) and Sumaya Farm House (500m).

4.5.3.1 Main Source of Livelihood/Income

Agriculture and Poultry farms are the two main sources of wage earning for the villagers. The people in the nearby villages are also employed in the surrounding industries of Dhabeji. Average monthly income of household in Lait Village is Rs. 12,000 to 15,000.

Shahzada Farm House

Daniyal Arain Agricultural Farm House

4.5.3.2 Social Services

During the field survey the field team observed that there are no education facilities in the surrounding of project area. When the consultation team visited the Yameen Khaskheli Goth, the children were getting religious education by the Imam of the Masjid.

There are no health facilities in the project area. People of these areas suffer huge problems when someone gets sick so the people go to Gharo Hospital for treatments which is approximately 18 kilometers away from the project site. Major health problems of the area include fever, cough and flu with are reported by the residents as common diseases. People use private transport to go to the health care facility.

4.5.3.3 Utilities

The main source of drinking water in most of the nearby villages is ground water drawn through motor and hand pumps. Water supply system through pipelines was not available in any village of the nearby project area. The villages do not have proper sewerage system for the disposal of domestic toilet waste. The toilets systems in these villages are pit-hole latrine type. There is no proper mechanism of solid waste disposal and people throw their waste in the open lands or in streets. Electricity is not available in the nearby villages of the project area. There is no gas connection in the villages so people use firewood for cooking purpose.

4.5.3.4 Transportation

There is no public transportation available in the area except a bus service from Gharo to Karachi as reported by the villagers. The most commonly used transportation mode is motorbike and majority of the population rely on it. The villagers cannot afford private vehicles or motorcars due to their lack of earnings thus they prefer to walk on foot.

5 Stakeholder Consultations

The participation of project stakeholders in project planning, design and implementation is now universally recognized as an integral part of environmental & social impact assessments. Representatives from local communities, government departments, national and international NGOs and the civil society at large all are able to contribute to and benefit from, the dialogue directed at identifying and resolving key project-related issues. Stakeholder consultation has become an important requirement of the EIA study after the enactment of the guidelines for public consultation under the Pakistan Environmental Protection Act (PEPA) 1997. After the 18th Amendment to the Constitution, the Government of Sindh passed the Sindh Environmental Protection Act 2014, which also stresses the importance of engaging with the concerned primary and secondary stakeholders during the EIA study.

The proposed project "Armstrong ZE Tyre Factory" is planned to be a constructed on a land situated on Gharo-Keti Bunder Highway (N110), Mirpursakro Taluka, Gharo, which falls under the jurisdiction of District Thatta, Sindh. The project activities involve the construction and production of a tyre manufacturing unit where various other industrial projects are already under development in this area.

While in the short-term, the impacts might be felt only in the microenvironment of the project, in the long-term, the impacts may also spread to other nearby neighborhoods and activities including traffic management (including the swift passageway for fire tenders and ambulance), and stress on existing utilities. In view of these perceived impacts, meaningful engagement with the project stakeholders has been carried out to identify the potential positive and negative impacts, assess the magnitude of these impacts from a social perspective and prescribe solutions for the construction and operations phase of the proposed project.

5.1 Stakeholder Mapping

To better understand the different stakeholder groups for this project, a stakeholder mapping exercise has been carried out whereby the different stakeholder groups and their interests in the project are discussed in this section:

5.1.1 Local People/Neighborhood

Individuals or groups in the vicinity of the project site are informed regarding the project background and context. Due to their proximity to the project site, they are often the most vulnerable stakeholders and therefore, consultation with these stakeholders is carried out throughout the project life. The consultation exercise provides an opportunity to appraise the stakeholders regarding the consultation process, identify likely project impacts, and record concerns of local communities. Moreover, intensive stakeholder engagement during the planning stage of the project provides a basis for reducing the trust deficit and encourages confidence-building.

5.1.2 Proponents

The main aim of the project proponent "M/s Armstrong ZE Pvt. Ltd." is to accomplish the objectives of the project through cost-effective and sustainable project activities. To this end, the project proponent has to recognize that strong associations and responsive relations with stakeholders would go a long way in achieving the project objectives. Therefore, the proponent must strive to engage stakeholders at all levels from the outset; inform them regarding project goals, design and alternatives. Moreover, they have to keep trying to create public understanding and acceptance of the proposal through a commitment to implement the promised objectives. They have to accomplish the project through general acceptance of the design and keep improving through the use of public inputs on alternatives and mitigation measures.

5.1.3 Government Agencies

The government agencies involved in the EIA process is mandated to have their policy and regulatory responsibilities addressed in impact analysis and mitigation consideration. For the competent authority, an effective public involvement program will ensure a project proposal that effectively incorporates environmental and social concerns. During the EIA review, the most important concern for SEPA is a transparent public consultation process and a strong stakeholder engagement plan that can address the concerns and suggestions of all stakeholders.

5.2 Primary and Secondary Stakeholders

Primary stakeholders are those who have a direct interest in the project which includes residents, commercial entities and institutions falling in the immediate environs of the project area. Secondary stakeholders include the relevant government agencies and public interest groups which may indirectly influence or be influenced by the project. The concerns and input from both primary and secondary stakeholders are important to identify the issues arising from the construction and/or operation phase of the project and propose mitigation measures that minimize the negative project impacts and enhance the positive ones.

Within the project vicinity, the primary stakeholders are the residential, commercial and institutional entities in the immediate vicinity include Jokia Goth (5km), Samo Goth (5km), Yameen Khaskheli Goth (5km), Kakran Goth (6km), Chachmera Goth (7km), Lait Village (8km), Daniyal Poultary Farm (300m), Sumaya Farm House (500m), Karachi Gliding Club (1km) and Shahzed Cattle Farm (100m). The secondary stakeholders for this project include the utility companies that operate in the area including HESCO, SSGC, as well as the regulatory authorities, mandated to ensure environmental protection in the city, which falls under the remit of SEPA. The primary and secondary stakeholders for the "Armstrong ZE Tyre Factory" have been identified in the table below.

Table 5.1: Stakeholders for Armstrong ZE Tyre Factory

Neighborhood	**Residential Interests** • Samo Goth • Yameen Khaskheli Goth • Kakran Goth • Jokia Goth • Chachmera Goth

	• Lait Village **Commercial Interests** • Daniyal Poultary Farm • Sumaya Farm House • Karachi Gliding Club • Shahzad Cattle Farm
Government Agencies & Other Service Providers	• Sindh Environmental Protection Agency (SEPA) • DC Thatta • HESCO • Sui Sothern Gas Company (SSGC)
NGOs/Interest groups	• Shehri-CBE • National Forum for Environment & Health (NFEH) • Citizens for Environment (NGO)

5.3 Consultation Approach & Methodology

5.1.4 Consultation with Primary Stakeholders

A survey was conducted to identify the residential and commercial interests in the area that may face direct impacts from the proposed development. The survey was conducted in two stages. In the first stage, several site visits were carried out to identify all stakeholders that either reside or work in the project vicinity and conduct an initial identification of potential positive and negative impacts. Relevant public service institutions directly involved in service provision in the areas were also identified.

During the second stage, a social survey field team used a pre-designed semi-structured template to engage the area residents, commercial interests and public service institutions. Those stakeholders, who were not available at the first attempt, were re-visited on the same day or followed-up for their comments during the next few days. During each meeting, the project team introduced the project to the stakeholders, recorded their concerns, suggestions and provided contact details to enable stakeholders to share further comments over email or in writing. A 'Project Brief' providing the salient features of the project were also handed over to the available stakeholders as part of the information disclosure process.

Moreover, the team inquired about the current situation of the area such as the status of utilities, security and law and order situation in the project area from the residents near the project site. Several open-ended questions were also included in the questionnaire to ensure that the respondents could openly share their opinions and suggestions relevant to the study. The following table shows the stakeholders that were approached during the survey.

Table 5.2: Consultation with Primary Stakeholders

#	Respondents	Stakeholders	Stakeholder Type	Date
1	Mr. Jamal Qadir (Manager)	Sumaya Farm House	Commercial	31-8-2021
2	Mr. Usman Mushtaq (Manager)	Daniyal Poultary Farm		
3	Mr. Ibrahim Bawany (Owner)	Karachi Gliding Club		
	Mr. Azhar (Manager)			
4	Mr. Shakeel Ahmed (Manager)	Shahzad Cattle Farm		

5	Mr. Nazar Ahmed Baloch (Resident)	Samo Goth	Residential	
6	Mr. Ibrahim Khaskheli (Resident)	Yameen Khaskheli Goth		
7	Mr. M.Hussain Jokio (Resident)	Jokia Goth		
8	Mr. Mohammad Ramzan Seikh (Resident)	Lait Village		
9	Mr. Abdul Jabbar (Resident)	Kakran Goth		
10	Mr. Yaqoob Amrah (Resident)	Chachmera Goth		

5.1.5 Consultation Feedback

The social team from EMC carried out consultations in the project area during the last week of August 2021. Consultations were conducted with the residential and commercial stakeholders in the vicinity of project site. The following major issues and concerns were raised by the primary stakeholders:

5.1.6 Concern & Suggestions

- The residents of Lait Village were happy to see new development in the area. They explained that such development projects will increase the property value of their land.
- The owner of Karachi Gliding Club, Mr. Ibrahim Bawany expressed his concern that the tyre factory will cause air pollution and appropriate measures should be taken place in order to minimize the emission of toxic gasses in the air.
- The residents of Samo, Jokia and Kakran Goth were positive that the tyre factory will provide them with better employment opportunities near their homes.
- The Manager of Shahzad Farm House, Mr. Shakeel Ahmed mentioned his concern that the tyre factory might cause pollution in the environment and can also be harmful for the agricultural fields and cattle farms. However in general the project is beneficial for the locals and the economy.
- The residents of Lait Village complained about the lack of public transportation facilities in the locality.
- The residents of Samo Goth suggested to have a hospital facility in the area because they have to travel 20 kilometers to get medical assistance/support.
- The residents of Jokia Goth reported that the private sector can plays a vital role in the development of the area by providing awareness to the authorities to take interest towards the problems faced by the residents of the neighborhood.
- The residents of Samo and Cachmera Goth suggested that 100% labour (skilled or unskilled) should be hired from the local community and should be provided with the necessary training and skill development so that more and more locals can be hired in the factory.

Primary Stakeholders Consultation Pictures	
	
Consultation with the Residents, Lait Village	Consultation with the Residents, Yameen Khaskheli Goth
	
Consultation with the villagers of village Ramesh Kohli	Consultation with the villagers of village Ali Muhammad Bukera
	
Consultation with a Resident, Jokia Goth	Consultation with the Residents, Samo and Chachmera Goth

	
Consultation with Manager, Shahzad Cattle Farm	Consultation with Manager, Karachi Gliding Club
	
Consultation with Manager, Sumaya Farm House	Consultation with a Resident, Kakran Goth

6 Screening of Alternatives

Identification and assessment of feasible alternatives to project design and implementation is among the main components of Environmental Impact Assessment procedures. Alternatives illustrate and contrast the environmental implications and consequences of different options available to achieve the proposed objective. In this way, both the proponent and the authorities who must consider granting the authorization, are put in a position where all involved are able to make informed choices or decisions.

Selection of preferred alternative is based on scores of factors including cost, schedule of delivery, environmental and social impact and the cost for their redressal. The drivers that affect potential alternative options and scenarios include: availability of project sites, current technologies; design changes that need to be introduced, operational situation, capital & recurrent costs, environmental & social issues, their potential impacts, and costs of mitigation. The “No Project” alternative situation is taken into account to demonstrate the need of the Project. In consideration of the different drivers, potential alternatives within the Project are restricted to the following aspects:

- No Project Option
- Project Alternatives
- Technology selection
- Availability of site and infrastructure
- Availability of appropriate energy source

6.1 No Project Alternative

No project alternative would mean that this project is not executed and the plan for tyre manufacturing plant is scrapped. However, this would eventually mean that the automotive sector of Pakistan would continue to be confined to the existing manufacturers and the new entrants will be discouraged. There would not be millions of rupees of investment if the proposed project would not go forth. Additionally, new entrants in the automotive market will increase competition and eventually better automotive technologies with regards to the fuel economy and emissions saving. These benefits however could not be ripen if the proposed project does not commence.

6.2 Project Location

The project location is optimally selected as it is at optimal distance from the main N5. This avoids unnecessary traffic congestion but provides opportunity to dispatch the produced tyres to Karachi city and to other major cities of Pakistan upcountry with relative ease. There is no land acquisition involved, as the project land has been purchase by the proponent.

6.3 Technological Options

Standard tyre manufacturing technologies with regards to required materials and testing will be deployed in the new plant.

7 Potential Environmental Impacts and Mitigation Measures

This section presents the screening of potential environmental, social and economic impacts and assessment of their severity in the proposed area. The screening process has through review of literature, primary as well as secondary baseline data, and expert judgment made assessment of the potential impacts of proposed project extensions on the physical, biological, and socioeconomic environment.

The screening process proceeds by identifying the potential environmental aspects of siting the project, identifying the potential environmental impacts at site preparedness, construction and operational stages of the project and identifying the residual impacts after adoption of mitigation measures that may be needed at the outset of activities. The impacts on environmental resources from the proposed project will be short-term and temporary in nature.

A systematic strategy was developed to provide an assessment of the likely impacts on the micro- and macro environment of the Project site. The strategy included:

- Review of general guidelines;
- Identification of potential environmental impacts by conducting survey, consultation and using checklists;
- Assessment of the intensity and significance of potential impacts by obtaining expert opinion and carrying out environment analysis;
- Defining mitigation measures to reduce impacts to as low as practicable;
- Predicting any residual impacts, including all long-term and short-term, direct and indirect, and beneficial and adverse impacts;
- Monitoring of residual impacts.

The strategy adopted for screening of potential impacts due to siting includes the Checklist in Table 7.1 that was adopted to provide an assessment of impact on the macroenvironment and microenvironment of the Project site.

The following Checklist provides the screening of potential environmental impact on different components of ecosystem of the proposed project.

Table 7.1: Checklist provides the screening of potential environmental impact

Screening Questions	Yes	No	Remarks
A. Project Siting **Is the project area..**			
Densely populated?		X	The microenvironment comprises of vacant land with sparse Xerophytic vegetation and within a designated industrial area
Heavy with development activities?		X	The Armstrong factory has been demarcated for tyre manufacturing.
Adjacent to or within any environmentally sensitive areas?		X	No environmentally sensitive areas are located in the microenvironment

Cultural heritage site		X	There are no cultural heritage sites nearby
Protected area		X	There is no protected area in the microenvironment
Wetland		X	No wetland in the microenvironment
Mangrove		X	No mangrove forests are in the microenvironment. They are located several kilometers away southwards from the project site.
Estuarine		X	Not Applicable
Buffer zone of protected area		X	No such buffer zone exists in the microenvironment
Bay		X	Not Applicable
B. Potential environmental impacts Will the project cause…			
Dislocation or involuntary resettlement of people?		X	There is no land acquisition, dislocation or involuntary resettlement of people involved, as the project land has been purchase by the proponent.
Deterioration of environmental conditions of surrounding of project site.		X	During construction phase, related environmental impacts may be envisaged however they will be curtailed by mitigation measures. During operation phase, mitigation measures will be implemented to minimize the environmental footprint of the plant.
Degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		X	No envisaged.
Degradation of cultural property, and loss of cultural heritage?		X	Not envisaged. No such sites are found in the microenvironment.
Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		X	No such impacts are expected as the industrial land is deprived of any such groups.
Pollution of receiving drainage waters resulting in residential land, agriculture grounds, gowchers and land resource?		X	Loss of land comprising residential, agriculture and grazing land is not envisaged.
Water resource problems (e.g. depletion / degradation of available water supply, deterioration for	X		Requirement of water for construction of the site and for human consumption during operation will be in significant

surface and ground water quality, and pollution of receiving waters?			quantity and will be met from the existing water supply systems. Better management & conservation practices have been proposed.
Air pollution due to emissions?	X		New development may impact local airshed due to vehicle movement but severity is likely to be low.
Social conflicts between construction workers from other areas and local workers?		X	Not expected.
Road blocking due to land excavation?		X	Road blockage is not envisaged during the construction phase as the site does not lie in the immediate vicinity of any major road.
Noise and dust from construction activities?	X		Likely but will be minimized through better management practices.
Traffic disturbances due to construction material transport?	X		Traffic may increase temporarily due to the transportation of Construction material and workforce to the site. It will be managed through the adoption of good management practices.
Temporary silt runoff due to construction?	X		If such situation emerges, it will be mitigated through better management practices and installation of silt traps.
Contamination of surface and ground waters due to improper waste disposal?		X	Solid and Liquid Waste Disposal system will be in place to prevent possible contamination of water resources
Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		X	The project area is not vulnerable with respect to any demographic or socioeconomic aspects.

7.1 Screening of Impacts during the Construction Phase

The activities during construction phase generally comprise site preparedness, civil works, mechanical installations, electrical work etc. Proposed Tyre manufacturing plant would not involve extensive land preparation since the site is mostly levelled having flat terrain. Construction activities on the project site for the proposed project include the following main components:

- Civil Works
- Electrical Works
- Mechanical Works
- Installation works
- Synchronization
- Testing and Commissioning

7.1.1 Seismic Impact

In view of the historical data as well as proximity to fault, being estimated for areas Gharo – Keti Bandar Highway Sindh "moderate to major", there is a possibility of earthquakes of intensity V to VII on (MM) scale and "probability" of those above VII. The project site lies in Zone 2B. Such Seismic Zoning would correspond to Magnitude between 5.0 and 6.5 on Richter Scale and Intensity between VII and IX on Modified Mercallis Scale.

Mitigation Measures

- Construction of the project shall be undertaken keeping the seismic categorization in accordance the relevant zoning.
- Construction material shall be used which could add to the bearing capacity of underneath soil.

7.1.2 Impacts on Air Quality

Site preparation activities involve excavation, earth and fill movement, concrete foundations, and transportation of construction machinery, accessories and associated equipment to the site. These activities will raise the fugitive dust emission, and will cause small variation in soil quality resulting from removal of topsoil at the micro-site.

The fugitive dust emissions will be a cause for annoyance but the same must be controlled through appropriate measures including water sprinkling and spreading heavy dust on eroded surfaces to reduce the impact to level of minor significance. The site of excavation will be restored by appropriate landscaping and signage. Diesel and other petroleum products used for the operation of construction machinery and equipment would cause air pollution besides causing soil pollution through oil spills.

A secondary source of emissions may include diesel operated equipment during construction phase is likely to contribute to the higher concentration of gaseous pollutants like oxides of Nitrogen (NOx), Carbon Monoxide (CO) and Hydrocarbons.

A marginal increase in the levels of oxides of nitrogen, carbon monoxide and hydrocarbons is envisaged due to the movement of vehicles for transportation of construction material and diesel generators required during construction phase. However, this increase in concentration would be temporary in nature and localized. The access to the site is over an existing paved road. The movement of trucks bringing in construction materials is therefore not expected to create significant dust nuisance.

The predominant wind direction in the area is from the south west that is from the sea to the land. As the site is located away from urban areas and human settlement and the surrounding industrial area is not fully developed yet, these will not create any negative impacts.

Suspended particulate matter (SPM) is likely to be a major problem because of the arid and dusty environment all around. Mitigation measures needed under the

circumstances would aim at protection of the personnel. Combustion of fuel for running the generators and construction equipment will have negative impact on the ambient air quality of the microenvironment of construction site if the operation of the equipment is not environment friendly in the sense that their engines are not appropriately tuned and their exhaust fumes are not suitably discharged.

Mitigation Measures

The emissions from operation of construction equipment and machinery as well as generators are not expected to have been significant as to affect the ambient air quality of the area. The small amount of exhaust emissions from the operation of equipment's are not expected to have any significant impact on the local air quality and airshed.

Adoption of following mitigation measures to mitigate dust emissions will result in further reduction / prevention:

- The Contractor will be required to have a dust abatement program that includes installing enclosures and covers around the boundary walls, spraying water on sand piles.
- PPE, such as dusk masks, will be used where dust generation occurred.
- Avoiding open burning of solid.
- Care will be taken to keep all material storages adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions.
- Fabrics and plastics for covering piles of soils and debris is an effective means to reduce fugitive dust.
- Regular and periodic sprinkling of water on all exposed surfaces to suppress emission of dust.
- Frequency of sprinkling may be increased to keep dust emissions under control, particularly during the mid-April to mid-June when wind is blowing at high speed and varying direction.
- Keeping the construction material in moist condition (if possible) at site.
- Locating stockpiles away from the wind direction and covering it with tarpaulin or thick plastic sheets, to prevent dust emissions.
- All routes within the project construction site facility will be paved providing hardened surface as early as possible upon the commencement of construction work. Other temporary tracks within the site boundary will be compacted and sprinkled with water during the construction works.
- Construction traffic will maintain a maximum speed limit of 20km/hr on all unpaved roads within the proposed site.
- Construction materials that are vulnerable to dust formation or those that comprise loose materials will be transported only in securely covered trucks to prevent dust emission during transportation.
- The exposure of construction workers to dust will be minimized by providing dust masks.
- All vehicles, generators and other equipment used during the construction will be appropriately tuned and maintained in good working condition in order to minimize exhaust emissions.
- The stacks of the generators while in operation will be vented through vertical stacks to safe heights in order to minimize dispersions at ground level.

- Diesel and other petroleum products used for the operation of construction machinery and transportation equipment would cause air pollution besides causing soil pollution through oil spills. The impact from such activity would be of minor significance and would be controlled by good housekeeping practices.

7.1.3 Noise Impact

Noise can be significant during construction. Sources of noise include construction equipment, machinery, building gates installation, welding & cutting, frame installation etc. The operation of these equipment will likely generate noise ranging between 70-80 dB (A). All the machinery will comply with the relevant local and international noise protection standards. As far as necessary, times and conditions of operation will be fixed in detail in co-operation with the competent authorities. The noise and vibration during the construction phase will be of short span of time.

Table 7.2: Construction Equipment Noise Ranges dB (Average)

Equipment	Peak Noise Range at 15.2 m	Typical Peak Sound level in a Work Cycle	Typical ' Quieted Equipment' Sound Level	Equivalent Noise Level in an 8-hr Shift at Receptor 150m from Source.
Batching plant	82-86	84	81	62.9
Concrete mixers	76-86	85	82	63.9
Excavators	74-92	85	82	59.5
Tractors and trolleys	77-94	88	85	62.1
Graders	72-92	85	82	59.5
Pumps	68-72	76	75	54.9
Diesel generators	72-82	78	75	58.1
Vibrators	68-82	76	75	50.5
Drilling Machines	82-98	90	87	61.5
Dumpers	77-96	88	83	59.5
Road Rollers	73-77	75	72	49.5

Mitigation Measures

- Noise control devices will be used such as temporary noise barriers and deflectors for impact activities.
- Construction machinery will be kept in good condition to reduce noise generation.
- The Contractor will need to ensure that machinery is adequately silenced

7.1.4 Blocked Access

There are no settlements in the immediate vicinity of the proposed site. Hence the construction activities at the site will not cause any inconvenience to the nearby population by blocking their access routes. The movement of extra heavy construction equipment along the roads leading to the site may require temporary adjustment and would not block the insignificant local traffic even for short periods of time.

7.1.5 Soil Contamination

Soil contamination is likely to be occurred diesel equipment activities. The leaked fuel or oil may degrade soil quality and leaching into depth of soil.

Mitigation Measures

Construction machinery will be kept in good condition in order to prevent the soil contamination. Spill kits will be available at site and drip trays are to be provided.

7.1.6 Waste Management

Different types of solid waste will be generated including construction waste including effluent containing sand, cement, silt or any other suspended or dissolved material, chemical waste (lubricants, oils etc.) or any waste matter or refuse to be deposited anywhere within the site or onto any adjoining land.

Mitigation Measures

All waste materials will be managed in accordance with the project environmental management plan in a manner that will promote waste avoidance and minimization. Waste materials will be disposed of in accordance with the relevant laws, guidelines and best practices.

Waste management options can be categorized in terms of preference from an environmental viewpoint whereby the more preferable options have the least impacts and provide for enhanced sustainability.

Avoidance and minimization, for example by:

- Selecting products that will cause no or minimal environmental impacts
- Not generating waste, which would be achieved by changing or improving practices and design;
- Reuse of materials, thus avoiding disposal; and
- Special controls will be imposed to regulate storage, labeling, transport and disposal of residues, lubricants and other oily wastes (chemical wastes).
- All construction waste shall be sorted on site into inert and non-inert materials. Non-inert materials such as wood and other materials including glass, plastics, steel and metals shall be disposed of to landfill. Inert materials like soil, sand, rubble shall be separated from non-inert material and disposed.
- All vehicles carrying waste shall have properly fitted side- and tailboards, and the materials being transported shall be securely covered.
- All works areas shall be cleaned of general litter and refuse daily.
- General refuse and litter shall be stored in enclosed bins or compaction units separate from construction or chemical wastes.
- Refuse shall not be burned at any Construction Area.
- General refuse may be generated by food service activities on site, so reusable rather than disposable dishware shall be used if feasible.

7.1.7 Impact on Water Resources

A. Ground water

Tyre Manufacturing plant construction necessitates the use of heavy equipment and associated fuels, lubricants, and other potentially hazardous substances that, if spilled, could affect shallow groundwater. Accidental spills or leaks of hazardous materials associated with fueling, vehicle maintenance, and construction materials storage would present the greatest potential contamination threat to groundwater resources. Soil contamination resulting from these spills or leaks could continue to add pollutants

to the groundwater long after a spill had occurred. However, the good construction & management practices will reduce such incidence making this insignificant.

B. Wastewater from Construction camp

Uncontrolled discharges of untreated or poorly treated liquid effluents from construction camps, potentially responsible for pollution of soil, groundwater and surface water.

Mitigation measures

- Septic tanks and soak pits with appropriate design and capacity shall be constructed at each work and campsite for the disposal of domestic liquid waste
- Untreated effluent from any works will not be released into the environment
- Maintenance of vehicles and other equipment will be allowed only in designated areas underlain with concrete slabs and a system to catch runoff. Washing of vehicles will be restricted to few in number.

7.1.8 Occupational Health and Safety

Site-specific occupational health and safety hazards are critical to identify based on job safety analysis or comprehensive hazard or risk assessment. Health and safety management planning should include the adoption of a systematic and structured approach for prevention and control of physical, chemical, and biological health and safety hazards. Contractor shall ensure that Job Hazard Analysis (JHA) is performed prior to commencing jobs. It shall also be ensured that the JHA is reviewed after the following,

- Whenever work is stopped
- Every time work conditions or the job scope changes
- Persons working or visiting the job shall review and acknowledge the JHA by their signature

A. Hazardous Substance Handling and Storage

Contractor should ensure that chemicals are handled and stored in accordance with the manufacturer recommendations found in the MSDS. Chemicals should be stored in a manner which will minimize releases to soil, groundwater or the atmosphere.

Containers and tanks which are used to store hazardous substances shall be,

- In good conditions
- Compatible with the material stored inside
- Closed when material is not being transferred into or withdrawn from them
- Flammable or combustible liquids shall not be stored in areas used for exits, stairways, or normally used for safe passages.
- No more than 25 gallons of flammable liquids shall be stored in a room outside of an approved storage cabinet. Flammable chemicals shall be stored in flammable storage cabinets, room or building when the volume stored exceeds 25 gallons (95 liters), as defined in the OSHA Regulations (Standard – 29 CFR); standard number: 1926.152.

Electrical pumps shall not be used to transfer flammable or combustible liquids. Toxic chemicals shall be stored and handled as defined in the chemical MSDS. Explosive products should be handled and stored according to applicable regulations. Explosive storage shall be located away from corrosives, flammable, oxidizers, or acids.

B. Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction site.

Mitigation Measures

Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Good housekeeping practices, such as the sorting and placing loose construction materials in established areas, would be implemented.
- Excessive waste debris and liquid spills will be cleaned up regularly.
- Electrical cords and ropes will be located in common areas.
- Slip retardant footwear will be used.

C. Struck By Objects

Construction activities of the project may pose significant hazards related to the ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.

Mitigation Measures

Techniques for the prevention and control of these hazards include:

- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap.
- Appropriate PPE such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be wore.

D. Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise.

Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving.

Mitigation Measures

Techniques for the prevention and control of these impacts include:

- The location of vehicle traffic, machine operation, walking areas, and controlling vehicle traffic will be planned and segregated through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic.
- The visibility of personnel will be ensured by high visibility vests when working in or walking through heavy equipment operating areas as well as training of workers to verify eye contact with equipment operators before approaching the operating vehicle.

- Inspected and well-maintained lifting devices will be used that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

E. Other Site Hazards

Construction of site may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms. Centralized residence of construction staff will lead to the easily spread of infectious diseases.

Mitigation Measures

It can be prevented through the implementation of project specific plans and other applicable management practices, including:

- Use of waste-specific PPE based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves & eye protection.
- Comprehensive disinfection in the construction area should be conducted before construction.
- Staff who will enter the area should be conducted a comprehensive physical examination, people who are suffering from infectious diseases is prohibited to enter the construction site.
- When infectious diseases and food poisoning occurs on the site, the project manager should report it to higher-level authorities and local health and epidemic prevention agencies as soon as possible; actively cooperate with the sanitation and epidemic prevention departments to investigate and disinfect, to protect the health and safety of construction personnel.

7.1.9 Community Health and Safety

A. General Site Hazards

Projects should implement risk management strategies to protect the community from physical, chemical, or other hazards associated with sites under construction.

Risks may arise from inadvertent or intentional trespassing, including potential contact with hazardous materials, contaminated soils and other environmental media, excavations and structures which may pose falling and entrapment hazards.

Mitigation Measures

Risk management strategies may include:

- Access to the site will be restricted through a combination of institutional and administrative controls.
- Removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials.

B. Disease Prevention

Increased incidence of communicable and vector-borne diseases attributable to construction activities represents a potentially serious health threat to project personnel and residents of local communities.

Mitigation Measures

- The mobility of the community living in the area will be restricted from the project site in order to prevent from catching any type of communicable diseases.
- Any labor found to catch any type of disease will leave the site immediately; and would be given proper medical facilities.

C. Traffic Safety

Construction activities may result in significant increase in the movement of heavy vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents and injuries to workers and local communities.

Mitigation Measures

The incidence of road accidents involving project vehicles during construction will be minimized through a combination of education & awareness raising, and the adoption of procedures.

7.1.10 Impacts on Ecology

The existing project site is a non-agricultural barren land. There is no protected area, wetland or cultural heritage site in the microenvironment. The siting of the project will however involve clearing the existing shrubs, herbs and grasses at the project site.

Mitigation Measures

- In case a mature tree is removed, it will be replanted in ratio 1:5. For immature tree, the compensatory plantation is in the order 1:3. Only native species will be selected for plantation.
- Effective measures shall be taken to protect the environment and control pollution so that restoration of regional ecology is ensured
- General awareness of construction crew will be increased regarding the biological resources.
- A 'no-hunting, no-trapping, no-harassment' policy will be strictly enforced at the project sites.
- Firewood, woody plants and shrubs will not be used as fuel during construction.
- Personnel and vehicle movements will be restricted to the construction site, camp and approved roads.

7.2 Screening of Potential Impacts during Operation Phase

During operational phase of the project, various activities associated with the Tyre Manufacturing facility will have some impact on environment. Therefore, relevant environmental attributes are to be studied during this phase for their overall impact on the surrounding environment.

7.2.1 Impact on Air Quality

During operational phase, there would be various air pollutants emissions from the different activities of the facility. The proposed development will involve generation of emissions, and increased vehicular movements which may also results in minimal dust emissions from paved access and all internal roads. These altogether may have overall negative impact on the air quality of the site and the nearby areas.

Air quality deterioration can be happen due to primary and secondary air pollutants. Primary pollutants (CO2, CO, SO_2, NOX, particulate matter) are formed from directly by the emissions from the plant. Secondary pollutants like SO3, NO2, ozone incomplete combustion products are detect by the use of pollution control equipment. So these air pollutants mainly affects for the fog, smog formation and acid rain.

Fugitive emissions of additive chemicals may be released from the compounding area. As additives are pre-weighed, there is potential for significant fugitive dust emissions from chemicals kept in open storage. Fugitive emissions may also be produced as the chemicals are loaded into the mixer.

Mainly volatile organic compounds (VOC) are emitted during the manufacturing of the Tyre, and the VOC emissions take place from compounding, VOCs emissions due to curing agents, accelerators, antioxidants and in mixing process, calendaring operation and green Tyre spraying. Also, during the vulcanization of synthetic rubber, soot is produced. Soot is a carbon particle that contributes to climate change. Soot being released into the atmosphere.

The raw materials such as Carbon Black, Natural/Synthetic Rubber, Oil, Additive, Accelerator etc. when used without packing, they are openly taken towards the weighing machine and internal mixing machine in order to produce rubber film. Some of them get in contact with air and may spread unpleasant odour and dust. During the mixing process, fillers are dumped on polymer in the mixing mill.

Airborne contamination from rubber fumes is either visible or nonvisible. The invisible pollutants are gases and vapors of low molecular weight organic compounds (carbon disulfide and amines) or inorganic (hydrogen sulfide) compounds. The visible pollutants arise from aerosols. These aerosols evolved during the mixing, milling, blending of elastomers or combination of them with chemicals involved in the process. The aerosol fraction of rubber fumes is complex and with unknown composition.

Moreover, vulcanization process releases complex fumes and smell, which may either be individual or reactant products. Rubbers are highly flammable. After coming into contact with heat and flame, ignites spontaneously and generates considerable quantities of smoke while burning. Basic raw materials for synthetic polymer making are petro based products. It should be stored away from energy-generating sources such as boiler and oil storage room.

Mitigation Measures

- Ensure the use of chemicals in small, pre-weighed, sealed bags for direct addition to the mixer to limit dust generation;
- Emissions from the internal mixers should be controlled using bag filters. Exhausts from the collection hoods should be conveyed to the bag filters to control particulate and possibly particle-bound semi volatiles, ammonia, and cleaning and equipment washing;
- Air pollution control devices such as LEV must be regularly inspected for performance check so that its effectiveness in protecting the employee(s) is achieved;
- The vehicle speeds on graded roads will be limited in order to minimize dust emissions;
- Provision of PPEs to workers working in order to minimize their exposure to harmful emission;

- Proper ventilation and Air filters should be installed;
- Air pollution control measures will be taken and Latest technology, methodology, and machinery involving minimal air emissions should be adopted;
- Power Generators should be provided with stacks of adequate height to allow enough dispersion of emission; Ensure Fuel to Air Ratios are maintained;
- Ensure Fuel quality is excellent for utilization even after fuel treatment;
- Installation of fuel economizers on boilers;
- Ensure the use of solvent recovery system being installed in order to reduce emissions of VOC from curing ovens;
- Energy conservation should be adopted by adopting the alternate energy options like solar power and other energy efficient technologies; and
- Ensure the development of green belt around the proposed project.

General Plant Ventilation

General ventilation systems (supply and exhaust) can be mechanical or mixed (natural supply, mechanical exhaust). Natural air supply through the windows, doors or fixed air vents is not recommended when the width of the building exceeds 24 m (79 ft.).

Also uncontrolled air supply may disturb the various processes in Tyre Manufacturing facility (e.g., Natural Tyre cutter, mixing mill, other mixing and cutting machines for Tyre manufacturing can create high air PM & VOCs.).

General Supply Systems

General supply systems are used for:

- heating or cooling working environment;
- removing contaminants not captured by local ventilation systems;
- replacement of air exhausted by local ventilation systems and process equipment;
- Controlling building pressure and airflow from space to space.

These systems typically consist of:

- outside air inlet;
- return air inlet;
- supply air handling unit,
- air distribution ductwork, and
- Supply air outlets.

General Exhaust Systems

General exhaust systems complement local exhaust systems by removing air contaminated by fumes, gases or particles not captured by local exhausts.

Such systems usually consist of outlets, ducts, an air cleaner and a fan. The efficiency of the air cleaner must be sufficient to meet the regulations of environmental agencies and may be affected by location, background concentration in the atmosphere, nature of contaminants, height and velocity of the air discharge stack. In some cases the air cleaners may be excluded from the general exhaust system and general exhaust can be provided by the roof fans.

Centralized and decentralized (modular) systems

Centralized ventilation systems supply air to entire Tyre processing department and have a large air distribution ductwork. Centralized system has lower maintenance costs compared to decentralized system. With decentralized ventilation, the entire processing area is divided into zones, ventilated by a separate system with or without air distribution ductwork. Decentralized units are normally located in the upper level below the roof (in the truss space) or on the roof. Decentralized systems provide better temperature and air pollution control in shops with spaces having different cooling/heating and contaminant loads. Also, decentralized systems allow faster response to the change of the load by production process in different zones. Normally centralized system does not have a capability for zonal control. In comparison to central units, decentral units incur less costs when retrofitting existing Tyre processing department.

Constant air volume (CAV) and variable air volume (VAV) systems

The airflow rate supplied into the processing area throughout the year may be constant (Constant Air Volume systems) or variable (Variable Air Volume systems). The design of the air supply system is normally based on the full load (cooling, contaminant or make-up airflow needs). When only a partial load exists (e.g., in body and welding shops, assembly shops), thermal or pollution control may be achieved either by changing supply air temperature and/or the ratio of the outdoor and return air (CAV systems) or by changing the supply airflow rate (VAV systems).

The required supply airflow rate may vary significantly between winter and summer conditions or between different shifts (e.g., by 65% in body shops and machining shops with tempered air systems, and by 80% with non-tempered air systems).

Often, ventilation systems for Tyre processing plants are designed when the machinery equipment data may not be available. Ventilation system designs may be required to account for some future building expansions and changes in processes or space requirements. In such situations ventilation system can be sized considering the maximum possible load with an airflow control based on the current load.

VAV systems save heating, cooling and fan energy in comparison with CAV systems, but may require more maintenance costs and expertise to operate them. VAV systems allowing significant reduction of supply airflow rate require special attention to:

- Selection of airflow control strategy (inlet vanes, fan motor speed control, etc.)
- ductwork design;
- air space air distribution; and
- Building pressure management (coordination of supply and exhaust systems operation).

Air handling unit

The supply air handling unit components and configuration depend on the system usage (make-up air system, dilution ventilation system, heating and cooling, etc.), climatic conditions, and operating modes (CAV or VAV systems).

Typically, air-handling units have components to temper, clean, mix (outside air and return air), and to move the air. Air handling unit may have equipment to recovery energy from the air exhausted outside to lower the enthalpy (temperature) of the air supplied into the building during the warm weather and to raise it during the cold

weather. A microprocessor controls the air handling unit devices through sensors and actuators.

Working environment heating and cooling

Heating systems

In Tyre mixing section various grades of natural and synthetic rubbers there is a there is a significant surplus heat generated by internal heat sources. Thus, in general climatic conditions of Karachi, cooling of the space is objective for most of the year.

The internal area of the mixing section can maintain comfortable temperatures using the heat given off by the process. Supply air is heated in the air handling unit with heated water flowing through the heating coil or in direct fired gas heating sections. When piped natural gas is available the fired-gas approach is preferable, since it offers almost 100% heating efficiency by burning the gas in the supply air stream. Sufficient amount of outside air must be supplied to prevent the build-up of carbon dioxide in the building. An alternative heating approach is indirect, gas-fired heating, but it has a higher first cost and the heating efficiency is less than with direct gas-fired.

Temperature control can be also achieved with separate air heating systems, e.g.

- recirculating or mixed air units located on walls and columns
- hot water or indirect gas-fired overhead radiant heating systems

Cooling systems

In cooling season, air temperature in the building is controlled either by bringing additional outside air or by using refrigeration equipment to cool the air. Cooling systems in Tyre manufacturing plants are not designed to provide high level of comfort or control humidity, but only to control the temperature at the level below 80°F (27°C).

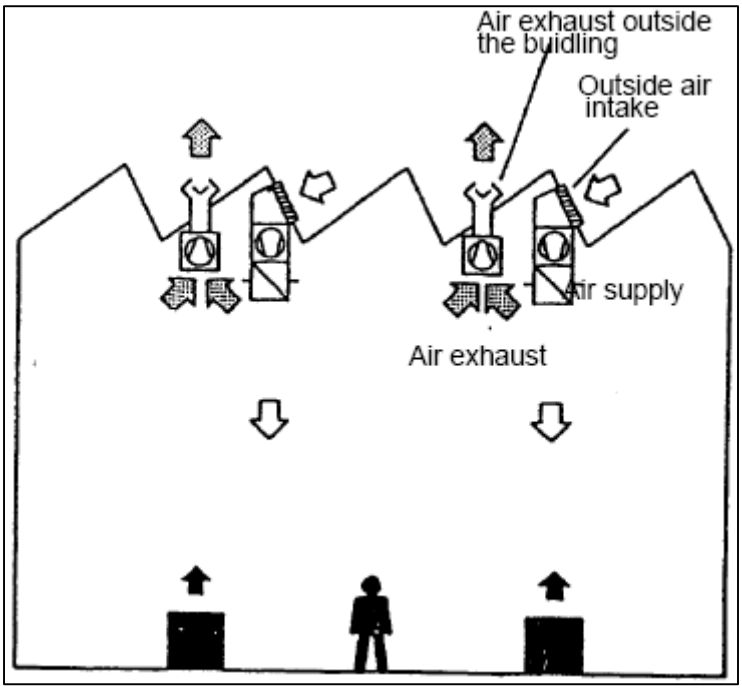


Figure 7.1: Schematic of decentralized general ventilation system

- Consider use of alternative or low VOC.
- Increase the transfer efficiency of the application technique.

- Capture and concentrate VOC emissions, e.g. with activated carbon.
- Implement a Solvent Management Plan to monitor and control the use of solvents on site.
- Install or upgrade abatement technology to minimize exposure to hazardous substances and to control the release of emissions, e.g. enclosure of equipment, use of appropriate ventilation with filters, gas balancing systems, cyclones, and wet or alkali scrubbers.
- Monitor indoor air quality and use signage where there are elevated levels of emissions and personal protective equipment (PPE) is required.
- Adjust delivery times to reduce GHG emissions due to traffic congestion at peak hours.

7.2.2 Indoor Air Quality

Tyre manufacturing operations rely on Rubber mixing, addition and subtraction of polymers, cutting, heating and cooling & inspection. All these processes have air emission (PM 10, PM2.5, VOC, Carbon particles, and black soot.

Types of Contaminants

Production processes of Tyre Manufacturing operations result in emission of:

- Fumes and gases from Mixing and cutting operations,
- Airborne Black carbon soot particles,
- Abrasive particles from grinding and polishing.
- burned oil fumes,
- Fumes from heated polymers.

Fumes and gases

Fumes and gases are particles originating from mixing process, Gases are produced during the mixing process or may be produced by the effects of process radiation on the surrounding environment. The quantities of these gases can be significant in some applications such as plasma arc cutting.

Particle Size. Fume particle size is an important safety related variable as particle size determines the degree of penetration and retention in the human respiratory system. Researchers have determined that while fume size varies with process variables, welding fume is consistently in the sub-micron range, averaging about 0.3 microns for typical welding and thermal cutting processes, a size that will easily penetrate the respiratory system. It should also be noted that these fine particles tend to agglomerate or form larger clusters, which can be retained in the lungs.

Target Levels

Threshold limit values (TLV) for fumes and gases produced by various mixing operations by chemical type are listed by National Occupational Safety and Health Organizations. In the U.S.A., the American Conference of Governmental Industrial Hygienists publishes a guide "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices", which is issued annually.

Permissible exposure limits (PEL) are regulatory and are published by the Occupational Safety and Health Administration (OSHA). OSHA's current standards for welding, cutting and brazing in general industry and construction are based on the 1967 American National Standards Institute (ANSI) standard Z49.1. While ANSI Z49.1

has been updated several times since 1967, the OSHA welding standards in subpart Q of part 1910 have not been updated to keep pace.

NIOSH published a Criteria Document "NIOSH Criteria for a Recommended Standard: Welding, Brazing, and Thermal Cutting," in 1988, recommending that "exposures to all welding emissions be reduced to the lowest feasible concentrations using state-of-the-art engineering controls and work practices". NIOSH has also recommended exposure limits for specific chemical and physical agents associated with welding.

Contaminants, which can be produced in welding and allied processes, are as follows.

- The metallic components are typically found in the form of oxides and/or fluorides. Aluminum is found in alloys and filler metals and is produced as aluminum oxide in aluminum processing. It can be a respiratory irritant.
- Barium may be found in some self-shielded flux-cored electrodes. Exposure to soluble barium compounds can cause irritation of the eyes, nose, throat and skin.
- Cadmium occurs as a plating material or brazing alloy. It can be a serious hazard resulting in emphysema, kidney damage and pulmonary edema.
- Carbon Monoxide in low concentrations results from the reaction of carbon dioxide and the welding arc in GMAW and FCAW welding. Symptoms include headaches, dizziness and mental confusion.
- Chromium is an alloying element most commonly found in stainless steels and in some low alloy steels. It can cause skin irritation and increased risk of lung cancer.
- Copper is used in some electrodes and in alloys. It may also be found as a coating material in some GMAW electrodes. Copper can cause respiratory irritation or metal fume fever.
- Fluorine in the form of fluorides is used in some fluxes and electrode coatings and as a fill ingredient in some flux-cored electrodes. It can cause respiratory and eye irritation.
- Iron in the form of iron oxide is the most common fume constituent. Iron oxide can be a respiratory irritant and can cause siderosis.
- Lead is found in some coatings and in some brass, bronze and steel alloys. Lead can cause nervous system disorders, kidney damage and reproductive problems.
- Molybdenum is found in some steel alloys and can cause respiratory and eye

Ventilation

Clean air for proposed operations is provided by ventilation systems, which typically consist of local exhaust systems and general ventilation supply and exhaust systems. The most efficient methods of contaminant control in the occupied zone of the processing department, and particularly in the breathing zone of the operator (with a manual Processing plant), are:

- exhaust from the mixing and heating process enclosure when automatic machines are used;
- Local exhaust which captures the contaminants at or near their source.

Exhaust from Tyre Manufacturing process from the operator's environment, or local exhaust systems with manual and semiautomatic operations are normally the most cost-effective solutions to fume control. They minimize the required outdoor airflow rate thus optimizing system installation and operating costs especially where filtered air return back into the building is not used. Control of fumes in the source area can also

reduce plant maintenance costs. A cleaner workplace may also lead to an in increase in employee productivity.

No local exhaust ventilation system is 100% effective in capturing fumes. However, it is important to note that capture efficiency has a greater influence on air quality than filtration efficiency. No filter device is effective until the fume is drawn into it. In addition, there will be circumstances, because of the size or mobility of the welding zone, where installation of local exhaust ventilation systems may not be possible. Also, local exhausts are typically not efficient in removing fumes generated after welding at the heat-affected zone.

General ventilation is needed to dilute pollutants not captured by the local ventilation system and to dilute fumes generated after welding. General ventilation systems supply make-up air to replace air extracted by local and general exhaust systems. Also, supply air is used to heat and cool the building. Volume of outside air to be supplied by a general ventilation system should exceed the volume of air exhausted by local ventilation systems. Buildings should be pressurized to prevent air infiltration creating cold drafts in winter, and hot humid air in summer. In addition to local exhaust system, a general exhaust system is used to evacuate air from the building.

Special attention should be paid to ventilation of areas with grinding and polishing operations. Air supply and exhaust should be arranged such to create low velocity-low turbulent airflow preventing dust dispersion in the shop. Low airflow, high vacuum exhaust systems built-in grinding and polishing machines significantly reduce contaminant load on the building.

Fume Filtration

Collector Selection

Often when air is exhausted, it is exhausted through a fume/dust collector. These collectors may be:

- small, portable collectors connected to the local exhaust and the fan;
- medium size wall- or floor-mounted collectors working as part of the local exhaust system with one or few exhaust hoods, or
- Large collectors that may work with either a centralized local exhaust system or with a general exhaust system.

It should be noted that most of collectors used in welding shops are designed to remove solid matter (fume) only and not gases. It is not cost efficient to use collectors capable of efficient removal of gaseous byproducts.

Collectors are selected based on the following factors:

1. Contaminant Concentration. The amount of dust and fume generated by the process.
2. Efficiency Requirements. Capture efficiency generally has greater influence on air quality than filtration efficiency. However, the filtration efficiency required must be sufficient to meet all national and local codes and standards (OSHA, EPA, etc.). HEPA filters are those classified with an initial efficiency of 99.97% at 0.3 micron (DOP test) but are not typically required in most welding applications.
3. Contaminant Characteristics. These include contaminant size and condition such as wet, dry or sticky.

4. Energy Consumption. All collectors consume energy in order to overcome pressure drop through the collector. The pressure drop is measured in Pa (inches of water). Energy is also consumed during the cleaning of contaminant from collectors.
5. Maintenance costs. Some collectors can be cleaned on-line, others require cleaning or replacement of filtration elements.

There are two major types of collectors used in welding fume control.

1. Cartridge Collectors,
2. Electrostatic Precipitators

Cartridge Collectors. Cartridge collectors use filters made out of pleated paper or synthetic filter media. This type of cartridge results in a much larger amount of filter media per collector volume than media used in conventional fabric filters. In addition, the type of filter media used in these cartridges is usually much more efficient on sub-micron sized particulate with filtration efficiencies exceeding 99%. It should be noted that while cartridge filters are generally more efficient on sub-micron sized particles, performance depends on the filter media used in the cartridge itself. All cartridges have a similar appearance regardless of efficiency. Specifications should define the filtration efficiency of the unit on sub-micron sized particles.

Cartridge collectors are relatively easy to maintain. Maintenance involves replacement of the non-cleanable cartridge when pressure drop significantly decreases fume capture. Non-cleanable cartridges are normally used in small portable collectors.

Many cartridge collectors are cleaned on line, using a reverse pulse of compressed air. Cartridge life is usually quite long on welding fume applications with a cleanable cartridge change required approximately once per year. Cartridge life can vary significantly with the application and type of media used. Most cartridges are relatively compact, easy to handle, and often can be changed from outside the collector.

Disadvantages of cartridges include a relatively higher pressure drop (500 to 1000 Pa) than an electrostatic precipitator (an inch or less) and the requirement for compressed air for cleaning. Filter life may be reduced if the welding fume is very oily.

Electrostatic Precipitators. Electrostatic precipitators operate by electrically charging dust and fume particles and collecting the charged particles on oppositely charged collector plates. This type of filtration has been used for many years on welding fume because it is effective on small, sub-micron sized particles. Also, the pressure drop through this type of collector is usually the lowest of the available options, allowing reduced horsepower blowers. Finally, unlike the other collector options, there is no filter to replace.

Disadvantages include the requirement for frequent maintenance. The collection plates must be cleaned frequently to maintain filtration efficiency and remove collected contaminant. The plates can be cleaned manually, by mechanical shaking, or with a water wash. In addition, these units are not well suited for collecting high concentrations of dust and fume. As particulate is collected, filter efficiency is reduced.

Filtration efficiency varies from 90% to 99% on sub-micron sized particles.

Fire and explosion protection for exhaust systems

Fire protection systems need to be evaluated for each application. Local and national codes should be used as a basis of the design of the fire protection system. The local

fire protection authority should be contacted for concurrence with the design and type of fire protection system(s) used.

The types of fire protection systems are water and gas (typically CO2) with an automatic and/or manual discharge system. Consideration should be given to providing a drop out chamber for the welding process dust particles and sparks. This drop out chamber should be located as close to the welding process as possible.

Some plants require that fume exhaust duct have fire sprinklers located from the hood to the drop out chamber. If the duct has fire protection sprinklers installed the static pressure should be adjusted accordingly. Some fire codes allow ducts less than 100 square inches to not have fire protection sprinklers installed.

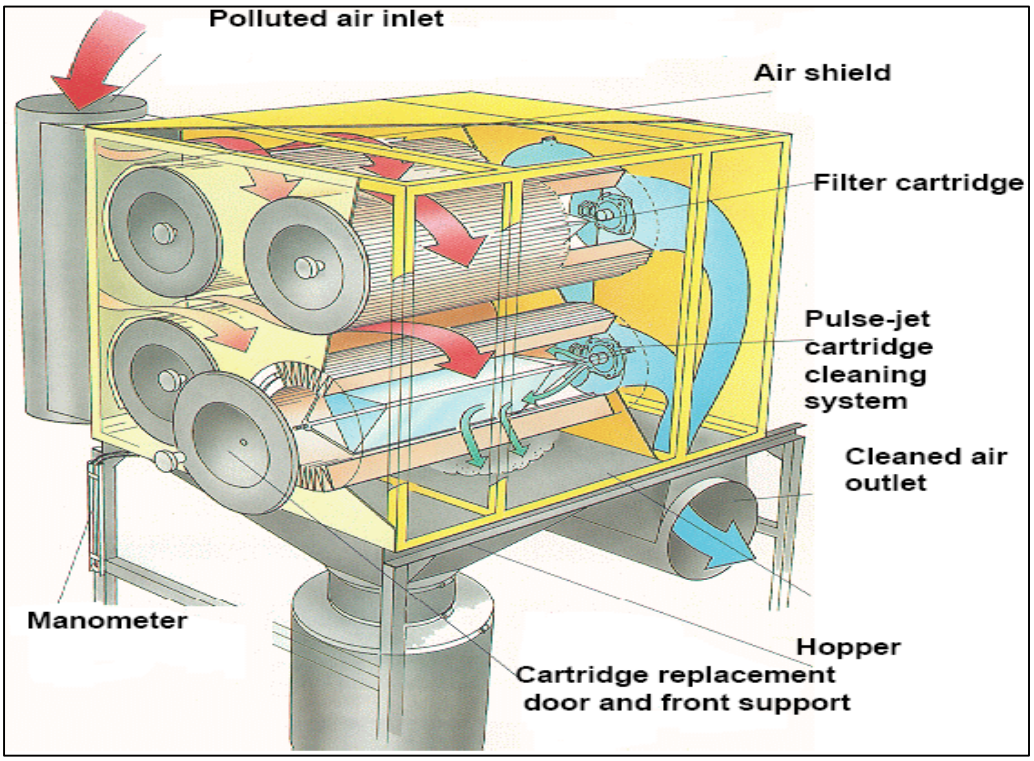


Figure 7.2: schematic of a self-cleaning cartridge filter[5]

[5] Plymovent AB.

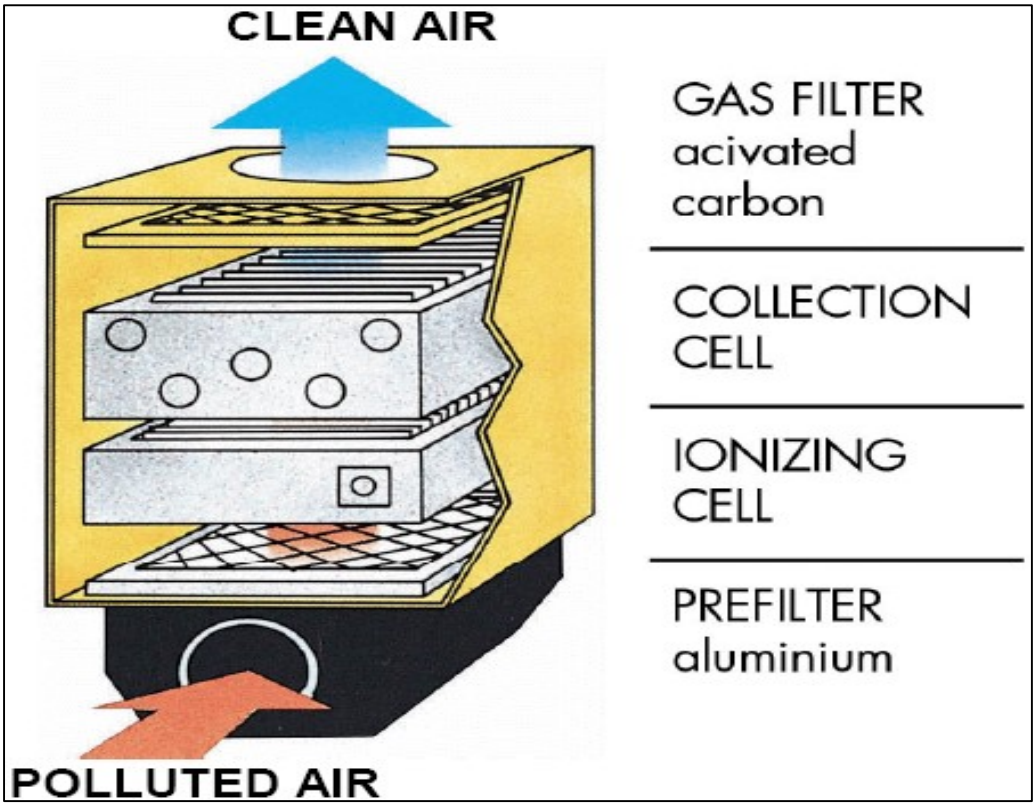


Figure 7.3: Schematic of two-stage electrostatic filter[6]

7.2.3 Indoor Air Quality and Emissions of Tyre Manufacturing

The operation of a Tyre Manufacturing line consists of long straight line(s) or lines that weave back and forth through the assembly building. Due to curing agents, accelerators, antioxidants and in mixing process, calendaring operation and green Tyre spraying.

Process Emissions Overview

In most of the Tyre Manufacturing process generates only heat primarily from the mixing, cutting, tread, wire fixing, electrical motors and lights. There are heat losses/gains through the building envelope. Also, at the following workstations there are emissions of contaminants:

- Windshield gluing station. Emissions are generated from the adhesive compounds which are used to seal the windshield to the body frame. In many cases this process is still performed manually, exposing the worker to hazardous solvent vapor compounds which vary depending on manufacturer's blend.
- Door seals and trim stations. Emissions are generated from adhesive compounds that are used to attach door seals and interior trim components to the body frame. The affixing of these components subject the worker to solvent vapor compounds which are potentially hazardous but more likely to be annoying or discomforting to the workers or operators in the surrounding areas.
- Fuel filling station. Emissions are generated from gasoline and Diesel fuel vapors which are generated during the first fueling process of the vehicle. These vapors

[6] Plymovent AB.

escape when the air is displaced by the liquid fuel as the fuel tank is filled. Emissions also occur in this area due to spillage which occurs through worker error.

Vehicle Exhaust Pollutants

- Hydrocarbons (HC). Hydrocarbon emissions result when fuel molecules in the engine do not burn or burn only partially. Hydrocarbons react in the presence of nitrogen oxides and sunlight to form ground-level ozone, a major component of smog. Ozone irritates the eyes, damages the lungs, and aggravates respiratory problems. A number of exhaust hydrocarbons are also toxic with the potential to cause cancer.
- Nitrogen oxides (NOx). Under the high pressure and temperature conditions in an engine, nitrogen and oxygen atoms in the air react to form various nitrogen oxides, collectively known as NOx.
- Carbon monoxide (CO). Carbon monoxide is a product of incomplete combustion and occurs when carbon in the fuel is partially oxidized rather than fully oxidized to carbon dioxide (CO2). Carbon monoxide reduces the flow of oxygen in the bloodstream and is particularly dangerous to persons with heart disease.
- Carbon dioxide (CO2). In recent years, carbon dioxide, a product of "perfect" combustion, is viewed as a pollution concern. Carbon dioxide does not directly impair human health, but it is a "greenhouse gas" that traps the earth's heat and contributes to the potential for global warming.
- Diesel exhausts. Workers exposed to Diesel exhaust face the risk of adverse health effects:

Short-Term (Acute) Effects

Workers exposed to high concentrations of Diesel exhaust have reported the following short-term health symptoms:

- irritation of the eyes, nose, and throat;
- lightheadedness;
- feeling "high"
- heartburn;
- headache;
- weakness, numbness, and tingling in extremities
- chest tightness;
- wheezing;
- vomiting.

Long-Term (Chronic) Effects

Although there have been relatively few studies on the long-term health effects of Diesel exhaust, the available studies indicate that Diesel exhaust can be harmful to your health. According to the National Institute for Occupational Safety and Health (NIOSH), the International Agency for Research on Cancer (IARC), the Environmental Protection Agency (EPA) of the US, Diesel exhaust should be treated as a human carcinogen (cancer-causing substance).

Evaporative Emissions

- Hydrocarbon pollutants also escape into the air through fuel evaporation. Evaporative emissions occur several ways:
- Diurnal: Gasoline evaporation from the fuel tank and venting gasoline vapors.
- Fueling: Gasoline vapors are always present in fuel tanks. These vapors are forced out when the tank is filled with liquid fuel.
- Idling Vehicle Emissions. There are situations in which estimates of emissions from idling vehicles are needed. As with driving emissions, idle emissions are affected by a number of parameters. For analyses not requiring detailed specific emission estimates tailored to local conditions, this summary of idle emission factors can be used to obtain first-order approximations of emissions under idle conditions (e.g., drive-through lanes).

Mitigation Measures

Process related measures to reduce occupational exposure to vehicle exhausts and fuel vapors.

- Separation of areas followed the engine starting from the rest of assembly line by creating a positive pressure buffer zone;
- Utilization of gasoline filling nozzles with a built-in vapor recovery system. With this system, as the gasoline enters the fuel tank, the displaced vapor is collected through a vacuum intake located concentrically with a nozzle near the filler neck of the tank as the nozzle spout is inserted. The captured vapors are transferred back to the storage tank. The capturing efficiency of these systems is greater than 95%, i.e., per each liter of dispensed gasoline. More than 0.9 liters of the vapors are captured. Diesel fuel is much heavier and does not create as much of a vapor emission problem as gasoline does.
- Utilization of onboard exhaust filters for driving the vehicles in the assembly shop. EHC filters are connected to exhaust pipes with a plastic adapter and will have a filter life of approximately 5 –10 minutes. Particles, smoke and soot with the size down to 0.1 mk are separated in the filter with up to 99% efficiency. Oxides of nitrogen (~60%) and hydrocarbons (~35%) are absorbed on the filter surface. The filter also reduces the concentration of carbon monoxide by 5-25%. The filter cartridge is disposable as normal industrial waste. Filters are available for different sizes of exhaust pipes on cars and trucks with gasoline and Diesel engines, primarily used for vehicle transportation with short running times such as plant exiting or ship board loading or unloading.

Ventilation

Ventilation systems in the Tyre manufacturing department typically consist of local exhaust ventilation systems to control vehicle exhaust and contaminant emissions from contaminant producing areas and a general ventilation system. General ventilation is needed to dilute the contaminants released into the building that are not captured by local ventilation systems. General ventilation systems supply make-up air to replace air extracted by local exhaust systems. Also, supply air is used to heat and cool the building. Buildings should be pressurized to prevent air infiltration creating cold drafts in winter and hot humid air in summer.

7.2.4 Effluent Discharge of Tyre Manufacturing Department and Effluent Treatment

The Tyre industry's wastewater not only contains high levels of suspended and total solids such as oil, grease, dyestuff, chromium, phosphate in washing products, and coloring, at various stages of manufacturing but also, a significant amount of dissolved organics, resulting in high BOD or COD loads. Effluent Treatment Plant is also proposed for the Armstrong ZE Tyre Manufacturing Factory, having the total area of 3880 m^2 or 41764.32 $ft^2$and the design of the treatment plant is presented as annexures in Site Layout Design.

Effluent Treatment is a Complex process and requires site specific design. Most plants cannot discharge the wastewater to a municipal system without treatment. Thus the treatment of wastewater coming out from different industries is a must as per the provincial and national standards.

The waste coming out from the Tyre processing Operations includes different types of wastes. These wastes are mixed together homogenously in an Equalization tank, where they are blended together to get the characteristics of the final waste that will be further treated.

As discussed earlier, Effluents come from various process stages, with the bulk of the pollutant charge steaming from:

- Bath purges
- Rinses after phosphatation
- Rinses after passivation
- Eluates from the recycling installations

Surface treatment discharges numerous types of pollutants depending on the type of treatment used. Those most commonly found in effluents are oils, chromium and phosphates to which are added the solvents and binding agents discharged by the cataphoresis baths (heavy COD charge).

A physical-chemical treatment (oil removal, metal abatement, etc.) is usually used to treat the effluents, followed by a biological treatment for COD abatement. The treatment is carried out in following steps;

Primary Treatment

Fine Screening

It involves fine screening using filters.

Disc filters:

- The water to be treated flows by gravity into the filter segments from the center drum. Solids catch on the inside of the filter panels mounted on the two sides of the disc segments.
- As the solids catch on the inside of the filter media impeding the flow of water through the disc, the water level inside the discs begin to rise, triggering a level sensor to start the disc to rotate and a backwash cycle begins.
- High pressure rinse water wash the solids off the filter media into the solids collection trough. Typically, the backwash requires 0,05-3% of the total filtered water flow.

Drum filters:

The water is filtered through the periphery of the drum. Backwash of the filter is only required according the loading of particles.

Assisted by the filter panels special cell structure, the particles are carefully separated from the water during backwash.

Separated solids are rinsed off the filter cloth into the solids collection trough and discharged.

Belt filter:

Sludge or wastewater is led into the filter 1 and passes by gravity through the filter belt 2.

The belt is designed as a slowly moving conveyer installed in a stainless-steel tank. As the water passes through the filter, the filtering process ensures the efficient removal of particles. These particles are drained on the belt to a high dry matter content. The dewatered sludge is removed at the top of the filter 3 and discharged through a hopper 4 for final treatment.

The belt is further cleaned by a high-pressure backwash system 5 and the rinse water is led either back to the process or to further treatment.

The Belt filter is normally operated intermittently (demand) controlled by a level switch.

High Speed Clarification

High speed clarification is a high rate compact water clarification process in which water is flocculated with micro sand and polymer in a draft tube. The microsand enhances the formation of robust flocs and acts as ballast, significantly increasing their settling velocity. The unique characteristics of the resulting microsand ballasted flocs allow for clarifier designs with very short retention times, high rise rates and extremely compact system footprints that are up to 50 times smaller than other clarification processes of similar capacity.

Secondary Treatment

Aerobic: Bio-filtration

It is a simple and innovative process, enabling removal of pollution in a compact structure, thereby presenting a low environmental footprint.

The process is able to eliminate all pollution, both organic (COD and BOD), nitrogenous ($N\text{-}NH_4$ and $N\text{-}NO_3$) and particulate compounds (TSS).

The modular design of the process makes it a suitable tool in cases of variable load as part of the cells can be stopped and restarted quickly.

As a biofilter, the process combines in a single structure:

- a biological reactor
- a physical filter to store the biomass and stop particulate pollution

Aerobic: Activated Sludge:

The process reduces to a minimum the content of nitrogen and phosphorus in wastewater in addition to significantly reducing organic matter (BOD), ammonia and suspended solids.

Furthermore, it eliminates odor nuisances as the sludge is stabilized in the process. The oxidation ditch system consists of an anaerobic tank located before two interconnected biological tanks of equal volumes and a final settling tank. The biological tanks work in an alternating mode of operation and are equipped with aerators, inlet distributors and outlet chambers. The process combines functional design with an outstanding flexibility and highly adaptable operation.

Tertiary and Specific Treatment

Heavy Metals Removal without Sludge Generation:

A process is capable of removing heavy metals (arsenic, cadmium, lead, zinc, nickel, iron, manganese, arsenic, uranium etc.) from different types of water, including industrial wastewaters. The process provides up to 99% treatment of the water and thus meets the EU drinking water directive.

The waste product is fine-grained granules with strong and stable metal bonds and the final deposits represent only about 10% of normal sludge volumes.

Sludge Disposal

Sludge will be disposed through SEPA certified contractor.

7.2.5 Noise

The cumulative noise level within the Tyre Manufacturing plant is higher as there are several high noise impact activities during operation Processes, It may occur due to accelerating, antioxidants and in mixing process, calendaring operation and green Tyre spraying etc.

Mitigation Measures

- Noise control devices will be used such as noise barriers and deflectors for high noise impact activities.
- Ensure the strict compliance of Personal Protective Equipment (Ear muff, ear plugs, etc.) in high noise areas.

7.2.6 Soil Contamination

During the Handling of chemicals there are chances of leaks, spills, and accidental mixing of incompatible chemicals. The potential for accidental spills and leaks is highest at the point of transfer of thinners from bulk drum storage to process equipment.

Mitigation Measures

- Material should never be poured directly from drums to small containers.
- Secondary containment should be provided in order to prevent the soil contamination.
- Spigots or pumps should always be used to transfer waste materials to storage containers.
- Do not handle chemicals with bare hands, no matter how harmless you may think they are.
- After handling chemicals, hands should be washed prior to eating or drinking.
- Chemicals that can produce fumes, dusts should always be handled in a well-ventilated area. Use of containment devices such as fume hoods, and gas cabinets

is particularly advisable. A fume hood, glove box or other appropriate exhaust ventilation is necessary when handling particularly hazardous substances.
- Do not eat and drink while working with chemicals.
- Do not light a match or smoke tobacco close to inflammable chemicals.
- Use appropriate devices like funnels or spatulas when transferring chemicals from one container to another or when mixing chemicals.
- Keep work surfaces and containers clean.
- Use corrosion-resistant tools and equipment.

7.2.7 Waste Stream & Sludge

The Tyre Manufacturing Processing waste streams in which black carbon solids are combined with the wastewater from the cleaning operations. Cleaning and maintenance of the mixing machine for Tyre chemicals are producer of hazardous sludge.

Mitigation Measures

- Ensure no wastewater run out from the washing area while washing and other activities takes place, waste stream should be connected to wastewater treatment plant.
- Sludge should be separated from the wastewater and consider hazardous waste and disposed of environmental friendly with the third-party certification.

7.2.8 Surface Water and Groundwater

In the immediate north of the proposed project site, Khari Seer Distry, a canal water channel runs along the northern boundary of the plot, which receives water from Jam Branch. The water to be used in the plant during operations will be obtained from local water supply sources in the area. Operation of the proposed plant would cause an increase in treated process wastewater discharges to the sewer. In addition, storm water discharges may increase as a result of the increase in impervious surfaces.

The position of groundwater table for each borehole is presented in the annexures as Geotechnical Soil Investigation Report. The depth of groundwater at project site generally ranges from 1.30m to 1.62m.

During operations accidental spills of toxic substances, such as hydrocarbons, could be a potential source of groundwater contamination. As stated above, the potential for contamination to occur would be minimized.

Mitigation Measures

The effluent and wastewater from the facility will be routed to Wastewater treatment plant and will be discharged to the local sewer/waste drainage system of Armstrong ZE Tyre Manufacturing Factory and will not be dumped in open land.

7.2.9 Vegetation and Fauna

Other than maintenance of grass areas surrounding the Proposed Project, operations of the plant are not anticipated to cause adverse impacts to vegetation.

Operation of the plant is not anticipated to create additional disturbance to wildlife other than the mowing of established grassy areas.

7.2.10 Solid and Hazardous Waste

Solid wastes may arise from several sources during assembly and the majority of wastes by volume result from packaging - reusable or disposable. Reusable packaging covers metal racks, bins and containers and disposable packaging covers wood pallets, cardboard, plastic, polystyrene and polythene film.

The estimated amount of total waste generation will be 656,894 kg per 13,137,880 kgs of final products

The solid waste would be generated from the plant may include:

- Scrap metal, which is normally recycled off-site.
- Sludge generated by wastewater treatment facilities of manufacturing plants.
- Additional wastes arise from general operations, cleaning and maintenance and the disposal of faulty equipment and parts.
- Improperly disposed of waste can lead to pollution and ground contamination.

Mitigation Measures

- Return packaging of hazardous and non-hazardous materials (wherever possible), such as empty drums, to supplier for reuse.
- Recycle packaging wherever possible.
- Develop and implement a waste management plan covering all aspects of waste treatment on site. Wherever possible, priority should be given to reduction of wastes generated, and recovery and re-use of raw materials

7.2.11 Transportation and Traffic

The Proposed Project would be expected to result in an increase of several dispatch trucks per week in and out of the property after the new plant is fully operation. This additional truck traffic would constitute the percentage of the current truck traffic on the internal roads, Gharo-Keti Bunder Highway and on N5 in either direction. The additional trucks would use the established truck routes currently in place. The additional truck trips to the site would be easily accommodated within the existing roadway and intersection network.

The Proposed Project would generate a minor long-term increase in privately-owned vehicle traffic. The proposed plant would operate 24 hours a day, 7 days a week. The new workers would be split among operation shifts, thus reducing the impact on traffic. The additional vehicle traffic would be less than 1 percent of the current Annual Daily Traffic count on the road, and therefore would generate a negligible impact. Proposed Project is an addition in an existing industrial land that currently has one industrial facility which operates production equipment and has existing truck and personal-vehicle traffic, therefore, this small increase in vehicle traffic would have only a minor impact to the surrounding community.

7.2.12 Possible Impacts due to Hazardous Substances on Site

Hazardous chemicals and process gases may be used in the assembly process of heating and mixing of Tyre raw materials. Hazardous properties relating to these substances are many and varied and include flammability, combustion potential, toxicity, corrosive potential and oxidizing potential. Chemicals with such properties should be labelled with the appropriate internationally recognized hazard symbol.

Some chemicals may only possess a hazard potential if they have the opportunity to react with other compounds.

Inadequate control or accidental releases of hazardous substances on site or in transit may result in significant environmental impacts in relation to soil, groundwater and surface water contamination and occupational health and safety e.g. disposal of empty drums and packaging of fuel and chemicals.

Mitigation Measures

- Hazardous Substances will be handled in accordance with Hazardous Substances Rules 2014.
- Chemicals with different hazard symbols should not be stored together - clear guidance on the compatibility of different chemicals can be obtained from the Materials Safety Data Sheets (MSDS) which should be readily available from the manufacturer and on site.
- Store chemicals in a dedicated, enclosed and secure facility with a roof and a paved/concrete floor. Chemical tanks should be completely contained within secondary containment such as bunding.
- Install devices to prevent spills and overfills, e.g. alarms to warn of overfilling and automatic shut-off devices or a secondary spill containment.
- Maintain and inspect storage units regularly.
- Consider installation and use of groundwater monitoring points on site to check for contamination. Implement a Solvent/Hazardous Materials Management Plan to monitor and control the use of solvents and hazardous materials on site.

All chemicals handling, transportation, and disposal should be done in accordance to the procedures defined in Management Plan.

A. Transport of Chemicals

Impact level-Medium

During the transport of chemicals there are chances of Spillage of chemicals and environmental contamination.

Mitigation Measures

- Information specified in sub-rule (1) of rule 21 of Hazardous Substance Rules, 2014 will be followed.
- Remove all sharp objects from the loading area of the transporting vehicle before loading the chemicals.
- Transport hazardous chemicals separately from food items.
- Ensure that the consignment is secure when you transport hazardous chemicals.
- Never keep hazardous chemicals near the driver's seat or on the passenger's seat.
- Do not carry heavy chemical containers on your shoulder or on your head. Use a trolley to carry them.

B. Storage of Chemicals

Impact level-High

Storage of chemicals can cause chemicals degradation and can become more hazardous in storage

Mitigation Measures

- Chemicals should always be stored in a cool, dry environment far from busy work areas.
- The quantities of hazardous chemicals should be kept to a minimum, in line with efficient operation, their usage and shelf life.
- Hazardous chemicals should be clearly marked.
- MSDSs for each chemical should be available.
- Chemicals must not be stored with foodstuffs, personal use products or personal protective equipment.
- Ensure chemical containers and their seals or stoppers are appropriate for the type and quantity of chemicals stored. As far as is practicable, chemicals should be stored in the containers in which they are supplied.
- Incompatible chemicals are segregated from one another (e.g. by fire isolation in a chemical storage cabinet or segregation in space).
- Chemicals should be stored in such a manner that leaks cannot affect other substances in the store. Liquids should not be stored above powders and solids.
- Packages are inspected regularly to ensure their integrity. Leaking or damaged packages are removed to a safe area for repacking or disposal immediately. Labels are reattached or replaced, as necessary, to clearly identify the contents of the package.
- Chemicals are stored away from any heating and ignition sources.
- Sunlight can affect some plastic containers or the chemical contents. Containers and chemicals must not be stored in a location where they can be exposed to direct sunlight.
- Secondary containment should be available.
- Stockpiling of hazardous chemicals should be avoided.

C. Disposal of Chemicals

Impact level-High

Improper disposal of chemicals can generate hazardous waste.

Mitigation Measures

- A waste management plan will be developed and includes information specified in sub-rule (1) of rule 19 of Hazardous Substance Rules, 2014.
- Place hazardous waste in containers prior to disposal. Containers should be filled, leaving headspace for expansion of the contents and should prevent leakages.
- Use appropriate container for disposing chemical waste.
- Similar wastes may be mixed only if they are compatible.
- Do not discard waste chemicals into sink drains, with general waste, liquid wastes or with municipal solid waste.
- It is the chemical user's responsibility to identify and properly label all chemical wastes.
- Contact your waste collection contractors when you want to dispose of chemicals. They should be notified as to the hazards of that particular chemical. They would then know the appropriate method and place of disposal.

D. Fire Hazards

Impact level-High

There is always risk of fire associated with chemicals.

Mitigation Measures

- Fire Alarms should be installed.
- Water Sprinklers should be installed.
- Fire extinguisher arrangements will be ensured.
- Fire extinguisher should be easily accessible.
- Proper signage for Fire Exist in the laboratory as well as in the factory should be made.
- Use extinguishing media appropriate for surrounding fire. Foam, Carbon dioxide, dry chemical powder where necessary.
- Do not use a water jet since it may cause the fire to spread.

E. Chemical Spills

Impact level-High

Spills of chemical can cause soil and water pollution.

Mitigation Measures

- Chemicals will be stored in covered and bounded areas, underlain with impervious lining.
- Regular inspections will be carried out to detect leakage in machines.
- Contaminated soil will be removed and properly disposed after treatment such as incineration etc.
- In case of hazardous chemicals spill, evacuate the area immediately. Isolate the hazard area. Keep out unnecessary and unprotected personnel. Use personal protective equipment as required. Remove or isolate incompatible materials as well as other hazardous materials. Contain and soak up spill with absorbent that does not react with spilled product. Shovel or sweep dry sodium hydroxide for recycling or disposal. Flush spill area. Dike spilled product to prevent runoff.

F. Occupational Health and Safety

Impact level-High

Transport, handling and storage of chemicals can cause Injury and illness.

Mitigation Measures

- A safety plan will be developed and includes information specified in sub-rule (1) of rule 17 of Hazardous Substance Rules, 2014.
- Information specified in sub-rule (1) of rule 11 and rule 12 of Hazardous Substance Rules, 2014 will be followed.
- Health surveillance of workers exposed to noise, hazardous chemicals and particulates.
- Investigation of incidents.
- Adoption of safe working practices.
- Showers and eye washers should be available.
- Use of PPEs (Gloves, Mask, goggles, coverall and etc.).
- Visible, illustrative and easily understood warning signs will be placed in all hazardous areas.
- Regular health and safety trainings will be provided to all workers and all new workers will be provided training prior to work;
- Chemicals will be handled with care and stored properly.

7.2.13 Occupational Health and Safety Aspects

Hazardous chemicals and process gases may be used in the assembly process of Tyre Manufacturing. Hazardous properties relating to these substances are many and varied and include flammability, combustion potential, toxicity, corrosive potential and oxidizing potential. Chemicals with such properties should be labelled with the appropriate internationally recognized hazard symbol. Some chemicals may only possess a hazard potential if they have the opportunity to react with other compounds.

Chemical exposure

Chemicals involved in the Tyre Processing facility may have a wide range of hazardous effects, including being toxins, carcinogens or highly corrosive upon skin contact. Direct skin and eye exposure to and/or inhalation of hazardous chemicals can result in health impacts for workers. Prolonged exposure over years can induce chronic health effects. Particular substances to be aware of include:

Coating powder. Some components of coating powders can cause irritation of lungs, eyes and skin and allergic skin reactions. They can also cause long-term health effects or asthma.

Curing agents. Some curing agents may damage genetic material, which could cause some diseases including cancer and impaired fertility.

Organic solvents. The most commonly used solvents for degreasing are chlorinated solvents such as trichloroethylene, dichloromethane (methylene chloride) and perchloroethylene. These substances may be harmful to health if inhaled. The ill-health effects from inhalation would depend on the substance in use and the concentration and length of exposure. At high concentrations, all organic solvents exert a strong narcotic effect and can be fatal. Skin exposure can cause irritation and dermatitis.

Noise and Vibration

Vehicle assembly plants can be noisy work places due to the high level of use of machinery. Transport of products by road may also generate noise. Those at risk include machine operators and those working nearby, e.g. maintenance staff, cleaners, forklift truck drivers and shop floor supervisors.

Noise may reach levels that are hazardous to health, leading to symptoms associated with permanent deafness. Noise, particularly during unsocial hours, may cause annoyance or disruption to local communities.

Hand-arm vibration syndrome from the prolonged use of vibrating tools and machinery causes effects on the body's blood circulation known as 'vibration white finger' (VWF). Other damage may be caused to the nerves and muscles of the fingers and hands causing numbness and tingling, reduced grip strength and sensitivity. Pain and stiffness in the hands, and joints of the wrists, elbows and shoulders are other possible symptoms.

Machinery

Moving parts of machinery can result in entanglement and entrapment. Particular attention should be paid to the following situations:

- Handling sheet or strip metal.
- Handling of small pieces of metal with sharp edges during work at presses.

- Accidental contact with scrap metal, banding or swarf, principally during cleaning and disposal.
- Contact with machinery blades, cutters or tools during use and when fitting, removing, cleaning or storing.

Manual handling and repetitive work

Lifting and carrying heavy or awkwardly shaped objects, such as bags, can result in manual handling injuries.

Slips, trips and falls

These are primarily caused by uneven surfaces, inappropriate footwear, poor lighting, weather conditions, trailing cables and pipe work, especially during unblocking, maintenance and cleaning activities.

Working hour's Long hours or night shifts can lead to fatigue, decrease wellbeing and ability to concentrate.

Mitigation Measures

Chemical exposure

- Provide personal protective equipment (PPE) that is fit for the task to prevent injury and maintain hygiene standards. Train staff in the correct selection, use and maintenance of PPE, and put in place measures to encourage/ mandate its use.
- Implement a Programme of assessment of routine monitoring of worker health.

Noise and Vibration

- Conduct a noise survey and mark out dedicated areas with signage where there are elevated noise levels and PPE is required.
- Enclose noisy machines to isolate people from the noise where practicable.
- Reduce vibration exposure times and provide PPE where people may be exposed to vibration.
- Limit scrap handling and transport during unsocial hours to reduce noise.

Machinery

- Train staff in correct selection, use and maintenance of PPE.
- Train workers in correct use of machinery and safety devices.
- Avoid direct handling of sharp edged items and/or remove sharp edges by machining.
- Engineer out sharp edges and access to dangerous parts of machinery through a hierarchy of controls (permanently fixed physical barrier, interlocked physical barrier, physical barrier, presence sensing system).

Manual handling and repetitive work

- Redesign manual processes and rotate work tasks to reduce heavy lifting/repetitive activities, and where possible install mechanical lifting aids.
- Train workers in correct lifting technique.

Collision

- Separate people from moving equipment:

- Ensure that the process layout reduces opportunities for process activities to cross paths; and
- Install safeguards on moving parts of conveyor belts to reduce the risk of entrapment of employees.
- Install walkways to separate people from vehicle movements to reduce risk of collision.

Slips, Trips and fall

- Ensure that walkways are constructed of non-slip materials and route cables and pipework under walkways.

Working Conditions

- Implement a Programme of routine monitoring of worker health.
- Implement a grievance/dispute resolution mechanism for workers.

Asbestos

Remove friable asbestos and PCBs using licensed contractors. This should be carried out in controlled conditions to ensure that there is no release of substances or materials to the environment.

7.3 Socioeconomic Impacts

The Proposed Project would result in hundreds of new jobs during the construction and even when the plant is fully operational. It is assumed that the majority of the workforce would be drawn from the Karachi city; therefore, no increase in population or major need for housing is anticipated. A breakup of possible workforce requirement during the construction and operation of proposed Tyre manufacturing plant is given below;

Secondary jobs may result from the increased economic activity stimulated by the Proposed Project. Additional retail services and business employment may result from the Proposed Project through a multiplier effect, yielding additional sales and income tax revenues for local and provincial governments. Armstrong ZE Tyre Factory will have a real impact on employment opportunities and will generate direct employment as well as will create multiple indirect jobs in downstream industries.

The Proposed Project would not result in direct impacts to community facilities, services, school systems, or emergency services of the area because significant numbers of employees are not anticipated to relocate as a result of the Proposed Project.

7.4 International Finance Corporation (IFC)'s Environment, Health and Safety (EHS) Guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS guidelines in the context of Tyre Manufacturing facility is tabulated as follows;

Domain	Guideline	Applicability	Applicability on the Project
Environmental	Air Emissions and Ambient Air Quality	This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle.	As discussed in detail, that there are air emissions during the construction phase and operation phase of the Tyre manufacturing project. Operation phase emission including emissions. Therefore, the Air Emissions and Ambient Air Quality guidelines will be followed during the course of project.
	Energy Conservation	This guideline applies to facilities or projects that consume energy in process heating and cooling; process and auxiliary systems, such as mixing, milling, blending of elastomers, ventilation and air conditioning systems (HVAC); and lighting systems.	The Tyre Manufacturing facility requires general ventilation as well as process and shop specific ventilation.
	Wastewater and Ambient Water Quality	This guideline applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment.	The process effluent from Tyre processing procedures will be treated in the wastewater treatment plant before discharging into the sewer. Therefore, these guidelines will be followed.
	Water Conservation	Water conservation programs should be implemented commensurate with the magnitude and cost of water use.	Since the auto manufacturing process consumes water, these will be followed.

	Hazardous Materials Management	These guidelines apply to projects that use, store, or handle any quantity of hazardous materials (Hazmats), defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics.	Proposed project process involves the use and handling of hazardous Volatile Organic Compounds (VOCs), therefore these guidelines will be followed.
	Waste Management	These guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors.	The construction and operation phase of the proposed plant will generate solid waste such as food waste, paper, plastics, glass, scrap, etc. Therefore, these guidelines will be followed.
Occupational Health and Safety	Occupational Health and Safety	This provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety.	Occupational health and safety will be given due consideration in operational and construction phases of the proposed plant.
Community Health and Safety	Community Health and Safety	This section complements the guidance provided in the preceding environmental and occupational health and safety sections, specifically addressing some aspects of project activities taking place outside of the traditional project boundaries, but nonetheless related to the project operations, as may be applicable on a project basis.	The project facility to will not discharge any untreated effluent or pollutant in the environment so it will not cause any nuisance, safety or health issue to the nearest located communities. However, the guidelines will be followed.

Construction and Decommissioning	Construction and Decommissioning	This provides additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project Life-cycle, or due to expansion or modification of existing project facilities.	Since the project involves major construction activities as well as plans for expansion, these guidelines will be duly followed.

8 Environmental Management Plan (EMP)

This Chapter presents an environmental management plan (EMP) as the implementation mechanism to manage environmental and social issues and mitigation measures identified in Chapter 7 on screening potential environmental impacts and mitigation measures.

8.1 Objectives of Environmental Management Plan

The EMP shall help Armstrong ZE Pvt. Ltd., the Proponent, in addressing the adverse environmental impacts due to the project, enhance project benefits, and introduce standards of good environmental practice. The primary objectives of the EMP are to:

- Outline functions and responsibilities of responsible persons.
- State and implement standards and guidelines which are required under environmental legislations particular in context to the project.
- Facilitates the implementation of the mitigation measures by providing the technical details of each project impact, and proposing implementation schedule of the proposed mitigation measures.
- Define a monitoring mechanism and identify monitoring parameters to ensure that all proposed mitigation measures are completely and effectively implemented.
- Identify training requirements at various levels and provide a plan for the implementation of training sessions.

8.2 Purpose of EMP

The purpose of the EMP is to ensure that the activities are undertaken in a responsible non-detrimental manner with the objectives to: (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental examination conducted for the project; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the project; and (iv) ensure that safety recommendations are complied with them.

8.3 EMP Process

The EMP describes the methods and procedures for implementation of following areas:

- Organizational structure and roles and responsibilities of the project of project personnel.
- Specific requirements for the implementation of the EMP
- Mitigation or impact management matrix
- Monitoring plan with the emphasis on specific parameters to monitor

In general, monitoring is a part of EMP, however, it may be described or taken as separately to make it essential part of work.

8.4 Management Approach

Management will undertake overall responsibility for compliance with the EMP. It will ensure that all the activities that the management executes comply with positive environmental sensitivities as well as it will cooperate with the concerned regulatory agencies such as Sindh Environmental Protection Agency (SEPA).

The dynamic approaches that are followed towards successful implementation of the environmental management plan listed below:

- Compliance with the relevant legislative and regulatory requirements of the project.
- Developing appropriate monitoring indicators in order to assess the performance as well as magnitude of impact on the environment.
- Regular review of the project activities and assessing their impacts on the environment.
- Setting project's key environmental concerns and addressing issues through public support, awareness and publicly reporting its progress.
- Communicating broadly with internal and external stakeholder on issue of environmental concerns.

8.5 Maintenance of EMP

EMP needs to be revised on periodic basis to maintain up-to-date environmental management requirements with the changing physical and regulatory constraints. Therefore outlining and defining the responsibilities of personnel and activities under the project's operation execution, implementation, operation & monitoring and decommissioning phase are integral part of maintenance of the EMP. Dissemination of reviewed and revised EMP need to be notified to all stakeholders particularly, relevant government and municipal agencies so that their modified role is also redefined and re-established in the overall environmental management process.

8.6 Organizational Structure for Safety, Health & Environmental Management

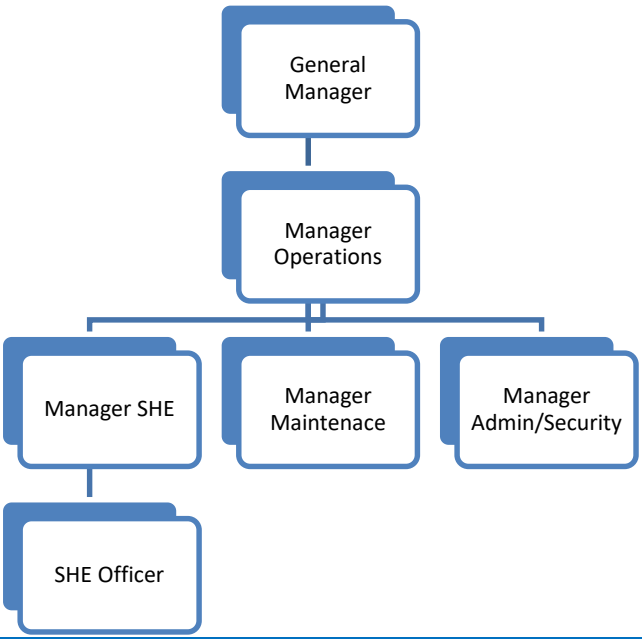


Figure 8.1: General Organizational Structure for Environmental Management

8.7 Roles and Responsibilities

Environmental management is an integral part of the Company's Integrated Management System Policy which reflects that Company's commitment to reduce the environmental impacts to ensure good environmental performance of the automotive facility. The responsibility for environmental performance lies with the General Manager and Manager Operations of Armstrong ZE Tyre Manufacturing Factory while daily management will be supervised under the direction of SHE Manager. It is recommended that at least one SHE Officer shall be working under the head of the SHE Manager during operation phases. A brief structure of roles and responsibilities is given below:

8.7.1 Manager Operations

Environmental management plan will be regulated by Manager Operations. He will be responsible to report to the General Manger, who will be the decision making authority. Some of the important roles to be provided by Manager Operations are given below:

- To consider and react to issues and solutions by the SHE department.
- To cooperate and consult with the environmental agency in order to perform in better way.
- To evaluate the progress of development and implementation of the management plan.
- To approve any change in decision making system in consultation with Manager SHE, if appropriate.

8.7.2 SHE Manager

The role of SHE manager is vital for the reason that the success of the Environmental Management Plan (EMP) always depends on the performance of the SHE Manager. Following are some of the roles and responsibilities that should be designated to the SHE Manager.

- To identify issues and where possible propose solutions for inclusion in the management plan review process.
- To ensure that the points and views of staff and SHE Officer are considered and appropriately incorporated in the EMP accordingly.
- To improve coordination and exchange of information between top management, employees, contractors etc.
- To contribute towards the actions to deliver the management plan and ensure its continued development.
- To review EMP every year, taking issues and change the EMP accordingly with the solutions and suggestions.
- To monitor the progress and development and implementation of the management plan.

8.7.3 SHE Officer

The role of SHE officer will be authorized by the SHE Manager. The key responsibilities of the SHE Officer include:

- To integrate, as far as possible, the aims and objectives of different users within an agreed plan.
- To maintain balanced, holistic approach to the solution of concerned issues in accordance with the compliance to the legislative requirements.
- To provide professional guidance on questions relating to the environment management and issues raised by contractors/ relevant personals.
- To progress the EMP process through development towards implementation.

8.8 Environmentally Sound & Safe Working Procedures

Contractors, sub-contractors and contract workers will be made aware of environmental aspects and Emergency Response Plan prior to commencing the work. Prior to leaving the site contractors, sub-contractors and contract workers will ensure that their work area is in safe position. On emergency call they will report in assembly area. Written procedures or standards will be prepared for all activities, where the absence of such procedures and standards could result in not following HSE policy, the law or the contract.

Safe Working Procedures will be based on the following four aspects of job safety:

- **Safe Place:** Work site will be designed and controls set up to ensure that working environment provides no significant risk to personnel, property and the environment.
- **Safe Equipment:** All equipment for any job, including tools, machinery and protective equipment will be specified and/or designed to ensure that it poses no significant risk to personnel, property or the environment. All equipment will comply with legislative standards for conformity and test.
- **Safe Procedure: Procedures** will be designed for all aspects of the job to facilitate safe use of equipment at the work site to complete tasks with no significant risk to personnel, property or the environment. Design of procedure will be based on step-by-step analysis of the tasks involved (Job Safety Analysis), identification of associated hazards and elimination of control of those hazards. Procedures should allow for work in ideal conditions as well as under aggravating conditions e.g., adverse weather.
- **Trained Personnel:** Suitable job-specific, safety skills and supervision training will be provided to personnel involved in construction and operation activities so that they are able to use the procedure and equipment at the worksite with no significant risk to personnel, property and environment.

Safe Working Procedures will be available to contractors and sub-contractors, who will adopt the relevant labor laws of the country.

8.9 Identification of Safe Environmental Aspects

EMP will identify Environmental aspects at the initiation of activities at the site with regard to:

- Disposal of excavated material and solid waste to land, water and air
- Noise quality
- Emissions of fugitive dust and Volatile organic compounds (VOCs)
- Discharges of liquid effluent including oily waste and seepage to land
- Consumption of natural resources and energy

8.10 Environmental Management

Environmental management will be the key priority of the administration of Armstrong ZE Pvt. Ltd. Commitment to execute all project activities with an attempt to keep intact the environmental integrity of the project area will be the core objective of the implementation of the EMP. The duties regarding environmental responsibilities on various activities will be clearly assigned to the appropriate individuals.

During the construction phase of the proposed project, responsibility to implement the EMP as per environmental requirement would be that of the Contractor who would ensure that none of the activities during project activities would impact the environmental quality. When the project will enter its operational phase, it will be the responsibility of the project manager or admin to confirm that performance is being monitored regularly.

Surveillance and monitoring of the project activities and its status to be carried out on periodic basis in order to identify any process or activity which is creating occupational risk or degrading the environment in any way. On the basis of the findings of the above surveillance and monitoring, EMP will be revised and modified as deemed necessary by the surveillance and monitoring team.

8.11 Emergency Response Plan

Armstrong ZE Pvt. Ltd. would implement the Emergency Response Plan during the construction and operation stages. The Emergency Response Plan during the construction and operation periods will be managed and monitored by the Armstrong ZE Pvt. Ltd. Management. The Response team will ensure that the operations are carried out in time avoiding any fire, safety and security hazard and those affecting the environment. The team will be in readiness to adopt the following procedure:

- Evaluation of the situation to identify the most important steps, which must be taken first and can have an important bearing on the overall action to be taken.
- Deployment of required manpower and equipment.
- Organizing required logistical support so that there are no bottlenecks hampering the construction work.
- See to it that injured persons are cared for.
- Respond to calls for ambulances for shifting the injured persons to neighborhood hospitals/healthcare units.
- Isolate all sources of ignition and environmental hazard.
- Evacuation of people who are in immediate or imminent danger. Response Team and/or in-charge of the Campsite will exert positive leadership and give instructions calmly, firmly, explicitly, and courteously and obtain help of law enforcement agencies, if necessary.
- Block approach roads if necessary, for safety of operations.
- Surveillance and monitoring operations.
- Retrieval and disposal of earth/debris and resources affected by the hazard at appropriate site.
- Termination of clean-up operation.

8.12 Environmental Management Program

The following environmental aspects would require planned intervention by EMP for the proposed project by Armstrong ZE Pvt. Ltd.

Table 8.1: Mitigation Matrix for the Siting Phase of the Proposed Project

Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
Site Selection	Land acquisition	No mitigation measures is required because the project shall not involve any land acquisition issue and the proposed site area of 50.25 acres has been purchased by the proponent.	Proponent
	Archaeological Site	Project site has no sensitive areas such as protected sites including wildlife sanctuaries, game reserves or national parks, or any archaeological, historical or cultural heritage in its immediate neighborhood; as such its siting would have no sensitivity in this regard.	Proponent
	Site Ecology	-No tree cutting is anticipated since the project site is barren. In case, however, a mature tree is removed, it will be replanted in ratio 1:5. For immature tree, the compensatory plantation is in the order 1:3 -Any nesting grounds of wildlife and birds should be relocated -Steady vegetation, greening and ecological restoration shall be undertaken at the site -Effective measures shall be taken to protect the environment and control pollution so that restoration of regional ecology is ensured	Proponent
	Seismic Activity	-Construction of the project shall be undertaken keeping the seismic categorization in accordance the relevant zoning. -Construction material shall be used which could add to the bearing capacity of underneath soil.	Proponent / Design Consultant
	Drainage System	-The drainage system will be designed to accommodate the waste water generated siting activities. Project facility would have the drainage system and it will be improved with the project operation. -The drainage system must be connected to wastewater treatment plant before discharging into any water body.	Proponent / Design Consultant
	Ventilation System	Designing of the ventilation system should be based on following key criteria and data; -Meteorological data such as outdoor air temperature, humidity and wind is required for the design conditions for the system for two main seasons and respective system design requirement. -Indoor air temperature and velocity -Supply and exhausted air rates -Indoor Air Quality -Air Distribution Method Selection -HVAC equipment selection	Proponent / Design Consultant

Table 8.2: Mitigation Matrix for the Construction Phase of the Proposed Project

Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
Site Construction	Blocked Access	-Diesel and other petroleum products used for the operation of construction machinery and transportation equipment would cause air pollution besides causing soil pollution through oil spills. The impact from such activity would be of minor significance and would be controlled by good housekeeping practices. -Noise and visual impact will mainly be limited to the microenvironment comprising the project facility.	Proponent/ Construction Contractor
	Air Quality	The emissions from operation of construction equipment and machinery as well as generators are not expected to have been significant as to affect the ambient air quality of the area. The small amount of exhaust emissions from the operation of equipment's are expected to have any significant impact on the local air quality. Adoption of following mitigation measures to mitigate dust emissions will result in further reduction / prevention: -The Contractor will be required to have a dust abatement program that includes installing enclosures and covers around the boundary walls, spraying water on sand piles. -PPE, such as dusk masks, will be used where dust generation occurred. -Avoiding open burning of solid. -Care will be taken to keep all material storages adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions. -Fabrics and plastics for covering piles of soils and debris is an effective means to reduce fugitive dust. • Regular and periodic sprinkling of water on all exposed surfaces to suppress emission of dust. • Frequency of sprinkling may be increased to keep dust emissions under control, particularly during the mid-April to mid-June when wind is blowing at high speed and varying direction.	Proponent/ Construction Contractor

Table 8.2: Mitigation Matrix for the Construction Phase of the Proposed Project

Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		• Keeping the construction material in moist condition (if possible) at site. • Locating stockpiles away from the wind direction and covering it with tarpaulin or thick plastic sheets, to prevent dust emissions. • All routes within the project construction site facility will be paved providing hardened surface as early as possible upon the commencement of construction work. Other temporary tracks within the site boundary will be compacted and sprinkled with water during the construction works. • Construction traffic will maintain a maximum speed limit of 20km/hr on all unpaved roads within the proposed site. • Construction materials that are vulnerable to dust formation or those that comprise loose materials will be transported only in securely covered trucks to prevent dust emission during transportation. • The exposure of construction workers to dust will be minimized by providing dust masks. • All vehicles, generators and other equipment used during the construction will be appropriately tuned and maintained in good working condition in order to minimize exhaust emissions. • The stacks of the generators while in operation will be vented through vertical stacks to safe heights in order to minimize dispersions at ground level. • Diesel and other petroleum products used for the operation of construction machinery and transportation equipment would cause air pollution besides causing soil pollution through oil spills. The impact from such activity would be of minor significance and would be controlled by good housekeeping practices.	
	Noise Quality	-Noise control devices will be used such as temporary noise barriers and deflectors for impact activities. -Construction machinery will be kept in good condition to reduce noise generation.	Proponent/ Construction Contractor

Table 8.2: Mitigation Matrix for the Construction Phase of the Proposed Project

Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		The Contractor will need to ensure that machinery is adequately silenced	
	Soil Quality	Construction machinery will be kept in good condition in order to prevent the soil contamination. Spill kit should be available at site and drip trays are to be provided.	Proponent/ Construction Contractor
	Waste Management	• Selecting products that will cause no or minimal environmental impacts • Not generating waste, which would be achieved by changing or improving practices and design; • Reuse of materials, thus avoiding disposal; and • Special controls will be imposed to regulate storage, labeling, transport and disposal of residues, lubricants and other oily wastes (chemical wastes). • All construction waste shall be sorted on site into inert and non-inert materials. Non-inert materials such as wood and other materials including glass, plastics, steel and metals shall be disposed of to landfill. Inert materials like soil, sand, rubble shall be separated from non-inert material and disposed. • All vehicles carrying waste shall have properly fitted side- and tailboards, and the materials being transported shall be securely covered. • All works areas shall be cleaned of general litter and refuse daily. • General refuse and litter shall be stored in enclosed bins or compaction units separate from construction or chemical wastes. • Refuse shall not be burned at any Construction Area. • General refuse may be generated by food service activities on site, so reusable rather than disposable dishware shall be used if feasible.	Proponent/ Construction Contractor
	Geophysical Impacts	• Change in topography will occur but at project site • Visual changes to the landscape will require mitigation measures and adoption of conservation practices by designing the Project to address the aesthetic concerns and sanctity of sensitive structures.	Proponent/ Construction Contractor

Table 8.2: Mitigation Matrix for the Construction Phase of the Proposed Project

Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
	Water Resources	• Septic tanks and soak pits with appropriate design and capacity shall be constructed at each work and campsite for the disposal of domestic liquid waste • Untreated effluent from any works will not be released into the environment • Maintenance of vehicles and other equipment will be allowed only in designated areas underlain with concrete slabs and a system to catch runoff. Washing of vehicles will be restricted to few in number.	Proponent/ Construction Contractor
	Occupational Health and Safety	**A. Hazardous Substance Handling and Storage** Containers and tanks which are used to store hazardous substances shall be, • In good conditions • Compatible with the material stored inside • Closed when material is not being transferred into or withdrawn from them • Flammable or combustible liquids shall not be stored in areas used for exits, stairways, or normally used for safe passages. • Flammable chemicals shall be stored in flammable storage cabinets, room or building when the volume stored exceeds 25 gallons (95 liters). **B. Slips and Falls** • Good housekeeping practices, such as the sorting and placing loose construction materials in established areas, would be implemented. • Excessive waste debris and liquid spills will be cleaned up regularly. • Electrical cords and ropes will be located in common areas. • Slip retardant footwear will be used. **A. Struck By Objects** • Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap. • Appropriate PPE such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be wore.	Proponent/ Construction Contractor

Table 8.2: Mitigation Matrix for the Construction Phase of the Proposed Project

Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		B. Moving Machinery • The location of vehicle traffic, machine operation, walking areas, and controlling vehicle traffic will be planned and segregated through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic. • The visibility of personnel will be ensured by high visibility vests when working in or walking through heavy equipment operating areas as well as training of workers to verify eye contact with equipment operators before approaching the operating vehicle. • Inspected and well-maintained lifting devices will be used that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations. **C. Other Site Hazards** • Use of waste-specific PPE based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves and eye protection. • Comprehensive disinfection in the construction area should be conducted before construction. • Staff who will enter the area should be conducted a comprehensive physical examination, people who are suffering from infectious diseases is prohibited to enter the construction site. • When infectious diseases and food poisoning occurs on the site, the project manager should report it to higher-level authorities and local health and epidemic prevention agencies as soon as possible; actively cooperate with the sanitation and epidemic prevention departments to investigate and disinfect, to protect the health and safety of construction personnel.	
	Community Health and Safety	Risk management strategies may include:	Construction Contractor/Proponent

Table 8.2: Mitigation Matrix for the Construction Phase of the Proposed Project

Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		• Access to the site will be restricted through a combination of institutional and administrative controls. • Removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials. **A. Disease Prevention** • The mobility of the community living in the area will be restricted from the project site in order to prevent from catching any type of communicable diseases. • Any labor found to catch any type of disease will leave the site immediately; and would be given proper medical facilities. **B. Traffic Safety** The incidence of road accidents involving project vehicles during construction will be minimized through a combination of education and awareness raising, and the adoption of procedures.	
	Biological Environment	• General awareness of construction crew will be increased regarding the biological resources. • A 'no-hunting, no-trapping, no-harassment' policy will be strictly enforced at the project sites. • Firewood, woody plants and shrubs will not be used as fuel during construction. • Personnel and vehicle movements will be restricted to the construction site, camp and approved roads.	Construction Contractor/Proponent

Table 8.3: Mitigation Matrix for the Operational Phase of the Proposed Project

Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
	General Indoor Air Quality	**General Automotive Plant Ventilation** - General ventilation systems (supply and exhaust) can be mechanical or mixed (natural supply, mechanical exhaust). Natural air supply through the windows, doors or fixed air vents is not recommended when the width of the building exceeds 24 m (79 ft). Also uncontrolled air supply may disturb the various processes in automotive facility. General Supply Systems - General supply systems are used for: □ heating or cooling working environment; □ removing contaminants not captured by local ventilation systems; □ replacement of air exhausted by local ventilation systems and process equipment; and □ controlling building pressure and airflow from space to space. General Exhaust Systems - General exhaust systems complement local exhaust systems by removing air contaminated by fumes, gases or particles not captured by local exhausts. Such systems usually consist of outlets, ducts, an air cleaner and a fan. Centralized and decentralized (modular) systems - Centralized ventilation systems supply air to entire shop and have a large air distribution ductwork. Centralized system has lower maintenance costs compared to decentralized system. With decentralized ventilation, the entire shop area is divided into zones, ventilated by a separate system with or without air distribution ductwork. Constant air volume (CAV) and variable air volume (VAV) systems - The airflow rate supplied into the shop throughout the year may be constant (Constant Air Volume systems) or variable (Variable Air Volume systems). The design of the air supply system is normally based on the full load (cooling, contaminant or make-up airflow needs). Working environment heating and cooling	Proponent
Plant Operations	Indoor Air Quality in Body Shops and	Process related measures allowing the emission rates reduction are; • Avoid or reduce oil film on the welded surfaces;	Proponent

	Component Manufacturing Shops with Welding and Joining Operations	• Use rectangular wave high frequency pulse GMAW machines to reduce fume generation. Results of tests conducted at John Deere in 1992 indicate, that pulse GMAW welding allows for fume reduction by ~80% compared to the constant voltage GMAW on clean parts and by ~60% on oily parts; • Reduce expulsion with spot welding; • Avoid short-time conditions with spot welding, changing over to medium-time conditions. • Place containers with welded small parts in the totally enclosed cabinets connected to exhaust system to avoid residual welding smoke release into the building. **Ventilation** Clean air for welding operations is provided by ventilation systems, which typically consist of local exhaust systems and general ventilation supply and exhaust systems. The most efficient methods of contaminant control in the occupied zone of the welding shop, and particularly in the breathing zone of the operator or welder (with a manual welding), are: ▪ exhaust from the total welding process enclosure when automatic welding machines are used; ▪ exhaust from the welding area enclosure, when robotic welding and material handling are used, and ▪ local exhaust which captures the contaminants at or near their source. Fume Filtration - Often when air is exhausted, it is exhausted through a fume/dust collector. These collectors may be: ▪ small, portable collectors connected to the local exhaust and the fan; ▪ medium size wall- or floor-mounted collectors working as part of the local exhaust system with one or few exhaust hoods, or ▪ large collectors that may work with either a centralized local exhaust system or with a general exhaust system.	

	Indoor Air Quality and Emissions of Assembly Shop	Process related measures to reduce occupational exposure to vehicle exhausts and fuel vapors. ▪ Separation of areas followed the engine starting from the rest of assembly line by creating a positive pressure buffer zone; ▪ Utilization of gasoline filling nozzles with a built-in vapor recovery system. With this system, as the gasoline enters the fuel tank, the displaced vapor is collected through a vacuum intake located concentrically with a nozzle near the filler neck of the tank as the nozzle spout is inserted. The captured vapors are transferred back to the storage tank. ▪ Utilization of onboard exhaust filters for driving the vehicles in the assembly shop. EHC filters are connected to exhaust pipes with a plastic adapter and will have a filter life of approximately 5 –10 minutes. Particles, smoke and soot with the size down to 0.1 mk are separated in the filter with up to 99% efficiency. Oxides of nitrogen (~60%) and hydrocarbons (~35%) are absorbed on the filter surface. The filter also reduces the concentration of carbon monoxide by 5-25%. The filter cartridge is disposable as normal industrial waste. **Ventilation systems** in the assembly shop typically consist of local exhaust ventilation systems to control vehicle exhaust and contaminant emissions from contaminant producing areas, and a general ventilation system. General ventilation is needed to dilute the contaminants released into the building that are not captured by local ventilation systems. General ventilation systems supply make-up air to replace air extracted by local exhaust systems. Also, supply air is used to heat and cool the building.	Proponent
	Air Quality, Emissions and Effluent Discharge	**Mitigation Measures** The exhaust air from the spray booth will be treated by a Venturi wet scrubber **Effluent Treatment** A physical-chemical treatment (oil removal, metal abatement, etc.) is usually used to treat the effluents, followed by a biological treatment for COD abatement. The treatment is carried out in following steps;	Proponent

		Primary Treatment *Fine Screening* It involves fine screening using filters. Disc filters: ► The water to be treated flows by gravity into the filter segments from the center drum. Solids catch on the inside of the filter panels mounted on the two sides of the disc segments. ► As the solids catch on the inside of the filter media impeding the flow of water through the disc, the water level inside the discs begin to rise, triggering a level sensor to start the disc to rotate and a backwash cycle begins. ► High pressure rinse water wash the solids off the filter media into the solids collection trough. Typically the backwash requires 0,05-3% of the total filtered water flow. Drum filters: The water is filtered through the periphery of the drum. Backwash of the filter is only required according the loading of particles. Assisted by the filter panels special cell structure, the particles are carefully separated from the water during backwash. Separated solids are rinsed off the filter cloth into the solids collection trough and discharged. Belt filter: Sludge or wastewater is led into the filter 1 and passes by gravity through the filter belt 2. The belt is designed as a slowly moving conveyer installed in a stainless-steel tank. As the water passes through the filter, the filtering process ensures the efficient removal of particles. These particles are drained on the belt to a high dry matter	

		content. The dewatered sludge is removed at the top of the filter 3 and discharged through a hopper 4 for final treatment. The belt is further cleaned by a high-pressure backwash system 5 and the rinse water is led either back to the process or to further treatment. The Beltfilter is normally operated intermittently (demand) controlled by a level switch. *High Speed Clarification* High speed clarification is a high rate compact water clarification process in which water is flocculated with microsand and polymer in a draft tube. The microsand enhances the formation of robust flocs and acts as ballast, significantly increasing their settling velocity. The unique characteristics of the resulting microsand ballasted flocs allow for clarifier designs with very short retention times, high rise rates and extremely compact system footprints that are up to 50 times smaller than other clarification processes of similar capacity. **Secondary Treatment** Aerobic: Bio-filtration It is a simple and innovative process, enabling removal of pollution in a compact structure, thereby presenting a low environmental footprint. The process is able to eliminate all pollution, both organic (COD and BOD), nitrogenous (N-NH4 and N-NO3) and particulate compounds (TSS). The modular design of the process makes it a suitable tool in cases of variable load as part of the cells can be stopped and restarted quickly. As a biofilter, the process combines in a single structure: ▪ a biological reactor ▪ a physical filter to store the biomass and stop particulate pollution Aerobic: Activated Sludge:	

		The process reduces to a minimum the content of nitrogen and phosphorus in wastewater in addition to significantly reducing organic matter (BOD), ammonia and suspended solids. Furthermore, it eliminates odor nuisances as the sludge is stabilized in the process. The oxidation ditch system consists of an anaerobic tank located before two interconnected biological tanks of equal volumes and a final settling tank. The biological tanks work in an alternating mode of operation and are equipped with aerators, inlet distributors and outlet chambers. The process combines functional design with an outstanding flexibility and highly adaptable operation. **Tertiary and Specific Treatment** *Heavy Metals Removal without Sludge Generation:* A process is capable of removing heavy metals (arsenic, cadmium, lead, zinc, nickel, iron, manganese, arsenic, uranium etc.) from different types of water, including industrial wastewaters. The process provides up to 99% treatment of the water and thus meets the EU drinking water directive. The waste product is fine-grained granules with strong and stable metal bonds and the final deposits represent only about 10% of normal sludge volumes. Sludge Disposal Sludge will be disposed through SEPA certified contractor.	
	Noise Quality	-Noise control devices will be used such as noise barriers and deflectors for high noise impact activities. -Ensure the strict compliance of Personal Protective Equipment (Ear muff, ear plugs, etc…) in high noise areas.	proponent
	Soil Contamination	-Material should never be poured directly from drums to small containers. -Secondary containment should be provided in order to prevent the soil contamination.	proponent

		-Spigots or pumps should always be used to transfer waste materials to storage containers. -Do not handle chemicals with bare hands, no matter how harmless you may think they are. -After handling chemicals, hands should be washed prior to eating or drinking. -Chemicals that can produce fumes, dusts should always be handled in a well-ventilated area. --Use of containment devices such as fume hoods, and gas cabinets is particularly advisable. A fume hood, glove box or other appropriate exhaust ventilation is necessary when handling particularly hazardous substances. -Do not eat and drink while working with chemicals. -Do not light a match or smoke tobacco close to inflammable chemicals. -Use appropriate devices like funnels or spatulas when transferring chemicals from one container to another or when mixing chemicals. -Keep work surfaces and containers clean. -Use corrosion-resistant tools and equipment.	
	Waste Stream & Sludge	-Ensure no wastewater run out while washing and other activities takes place, waste stream should be connected to wastewater treatment plant. -Sludge should be separated from the wastewater and consider hazardous waste and disposed of environmental friendly with the third party certification.	proponent
	chemicals degradation and can become more hazardous in storage	-Chemicals should always be stored in a cool, dry environment far from busy work areas. -The quantities of hazardous chemicals should be kept to a minimum, in line with efficient operation, their usage and shelf life. -Hazardous chemicals should be clearly marked. -MSDSs for each chemical should be available. -Chemicals must not be stored with foodstuffs, personal use products or personal protective equipment. -Incompatible chemicals are segregated from one another (e.g. by fire isolation in a chemical storage cabinet or segregation in space). -Chemicals should be stored in such a manner that leaks cannot affect other substances in the store. Liquids should not be stored above powders and solids. -Chemicals are stored away from any heating and ignition sources.	proponent

		-Secondary containment should be available. -Stockpiling of hazardous chemicals should be avoided.	
	Transportation of chemicals and environmental contamination	-Remove all sharp objects from the loading area of the transporting vehicle before loading the chemicals. -Transport hazardous chemicals separately from food items. -Ensure that the consignment is secure when you transport hazardous chemicals. -Never keep hazardous chemicals near the driver's seat or on the passenger's seat. -Do not carry heavy chemical containers on your shoulder or on your head. Use a trolley to carry them.	proponent
	Generation of hazardous waste	-A waste management plan will be developed and includes information specified in sub-rule (1) of rule 19 of Hazardous Substance Rules, 2014. -Place hazardous waste in containers prior to disposal. Containers should be filled, leaving headspace for expansion of the contents and should prevent leakages. Often the original container is perfectly acceptable. -Use appropriate container for disposing chemical waste. -Similar wastes may be mixed only if they are compatible.	proponent
	Surface Water and Groundwater	The effluent and wastewater from the facility will be routed to Wastewater treatment plant and will be discharged to the local sewer/waste drainage system of project and will not be dumped in open land.	Proponent
	Vegetation and Fauna	-Other than maintenance of grass areas surrounding the Proposed Project, operations of the plant are not anticipated to cause adverse impacts to vegetation. -Operation of the plant is not anticipated to create additional disturbance to wildlife other than the mowing of established grassy areas.	Proponent
	Hazardous Waste	Waste materials would be sent offsite for recycling, or treated and disposed of at a hazardous waste disposal facility or landfill.	Proponent
	Transportation and Traffic	The Proposed Project would generate a minor long-term increase in privately-owned vehicle traffic. The proposed plant would operate 24 hours a day, 7 days a week. The new workers would be split among operation shifts, thus reducing the impact on traffic. The additional vehicle traffic would be less than 1 percent of the current Annual Daily Traffic count on the road, and therefore would generate a	Proponent

		negligible impact. Proposed Project is an addition to an existing industrial park that currently houses industrial enterprise and has existing truck and personal-vehicle traffic, therefore, this small increase in vehicle traffic would have only a minor impact to the surrounding community. Additional mitigation measures include: 1-Vehicle road worthiness certification and vehicle fitness certificate will be ensured. 2-With the culmination of construction activities at the M-9 and N5 in next two years, by which the plant is expected to be operational, the number of traffic mishaps due to unpaved and unlevelled diversions will go down eventually.	
	Human Health and Safety	During operations, mitigation measures would include appropriate training of all employees in the safe handling and storage of chemicals onsite.	Proponent
	Socio-economic Impacts	The Proposed Project would result in hundreds of new jobs during the construction and even when the plant is fully operational. It is assumed that the majority of the workforce would be drawn from the Karachi city; therefore, no increase in population or major need for housing is anticipated. Under the Proposed Project, relevant taxes would continue to be paid by the proponent. Increased sales transactions for the purchase of materials and supplies would generate some additional revenues for local and the provincial government, which would have a minor positive impact on taxes and revenue. Secondary jobs may result from the increased economic activity stimulated by the Proposed Project. Additional retail services and business employment may result from the Proposed Project through a multiplier effect, yielding additional sales and income tax revenues for local and provincial governments. Armstrong ZE Tyre Manufacturing Factory will have a real impact on employment opportunities and will generate direct employment as well as will create multiple indirect jobs in downstream industries.	Proponent

8.13 Environmental Monitoring Program

Monitoring of different activities will be required to assess the impacts of activities on the environment during construction. For this purpose Armstrong ZE Pvt. Ltd. will establish its own unit to:

- Follow the monitoring frequency of selected parameters as per the monitoring plan given in the following Table.
- Record all non-conformities observed and report them along with actions to Project Manager for further action.
- Report any impact anticipated along with recommendations for further action.

Contractor shall take note of the recommendations relating to issues arising during monitoring of construction activities. The following Tables show the checklist of actions for monitoring different environmental Aspect during the Construction Phase of the Project:

Table 8.2: Monitoring Plan

Stage	Monitoring areas	Location of monitoring	Parameters to monitor	Documentation & Monitoring Frequency
Construction	Air quality	15 meters distance from activity area	Parameters to monitor include: • CO • SPM • SO_2 • NOx	Before beginning of construction Quarterly during construction
Construction	Noise	Construction Activity areas And 7.5meters away from construction equipment	Noise intensity measurement	Monthly During construction and Operation
Construction	Wastewater	Outlet of the wastewater treatment system	Wastewater analysis for the following parameters: • pH • Total suspended solids • COD • BOD • Oil & grease • Phenolic Compound	Monthly During construction

Construction	Solid Waste	Collection, handling and disposal to designated areas/borrow pits	Observations on solid waste type, quantity and disposal arrangement	Monthly During construction
Construction	Occupational Safety	Construction activities	Visual observations and Recording hazard/accident	Monthly During Construction
Construction	Accidental risk at site	Project site at Armstrong ZE Tyre Manufacturing Factory	Visual Observations Recording accidents during construction of the road	Monthly During Construction
Operation	Indoor Air Quality	Processing at Project site at Armstrong ZE Tyre Manufacturing Factory	Parameters to monitor include: • CO • SO_2 • NOx • PM • VOC	Quarterly
Operation	Air Emissions (Stack / Exhaust)	• Generator Exhaust • Overn Stacks • Fork lifter • Equipment	Parameters to monitor include: • CO • SO_2 • NOx • PM • Smoke	Quarterly
Operations	Noise	• Plant Inside/ outside • Four corners of plant area	Noise intensity measurement	Quarterly
Operation	Wastewater	Outlet of the wastewater treatment system	Wastewater analysis for the following parameters: • pH • Total suspended solids • COD • BOD • Oil & grease	Quarterly

			• Phenolic Compound	
Operation	Solid Waste	Cutting and Finishing Project site at Armstrong ZE Tyre Manufacturing Factory	Observations on solid waste type, quantity and disposal arrangement	Monthly
Operation	Occupational Safety	Project site at Armstrong ZE Tyre Manufacturing Factory	Visual observations and Recording hazard/accident	Monthly
Operation	Occupational Risk	Project site at Armstrong ZE Tyre Manufacturing Factory	Visual observations Accident records of Fire Hazards, Safety Protocols, Spill on Land, Spill on Water	Monthly

Table 8.3: EMP Implementation Cost

Activity	Cost (Rupees PKR)	Remarks
Training Program	500, 000	refer section 8.8
Environmental Monitoring		
Ambient Air (Construction)	(40,000 * 12) = 480,000	Cost for 1-year monitoring at 01 location @Rs.40,000/per location.
Ambient Air (Operation)	(40,000 * 4) = 160,000	Cost for 1-year monitoring at 1 location @Rs.40,000/per location
Drinking Water Quality (Construction)	(20,000 * 12) = 240,000	Cost for 1-year monitoring at 1 sample @Rs.20,000 for all primary parameters
Drinking Water Quality (Operation)	(20,000 * 4) = 80,000	Cost for 1-year monitoring at 1 sample @Rs.20,000 for all primary parameters
Wastewater (Construction)	(50,000 * 12) = 600,000	Cost for 1-year monitoring at 1 location @Rs.50,000/location
Wastewater (Operation)	(50,000 * 12) = 600,000	Cost for 1-year monitoring at 1 location @Rs.50,000/location
Noise Levels (Construction)	(1,000 * 4 * 12) = 48,000	Cost for 1-year monitoring at 04 locations @Rs.1,000/location
Noise Levels (Operation)	(1,000 * 4 * 4) = 16,000/-	Cost for 1-year monitoring at 04 location @Rs.1,000/location
Solid Waste (Construction/Operation)	10,000	Estimated cost for 1 year
Gaseous Emissions (Construction)	(1,500 * 1 * 6 * 4) = 36,000	Cost for 1-year monitoring at 1 location for 06 parameters @Rs.1,500/parameter

Gaseous Emissions (Operation)	(1,500 * 2 * 6 * 4) = 72,000	Cost for 1-year monitoring at 2 location for 06 parameters @Rs.1,500/parameter
Mitigation Measures (Construction)	500,000	Initial estimates
Mitigation Measures (Operation)	1,000,000	Initial estimates
Reporting	1,000,000	Initial estimates
Contingencies (5% of EMP cost)	500,000	-
Grand Total	5,342,000	-
Grand Total (in words)	Five Million Three Hundred Forty-Two Thousand	-

9 Conclusion

On the basis of the findings of the EIA Study, it is possible to conclude that:

- Operation of Armstrong ZE Tyre Manufacturing Factory will on adoption of the mitigation measures, have no significant impact on the physical as well as socio-economic composition of the microenvironment and macro environment of the project area.
- The likely impact of construction and operation of the Armstrong ZE Tyre Manufacturing Factory will be appropriately mitigated through proven technologies, careful planning and landscaping.

Mitigation will be assured by a program of environmental monitoring conducted to ensure that all measures are provided as intended, and to determine whether the environment is protected as envisaged. This will include observations on and off site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the EPA Sindh.

There are two essential recommendations that need to be followed to ensure that the environmental impacts of the project are successfully mitigated. Armstrong ZE Pvt. Ltd. shall ensure that: i) All mitigation, compensation and enhancement measures proposed in this EIA report are implemented in full, as described in the document; and ii) The Environmental Management & Monitoring Plan is implemented in letter and spirit.

The Study therefore recommends that the EIA should be approved with the condition that all mitigation measures recommended in EIA report, suggestions of stakeholders and recommendations of experts committee will be adhered to by Armstrong ZE Pvt. Ltd. and the legal requirements as well as the Environmental Management & Monitoring Plan shall be implemented in letter & spirit.

ANNEXURES

Annex – A
Ambient Air and Noise Quality Monitoring Report

Ambient Air Quality Test Report

Client Name:	**Armstrong ZE (Zafar Enterprises)**	**Test Report No:**	**EMC/QTS/ASZE/21/9087**
		Sample Duration:	**24hr's**
Sample Description:	**Ambient Air Quality Test**	**Location:**	**24°42'38.02"N 67°35'27.92"E**

SEQS-PARAMETERS									
Date	**Time**	**CO (µg/m³)**	**NO (µg/m³)**	**NO_2 (µg/m³)**	**SO_2 (µg/m³)**	**PM 10 (µg/m³)**	**PM 2.5 (µg/m³)**	**SPM (µg/m³)**	**Lead (µg/m3)**
03.04.2021	11:00	0.07	10.5	16.2	20.5	58	12	202	BDL
03.04.2021	12:00		12.4	17.4	23.4	62	15	205	BDL
03.04.2021	13:00		14.0	21.2	20.2	65	21	212	BDL
03.04.2021	14:00	0.05	09.9	19.6	22.3	81	36	218	BDL
03.04.2021	15:00		08.5	15.4	24.4	92	41	225	BDL
03.04.2021	16:00		10.2	13.9	26.9	81	33	229	BDL
03.04.2021	17:00	0.08	12.4	15.3	31.5	79	29	235	BDL
03.04.2021	18:00		14.6	10.8	30.9	62	28	234	BDL
03.04.2021	19:00		16.3	11.4	30.0	56	20	231	BDL
03.04.2021	20:00	0.04	18.4	10.2	29.4	52	15	224	BDL
03.04.2021	21:00		15.8	10.9	24.3	45	12	219	BDL
03.04.2021	22:00		14.7	13.0	21.4	38	17	210	BDL
03.04.2021	23:00	0.03	12.2	08.4	18.6	37	12	201	BDL
04.04.2021	00:00		12.1	09.0	14.4	30	11	192	BDL
04.04.2021	01:00		08.4	10.2	12.8	32	13	181	BDL
04.04.2021	02:00	0.02	06.8	11.4	16.2	42	10	176	BDL
04.04.2021	03:00		05.3	12.3	18.5	44	10	170	BDL
04.04.2021	04:00		09.5	14.6	20.3	46	11	186	BDL
04.04.2021	05:00	0.05	10.8	16.7	21.4	52	08	198	BDL
04.04.2021	06:00		11.3	12.5	23.3	53	12	201	BDL
04.04.2021	07:00		13.5	14.6	24.2	64	10	213	BDL
04.04.2021	08:00	0.06	12.2	15.4	20.5	73	13	220	BDL
04.04.2021	09:00		10.6	16.7	18.5	81	12	225	BDL
04.04.2021	10:00		12.8	17.6	20.2	86	15	226	BDL
MINIMUM		0.02	05.3	08.5	12.8	30	08	170	BDL
MAXIMUM		0.08	18.4	21.2	31.5	92	41	234	BDL
AVERAGE		0.05	11.8	13.9	22.2	58.7	17.3	209.7	BDL
SEQS		5	40	80	120	150	75	500	1.5
LDL-Limits		0.01	0.1	0.1	0.1	10	2.5	1.0	0.01

Ambient Air Quality Test Report

Client Name:	**Armstrong ZE (Zafar Enterprises)**	**Test Report No:**	**EMC/QTS/ASZE/21/9087**
		Sample Duration:	**24hr's**
Sample Description:	**Ambient Air Quality Test**	**Location:**	**24°42'38.02"N 67°35'27.92"E**

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m³	08 Hours	0.05	5.0	0.01	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m³	24 Hours	11.8	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO_2)	µg/m³	24 Hours	13.9	80.0	0.0	
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	22.2	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O_3)	µg/m³	01 Hour	22.6	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM_{10})	µg/m³	24 Hours	58.7	150.0	10.0	β Ray Absorption Method
Particular Matter ($PM_{2.5}$)	µg/m³	24 Hours	17.3	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m³	24 Hours	209.7	500.0	1.0	
Lead (Pb)	µg/m³	24 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards (The Gazette of Pakistan) Registered No. EPA/TECH/739/2014
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ND= Not Detected
BDL=Below Detection Limits
LDL=Least Detection Limit

Terms & Conditions:

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- This report is intended only for your guidance & not for legal purpose or for advertisement

Sample Analyzed By: Hassan Ali	**Signature of Laboratory Incharge:** **Name : Sumbla Ahmed**

Quality Testing Services Karachi Q.T.S

Lab Report Ref. No. : QTS/ASZE/21/9086 Reporting Date: 06/04/2021

Project: EMC- EIA Project, Armstrong ZE (Zafar Enterprises)

SAMPLE DESCRIPTION

Sample ID: Noise Level Test
Sample Description: Ambient *Noise*
No. of samples: 05
Sample Collected/Submitted by: QTS representative
Sampling Date :03/04/2021
Sample Receipt at QTS - Date : 03/04/2021

NOISE LEVEL EMISSION TEST REPORT

S.NO.	LOCATION/SOURCE	Noise Level Readings			
		Minimum	Maximum	Average	Mean
1	Front Side Right Corner	48.4	65.4	56.9	SEQS Limits : *75dB(A) *Leq
2	Front Side Left Corner	50.5	66.0	58.2	
3	Back Side Right Corner	45.8	55.3	50.5	
4	Back Side Left Corner	46.2	57.4	51.8	
5	Near Road Side	62.8	73.4	68.1	

SEQS= Sindh Environmental Quality Standard
***dB (A) Leq:= Time weighted average of the level of sound in decibel on scale which is relatable to human hearing.**
***Noise Standard Limits for Category (C)- Industrial Area/Zone.**

Terms & Conditions:

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- This report is intended only for your guidance & not for legal purpose or for advertisement.

Sample Analyzed by: Hassan Ali

Signature of Laboratory In charge:
Name : Sumbla Ahmed

Lab Report Ref. No. : QTS/ASZE/21/1378 Reporting Date: 06/04/2021

Report to: **EIA Project,** Armstrong ZE (Zafar Enterprises)

SAMPLE DESCRIPTION

Sample ID: Ground Water
Sampling Method: APHA 1060-A & B
Sample Type: Liquid
Sample Collected/Submitted by: QTS Representative
Sampling Date: 03/04/2021
Sample Receipt at QTS - Date : 03/04/2021

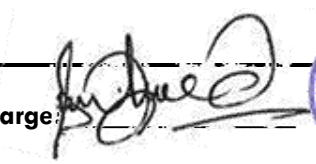
ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	LDL	UNITS	RESULTS	TEST METHOD
1	pH value	0.01	-	7.32	USEPA 150.1
2	Total Dissolved Solids(TDS)	1.0	mg/L	782	Hach 8160
3	Total Hardness(as $CaCO_3$)	0.1	mg/L	419	Hach 8213
4	Turbidity	0.01	NTU	1.16	Turbidity meter
5	Nitrate(NO_3)	0.01	mg/L	0.97	Hach 8039
6	Nitrite(NO_2)	0.001	mg/L	0.083	Hach 8153
7	Phenolic compounds(as phenol)	0.001	mg/L	BDL	USEPA 420.1
8	Chloride(as Cl^-)	0.1	mg/L	166	Hach 8206
9	Fluoride(as F^-)	0.01	mg/L	0.54	USEPA 340.1
MICROBIOLOGICAL TEST REPORT					
10	Total Coliform	cfu		32	APHA-SM9221B
11	Fecal Coliform	cfu		13	APHA-SM9221F
12	Escherichia Coli(E-Coli)	cfu		02	APHA-SM9221F

USEPA = United State Environmental Protection Agency method
Hach USA, method
BDL= Below Detection Limit
LDL= Least Detectable Limit

Term & Condition:

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed
- This report is intended only for your guidance & not for legal purpose or for advertisement

Sample Analyzed by: Sadat Ali	**Signature of Laboratory In charge:**   **Name : Sumbla Ahmed**

Annex – B
Geotechnical Soil Investigation Report

M/S ARMSTRONG ZE (PVT) LTD.

R E P O R T
O N
GEOTECHNICAL INVESTIGATION FOR TYRE FACTORY AT GHARO-KETI BUNDER ROAD GHARO, SINDH

AUGUST, 2021

GEOTECHNICAL SERVICES

Civil & Geotechnical Engineers
Testing Laboratory

52/3, Darul Aman Society, Haider Ali Road,
Off Shaheed-e-Millat Road, Karachi.
Tele: (9221) 34532851 – 34535607
Email: info@geotechnicalservices.com.pk

R E P O R T
O N
GEOTECHNICAL INVESTIGATION
FOR
ARMSTRONG ZE (PVT.) LIMITED
TYRE PLANT AT GHARO-KETI BUNDER ROAD
G H A R O

C O N T E N T S

A P P E N D I X

R E P O R T
O N
GEOTECHNICAL INVESTIGATION
FOR
ARMSTRONG ZE (PVT.) LIMITED
TYRE PLANT AT GHARO-KETI BUNDER ROAD
G H A R O

1. INTRODUCTION:

M/s Armstrong ZE (Pvt.) Limited have planned to construct Tyre Factory at Gharo-Keti Bunder Road, Gharo, Sindh.

M/s Akbar & Associates are providing consultancy services to the project.

In order to obtain geotechnical information for the design of foundations, it was considered necessary to carry out subsoil investigation at the project site. '*Geotechnical Services*' were assigned the job of subsoil investigation. The report was prepared in August, 2021.

The program of investigation comprised of drilling 41 boreholes. The boreholes depth varied from 8.0 to 20.0 m.

In order to ascertain the degree of compactness / consistency of substrata, standard penetration tests (SPTs) were performed at various depth horizons.

Selected soil and water samples were sent to the laboratory of 'Geotechnical Services' Karachi, for the evaluation of geo-engineering characteristics.

This report presents a review of subsoil investigation performed at the project site. The field and laboratory test data has been analyzed for the evaluation of allowable bearing pressure. The recommendations regarding the type and bearing capacity of foundations are incorporated in the report.

The report also incorporates borehole location plan, borelogs, field/laboratory test results and photographs.

2. PROGRAM OF INVESTIGATION:

2.1 Detail of Boreholes:

The program of subsurface investigation at the project site consisted of executing 41 boreholes. The boring was accomplished by rotary method.

Table 2.1 on the following page is the break-up of borehole depths:

TABLE 2.1

Boring No.	Investigated Depth (m)
BH-1	8.0
BH-2	15.0
BH-3	10.0
BH-4	10.0
BH-5	10.0
BH-6	15.0
BH-7	8.0
BH-8	15.0
BH-9	20.0
BH-10	10.0
BH-11	10.0
BH-12	10.0
BH-13	15.0
BH-14	8.0
BH-15	20.0
BH-16	15.0
BH-17	10.0
BH-18	10.0
BH-19	10.0
BH-20	20.0

TABLE 2.1

Boring No.	Investigated Depth (m)
BH-21	15.0
BH-22	15.0
BH-23	10.0
BH-24	10.0
BH-25	10.0
BH-26	15.0
BH-27	15.0
BH-28	20.0
BH-29	10.0
BH-30	10.0
BH-31	10.0
BH-32	15.0
BH-33	20.0
BH-34	15.0
BH-35	15.0
BH-36	10.0
BH-37	10.0
BH-38	20.0
BH-39	15.0
BH-40	15.0
BH-41	10.0

The locations of these boreholes are shown on borehole location plan appended to this report.

2.2 Standard Penetration Tests (SPTs):

Standard penetration tests (SPTs) were performed at various depth horizons wherever found feasible. These tests were performed in accordance with ASTM Designation D-1586. This test gives indication of degree of compactness/consistency of granular/cohesive substrata. The 'N'-values are shown on borelogs appended to this report.

The SPT is a sounding method in which the standard split spoon sampler of 35mm internal diameter provided with cutting shoe is driven into the subsoil at the testing horizon with a standard force of 63.5 kg hammer having a free fall of 762mm. The number of blows required for a total of 450mm penetration is recorded. The number of blows for first 150mm penetration is recorded. The number of blows for first 150mm penetration is generally not considered for interpretation of results. The number of blows required for the last 300mm penetration is recorded in four 75mm penetrations. The sum of four successive 75mm blow counts is called the "standard penetration resistance" or the "N"-value and expressed as blows/300mm.

Refusal during the SPT is generally assumed to occur when the blow count exceeds 50 without further penetration taking place. In the case of refusal, the number of blows and actual penetration are recorded.

After completion of the test, the soil sample from the split spoon sampler is taken out and preserved in airtight container.

2.3 Sampling:

2.3.1 Disturbed Samples:

Disturbed samples were obtained through split spoon sampler used in the standard penetration tests. These samples were carefully examined to identify the soil types at various depths.

2.3.2 Disturbed Samples:

Undisturbed samples were extracted by means of thin-walled Shelby tube sampler. The end of Shelby tubes were sealed with wax before dispatching to the laboratory.

These samples were placed in plastic containers, marked with borehole number, depth and subsequently, dispatched to the laboratory

Laboratory Testing:

In order to arrive at a rational evaluation of the geotechnical properties of the substrata, a program of laboratory testing was undertaken in the laboratory of Geotechnical Services.

Following physical and chemical tests were performed on representative soil and water samples:

- Grain size analysis
- Atterberg Limits
- Moisture Content
- Unconfined Compression
- Bulk Density
- Total salts
- Sulphate content
- Chloride content
- pH value

The results of laboratory tests are appended to this report.

Observations were regularly made in boreholes to determine the position of ground water table. The position of water table is indicated on the borelogs.

3. SUBSURFACE CHARACTERISTICS:

Subsoil investigation has revealed that top 1.0 m consist of fill material. This is underlain by medium dense, silty SAND / sandy SILT deposits. This is followed by dense to very dense, fine to coarse SAND and sandy SILT deposits that continue upto the investigated depth of 20.0 m

Major subsurface deposits can be described as follows:

- Brownish gray, medium dense, sandy SILT
- Grayish brown, medium dense, silty SAND / sandy SILT
- Brown/Grayish brown, dense to very dense, fine to coarse SAND
- Gray / Brown, dense to very, silty SAND / sandy SILT

The exact sequence of occurrence of these deposits is shown on boreholes appended to this report.

It must be noted that in boreholes BH-11, 27, 35, top 3.0 m comprise of loose, sandy SILT or soft CLAY deposits. This is followed by medium to dense, silty SAND / sandy SILT deposits that continue upto the investigated depth of 20.0 m

Ground Water Table:

Following Table 3.1 presents position of ground water table for each borehole:

TABLE 3.1

POSITION OF GROUND WATER TABLE

Borehole No.	Depth of Water Table (m)
BH-1	1.45
BH-2	1.50
BH-3	1.48
BH-4	1.50
BH-5	1.38
BH-6	1.40
BH-7	1.50
BH-8	1.62
BH-9	1.43
BH-10	1.40
BH-11	1.60
BH-12	1.50
BH-13	1.39
BH-14	1.40
BH-15	1.55
BH-16	1.57
BH-17	1.40
BH-18	1.42
BH-19	1.45
BH-20	1.50

TABLE 3.1

POSITION OF GROUND WATER TABLE

Borehole No.	Depth of Water Table (m)
BH-21	1.62
BH-22	1.50
BH-23	1.55
BH-24	1.60
BH-25	1.55
BH-26	1.42
BH-27	1.45
BH-28	1.39
BH-29	1.45
BH-30	1.50
BH-31	1.60
BH-32	1.45
BH-33	1.50
BH-34	1.50
BH-35	1.45
BH-36	1.50
BH-37	1.55
BH-38	1.60
BH-39	1.45
BH-40	1.50
BH-41	1.60

4. LIQUEFACTION POTENTIAL:

4.1 Seismicity:

Building Code of Pakistan (Seismic Provision – 2007) has established 'seismic zones' of different towns in Pakistan. The Armstrong site is located in Thatta District. According to Building Code, Thatta District belongs to 'Seismic Zone-2A'.

In accordance with UBC 1997 Seismic Zone 2A corresponds to design earthquake with peak horizontal acceleration of 0.15g for an earthquake magnitude 6.5 (Richter Scale).

* `g' is the acceleration due to gravity.

According to the Uniform Building Code (1997), the soil profile falls in 'S_D' category corresponding to 'stiff soil profile '.

Following table gives seismic zone, seismic zone factor, soil profile type and seismic coefficients.

Seismic zone	Zone factor 'z'	Soil profile Type	Seismic Coefficient 'Ca'	Seismic Coefficient 'Cv'
2A	0.15	' S_D'	0.22	0.32

4.2 Liquefaction:

Liquefaction has been described as the phenomenon in which a saturated cohesionless soil loses strength during an earthquake and acquires a degree of mobility sufficient to permit movements ranging from several feet to several thousand feet. The liquefaction potential of a soil deposit is influenced by soil type, relative density, initial stresses acting on the soil and characteristics of the earthquake involved.

Studies have shown that saturated uniformly graded sands and silts are most susceptible to liquefaction than well-graded soils and that for uniformly graded soil; fine sands & silt tend to liquefy more easily than do coarse sands, gravelly soil & clays. Case histories indicate that liquefaction usually occurs within a depth of 15 m (50 feet) or less,

Liquefaction susceptibility at a site is commonly expressed in terms of a factor of safety against occurrence of liquefaction. This factor of safety is defined as the ratio between available soil resistance to liquefaction, expressed in terms of cyclic stresses required to cause soil liquefaction and the cyclic stresses generated by a design earthquake. A safety factor of 1.20 is considered appropriate for engineering design.

Hence Fs = CRR / CSR > 1.20 for liquefaction to be unlikely

where CRR = cyclic resistance ratio required to resist liquefaction

CSR = cyclic stress ratio generated by the design earthquake

United States Department of Defense Handbook on "Soil Dynamics and Special Design Aspects" (1997) presents `Simplified Empirical Methods' for the evaluation of liquefaction potential. These methods are based on evaluation of liquefaction case histories and the in-situ strength characteristics such as that measured by the SPT `N'-values and the CPT `q_c' data.

Taking into account the subsoil characteristics at the site, it is seen that top 3.0-10.5 m medium dense, silty SAND / sandy SILT which is mostly poorly graded. Ground water table occurs at about 1.50 m depth below the existing ground level meaning that the cohesionless soil is saturated.

Following section presents computations for the evaluation of liquefaction potential based on the SPT method. It should be noted that reference has been made to figures given in the Department of Defense method and, for simplicity; same figure numbers have been retained

EVALUATION OF LIQUEFACTION POTENTIAL
(Borehole No. BH-39)

It is observed that the SPT blow counts in borehole BH-39 are critical for liquefaction. Hence, analysis has been performed using blow counts data of borehole BH-39.

1st Layer: 2.0-4.0 m

Cyclic Stress Ratio:

$$CSR = 0.65 \, (a_{max} / g) \, (\sigma_o / \sigma_o^1) \, r_d$$

where CSR = cyclic stress ratio

σ_o^1 = initial static effective overburden stress on sand layer under consideration

(Assume GWT at 0.0 m depth)

= (1.8-1.0) x 4.0

= 3.2 T/m^2

σ_o = initial total overburden stress on sand layer under construction

= 1.80 x 4.0

= 7.2 T/m^2

a_{max} / g = 0.20

r_d = 0.90

CSR = 0.65 x 0.20 x (7.2/3.2) x 0.90

CSR = 0.263

Cyclic Resistance Ratio:

From fig 23, C_N has been found against effective stresses calculated at each depth:

Layer. Depth (m)	SPT N Value	Effective Insitu Stress σ'	C_N From fig 23	N_1*	N_{avg}
2.0	12	(1.8-1.0) x 2.0 = 1.6 t/m^2 = 0.15 tsf	1.60	19	27
3.0	20	1.6 +(1.8-1) x 1.0= 2.4 t/m^2 = 0.22 tsf	1.58	32	
4.0	20	2.4 +(1.8-1) x 1.0= 3.2 t/m^2 = 0.30 tsf	1.45	29	

* N_1 = Corrected N value

From fig 26, Correction for fine content FC≥35% $\Delta(N_1)_{60} = 7$

Therefore, N_{avg} = 27 +7 =34

From fig 24, for Magnitude `M' = 7.5 & N_{avg} = 37

CRR = 0.46

Now, referring to Fig 27, for M = 6.5 the magnitude scaling factor MSF = 1.60

Hence CRR for M = 6.5 is 1.60 x 0.46

= 0.736

Factor of safety Fs = CRR / CSR

= 0.736 / 0.263

= 2.796 > 1.20 ok

Similarly, liquefaction potential has been evaluated at 9.0 m depth. Table 4.1 presents summary of liquefaction calculation & factor of safety for each layer of borehole BH-39.It is, therefore, concluded that for the design earthquake [peak horizontal acceleration of 0.15g for an earthquake magnitude 6.5 (Richter Scale)], liquefaction is unlikely to occur.

Table 4.1

EVALUATION OF LIQUEFACTION POTENTIAL

M/S ARMSTONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

(Considering Borehole BH-39)

Earthquake magnitude 6.5 (Richter Scale).		a_{max}/g = 0.2	r_d = 0.9	Ground Water Depth = 0.0 m

Layer . Depth (m)	SPT N Value	σ' (tsf)	C_N (from fig 23)	N_1	Navg	Corr. for FC (from fig 26)	CRR for M=7.5 (from fig 24)	MSF for M=6.5 (from fig 27)	CRR for M=6.5	Unit Weight (γ) (T/m^3)	Total Insitu Stress σ (T/m^2)	Effective Insitu Stress σ' (T/m^2)	CSR	FOS	Remarks
2.0	12	0.15	1.60	19						1.8	3.6	1.6			
3.0	20	0.22	1.58	32						1.8	5.4	2.4			
4.0	20	0.30	1.45	29	27	34	0.46	1.6	0.74	1.8	7.2	3.2	0.263	2.796	>1.20 ok
5.0	26	0.37	1.52	40						1.8	9.0	4.0			
6.0	28	0.45	1.40	39						1.8	10.8	4.8			
7.5	30	0.56	1.33	40						1.8	13.5	6.0			
9.0	30	0.67	1.29	39	39	46	0.54	1.6	0.86	1.8	16.2	7.2	0.263	3.282	>1.20 ok

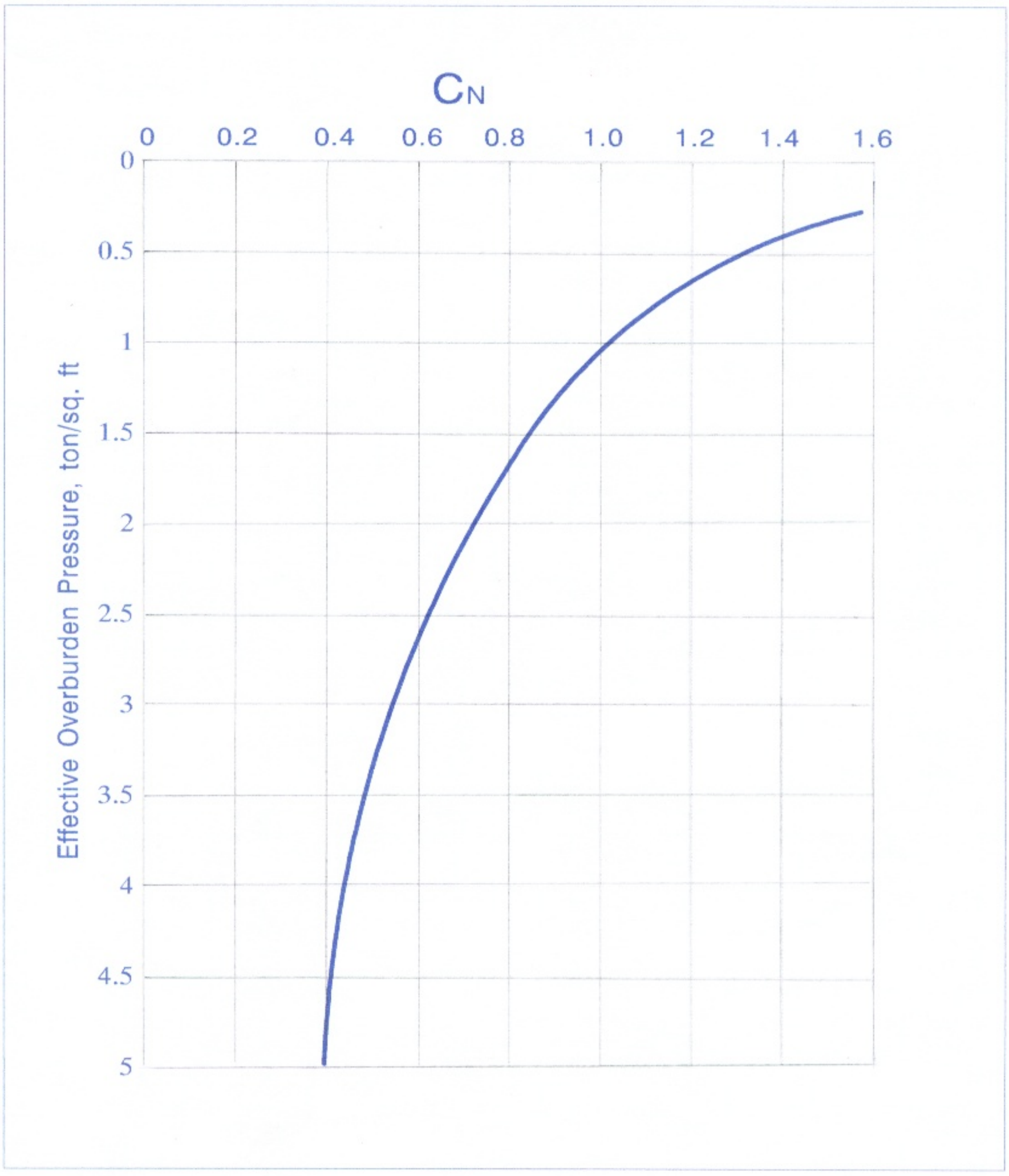


Figure 23
Correlation Between C_N and Effective Overburden Pressure

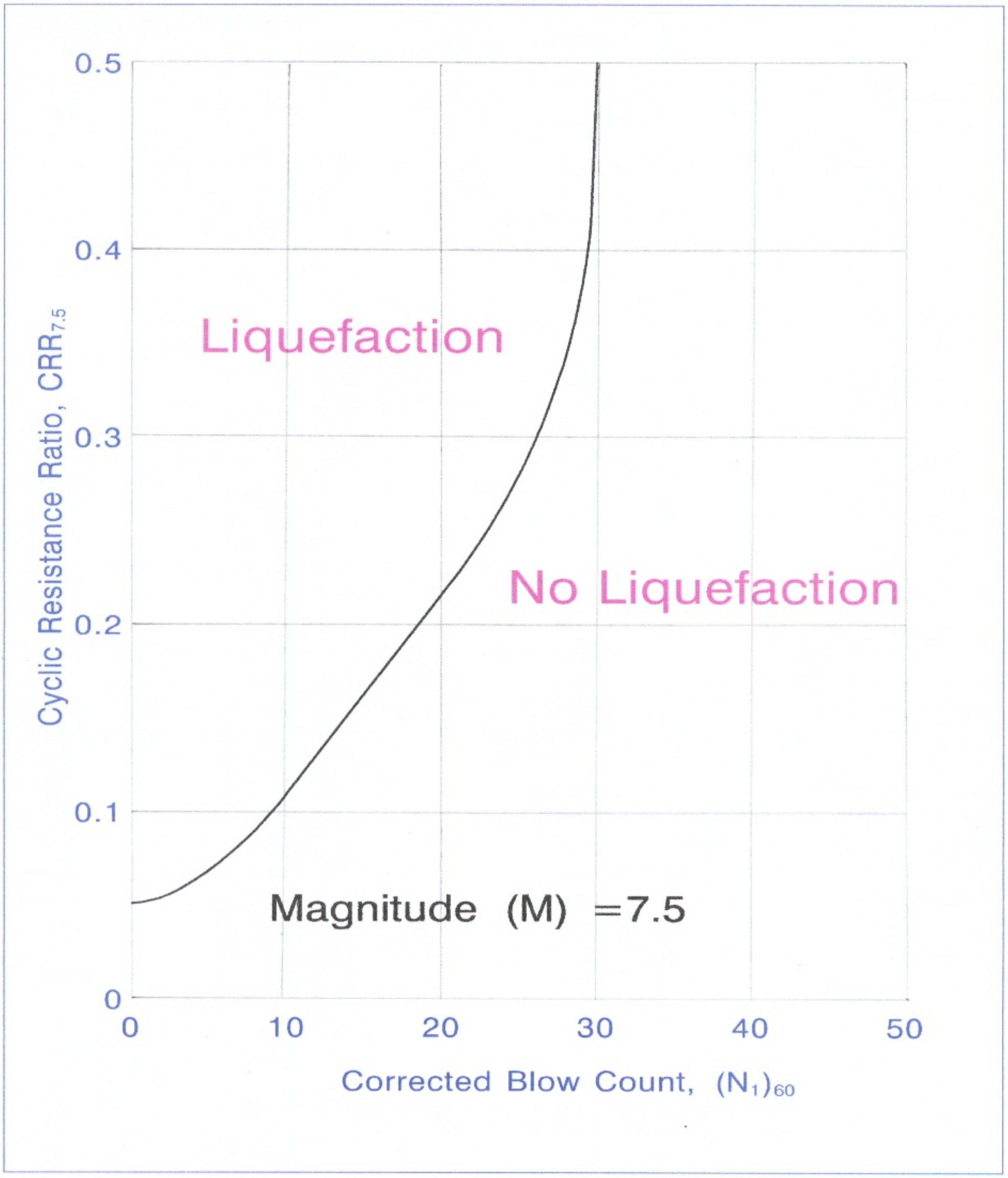


Figure 24
Cyclic Resistance Ratio (CRR) for Clean Sands
Under Level Ground Conditions Based on SPT
(After Robertson and Fear, 1996)

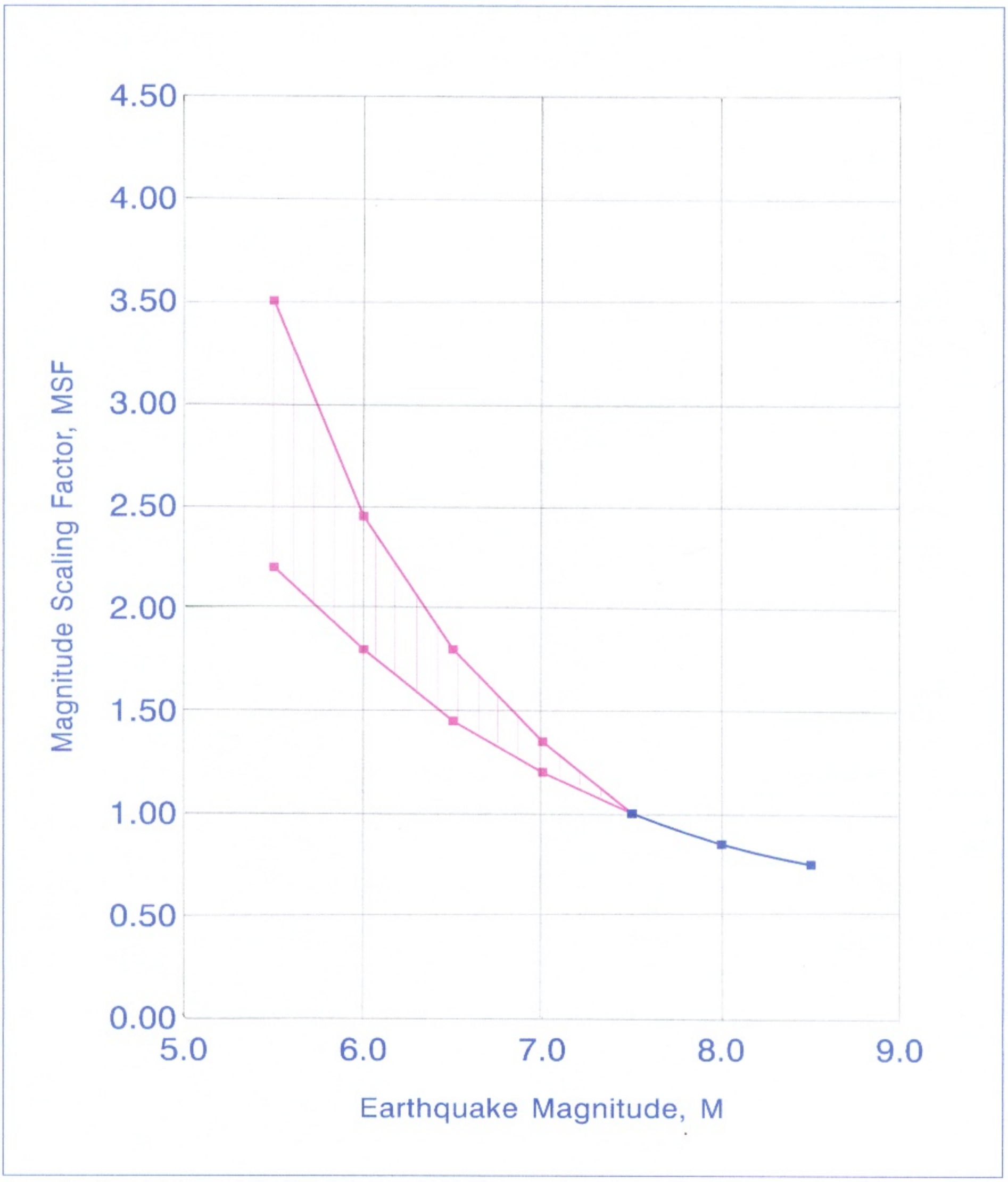


Figure 27
Range of Magnitude Scaling Factors for
Correction of Earthquake Magnitudes

5. FOUNDATION RECOMMENDATIONS:

5.1 General:

Foundation is a structural member that supports the loads of a structure and distributes them over the substrata on which it rests. In order to be satisfactory, the foundation should satisfy the following requirements:

a) The foundation must be safe against the possibility of shear failure

b) The foundation must not undergo excessive differential settlement

Calculations have been made to check allowable soil pressure for both the shear and settlement criteria.

Keeping in view the stratigraphy of the area and field and laboratory test results, the allowable pressures have been computed.

5.2 Foundation Type:

The selection of foundation type depends upon the subsoil conditions, type of structure, and structural loads.

A study of boreholes shows that top 1.0 m consist of fill material. This is underlain by medium dense, silty SAND / sandy SILT deposits. This is followed by dense to very dense, fine to coarse SAND and sandy SILT deposits that continue upto the investigated depth.
It must be noted that in boreholes BH-11, 27, 35, top 3.0 m depth comprises of loose, sandy SILT and soft CLAY deposits. This is followed by medium to dense, silty SAND / sandy SILT deposits that continue upto the investigated depth of 20.0 m

Taking into account the subsoil conditions and anticipated structural loads, it is recommended that the proposed structure be supported on **isolated / combined footing** placed at **1.50 m** below existing ground level.

However in 3 boreholes, namely, BH-11, 27, 35, there is soft /loose, CLAY / SAND occurring upto a depth of 3.0 m, underlain by medium dense, silty SAND/ sandy SILT deposits. Therefore the foundation of structures under these boreholes should be placed at **3.0 m** depth below existing ground level.

5.3 Allowable Bearing Capacity

For BH-1 to BH-41 (except 3 boreholes)

Allowable (net) bearing capacity of **isolated / combined footing** placed at **1.50 m** depth below the existing ground level should be adopted as **1.25 tons/ft^2**

For BH-11, BH-27, BH-35

Allowable (net) bearing capacity of **isolated / combined footing** placed at **3.0 m** depth below the existing ground level should be adopted as **1.25 tons/ft^2**

It is important to note that before placing foundation concrete the excavations should be carefully inspected to ensure that foundation is being placed in competent stratum and loose / soil has been crossed. This precaution is necessary to guard against localized fills and inhomogenities.

5.4 Cement Type:

American Concrete Institute (ACI) gives the requirements for concrete exposed to sulphate (SO_4) containing solutions. The ACI standards are given below:

Sulphate Exposure	Water Soluble Sulphate in Soil (%)	Sulphate in Water (mg/lit)	Cement Type
Negligible	0.00-0.10	0-150	OPC
Moderate	0.10-0.20	150-1500	Type II
Severe	0.20-2.00	1500-10000	Type V
Very Severe	Over 2.00	Over 10000	Type V plus pozzolan

Sulphate content in water has been found to be negligible. It is therefore recommended that Ordinary Portland Cement (OPC) be used in concrete in contact with soil.

For GEOTECHNICAL SERVICES

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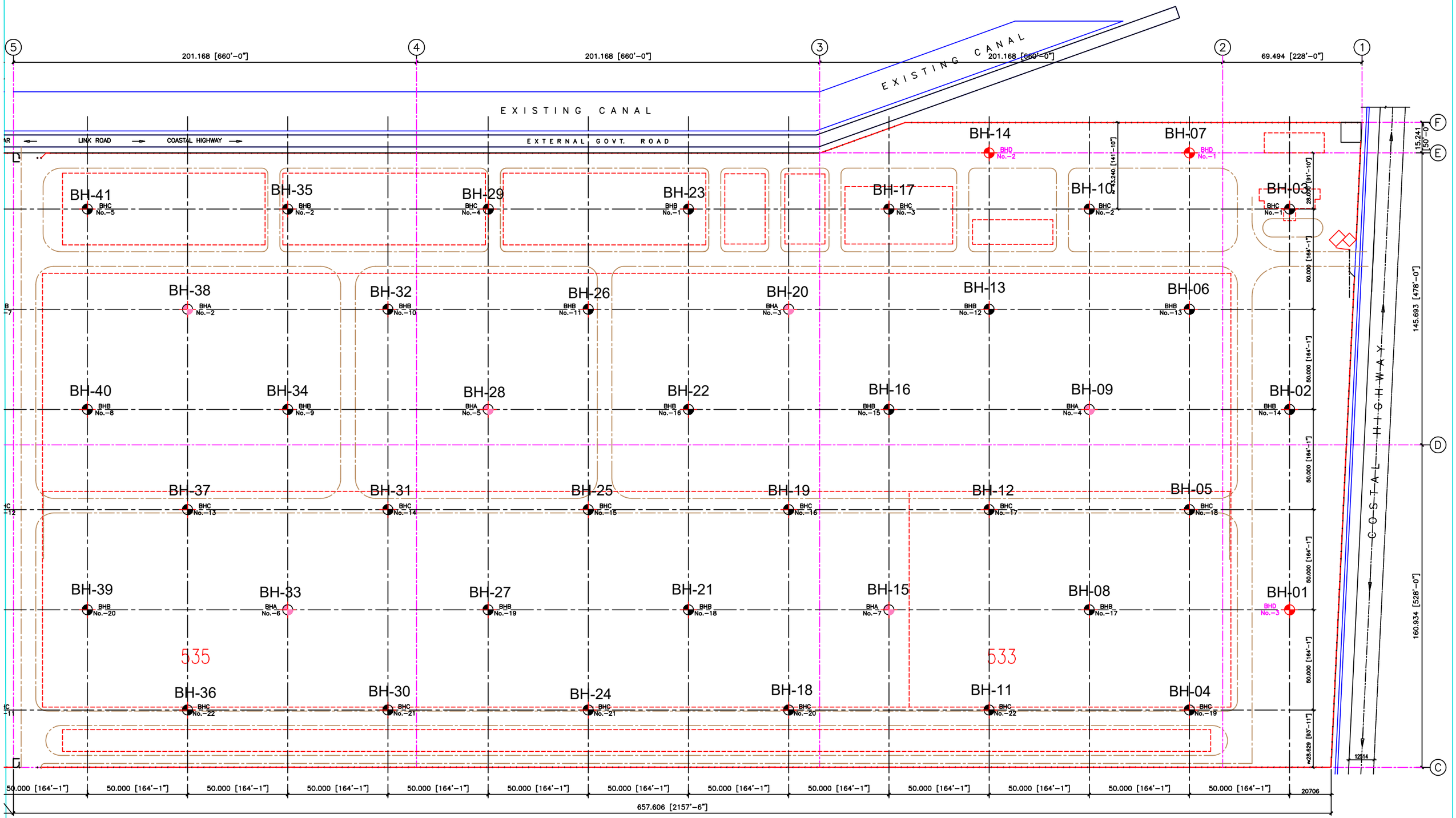
A P P E N D I X

BOREHOLE LOCATION PLAN



ARMSTRONG ZE (PVT) LTD. PROPERTY

LEGEND OF BOREHOLES

BHA = 15.0m. DEEP (22 NOS.)

BHB = 20.0m. DEEP (22 NOS.)

BHC = 30.0m. DEEP (22 NOS.)

BHD = 45.0m. DEEP (08 NOS.)

E:\Khan 01-01-2021\Zafar Enterprises\ZZ\1091-BH-01 (Boreholes Location for Geo Technical Investigation).dwg 06-13-21 09:44 Computer Salman Khan

REVISION	DRAWN	DATE	REV.	CHECKED	APPROVED
THIS PRINT SUPERSEDES ALL PRINTS BEARING A LOWER LETTER A	DO NOT SCALE IF IN DOUBT ASK				

CLIENT
M/S ARMSTRONG ZE (PVT) LTD.
(GHARO-KETI BUNDER ROAD)

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LAHORE 042-35770033-4
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TITLE
LOCATION OF BOREHOLES
GEO TECHNICAL INVESTIGATION

SCALE	1:1000	CHECKED	DRAWING NO.
DATE	13-06-2021	APPROVED	1091-BH-01
DRAWN	KHAN	REVISIONS	

BORELOGS

GEOTECHNICAL SERVICES

Bore Hole No BH-1

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.45m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 07.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT ' N '	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
0.6	DS		Fill comprising of silty sand, trace clay, trace roots						
	SPT-1	ML	Brownish gray, medium dense, sandy SILT, trace mica		26				
	SPT-2				27				02
3.0	SPT-3				33				
	SPT-4	ML	Brownish gray, dense, sandy SILT, trace mica		44				04
	SPT-5				31				06
	SPT-6				38				
	SPT-7				44				08
8.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-2

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.50m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 07.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT ' N '	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
0.6	DS		Fill comprising of silty sand, trace clay, trace roots						
	SPT-1	ML	Brownish gray, medium dense, sandy SILT, trace mica		30				
	SPT-2				20				02
3.0	SPT-3				36				
	SPT-4	ML	Brownish gray, dense to very dense, sandy SILT, trace mica		39				04
	SPT-5				44				06
	SPT-6				53				
	SPT-7				37				08
	SPT-8				36				10
12	SPT-9				37				12
	SPT-10	SM	Brownish gray / Brown, dense, fine to coarse SAND, trace gravel, trace silt		41				14
	SPT-11				38				15
15.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-3

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.48m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 07.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
0.6	DS		Fill comprising of silty sand, trace clay, trace roots						
	SPT-1	ML	Brownish gray, loose, sandy SILT		09				
1.5	SPT-2				17				02
	SPT-3	ML	Brownish gray, medium dense, sandy SILT, trace mica		26				04
4.5	SPT-4				30				
	SPT-5	ML	Brownish gray, dense, sandy SILT, trace mica		34				06
7.5	SPT-6				29				
		ML	Brownish gray, medium dense, sandy SILT, trace mice						08
9.0	SPT-7				34				
	SPT-8	ML	Brownish gray, dense, sandy SILT, trace mica		45				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-4

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.50m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 07.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				17				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT, trace mica		23				02
3.0	SPT-3				31				
	SPT-4				42				04
	SPT-5				33				06
		ML	Brownish gray, dense, sandy SILT, trace mica						
	SPT-6				45				08
	SPT-7				41				
	SPT-8				43				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-5

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.38m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 07.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				14				
	SPT-2	SM	Brownish gray, medium dense, silty, fine SAND		15				02
3.0	SPT-3				31				
	SPT-4				44				04
	SPT-5				38				06
		SM-ML	Brownish gray, dense, silty SAND / sandy SILT, trace mica						
	SPT-6				39				08
	SPT-7				38				
	SPT-8				43				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-6

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.40m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 08.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				16				
	SPT-2				17				02
	SPT-3				15				
	SPT-4				25				04
		ML	Gray, medium dense, sandy SILT, trace mica						
	SPT-5				24				06
	SPT-6				15				
									08
9.0	SPT-7				37				
	SPT-8				35				10
	SPT-9	ML	Gray, dense, sandy SILT, trace coarse sand, trace mica		40				12
	SPT-10				42				
									14
	SPT-11				45				15
15.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-7

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.50m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 07.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				14				
	SPT-2	ML	Gray, medium dense, sandy SILT, trace mica		18				02
3.0	SPT-3				32				
		ML	Gray, dense, sandy SILT, trace mica						04
4.5	SPT-4				20				
		ML	Gray, medium dense, sandy SILT, trace mica						
6.0	SPT-5				30				06
	SPT-6	ML	Gray, dense, sandy SILT, trace mica		35				
	SPT-7				50				08
8.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-8

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.62m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 07.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				18				
	SPT-2				26				02
	SPT-3				19				
	SPT-4	ML	Gray, medium dense, sandy SILT, trace mica		23				04
	SPT-5				28				06
7.5	SPT-6				35				
	SPT-7				33				08
	SPT-8				31				10
	SPT-9	ML	Gray, dense, sandy SILT, trace mica		41				12
	SPT-10				44				14
	SPT-11				44				15
15.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-9

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.43m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 08.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				33				
	SPT-2				39				02
	SPT-3				30				
	SPT-4				36				04
	SPT-5				36				
	SPT-6				38				06
	SPT-7	SM-ML	Gray, dense to very dense, silty SAND / sandy SILT, trace mica		31				
	SPT-8				37				08
	SPT-9				54				10
	SPT-10				41				12
13.5	SPT-11				28				
		ML	Brownish gray / Gray, medium dense, sandy SILT, little clay, trace gravel, trace mica						14
15	SPT-12				32				
	SPT-13	ML	Gray, dense, sandy SILT, little clay, trace gravel, trace mica		32				16
18	SPT-14				50/6"				18
		SM	Gray, very dense, coarse SAND, little gravel						
	SPT-15				50/6"				
20	SPT-16				50/6"				20

BOTTOM OF BOREHOLE

GEOTECHNICAL SERVICES

Bore Hole No BH-10

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.40m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 07.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				13				
	SPT-2				17				02
	SPT-3	ML	Gray, medium dense, sandy SILT, trace mica		26				
	SPT-4				17				04
6.0	SPT-5				37				06
	SPT-6				37				
	SPT-7	ML	Gray, dense, sandy SILT, trace mica		36				08
	SPT-8				41				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-11

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.60m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 09.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				09				
	SPT-2	ML	Brownish gray, loose, sandy SILT, trace mica		08				02
3.0	SPT-3				12				
	SPT-4				11				04
	SPT-5				12				
	SPT-6	ML	Brownish gray, medium dense, sandy SILT, trace mica		16				06
	SPT-7				17				
									08
9.0	SPT-8				40				
	SPT-9	ML	Brownish gray, dense, sandy SILT, trace mica		31				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-12

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.50m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 09.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				32				
		SM-ML	Gray, dense, silty SAND / sandy SILT						
2.0	SPT-2				27				02
	SPT-3	SM-ML	Gray, medium dense, silty SAND / sandy SILT		30				
4.0	SPT-4				30				04
	SPT-5				35				
	SPT-6	ML	Gray, dense, sandy SILT, trace mica		36				06
	SPT-7				38				
									08
9.0	SPT-8				40				
	SPT-9	SM-ML	Gray, dense, silty SAND / sandy SILT, trace mica		32				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-13

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.39m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 09.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				17				
		ML	Brownish gray, medium dense, sandy SILT, trace mica						
2.0	SPT-2				31				02
		ML	Brownish gray, dense, sandy SILT, trace mica						
3.0	SPT-3				26				
	SPT-4	ML	Brownish gray, medium dense, sandy SILT, trace mica		27				04
5.0	SPT-5				37				
	SPT-6				37				06
	SPT-7	ML	Brownish gray, dense, sandy SILT, trace mica		46				08
	SPT-8				47				
10.5	SPT-9				54				10
	SPT-10				59				12
		ML	Brownish gray, very dense, sandy SILT, trace mica						
	SPT-11				58				14
	SPT-12				61				15
15.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-14

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.40m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 09.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				13				
	SPT-2	SM	Brownish gray, medium dense, silty, fine SAND, trace mica		13				02
	SPT-3				20				
	SPT-4				20				04
5.0	SPT-5				27				
	SPT-6	ML	Brownish gray, medium dense, sandy SILT, trace mica		28				06
7.5	SPT-7				32				
	SPT-8	ML	Brownish gray, dense, sandy SILT, trace mica		38				08
8.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-15

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.55m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 08.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				21				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT, trace mica		28				02
	SPT-3				18				
	SPT-4				13				04
	SPT-5				14				
	SPT-6				12				06
	SPT-7				11				
	SPT-8				23				08
	SPT-9				24				10
12	SPT-10				40				12
	SPT-11	SM	Brownish gray, dense to very dense, medium to coarse SAND, little silt, trace gravel		50/6"				
									14
15	SPT-12				19				
	SPT-13	SM-ML	Brownish gray / Gray, medium dense, silty SAND / sandy SILT		22				16
	SPT-14				15				18
	SPT-15				25				
20	SPT-16				30				20

BOTTOM OF BOREHOLE

GEOTECHNICAL SERVICES

Bore Hole No BH-16

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.57m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 09.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				46				
	SPT-2	SM-ML	Brownish gray, dense, silty SAND / sandy SILT		39				02
3.0	SPT-3				28				
	SPT-4	ML	Brownish gray, medium dense, sandy SILT, trace mica		29				04
	SPT-5				27				
6.0	SPT-6				32				06
	SPT-7	ML	Brownish gray, dense, sandy SILT, trace mica		31				08
	SPT-8				35				
	SPT-9				32				10
	SPT-10				38				12
13.0	SPT-11				42				
	SPT-12	SM	Brownish gray, dense, silty, fine SAND, trace mica		46				14 15
15.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-17

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.40m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				15				
	SPT-2	ML	Brownish gray, medium dense, silty, fine SAND		21				02
	SPT-3				26				
4.0	SPT-4				36				04
	SPT-5	SM-ML	Brownish gray, dense to very dense, silty SAND / sandy SILT, trace mica		41				
	SPT-6				39				06
	SPT-7				49				08
	SPT-8				51				
	SPT-9				52				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-18

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.42m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				20				
	SPT-2				21				02
	SPT-3				12				
	SPT-4				10				04
	SPT-5				17				
	SPT-6	ML	Gray, medium dense, sandy SILT		12				06
	SPT-7				10				
	SPT-8				16				08
	SPT-9				23				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-19

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.45m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				36				
	SPT-2	SM	Brownish gray, dense, silty, fine SAND		32				02
	SPT-3				32				
4.0	SPT-4				28				04
		SM	Brownish gray, medium dense, silty, fine SAND						
5.0	SPT-5				36				
	SPT-6	ML	Brownish gray, dense, Sandy SILT, trace mica		35				06
	SPT-7				30				
	SPT-8				34				08
	SPT-9				39				
10.5			BOTTOM OF BOREHOLE						10

GEOTECHNICAL SERVICES

Bore Hole No BH-20

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.50m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				20				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT, trace mica		18				02
	SPT-3				14				
	SPT-4				21				04
	SPT-5				23				
	SPT-6				29				06
7.5	SPT-7				32				
	SPT-8	ML	Brownish gray, dense, sandy SILT, trace mica		36				08
	SPT-9				41				10
12	SPT-10				38				12
	SPT-11	SP	Brown, dense to very dense, gravelly SAND, little silt		50				14
15	SPT-12				39				
	SPT-13	ML	Gray, dense, sandy SILT, trace mica		43				16
18	SPT-14				16				18
	SPT-15	ML	Gray, medium dense, sandy SILT, trace mica		22				
20	SPT-16				23				20

BOTTOM OF BOREHOLE

GEOTECHNICAL SERVICES

Bore Hole No BH-21

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.62m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				14				
	SPT-2				19				02
	SPT-3				14				
	SPT-4				18				04
	SPT-5				28				
		ML	Brownish gray, medium dense, sandy SILT, trace mica						
	SPT-6				22				06
	SPT-7				22				
									08
	SPT-8				23				
									10
10.5	SPT-9				35				
	SPT-10				41				12
		SM	Brown / Brownish gray, dense to very dense, fine to coarse SAND, some silt, trace gravel						
	SPT-11				50/6"				14
	SPT-12				38				15
15.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-22

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.50m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				21				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT		24				02
	SPT-3				18				
4.0	SPT-4				33				04
		ML	Brownish gray, dense, sandy SILT						
5.0	SPT-5				23				
	SPT-6	SM	Brownish gray, medium dense, silty, fine SAND		24				06
	SPT-7				22				08
	SPT-8				30				
10.5	SPT-9				35				10
	SPT-10	SM	Brownish gray, dense, silty, fine SAND		39				12
	SPT-11				38				14
15	SPT-12				23				15
15.5		SM	Brownish gray, medium dense, silty, fine SAND						
			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-23

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.55m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 11.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				15				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT, trace mica		24				02
3.0	SPT-3				35				
	SPT-4	ML	Brownish gray, dense, sandy SILT, trace mica		33				04
5.0	SPT-5				25				
	SPT-6	ML	Brownish gray, medium dense, sandy SILT, trace mica		30				06
7.5	SPT-7				44				
	SPT-8	SM-ML	Brownish gray, dense to very dense, silty sand / sandy SILT		50				08
	SPT-9				53				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-24

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.60m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 11.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				17				
	SPT-2				16				02
	SPT-3				19				
	SPT-4				11				04
	SPT-5				14				
	SPT-6	ML	Brownish gray, medium dense, sandy SILT, trace mica		13				06
	SPT-7				23				
	SPT-8				25				08
	SPT-9				27				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-25

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.55m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				13				
	SPT-2				14				02
	SPT-3				17				
	SPT-4				15				04
	SPT-5	ML	Gray, medium dense, sandy SILT, trace mica		17				
	SPT-6				22				06
	SPT-7				29				
									08
9.0	SPT-8				40				
	SPT-9	ML	Gray, dense, sandy SILT, trace mica		36				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-26

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.42m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 14.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				14				
	SPT-2				20				02
	SPT-3				14				
	SPT-4				25				04
	SPT-5	ML	Gray, medium dense, sandy SILT, trace mica		25				
	SPT-6				26				06
	SPT-7				28				
9.0	SPT-8				31				08
	SPT-9				33				10
	SPT-10	SM	Gray, dense, silty, fine SAND		35				12
	SPT-11				38				14
	SPT-12				44				15
15.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-27

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.45m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 13.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				02				
	SPT-2	ML	Brown, soft to firm, clayey SILT		02				02
	UDS							1.07	
3.0	SPT-3				12				
	SPT-4				25				04
	SPT-5				21				
	SPT-6	SM	Gray, medium dense, fine SAND, some silt		25				06
	SPT-7				26				
									08
9.0	SPT-8				33				
	SPT-9				41				10
	SPT-10	SM	Gray, dense, fine SAND, little SILT, trace gravel		42				12
	SPT-11				33				14
	SPT-12				30				15
15.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-28

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.39m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				06				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT, trace mica		14				02
	SPT-3				18				
	SPT-4				14				04
	SPT-5				16				
	SPT-6				26				06
	SPT-7				26				
									08
9.0	SPT-8				33				
	SPT-9	ML	Brownish gray, dense, sandy SILT, trace mica		30				10
12	SPT-10				34				12
	SPT-11	SM	Brownish gray, dense to very dense, fine to coarse SAND, some gravel, little silt		50/4"				
15	SPT-12				40				14
	SPT-13	ML	Gray, dense, sandy SILT, trace mica		43				16
	SPT-14				46				18
	SPT-15				36				
20	SPT-16				42				20

BOTTOM OF BOREHOLE

GEOTECHNICAL SERVICES

Bore Hole No BH-29

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.45m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 13.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				16				
	SPT-2				16				02
	SPT-3	ML	Brownish gray, medium dense, sandy SILT, trace mica		17				
	SPT-4				27				04
	SPT-5				27				
6.0	SPT-6				32				06
	SPT-7	SM	Brownish gray, dense, silty, fine SAND		37				08
	SPT-8				32				
	SPT-9				36				10
10.5			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-30

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water Depth 1.50m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 13.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing /Hole	SPT 'N'	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace clay, trace roots						
1.0	SPT-1				18				
	SPT-2				16				02
	SPT-3				12				
	SPT-4				16				04
		SM-ML	Gray, medium dense, silty SAND / sandy SILT, trace mica						
	SPT-5				17				
	SPT-6				17				06
	SPT-7				20				
									08
	SPT-8				28				
10	SPT-9				34				10
10.5		SM-ML	Gray, dense, silty SAND / sandy SILT, trace mica						
			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-31

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.60 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 10.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, silty sand, trace roots						
1.0	SPT-1				10				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT, trace mica		14				02
	SPT-3				21				
	SPT-4				18				04
	SPT-5				21				
	SPT-6				25				06
	SPT-7				30				
									08
9.0	SPT-8				40				
		SM	Brownish gray, dense, silty, fine SAND, trace mica						
10	SPT-9				38				10
			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-32

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.45 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 15.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, silty sand, trace roots						
1.0	SPT-1				20				
	SPT-2	SM	Gray, medium dense, silty, fine SAND, trace mica		26				02
	SPT-3				28				
4.0	SPT-4				31				04
	SPT-5				34				
	SPT-6				34				06
	SPT-7				40				
	SPT-8				38				08
	SPT-9	SM-ML	Gray, dense, silty SAND / sandy SILT, trace mica		43				10
	SPT-10				39				12
	SPT-11				44				
									14
15	SPT-12				41				15
			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-33

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.50 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 12.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
1.0	DS SPT-1		Fill comprising of clayey, sandy silt, trace roots		10				
	SPT-2	ML	Gray, medium dense, sandy SILT, trace mica		12				02
	SPT-3				13				
	SPT-4				14				04
	SPT-5				20				
	SPT-6				30				06
7.5	SPT-7				34				
	SPT-8	SM	Gray / Brown, dense, fine SAND, some silt, trace mica		34				08
	SPT-9				36				10
	SPT-10				32				12
13.5	SPT-11				27				
	SPT-12	SM	Brown to gray, medium dense, fine to medium SAND, some silt, trace mica		30				14
16.5	SPT-13				33				16
	SPT-14	SM	Gray, dense, silty, fine SAND, trace mica		37				18
	SPT-15				42				
20	SPT-16				45				20

BOTTOM OF BOREHOLE

GEOTECHNICAL SERVICES

Bore Hole No BH-34

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.50 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 11.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, silty sand, trace roots						
1.0	SPT-1				13				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT, trace mica		14				02
	SPT-3				18				
	SPT-4				18				04
	SPT-5				25				
	SPT-6				29				06
7.5	SPT-7				32				
		SM	Brownish gray, dense, silty, fine SAND, trace mica						08
9.0	SPT-8				29				
	SPT-9	SM	Brownish gray, medium dense, silty, fine SAND, trace mica		30				10
12	SPT-10				36				
	SPT-11	SM	Brownish gray, dense, fine SAND, little silt, trace mica		37				12
									14
15	SPT-12				42				15
			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-35

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.45 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 12.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, silty sand, trace roots						
1.0	SPT-1				09				
	SPT-2	ML	Brown, loose, sandy SILT, trace mica		08				02
3.0	SPT-3				16				
		ML	Brown, stiff, clayey SILT, trace sand, trace mica						
4.0	SPT-4				23				04
	SPT-5				32				
	SPT-6				20				06
	SPT-7	SM-ML	Gray, medium to dense, silty SAND / sandy SILT, trace mica		31				
	SPT-8				20				08
10.5	SPT-9				37				10
	SPT-10				38				
		SM	Brown, dense, fine to medium SAND, little silt, trace mica						12
	SPT-11				38				
									14
15	SPT-12				41				15
			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-36

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.50 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 19.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, silty sand, trace roots						
1.0	SPT-1				20				
	SPT-2	SM	Brownish gray, medium dense, silty, fine SAND, trace mica		17				02
	SPT-3				26				
	SPT-4				27				04
	SPT-5				30				
6.0	SPT-6				32				06
	SPT-7	SM	Brownish gray, dense, silty, fine SAND, trace mica		33				
	SPT-8				36				08
10	SPT-9				41				
			BOTTOM OF BOREHOLE						10

GEOTECHNICAL SERVICES

Bore Hole No BH-37

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.55 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 13.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, silty sand, trace roots						
1.0	SPT-1				14				
	SPT-2				15				02
	SPT-3				22				
	SPT-4		Gray,		20				04
		SM	medium dense, fine SAND,						
	SPT-5		some silt, trace mica		28				
	SPT-6				30				06
7.5	SPT-7				33				
									08
	SPT-8	SM	Gray, dense, silty, fine SAND, trace mica		39				
10	SPT-9				38				10
			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-38

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.60 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 12.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, sandy silt, trace roots						
1.0	SPT-1				19				
	SPT-2	ML	Gray, medium dense, sandy SILT, trace mica		16				02
	SPT-3				22				
	SPT-4				16				04
	SPT-5				16				
	SPT-6				20				06
7.5	SPT-7				40				
	SPT-8	SM	Gray / Brown, dense, fine SAND, some silt, trace mica		41				08
	SPT-9				43				10
	SPT-10				47				12
	SPT-11				36				14
	SPT-12				35				
	SPT-13				38				16
	SPT-14				41				18
	SPT-15				41				
20	SPT-16				43				20

BOTTOM OF BOREHOLE

GEOTECHNICAL SERVICES

Bore Hole No BH-39

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.45 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 15.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, silty sand, trace roots						
1.0	SPT-1				18				
	SPT-2	SM-ML	Gray, medium dense, silty SAND / sandy SILT, trace mica		12				02
	SPT-3				20				
	SPT-4				20				04
	SPT-5				26				
	SPT-6				28				06
	SPT-7				30				
	SPT-8				29				08
10.5	SPT-9				41				10
	SPT-10	ML	Gray, dense, sandy SILT, trace mica		37				12
	SPT-11				37				
15	SPT-12				35				14
			BOTTOM OF BOREHOLE						15

GEOTECHNICAL SERVICES

Bore Hole No BH-40

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.50 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 13.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of clayey, silty sand, trace roots						
1.0	SPT-1				11				
	SPT-2	ML	Brown, medium dense, sandy SILT, trace mica		11				02
3.0	SPT-3				09				
	SPT-4	ML	Brown, stiff, clayey SILT, trace sand, trace mica		12			1.67	04
5.0	SPT-5				19				
	SPT-6	SM-ML	Grayish brown, medium dense, silty SAND / sandy SILT, trace mica		26				06
	SPT-7				28				08
9.0	SPT-8				33				
	SPT-9	SM	Gray, dense, fine SAND with silt, trace mica		36				10
	SPT-10				32				12
	SPT-11				33				14
15	SPT-12				36				15
			BOTTOM OF BOREHOLE						

GEOTECHNICAL SERVICES

Bore Hole No BH-41

Sheet 1 of 1

SUBSURFACE EXPLORATION LOG

Project ARMSTRONG ZE (PVT.) LIMITED, GHARO-KETI BUNDER ROAD, GHARO

Ground Water 1.60 m

Geologist M. Faisal Jawed

Type of Boring ROTARY

Date 14.07.21

Depth (m)	Sample No.	CLASSIFICATION	STRATUM DESCRIPTION	Dia of Casing	SPT 'N' /Hole	Percent Recovery	R.Q.D.	Unconfined Compression (kg/sq.cm)	REMARKS (m)
	DS		Fill comprising of silty sand, trace roots						
1.0	SPT-1				24				
	SPT-2	ML	Brownish gray, medium dense, sandy SILT, trace mica		20				02
	SPT-3				27				
	SPT-4				28				04
	SPT-5				30				
6.0	SPT-6				32				06
	SPT-7	ML	Brownish gray, dense, sandy SILT, trace mica		36				
	SPT-8				39				08
10	SPT-9				40				
			BOTTOM OF BOREHOLE						10

LABORATORY
TEST RESULTS

PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21
SHEET 1 OF 6

GRAIN SIZE ANALYSIS (PER CENT FINER BY WEIGHT) **HYDROMETER**
SIEVE SIZES IN mm **(DIA IN mm)**

S No	BH NO.	SAMPLE	DEPTH (m)	75.0	37.5	19.0	9.50	4.75	2.36	1.18	0.600	0.300	0.150	0.075	.05	.01	.002	.001
1.	BH-1	SPT-1	1.00	-	-	-	-	-	-	-	-	100	99	92	78	45	18	05
2.	BH-1	SPT-4	4.50	-	-	-	-	-	-	-	100	99	98	77	63	38	14	04
3.	BH-2	SPT-2	2.00	-	-	-	-	-	-	-	100	99	98	82	69	42	15	05
4.	BH-2	SPT-5	6.00	-	-	-	-	-	-	-	100	99	98	70	57	34	14	04
5.	BH-2	SPT-11	15.00	-	-	-	100	99	91	70	40	20	17	10	-	-	-	-
6.	BH-3	SPT-3	3.00	-	-	-	-	-	-	-	-	100	99	66	52	30	12	03
7.	BH-3	SPT-7	9.00	-	-	-	-	-	-	-	100	99	98	66	53	31	13	03
8.	BH-4	SPT-1	1.00	-	-	-	-	-	-	-	-	100	99	65	52	29	12	03
9.	BH-4	SPT-4	4.50	-	-	-	-	-	-	-	-	100	99	74	59	34	16	04
10.	BH-4	SPT-7	9.00	-	-	-	-	-	-	-	-	100	99	88	75	42	20	06
11.	BH-5	SPT-2	2.00	-	-	-	-	-	-	-	100	99	96	41	30	16	07	02
12.	BH-5	SPT-5	6.00	-	-	-	-	-	-	-	100	99	89	69	55	34	15	04
13.	BH-5	SPT-8	10.00	-	-	-	-	-	-	-	100	99	98	48	36	17	07	02
14.	BH-6	SPT-1	1.00	-	-	-	-	-	-	-	-	100	99	58	46	21	11	03
15.	BH-6	SPT-3	3.00	-	-	-	-	-	-	-	-	100	99	79	68	41	19	06
16.	BH-6	SPT-9	12.00	-	-	-	-	-	-	-	-	100	99	65	53	30	14	04
17.	BH-7	SPT-3	3.00	-	-	-	-	-	-	-	-	100	99	68	54	32	15	04
18.	BH-7	SPT-7	8.00	-	-	-	-	-	-	-	100	98	92	58	45	20	11	03
19.	BH-8	SPT-1	1.00	-	-	-	-	-	-	-	100	99	98	62	50	26	11	03
20.	BH-8	SPT-4	4.50	-	-	-	-	-	-	-	100	99	97	61	48	24	11	03

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PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21
SHEET 2 OF 6

GRAIN SIZE ANALYSIS (PER CENT FINER BY WEIGHT) **HYDROMETER**

SIEVE SIZES IN mm **(DIA IN mm)**

S No	BH NO.	SAMPLE	DEPTH (m)	75.0	37.5	19.0	9.50	4.75	2.36	1.18	0.600	0.300	0.150	0.075	.05	.01	.002	.001
21.	BH-8	SPT-9	12.00	-	-	-	-	-	-	-	100	99	98	54	42	20	10	03
22.	BH-9	SPT-2	2.00	-	-	-	-	-	-	-	-	100	99	56	43	21	10	03
23.	BH-9	SPT-5	5.00	-	-	-	-	-	-	-	-	100	99	47	38	18	09	03
24.	BH-9	SPT-11	13.50	-	-	-	100	98	94	90	86	85	84	64	56	40	22	10
25.	BH-9	SPT-15	19.50	-	-	100	88	83	43	11	08	06	05	04	-	-	-	-
26.	BH-10	SPT-3	3.00	-	-	-	-	-	-	-	-	100	99	71	58	28	14	05
27.	BH-10	SPT-7	9.00	-	-	-	-	-	-	-	-	100	99	69	56	26	12	05
28.	BH-11	SPT-1	1.00	-	-	-	-	-	-	-	100	99	98	89	75	42	18	06
29.	BH-11	SPT-4	4.00	-	-	-	-	-	-	-	100	99	98	72	59	27	15	05
30.	BH-11	SPT-8	9.00	-	-	-	-	-	-	-	100	99	98	85	71	40	17	06
31.	BH-12	SPT-2	2.00	-	-	-	-	-	-	-	100	99	97	50	38	20	10	03
32.	BH-12	SPT-5	5.00	-	-	-	-	-	-	-	100	99	98	64	50	28	13	04
33.	BH-12	SPT-9	10.00	-	-	-	-	-	-	-	100	99	97	51	40	22	11	03
34.	BH-13	SPT-3	3.00	-	-	-	-	-	-	-	100	99	98	61	48	26	12	04
35.	BH-13	SPT-7	7.50	-	-	-	-	-	-	-	100	99	98	81	68	44	17	06
36.	BH-13	SPT-11	13.50	-	-	-	-	-	-	-	100	99	97	60	47	24	12	04
37.	BH-14	SPT-1	1.00	-	-	-	-	-	-	-	100	99	95	48	37	18	08	02
38.	BH-14	SPT-5	5.00	-	-	-	-	-	-	-	-	100	99	69	54	32	14	04
39.	BH-14	SPT-8	9.00	-	-	-	-	-	-	-	100	99	98	64	51	30	12	03
40.	BH-15	SPT-2	2.00	-	-	-	-	-	-	-	100	99	98	72	58	36	13	04

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PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21
SHEET 3 OF 6

GRAIN SIZE ANALYSIS (PER CENT FINER BY WEIGHT) **HYDROMETER**
SIEVE SIZES IN mm **(DIA IN mm)**

S No	BH NO.	SAMPLE	DEPTH (m)	75.0	37.5	19.0	9.50	4.75	2.36	1.18	0.600	0.300	0.150	0.075	.05	.01	.002	.001
41.	BH-15	SPT-6	6.00	-	-	-	-	-	-	-	100	99	98	69	56	32	12	04
42.	BH-15	SPT-10	12.00	-	-	-	-	100	99	63	33	19	18	11	-	-	-	-
43.	BH-15	SPT-14	18.00	-	-	-	-	-	-	-	100	97	95	80	66	42	15	05
44.	BH-16	SPT-2	2.00	-	-	-	-	-	-	-	-	100	99	52	40	18	08	02
45.	BH-16	SPT-6	6.00	-	-	-	-	-	-	-	-	100	99	57	45	23	12	03
46.	BH-16	SPT-11	13.50	-	-	-	-	-	-	-	100	99	94	34	-	-	-	-
47.	BH-17	SPT-3	3.00	-	-	-	-	-	-	-	100	99	94	37	-	-	-	-
48.	BH-17	SPT-7	7.50	-	-	-	-	-	-	-	100	99	96	52	39	17	08	02
49.	BH-18	SPT-3	3.00	-	-	-	-	-	-	-	100	99	94	67	54	30	14	04
50.	BH-18	SPT-8	9.00	-	-	-	-	-	-	-	100	99	97	59	46	24	12	03
51.	BH-19	SPT-2	2.00	-	-	-	-	-	-	-	100	99	97	43	30	16	08	02
52.	BH-19	SPT-6	6.00	-	-	-	-	-	-	-	100	99	98	53	40	18	09	02
53.	BH-20	SPT-4	4.00	-	-	-	-	-	-	-	100	99	97	62	50	28	12	03
54.	BH-20	SPT-10	12.00	-	100	79	77	69	54	37	29	25	24	13	-	-	-	-
55.	BH-20	SPT-14	18.00	-	-	-	-	-	-	-	100	98	96	82	68	40	16	05
56.	BH-21	SPT-2	2.00	-	-	-	-	-	-	-	-	100	99	59	46	21	10	03
57.	BH-21	SPT-5	5.00	-	-	-	-	-	-	-	-	100	99	58	45	20	10	03
58.	BH-21	SPT-9	10.50	-	-	-	100	98	95	66	36	29	27	20	-	-	-	-
59.	BH-22	SPT-1	1.00	-	-	-	-	-	-	-	100	99	98	66	52	30	14	03
60.	BH-22	SPT-5	5.00	-	-	-	-	-	-	-	100	99	94	36	-	-	-	-

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PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21
SHEET 4 OF 6

GRAIN SIZE ANALYSIS (PER CENT FINER BY WEIGHT) **HYDROMETER**
SIEVE SIZES IN mm **(DIA IN mm)**

S No	BH NO.	SAMPLE	DEPTH (m)	75.0	37.5	19.0	9.50	4.75	2.36	1.18	0.600	0.300	0.150	0.075	.05	.01	.002	.001
61.	BH-22	SPT-10	12.00	-	-	-	-	-	100	97	94	93	89	39	-	-	-	-
62.	BH-23	SPT-2	2.20	-	-	-	-	-	-	-	100	99	94	46	34	18	08	02
63.	BH-23	SPT-4	4.00	-	-	-	-	-	-	-	100	99	93	46	35	19	08	02
64.	BH-23	SPT-8	9.00	-	-	-	-	-	-	-	100	99	93	51	40	19	09	03
65.	BH-24	SPT-1	1.00	-	-	-	-	-	-	-	100	99	98	61	48	24	12	04
66.	BH-24	SPT-6	6.00	-	-	-	-	-	-	-	100	99	97	54	40	19	09	02
67.	BH-25	SPT-3	3.00	-	-	-	-	-	-	-	100	99	98	72	58	36	16	05
68.	BH-25	SPT-7	7.50	-	-	-	-	-	-	-	100	99	98	81	67	43	20	06
69.	BH-26	SPT-1	1.00	-	-	-	-	-	-	-	-	100	99	69	56	34	14	05
70.	BH-26	SPT-4	4.00	-	-	-	-	-	-	-	-	100	99	66	54	31	13	05
71.	BH-26	SPT-9	10.50	-	-	-	-	-	-	-	100	99	93	40	29	16	08	02
72.	BH-27	SPT-1	1.00	-	-	-	-	-	-	-	-	100	99	94	80	56	26	13
73.	BH-27	UDS	2.50	-	-	-	-	-	-	-	100	99	98	97	85	61	32	15
74.	BH-27	SPT-7	7.50	-	-	-	-	-	-	-	100	99	87	22	-	-	-	-
75.	BH-27	SPT-9	10.50	-	-	-	100	98	96	94	93	90	72	15	-	-	-	-
76.	BH-27	SPT-12	15.00	-	-	-	-	-	-	100	97	96	90	23	-	-	-	-
77.	BH-28	SPT-1	1.00	-	-	-	-	-	-	-	100	99	98	93	80	51	22	07
78.	BH-28	SPT-6	6.00	-	-	-	-	-	-	-	100	99	97	66	52	29	11	03
79.	BH-28	SPT-10	12.00	-	-	-	100	80	59	40	32	24	20	14	-	-	-	-
80.	BH-28	SPT-15	19.50	-	-	-	-	-	-	-	100	99	97	67	54	31	12	03

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PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21
SHEET 5 OF 6

GRAIN SIZE ANALYSIS (PER CENT FINER BY WEIGHT) **HYDROMETER**

SIEVE SIZES IN mm **(DIA IN mm)**

S No	BH NO.	SAMPLE	DEPTH (m)	75.0	37.5	19.0	9.50	4.75	2.36	1.18	0.600	0.300	0.150	0.075	.05	.01	.002	.001
81.	BH-29	SPT-2	2.00	-	-	-	-	-	-	-	100	99	98	97	83	50	17	06
82.	BH-29	SPT-6	6.00	-	-	-	-	-	-	-	100	99	96	44	32	17	08	02
83.	BH-30	SPT-1	1.00	-	-	-	-	-	-	-	100	99	98	51	40	21	11	03
84.	BH-30	SPT-5	5.00	-	-	-	-	-	-	-	100	99	96	31	-	-	-	-
85.	BH-30	SPT-9	10.00	-	-	-	-	-	-	-	100	99	96	52	41	22	12	03
86.	BH-31	SPT-2	2.00	-	-	-	-	-	-	-	100	99	97	67	54	30	12	03
87.	BH-31	SPT-8	9.00	-	-	-	-	-	-	-	100	99	94	48	36	18	08	02
88.	BH-32	SPT-1	1.00	-	-	-	-	-	-	-	100	99	96	45	35	20	10	02
89.	BH-32	SPT-6	6.00	-	-	-	-	-	-	-	100	99	96	59	45	24	13	03
90.	BH-32	SPT-11	13.50	-	-	-	-	-	-	100	97	96	90	53	42	23	12	03
91.	BH-33	SPT-1	1.00	-	-	-	-	-	-	-	-	100	99	81	68	41	17	06
92.	BH-33	SPT-3	3.00	-	-	-	-	-	-	-	100	99	96	26	-	-	-	-
93.	BH-33	SPT-9	10.50	-	-	-	-	-	100	89	69	55	52	26	-	-	-	-
94.	BH-33	SPT-14	18.00	-	-	-	-	-	100	91	84	79	77	43	30	14	09	02
95.	BH-34	SPT-3	3.00	-	-	-	-	-	-	-	-	100	99	75	61	36	16	06
96.	BH-34	SPT-7	7.50	-	-	-	-	-	-	-	100	99	96	41	30	17	07	02
97.	BH-34	SPT-11	13.50	-	-	-	-	100	98	85	82	80	68	19	-	-	-	-
98.	BH-35	SPT-1	1.00	-	-	-	-	-	-	-	100	99	98	97	84	51	20	07
99.	BH-35	SPT-4	4.00	-	-	-	-	-	-	-	100	99	97	31	-	-	-	-
100	BH-35	SPT-5	5.00	-	-	-	-	-	-	-	100	98	91	29	-	-	-	-

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PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21
SHEET 6 OF 6

GRAIN SIZE ANALYSIS (PER CENT FINER BY WEIGHT) **HYDROMETER**
SIEVE SIZES IN mm **(DIA IN mm)**

S No	BH NO.	SAMPLE	DEPTH (m)	75.0	37.5	19.0	9.50	4.75	2.36	1.18	0.600	0.300	0.150	0.075	.05	.01	.002	.001
101.	BH-35	SPT-10	12.00	-	-	-	-	-	100	82	52	28	25	11	-	-	-	-
102.	BH-36	SPT-3	3.00	-	-	-	-	-	-	-	100	99	94	48	30	19	08	02
103.	BH-36	SPT-8	9.00	-	-	-	-	-	-	-	100	99	91	40	28	15	07	02
104.	BH-37	SPT-1	1.00	-	-	-	-	-	-	100	99	98	97	73	58	37	14	04
105.	BH-37	SPT-5	5.00	-	-	-	-	-	-	-	100	99	91	26	-	-	-	-
106.	BH-37	SPT-9	10.00	-	-	-	-	-	-	-	100	98	93	43	29	13	09	02
107.	BH-38	SPT-1	1.00	-	-	-	-	-	-	-	-	100	99	79	65	38	14	06
108.	BH-38	SPT-8	9.00	-	-	-	-	-	-	-	100	98	92	27	-	-	-	-
109.	BH-38	SPT-15	19.50	-	-	-	-	-	-	-	100	99	97	38	-	-	-	-
110.	BH-39	SPT-1	1.00	-	-	-	-	-	-	-	100	99	97	58	46	26	12	04
111.	BH-39	SPT-7	7.50	-	-	-	-	-	-	-	100	99	93	40	28	14	08	02
112.	BH-39	SPT-12	15.00	-	-	-	-	-	-	-	100	99	95	54	42	22	10	03
113.	BH-40	SPT-1	1.00	-	-	-	-	-	100	99	98	97	96	95	81	50	24	08
114.	BH-40	UDS	3.50	-	-	-	-	-	-	-	100	99	97	96	84	56	30	14
115.	BH-40	SPT-12	15.00	-	-	-	-	-	-	-	100	98	91	33	-	-	-	-
116.	BH-41	SPT-1	1.00	-	-	-	-	-	-	-	100	99	95	58	45	21	10	03
117.	BH-41	SPT-7	7.50	-	-	-	-	-	-	-	100	99	96	58	44	20	10	03

PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21

ATTERBERG LIMITS / MOISTURE CONTENT

S. NO.	BORING NO.	SAMPLE	DEPTH (m)	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT (%)
1.	BH-9	SPT-11	13.50	21	04	16.47
2.	BH-15	SPT-14	18.00	NON-PLASTIC	NON-PLASTIC	20.87
3.	BH-27	SPT-1	1.00	24	05	20.32
4.	BH-27	UDS	2.50	33	10	21.43
5.	BH-30	SPT-1	1.00	NON-PLASTIC	NON-PLASTIC	25.06
6.	BH-32	SPT-1	1.00	NON-PLASTIC	NON-PLASTIC	20.00
7.	BH-33	SPT-1	1.00	NON-PLASTIC	NON-PLASTIC	23.29
8.	BH-35	SPT-1	1.00	NON-PLASTIC	NON-PLASTIC	26.13
9.	BH-35	SPT-4	4.00	NON-PLASTIC	NON-PLASTIC	23.35
10.	BH-37	SPT-1	1.00	NON-PLASTIC	NON-PLASTIC	23.41
11.	BH-38	SPT-1	1.00	NON-PLASTIC	NON-PLASTIC	23.77
12.	BH-39	SPT-1	1.00	NON-PLASTIC	NON-PLASTIC	23.61
13.	BH-40	SPT-1	1.00	NON-PLASTIC	NON-PLASTIC	24.26
14.	BH-40	UDS	3.50	31	07	23.87

PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21

UNCONFINED COMPRESSION / BULK DENSITY

S. NO.	BORING NO.	SAMPLE	DEPTH (m)	UNCONFINED COMPRESSION		BULK DENSITY (gm/cc)
				qu (kg/cm^2)	STRAIN (%)	
1.	BH-27	UDS	2.50	1.07	20.00	2.036
2.	BH-40	UDS	3.50	1.67	20.00	2.057

PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21

CHEMICAL TESTS ON SOIL

S. NO.	BORING NO.	SAMPLE	DEPTH (m)	SULPHATE CONTENT (%)
1.	BH-1	SPT-1	1.00	0.054
2.	BH-4	SPT-1	1.00	0.070
3.	BH-6	SPT-1	1.00	0.068
4.	BH-8	SPT-1	1.00	0.074
5.	BH-11	SPT-1	1.00	0.058
6.	BH-14	SPT-1	1.00	0.082
7.	BH-22	SPT-1	1.00	0.080
8.	BH-26	SPT-1	1.00	0.071
9.	BH-28	SPT-1	1.00	0.064
10.	BH-30	SPT-1	1.00	0.058
11.	BH-37	SPT-1	1.00	0.086
12.	BH-41	SPT-1	1.00	0.080

PROJECT : TYRE FACTORY AT GHARO-KETI BUNDER ROAD, GHARO, SINDH

DATE: Aug. 06, 2021.
L.R. No.: 496/21

CHEMICAL TESTS ON WATER

S. NO.	BORING NO.	TOTAL DISSOLVED SALTS (mg/lit)	SULPHATE CONTENT (mg/lit)	CHLORIDE CONTENT (mg/lit)	pH VALUE
1.	BH-1	1200	165	470	7.50
2.	BH-5	1600	247	620	7.60
3.	BH-10	1400	240	500	7.60
4.	BH-15	1200	160	455	7.50
5.	BH-20	1650	250	645	7.60
6.	BH-25	1700	256	650	7.60
7.	BH-30	1430	240	570	7.60
8.	BH-36	1800	260	700	7.60
9.	BH-41	1400	234	555	7.50

PHOTOGRAPHS

Annex – C
NOCs and Approvals

Book No: 5637

Total Pages	٥١

Page No: AB563677

Challan Rs.______Paid At NBP______ Through Challan	
No:	Date

رڪارڊ جو اختصار

ديھ/وارڊ/سيڪٽر	پاينڊو	تپو	پائريٽ	تعلقو	م.ساڪرو	ضلعو	ٺٽو

سروي نمبر/ سٽي سروي نمبر/ ناڪلاس نمبر/ پلاٽ نمبر	ڪل ايراضي	نالو ۽ ولديت ڪاتيدار/ڪاتيدارن جو ۽ شناختي ڪارڊ نمبر	حصو پئسن ۾	حصي موجب ايراضي	وڪري هيٺ ايراضي	داخلا نمبر/تاريخ/ رجسٽر۽ اسڪيننگ نمبر (اگر آهي)
466/1504	15.03	ظفر انثر پراڻيشر معرفت عظيم خان	1-00	50.25	50.25	داخلا فارم آ
468/1504	15.03					
469/1504	16-00	يوسف زئي خانشر ولد خانشر خان	/	/	/	
480/1.4	04-19	42201-0710967-7				
جملي	50.25					
		پنجاهه ايڪڙ پنجويهه گهنٽا				
ٽوٽل						
رجسٽرڊ پاور آف اٽارني/ ناظر ڪورٽ وغيره						Registered Deed No & Date/ Letter No & Date

پلاٽ جي صورت ۾ ان جا وڌيڪ تفصيل		پلاٽ نمبر	ايراضي
حدون	NORTH	اسڪير جو نالو	
	SOUTH		
	EAST		
	WEST		

	DD	MM	YEAR
Valid Upto			

سرٽيفڪيٽ

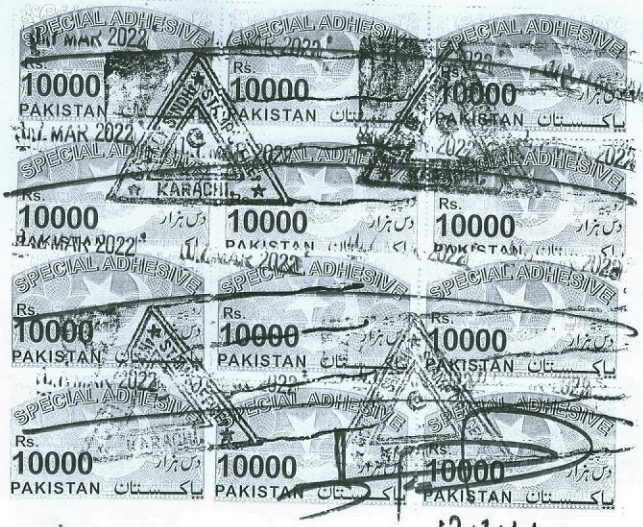
اهڙو سرٽيفڪيٽ مٿي ڄاڻايل ڪاتيدار/ ڪاتيدارن/ پاور آف اٽارني/ ناظر ڪورٽ وغيره جي درخواست تي جاري ڪجي ٿو. هر زير بار ۽ ڪورٽ ڪيس وغيره کان آزاد آهي.

جملي وڪري هيٺ ايراضي 50.25 ايڪڙ پنجاهه ايڪڙ پنجويهه گهنٽا آهي.

Outward No:	- Nil -	No: Mukht:/SC/	No: AC/SC/
Date:			
Signature			
Name & Designation Stamp	NABI BUX BALOCH SUPERVISING TAPEDAR CIRCLE M.P SAKRO Supervising Tapedar / City Surveyor	ASIF ALI SOOMRO Mukhtiarkar (R) Taluka Mirpur Sakro Mukhtiarkar / CSO	NASIR AHMED ABBASI Assistant Commissioner Taluka Mirpur Sakro Assistant Commissioner

Annex – D
Land Documents

368828



17.3.22.

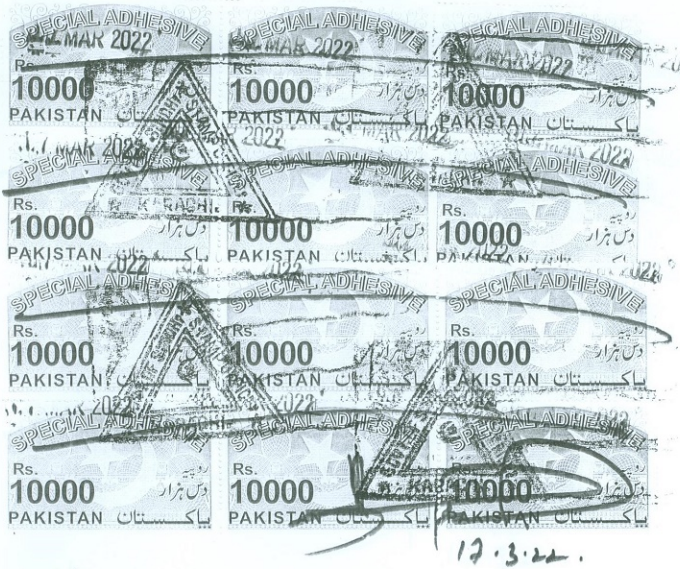
10000 4/P
12

CONVEYANCE DEED
OF IMMOVABLE PROPERTY
Valued at Rs. 36,882,800/-

THIS CONVEYANCE DEED is made at Mirpur Sakro, on this 17th day of March 2022.

BETWEEN

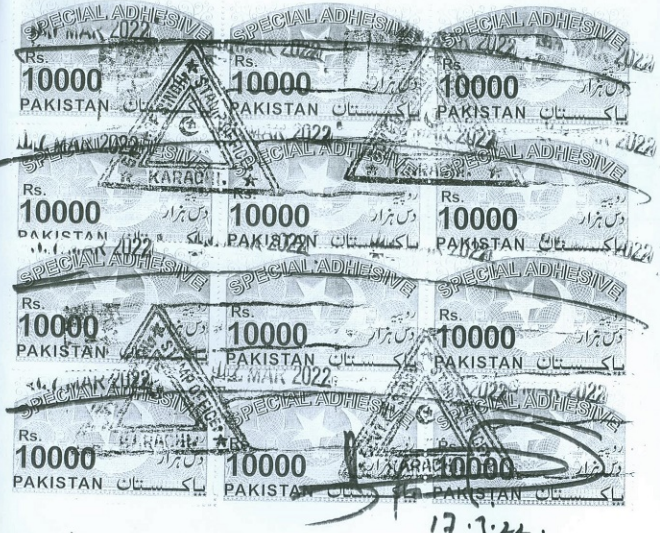
ZAFAR ENTERPRISES, a partnership firm, registered under the laws of Pakistan, having its registered office at 801-802, Fortune Centre, Block 6, P.E.C.H.S., Shahrah-e-Faisal, Karachi, acting through its authorized partner **Mr. Azim K. Yusufzai** s/o Khaista Khan resident of House No. 21, DOHS, Stadium



Colony, Karachi holding CNIC # 42201-0710967-7 (hereinafter referred to the **"Vendor",** which expression shall, unless repugnant to or excluded by the context mean and include its successors-in-interest, liquidators, and assigns) **OF THE FIRST PART**;

AND

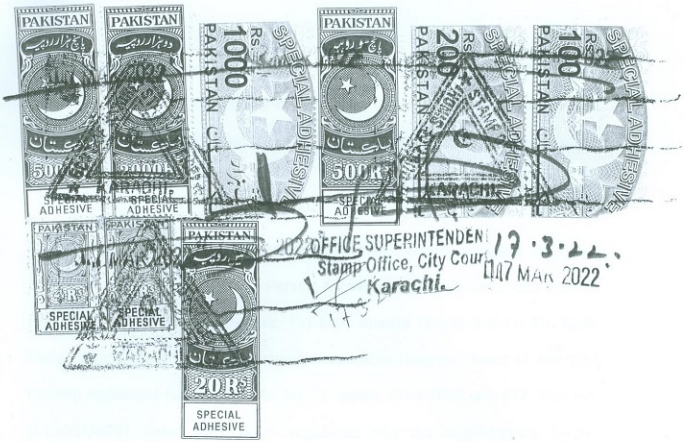
ARMSTRONG ZE (PVT) LIMITED, a company incorporated under the corporate laws of Pakistan, having its registered address 701, Fortune Centre, Block-6 P.E.C.H.S., Shahrah e Faisal Karachi, acting through its authorized General Manager **MR. IRFAN ABBAS** s/o Ghulam Abbas, Muslim, adult, holding CNIC No. 42201-0415054-1, resident of Karachi vide Board Resolution passed on



17.3.22.

February 9, 2022 (hereinafter referred to the **"Vendee"**, which expression shall, unless repugnant to or excluded by the context mean and include its successors-in-interest, executors, attorneys and assigns) **OF THE OTHER PART**.

WHEREAS the Vendor on the date of these presents is seized and well and sufficiently entitled to agricultural land measuring 31-03 Acres comprising of (1) Survey No. 477/1 to 4 measuring 15-03 Acres and (2) Survey No. 535/1 to 4 measuring 16-00 Acres, located in Deh Bhanero, situated at Tapo Babra, Taluka Mirpur Sakro, District Thatta (the "**Main Plot**")



WHEREAS the Vendor out of the Main Plot agreed to sell an undivided share **i.e.** land measuring **15 Acres and 03 Ghuntas out of the total area measuring 31-03 acres having Survey Nos. 477/1, 2, 3 and 4 located in Deh Bhanero, situated at Tapo Babra, Taluka Mirpur Sakro, District Thatta** (hereinafter referred to as the **"Said Property"** more fully described in the schedule at the foot of these presents) having acquired the same from Logistic Enterprises (Private) Limited through its authorized representative Mr. Mohammad Faisal Jamal vide a Conveyance Deed executed and registered at No. 464 Book No. I dated 30.10.2019 in the office of Sub-Registrar Mirpur Sakro and scanned at Digital Scanning Number RD:464/SRO:8045/ Doc Type:14, dated 18.11.2019.

AND WHEREAS necessary entries for transfer/mutation of the Said Property were made in the Record of Rights in favor of the Vendor and confirmed vide Dehjo Form VII bearing entry No. 191, dated 22.10.2020, issued by the Mukhtiarkar (Rev.) Mirpur Sakro.

AND WHEREAS Logistic Enterprises (Private) Limited acquired the Said Property from (i) Captain Shahid Pervaiz *for self and attorney* of (ii) Mst. Naseer Begum, (iii) Major Arshad Pervaiz, (iv) Mrs. Shaista Hamid and (v) Mr. Malik Mohammad Hamid through registered Irrevocable General Power of Attorney, bearing registered No. 1105, Book No. IV, dated 10.04.2008 with M.F. Roll No. U-25937/4980, dated 26.04.2008, registered with the Sub-Registrar Gadap Town, Karachi, by virtue of Sale Deed duly registered in office of the Sub-Registrar Mirpur Sakro at No. 258 Book No. I, dated 02.08.2018 with Digital Scanning No. RD:258/SRO:8045/ Doc Type:14, dated 03.09.2018. .

AND WHEREAS necessary entries for transfer/mutation of the Said Property were made in the Record of Rights in favor of the Vendor and confirmed vide Dehjo Form VII bearing entry No. 148, dated 14.02.2019, issued by the Mukhtiarkar (Rev.) Mirpur Sakro.

AND WHEREAS the said (i) Captain Shahid Pervaiz; (ii) Mst. Naseer Begum; (iii) Major Arshad Pervaiz; (iv) Mrs. Shaista Hamid; and (v) Mr. Malik Mohammad Hamid had acquired the Said Property by way of inheritance after the demise of Lt. Col (Retd.) Shah Mohammad and their names were entered in the Record of Rights (Foti Khata) as legal heirs of the deceased Lt. Col (Retd.) Shah Mohammad vide Dehjo Form VII bearing entry No. 11/7409, dated 07.03.2018 issued by the Mukhtiarkar (Rev.) Mirpur Sakro.

AND WHEREAS the Vendor has obtained Extract/NOC bearing No. Mukh:/SC/1351 dated 15.02.2022, issued by the Mukhtiarkar (Rev.) Mirpur Sakro.

AND WHEREAS the Vendor has agreed to sell, transfer, assign and convey the Said Property to the Vendee and the Vendee has agreed to purchase the Said Property from the Vendor free from all charges, claims, encumbrances, mortgages, liens, rights, obligations, objections of any nature whatsoever and together with valid, marketable and transferable ownership rights free of any restrictions or objections from any department, authority or person whatsoever for an aggregate sale consideration of **Rs. 36,882,800/-** (Rupees Thirty Six Million Eight Hundred Eighty Two Thousand Eight Hundred Only) (**"Sale Consideration"**) on the terms and conditions set-forth in this Conveyance Deed.

AND WHEREAS the Vendee has paid the Sale Consideration to the Vendor as full and final Sale Consideration at the time of execution and registration of this Conveyance Deed vide cheques details of which attached herewith the **Annexure-A**, receipt whereof the Vendor doth hereby admits and acknowledges, on the terms and conditions set-forth in this Conveyance Deed.

NOW, THEREFORE, THIS CONVEYANCE DEED WITNESSETH AS UNDER:

1. In consideration of the full and final Sale Consideration i.e. **Rs. 36,882,800/-** (Rupees Thirty Six Million Eight Hundred Eighty Two Thousand Eight Hundred Only) for the sale of the Said Property, paid by the Vendee to the Vendor prior to execution of this Conveyance Deed, receipt whereof the Vendor hereby admits and acknowledges, and of and from the same and every part thereof the Vendor hereby acquits, discharges and exonerates the Vendee and the Vendor as the exclusive,

legal and beneficial owner of the Said Property hereby sells, transfers, assigns and conveys absolutely unto the Vendee the Said Property **TOGETHER WITH** marketable and transferable title thereto and the existing privileges, rights, title, interest, easements, passages and all advantages whatsoever belonging thereto or in any way appertaining therewith or any part thereof now or at any time hereto before usually held, occupied or enjoyed by the Vendor **TO HAVE AND TO HOLD THE SAME** unto and to the use and benefit of the Vendee as absolute owner thereof, free from all lets, hindrances, claims, demands, suits, disputes, denials, interruptions, litigations, previous commitments, sureties, mortgages, charges and /or ejection whatsoever **AND** together with the absolute right to further sell , transfer , convey, mortgage, gift, and assign the Said Property.

2. That the Vendor further doth hereby covenants with the Vendee and represents that the Vendee shall be absolutely entitled to peacefully and quietly own, possess, occupy and enjoy the Said Property free from all claims, demands, charges, lets, hindrances, interruptions and disputes, litigations, and eviction whatsoever from any persons claiming through, under or in trust from the Vendor.

3. That the Vendor doth hereby covenants with the Vendee and represents that the Vendor has not done, made, committed, permitted or caused suffer to be done or neglected from doing anything whereby the Vendor's right to grant, sell, assign, convey or transfer any of estate, rights, titles and interest in respect of the Said Property and/or right of possession and enjoyment have been or may be impaired.

4. That the Vendor further doth hereby covenants with the Vendee that the Vendor has valid marketable title to the Said Property and the Said Property is free from all claims, disputes, mortgages, charges, liens, demands and encumbrances whatsoever and that the Vendor shall keep and hold the Vendee secured, harmless and indemnified against any losses, damages or costs suffered or incurred by the Vendee on account of any defect in the title of the Vendor to the Said Property or on account of any lawful claims, liens, mortgages, charges, evictions, lets, hindrances and encumbrances in respect of the Said Property created prior to the date hereof.

5. That the Vendor doth hereby declares that the peaceful complete physical vacant possession of the Said Property has been handed over to the Vendee and the Vendor has also delivered to the Vendee all the original deeds and documents of title pertaining to the Said Property in the possession of the Vendor and relating to the Said Property and that henceforth the Vendor has ceased to have any right, title, interest or claim in the Said Property or any part thereof and the Vendee shall be the exclusive, absolute and rightful owner of the Said Property, and Vendee acknowledges receipt of peaceful complete physical possession of the Said Property and of the said original deeds and documents.

6. The Vendor further covenants with the Vendee and represents that all dues, outgoings, taxes, levies, charges in respect of the Said Property and bills for utilities if any availed or connected at the Said Property for the period up to the date of presentment for registration of this Conveyance Deed have been paid and cleared by the Vendor, however, if any, claims and /or bills in respect of the same are received by the Vendee pertaining to the period up to the date of registration of this Conveyance Deed, the

same shall be borne by the Vendor and the amount thereof immediately paid to the Vendee on demand.

7. The Vendor undertakes to execute or sign such other documents, applications, declarations, and forms and provide all necessary co-operation as may be necessary or required for more fully perfecting the conveyance and transfer of the Said Property to the Vendee and to procure the Said Property to be transferred / mutated in the records of Mukhtiarkar (Rev.) concerned and/or other departments, all at the entire cost and expense of the Vendee.

SCHEDULE OF THE SAID PROPERTY

ALL THAT piece and parcel of a Form-II land having undivided share of land bearing **Survey No. 477/1, 2, 3 and 4 measuring 15 Acres and 03 Ghuntas out of total area measuring 31-03 Acres, located in Deh Bhanero, situated at Tapo Babra, Taluka Mirpur Sakro, District Thatta, Sindh** within the registration jurisdiction of Sub-Registrar Mirpur Sakro, District Thatta.

IN WITNESS WHEREOF the parties hereto have executed and delivered this Deed on the day month and year first above mentioned.

WITNESSES:

1. _____
MUHAMMAD RIAZ
S/O ABDUL AZIZ
CNIC - 42201-9022482-5

ZAFAR ENTERPRISES
through its authorized Partner
Mr. Azim K. Yusufzai
Son of Khaista Khan
42201-0710967-7

Vendor


KARACHI


Karachi


KARACHI

2. Sanawar Abbas.

Sanawar Abbas.
S/o Muhammad Hussain.
CNIC: 42301-0776299-9.

ARMSTRONG ZE (PVT) LIMITED
through its authorized General Manager
Mr. IRFAN ABBAS
Son of GHULAM ABBAS QASIM ALI
CNIC 42201-0415059-1

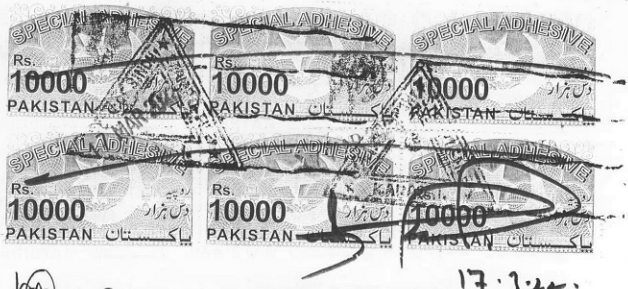
Vendee

ANNEXURE A

Details of Pay Orders / Cheque of Sale Consideration

Bank Name	Date	Instrument No.
Bank Al Habib Limited	23.02.2022	11595219
Bank Al Habib Limited	23.02.2022	11595220
Bank Al Habib Limited	23.02.2022	11595221
Bank Al Habib Limited	23.02.2022	11595222
Bank Al Habib Limited	23.02.2022	11595223
Bank Al Habib Limited	23.02.2022	11595224
Bank Al Habib Limited	23.02.2022	11595225
Bank Al Habib Limited	23.02.2022	11595226
Bank Al Habib Limited	23.02.2022	11595227
Bank Al Habib Limited	23.02.2022	11595228
Bank Al Habib Limited	23.02.2022	11595229
Bank Al Habib Limited	23.02.2022	11595230
Bank Al Habib Limited	23.02.2022	11595231
Bank Al Habib Limited	23.02.2022	11595232
Bank Al Habib Limited	23.02.2022	11595233
Bank Al Habib Limited	23.02.2022	11595234
Bank Al Habib Limited	23.02.2022	11595235
Bank Al Habib Limited	23.02.2022	11595236
Bank Al Habib Limited	23.02.2022	11595237
Bank Al Habib Limited	23.02.2022	11595238
Bank Al Habib Limited	23.02.2022	11595239
Bank Al Habib Limited	23.02.2022	11595240
Bank Al Habib Limited	23.02.2022	11595241
Bank Al Habib Limited	23.02.2022	11595242
Bank Al Habib Limited	16.03.2022	11595246

869774



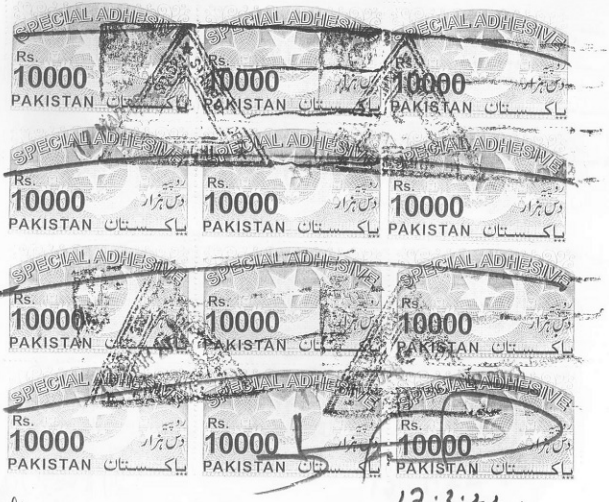
17.3.22.

CONVEYANCE DEED
OF IMMOVABLE PROPERTY
Valued at Rs. 86,977,400/-

THIS CONVEYANCE DEED is made at Mirpur Sakro, on this 17th day of March 2022.

BETWEEN

ZAFAR ENTERPRISES, a partnership firm, registered under the laws of Pakistan, having its registered office at 801-802, Fortune Centre, Block 6, P.E.C.H.S., Shahrah-e-Faisal, Karachi, acting through its authorized partner **Mr. Azim K. Yusufzai** s/o Khaista Khan resident of House No. 21, DOHS, Stadium Colony, Karachi holding CNIC # 42201-0710967-7 (hereinafter referred to the

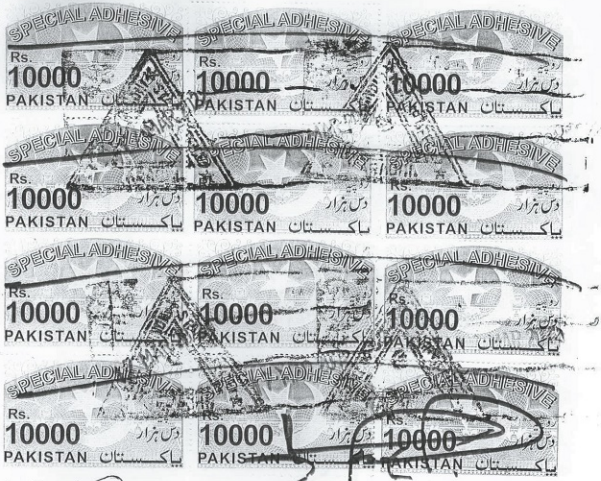


17.3.22.

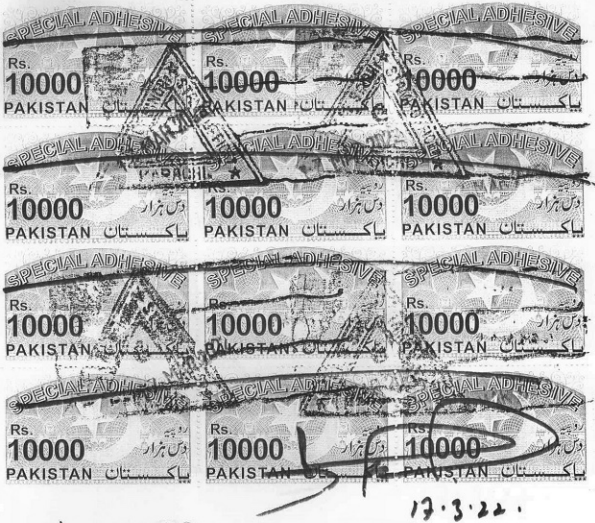
"Vendor", which expression shall, unless repugnant to or excluded by the context mean and include its successors-in-interest, liquidators, and assigns) **OF THE FIRST PART**;

AND

ARMSTRONG ZE (PVT) LIMITED, a company incorporated under the corporate laws of Pakistan, having its registered address 701, Fortune Centre, Block-6 P.E.C.H.S., Shahrah e Faisal Karachi, acting through its authorized General Manager **MR. IRFAN ABBAS** s/o Ghulam Abbas, Muslim, adult, holding CNIC No. 42201-0415054-1, resident of Karachi vide Board Resolution passed on February 9, 2022 (hereinafter referred to the **"Vendee",** which expression shall, unless repugnant to or excluded by the context mean and include its successors-in-interest, executors, attorneys and assigns) **OF THE OTHER PART**.



WHEREAS the Vendor on the date of these presents is seized and well and sufficiently entitled to a Form-II open land measuring **35-22 Acres comprising (1) Survey No. 478/1 to 4 measuring 15-03 Acres, (2) Survey No. 479/1 to 4, measuring 16-00 Acres; and (3) Survey No. 480/1.4 measuring 04-19 Acres, located in Deh Bhanero, situated at Tapo Babra, Taluka Mirpur Sakro, District Thatta** (hereinafter referred to as the **"Said Property"** more fully described in the schedule at the foot of these presents) having acquired the same from Logistic Enterprises (Private) Limited through its authorized representative Mr. Mohammad Faisal Jamal vide a Conveyance Deed executed and registered at No. 462 Book No. I dated 30.10.2019 in the office of Sub-Registrar Mirpur Sakro and scanned at Digital Scanning Number RD:462/SRO:8045/ Doc Type:14, dated 18.11.2019.



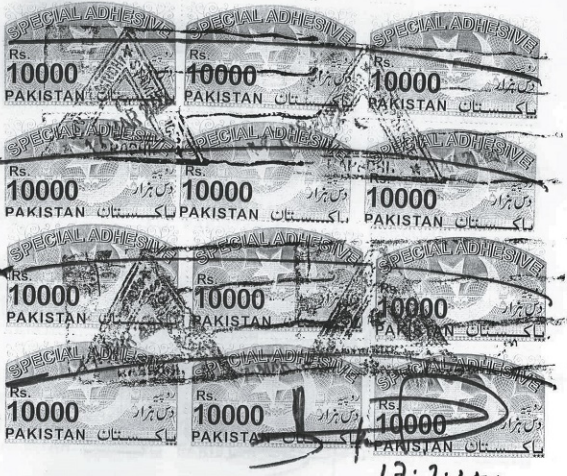
17.3.22.

AND WHEREAS necessary entries for transfer/mutation of the Said Property were made in the Record of Rights in favor of the Vendor and confirmed vide Dehjo Form VII bearing entry No. 189, dated 22.10.2020, issued by the Mukhtiarkar (Rev.) Mirpur Sakro.

WHEREAS Logistic Enterprises (Private) Limited acquired the Said Property from Mst. Naseer Begum *through her attorney* Captain Shahid Pervaiz by virtue of Conveyance Deed duly registered in office of the Sub-Registrar Mirpur Sakro, at No. 260 Book No. I dated 02.08.2018 with Digital Scanning No. RD:260/SRO: 8045/DocType:14, dated 03.09.2018.

ZAFAR ENTERPRISES Karachi

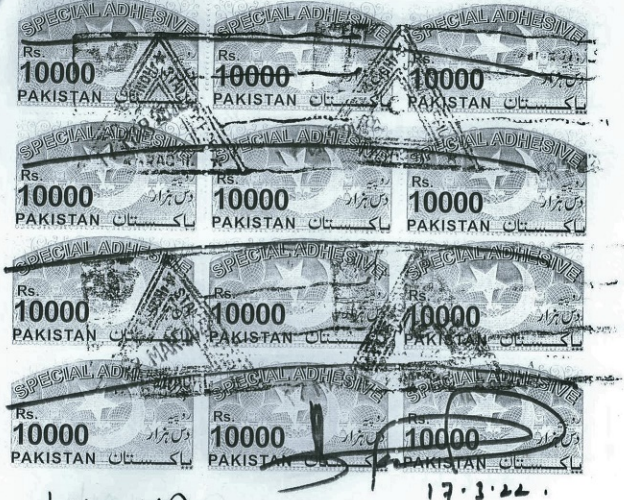
ARMSTRONG ZEPHYR KARACHI



17.3.22.

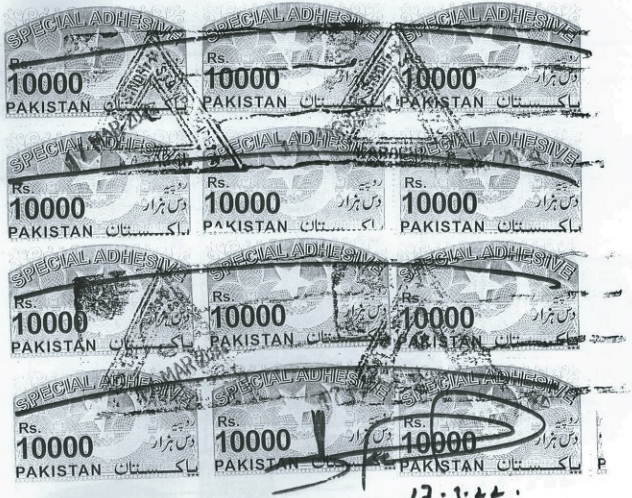
AND WHEREAS necessary entries for transfer/mutation of the Said Property were made in the Record of Rights in favor of the Vendor vide Dehjo Form VII bearing entry No. 150, dated 14.02.2019, issued by the Mukhtiarkar (Rev.) Mirpur Sakro.

AND WHEREAS the said Mst. Naseer Begum had acquired the Said Property by way of oral gift from her husband Col. (Retd.) Shah Mohammad. Necessary entries for transfer/mutation of the Said Property were made in the Record of Rights in favor of Mst. Naseer Begum and confirmed the same vide Dehjo Form VII bearing entry No. 76, dated 11.09.2007.



AND WHEREAS the said Property was originally granted to Col. (Retd.) Shah Mohammad by the West Pakistan, Agricultural Development Corporation through Revenue Officer G.M.B. Projects, Hyderabad in Defense Quota by virtue of Letter bearing Ref No. LSB/H-12244, dated 17.11.1962 followed by Form "A" dated 21.021974.

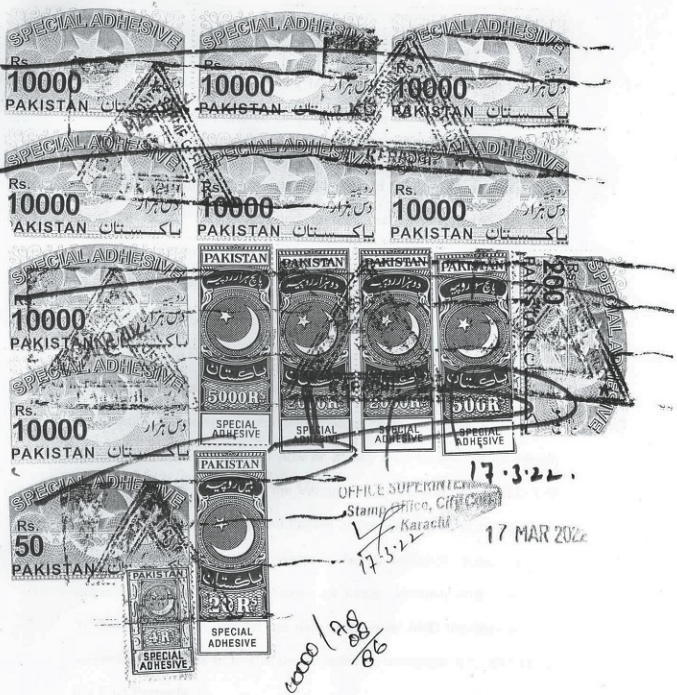
AND WHEREAS the Vendor has obtained Extract/NOC bearing No. Mukh:/SC/1351 dated 16.02.2022 issued by the Mukhtiarkar (Rev.) Mirpur Sakro.



17.3.22.

10000/ 68 12 78 00

AND WHEREAS the Vendor has agreed to sell, transfer, assign and convey the Said Property to the Vendee and the Vendee has agreed to purchase the Said Property from the Vendor free from all charges, claims, encumbrances, mortgages, liens, rights, obligations, objections of any nature whatsoever and together with valid, marketable and transferable ownership rights free of any restrictions or objections from any department, authority or person whatsoever for an aggregate sale consideration of **Rs. 86,977,400/-** (Rupees Eighty Six Million Nine Hundred Seventy Seven Thousand and Four Hundred Only) (**"Sale Consideration"**) on the terms and conditions set-forth in this Conveyance Deed.



AND WHEREAS the Vendee has paid the Sale Consideration to the Vendor as full and final Sale Consideration at the time of execution and registration of this Conveyance Deed vide cheques details of which attached herewith the **Annexure-A**, receipt whereof the Vendor doth hereby admits and acknowledges, on the terms and conditions set-forth in this Conveyance Deed.

NOW, THEREFORE, THIS CONVEYANCE DEED WITNESSETH AS UNDER:

1. In consideration of the full and final Sale Consideration i.e. **Rs.**

ZAFAR ENTERPRISES Karachi

ARMSTRONG ZEAL (PVT) LTD KARACHI

86,977,400/- (Rupees Eighty Six Million Nine Hundred Seventy Seven Thousand and Four Hundred Only) for the sale of the Said Property, paid by the Vendee to the Vendor prior to execution of this Conveyance Deed, receipt whereof the Vendor hereby admits and acknowledges, and of and from the same and every part thereof the Vendor hereby acquits, discharges and exonerates the Vendee and the Vendor as the exclusive, legal and beneficial owner of the Said Property hereby sells, transfers, assigns and conveys absolutely unto the Vendee the Said Property **TOGETHER WITH** marketable and transferable title thereto and the existing privileges, rights, title, interest, easements, passages and all advantages whatsoever belonging thereto or in any way appertaining therewith or any part thereof now or at any time hereto before usually held, occupied or enjoyed by the Vendor **TO HAVE AND TO HOLD THE SAME** unto and to the use and benefit of the Vendee as absolute owner thereof, free from all lets, hindrances, claims, demands, suits, disputes, denials, interruptions, litigations, previous commitments, sureties, mortgages, charges and /or ejection whatsoever **AND** together with the absolute right to further sell , transfer , convey, mortgage, gift, and assign the Said Property.

2. That the Vendor further doth hereby covenants with the Vendee and represents that the Vendee shall be absolutely entitled to peacefully and quietly own, possess, occupy and enjoy the Said Property free from all claims, demands, charges, lets, hindrances, interruptions and disputes, litigations, and eviction whatsoever from any persons claiming through, under or in trust from the Vendor.

3. That the Vendor doth hereby covenants with the Vendee and represents that the Vendor has not done, made, committed, permitted or caused

ZAFAR ENTERPRISES Karachi

KARACHI

suffer to be done or neglected from doing anything whereby the Vendor's right to grant, sell, assign, convey or transfer any of estate, rights, titles and interest in respect of the Said Property and/or right of possession and enjoyment have been or may be impaired.

4. That the Vendor further doth hereby covenants with the Vendee that the Vendor has valid marketable title to the Said Property and the Said Property is free from all claims, disputes, mortgages, charges, liens, demands and encumbrances whatsoever and that the Vendor shall keep and hold the Vendee secured, harmless and indemnified against any losses, damages or costs suffered or incurred by the Vendee on account of any defect in the title of the Vendor to the Said Property or on account of any lawful claims, liens, mortgages, charges, evictions, lets, hindrances and encumbrances in respect of the Said Property created prior to the date hereof.

5. That the Vendor doth hereby declares that the peaceful complete physical vacant possession of the Said Property has been handed over to the Vendee and the Vendor has also delivered to the Vendee all the original deeds and documents of title pertaining to the Said Property in the possession of the Vendor and relating to the Said Property and that henceforth the Vendor has ceased to have any right, title, interest or claim in the Said Property or any part thereof and the Vendee shall be the exclusive, absolute and rightful owner of the Said Property, and Vendee acknowledges receipt of peaceful complete physical possession of the Said Property and of the said original deeds and documents.

6. The Vendor further covenants with the Vendee and represents that all dues, outgoings, taxes, levies, charges in respect of the Said Property and

bills for utilities if any availed or connected at the Said Property for the period up to the date of presentment for registration of this Conveyance Deed have been paid and cleared by the Vendor, however, if any, claims and /or bills in respect of the same are received by the Vendee pertaining to the period up to the date of registration of this Conveyance Deed, the same shall be borne by the Vendor and the amount thereof immediately paid to the Vendee on demand.

7. The Vendor undertakes to execute or sign such other documents, applications, declarations, and forms and provide all necessary co-operation as may be necessary or required for more fully perfecting the conveyance and transfer of the Said Property to the Vendee and to procure the Said Property to be transferred / mutated in the records of Mukhtiarkar concerned and/or other departments, all at the entire cost and expense of the Vendee.

SCHEDULE OF THE SAID PROPERTY

ALL THAT piece and parcel of a Form-II land bearing **(1) Survey No. 478/1 to 4 measuring 15-03 Acres, (2) Survey No. 479/1 to 4, measuring 16-00 Acres and (3) Survey No. 480/1.4 measuring 04-19 Acres total measuring 35 acres and 22 ghuntas, located in Deh Bhanero, situated at Tapo Babra, Taluka Mirpur Sakro, District Thatta, Sindh** within the registration jurisdiction of Sub-Registrar Mirpur Sakro, District Thatta.

IN WITNESS WHEREOF the parties hereto have executed and delivered this Deed on the day month and year first above mentioned.

WITNESSES:

1. _____
MUHAMMAD RIAZ
S/O ABDUL AZIZ
CNIC - 42201-9022452-5

2. _____
SANAWAR ABBAS.
S/O MUHAMMAD HUSSAIN.
CNIC: 42201-0776289-9.

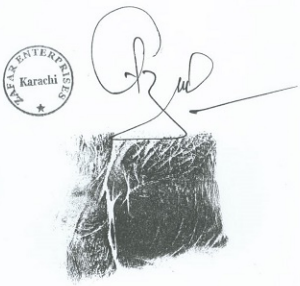
ZAFAR ENTERPRISES
through its authorized Partner
Mr. Azim K. Yusufzai
Son of Khaista Khan
42201-0710967-7

Vendor

ARMSTRONG ZE (PVT) LIMITED
through its authorized General Manager
MR. IRFAN ABBAS
Son of Ghulam Abbas
CNIC No. 42201-0415054-1

Vendee


KARACHI


Karachi


KARACHI

ANNEXURE A

Details of Cheques of Sale Consideration

Bank Name	Date	Instrument No.
Bank Al Habib Limited	23.02.2022	11595219
Bank Al Habib Limited	23.02.2022	11595220
Bank Al Habib Limited	23.02.2022	11595221
Bank Al Habib Limited	23.02.2022	11595222
Bank Al Habib Limited	23.02.2022	11595223
Bank Al Habib Limited	23.02.2022	11595224
Bank Al Habib Limited	23.02.2022	11595225
Bank Al Habib Limited	23.02.2022	11595226
Bank Al Habib Limited	23.02.2022	11595227
Bank Al Habib Limited	23.02.2022	11595228
Bank Al Habib Limited	23.02.2022	11595229
Bank Al Habib Limited	23.02.2022	11595230
Bank Al Habib Limited	23.02.2022	11595231
Bank Al Habib Limited	23.02.2022	11595232
Bank Al Habib Limited	23.02.2022	11595233
Bank Al Habib Limited	23.02.2022	11595234
Bank Al Habib Limited	23.02.2022	11595235
Bank Al Habib Limited	23.02.2022	11595236
Bank Al Habib Limited	23.02.2022	11595237
Bank Al Habib Limited	23.02.2022	11595238
Bank Al Habib Limited	23.02.2022	11595239
Bank Al Habib Limited	23.02.2022	11595240
Bank Al Habib Limited	23.02.2022	11595241
Bank Al Habib Limited	23.02.2022	11595242
Bank Al Habib Limited	16.03.2022	11595246

S:410-211

Regn Form 38-B

063 Of Document Application

Dated 17 MAR 2022 Of 20

Nature Of Document

By whom presented Sale Deed

Received fees as follows:-

Registration Fee	do	36882-00/-
Copying Fees (folies)		
Do for endorsements		1000-0
Postage		
Copies of Menorandums (Section64to 67)-		
Search of Inspection		05-0
Fines-Section 25		
Section 34		
Certified copies (Section 57) Folios		120-0
Other Fess-Item (on reserve) No.		
Do	do	
Do	do	
Do	do	
Do	do	
Total Rs.		1125/-

The Document/copy will be read on and will be
Sent by registered post
Delivered at this office.

SUB-REGISTRAR
PUTTUR SAKRO

Sub-Registrar

1:46-210

Regn Form 38-B

062 Of Document Application

Dated 17 MAR 2022

Nature Of Document

By whom presented Sale Deed

Received fees as follows:- @ 86977-400/-

Registration Fee		
Copying Fees (folios)		
Do for endorsements		1000-0
Postage		
Copies of Memorandums (Section 64 to 67)		
Search of Inspection		05-0
Fines-Section 25		
Section 34		NIL 120-0
Certified copies (Section 57) Folios		
Other Fess-Item (on reserve) No.		
Do	do	
Do	do	
Do	do	
Do	do	
Total Rs.		1125/-

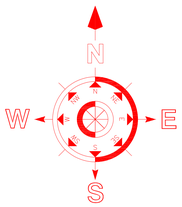
The Document/copy will be read on and will be
Sent by registered post
Delivered at this office.

SUB-REGISTRAR
CHEVELLA

Sub-Registrar

Please Send the document by registered post to

Annex – E
Topographic Plan



NOTES:–

1. ALL DIMENSIONS ARE IN METER UNITS.
2. HORIZONTAL & VERTICAL DATUM ARE WITH RESPECT TO WGS84 DATUM AND UTM PROJECTION ZONE 42 OBSERVED USING DUAL FREQUENCY GPS AT DATUM STATIONS BM1 & BM2.
   VALUES OF THESE DATUM STATIONS ARE AS FOLLOWS:

WGS84 SPHERICAL COORDINATES	BM1	24°42'38.69902"N	67°35'28.94754"E	
	BM2	24°42'38.75241"N	67°35'22.23145"E	
UTM 42 ZONE GRID COORDINATES	BM1	E=357515.619	N=2733652.389	Z=2.323
	BM2	E=357326.905	N=2733655.973	Z=2.322

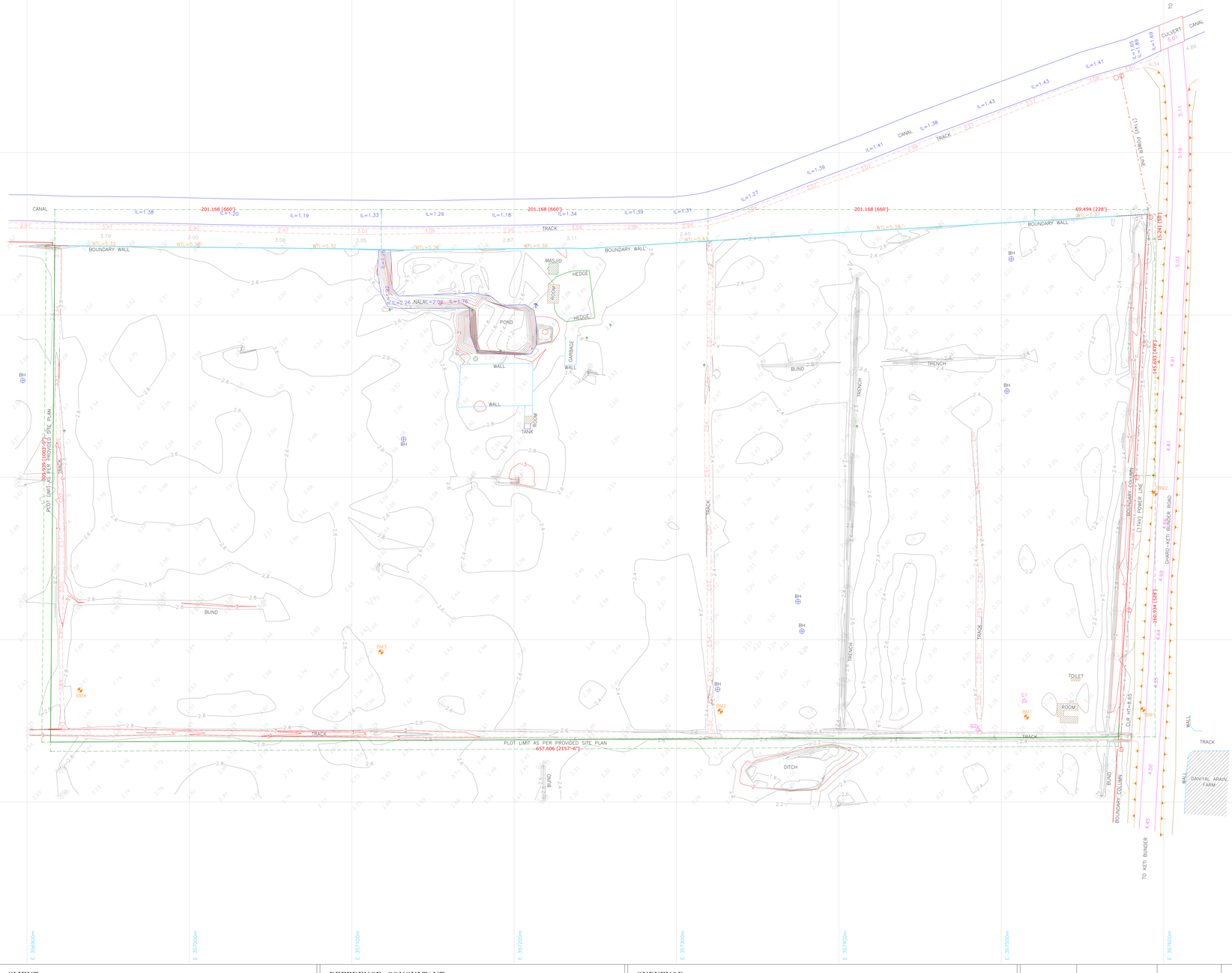
3. CONTOUR INTERVAL:
   MAJOR : 1.00m
   MINOR : 0.20m
4. AREA AS PER PROVIDED SITE PLAN = 50 ACRES 25 GHUNTA

LEGEND:–

AUXILIARY SURVEY CONTROL STATION	△
BENCHMARK	⊕
BOREHOLE	BH
GATE	═
HAND PUMP	
TREE	
PALM TREE	
POLE	○
ELECTRIC POLE	
POWER LINE	
PAVED ROAD	
TRACK	
BOUNDARY WALL	
BOUNDARY COLUMN	
PLOT LIMIT	
WALL TOP LEVEL	WTL=
INVERT LEVEL	IL=
AREA LIMIT AS PER PROVIDED SITE PLAN	

COORDINATES OF BENCHMARKS

BM.	EASTING	NORTHING	LEVEL	DESCRIPTION
BM1	357515.619	2733652.389	2.323	IRON ROD EMBEDDED IN CEMENTED MONUMENT
BM2	357326.905	2733655.973	2.322	IRON ROD EMBEDDED IN CEMENTED MONUMENT
BM3	357117.988	2733692.482	2.869	IRON ROD EMBEDDED IN CEMENTED MONUMENT
BM4	356932.646	2733668.954	2.802	IRON ROD EMBEDDED IN CEMENTED MONUMENT
TBM1	357587.172	2733656.978	4.414	STEEL NAIL EMBEDDED ON GHARO–KETI BUNDER ROAD
TBM2	357594.681	2733790.054	4.622	STEEL NAIL EMBEDDED ON GHARO–KETI BUNDER ROAD



JOB.	DRAWING TITLE.	CLIENT.	REFERENCE CONSULTANT.
TOPOGRAPHICAL & CONTOUR SURVEY	50 ACRES 25 GHUNTA LAND LOCATED AT GHARO – KETI BUNDER HIGHWAY SINDH	M/S ARMSTRONG ZE (PRIVATE) LIMITED SUITE 801~802, FORTUNE CENTER BLOCK 6, P.E.C.H.S. SHARA–E–FAISAL KARACHI PHONE: (92–21) 111 938 938	MR. SHAHAB AFTAB – MANAGING PARTNER M/S SYSTEM SERVICES 234–A, BLOCK–2, P.E.C.H.S. KARACHI CELL: 0321–9271857, 0333–3471857 Email: shaftab@hotmail.com

SURVEYOR.

SURVEY ENGINEERS
ENGINEERING SURVEY & MAPPING CONSULTANTS
SUITE # 5, 3rd FLOOR, PLOT#19–C, SOUTH PARK AVENUE
PHASE–II, EXTENSION, DHA, KARACHI
Ph:– 021–35312400, Cell:– 0333–2233863
Email:– info@surveyengineers.com.pk

SURVEYED	TAHA SHEIKH	DRG SIZE	A0
DRAWN	TAHA SHEIKH	H–SCALE	1 : 1000
CHECKED	SIKANDER SHAH	DRG NO.	01
DATE REV–1	16–08–2021 26–03–2022	D:\2021\SYSTEM\ARMSTRONG\	

Annex – F
Topographic Survey Report

DIGITAL TOPOGRAPHICAL AND CONTOUR SURVEY OF LAND LOCATED AT GHARO, SINDH

CLIENT

M/S ARMSTRONG ZE (PRIVATE) LIMITED

CONSULTANT

M/S SYSTEM SERVICES

REVISED SURVEY REPORT

MARCH – 2022

SURVEY ENGINEERS
Engineering Survey & Mapping Consultants
Suite # 5, 3rd Floor, Plot # 19-C, South Park Avenue, Phase-II, (Ext),
DHA, Karachi-75500, Ph: 021-35312400, Fax: 021-35380636
E-mail: info@surveyengineers.com.pk, https://www.surveyengineers.com.pk

TABLE OF CONTENTS

1. INTRODUCTION

M/s Armstrong ZE (Private) Limited has intends to build his project in Gharo, Sindh**.** Therefore, he awarded the design work to M/s SYSTEM SERVICES having Head Office at 234-A, Block-2, PECHS, Karachi. M/s System Services had realized that most construction projects could not be designed or built without significant input from the Land Surveyor. So they desired to have a complete survey for designing and assigned the task to M/s Survey Engineers having Head Office at Suite # 5, 3rd Floor, Plot # 19-C, South Park Avenue, Phase-II, Ext. DHA, Karachi-75500, Pakistan for carrying out Topographical Survey. We Survey Engineers believe that the quantity without quality is of highly objectionable value and as such we blend the quality with quantity to the entire satisfaction of our clients.

2. PROJECT LOCATION AND TERRIAN

The project site is located on Gharo – Keti Bundar Highway approx. 3.2 km in the south from National Highway. The site covers 50 acres 25 ghunta of plain terrain, as per provided site plan. Every visible features and exposed utility within the project area is observed and incorporated in the survey drawing.

3. APPROACH

It was a huge task to carry out the topographical survey of plain terrain, to achieve the target, a very experienced 02 survey teams were deployed on the project as hereunder.

The survey teams were headed by Engr. Syed Khawer Haqdad Shah – Project Director.

Survey Team No. 1

- Taha Sheikh — Survey Engineer
- Syed Ansar Hussain Rizvi — Asst. Survey Engineer
- Ahsan Nisar — Survey Helper
- Waqar Ahmed — Survey Helper

Survey Team No. 2

- Muhammad Sajid Channa — Survey Engineer
- Syed Khurram Shahid — Asst. Survey Engineer
- Muhammad Usama — Survey Helper
- Muhammad Owais — Survey Helper

It was the result of combined efforts of all the above mentioned personnel and the teamwork spirit that the fieldwork could be completed according to the schedule.

4. GENERAL SCOPE OF WORK

- Provide Unit Measurements in Meter System
- Establish Horizontal and Vertical Survey Control
- Carry out Detail Topographical Survey
- Produce Computer Aided Drawing

5. SURVEY ENGINEERS METHODOLOGY

To meet the requirement of the client, the survey work was sub-divided into various activities as described below:

5.1 Reference Datum
5.2 Reconnaissance of Project area and Pegging
5.3 Control Work.
5.4 Detail Topographical Survey with Total Station

The above mentioned activities were conducted in the following manner:

5.1 Datum Reference

All coordinates are with respect to WGS84 datum and UTM Projection Zone 42 observed using Dual Frequency GPS at datum stations BM1 & BM2. Values of these datum stations are as follows in meter units:

WGS84 Spherical Coordinates are:

BM1	24°42'38.69902"N	67°35'28.94754"E
BM2	24°42'38.75241"N	67°35'22.23145"E

UTM 42 Zone Grid Coordinates are:

BM1	E = 357515.619m	N = 2733652.389m	Z= 2.323m
BM2	E = 357326.905m	N = 2733655.973m	Z= 2.322m

5.2 Reconnaissance of Project area and Pegging

The Senior Survey Engineer was entrusted with the responsibility of carrying out the reconnaissance and pegging of the project site. First of all, control stations / benchmarks at suitable interval and in commanding positions on the project area were fixed at approx. 200 meters interval on visible stretches of the project area and closer on maximum detail portion.

5.3 Control work

One of the first major tasks for surveying of large areas is the establishment of accurate survey control over the project area. In the technical survey sense, control means the framework of survey stations and benchmarks to which all other subsequent survey, design and construction operations are spatially related.

The control should conform to the time honored basic survey principle of "always working from the whole to the part". If the survey is allowed to build up bit-by-bit, growing outwards as the project is extended, errors and tolerance will tend to accumulate beyond acceptable engineering limits. Every measurement is subject to some tolerance, thus the measurements, larger the overall error. A primary control framework on the project area can contain the tolerance within reasonable limits and therefore, it cannot and should not be overstressed or bypassed. The survey control is established as horizontal and vertical control.

5.3.1 Horizontal Control by Global Positioning System (GPS)

5.3.1.1 Static GPS Survey – Two Dual Frequency GPS receivers were used to establish the control stations / benchmarks. One receiver is set up over the datum station, whose coordinates are known and the second is positioned over other station whose coordinates are unknown. Both GPS receivers must receive signals from the same four (or more) satellites for a period of time that can range from a few minutes to several hours, depending on the conditions of observation and precision required. Station occupation time is dependent on baseline length, number of satellites observed, and the GPS equipment used. In general, 1hr to 2hr is a good approximation for baseline occupation time for shorter baselines of (1-30 kilometers) and we have observed minimum 1hr for each station, the maximum baseline distance is 581m on this project.


5.3.1.2 RTK GPS Survey Techniques – RTK survey is required also two or more dual frequency LI/L2 GPS rover receivers. One of the GPS receivers is set over a known benchmark station, while the other rover receivers are free to travel from traverse station to traverse station. The RTK technology allows the rover receiver to initialize and resolve the integer ambiguities without a period of static initialization. The survey is performed in real time, a radio link and a processor or data collector are used. The radio link is used to transfer the raw data from the reference benchmark station to the other rover receiver. The traverse station coordinate differences are also calculated in terms of a 3D, earth centered coordinate system that utilizes X-, Y-, and Z- values based on the WGS 84 geocentric ellipsoid model. These coordinate differences are then subsequently shifted to fit the plain coordinate system applying a combined scale factor accounts for the difference between a distances on a curved surface (Earth).


5.3.1.3 Data Post-processing - After the observation session has been completed, the received GPS signals from both receivers are then processed by Spectrum Survey Software to calculate the 3D coordinate X, Y and Z values based on the WGS84 - UTM coordinate system.

5.3.1.4 Accuracy of Static and RTK Surveys – The accuracy of Static and RTK surveys is the most accurate and can be used for any order of survey providing a good network.

5.3.2 Vertical Control by Level Machine

The vertical control points are provided to determine heights from project datum by double tertiary method which in turn is used for project leveling.

Like the traverse, the main leveling lines also emanated from known benchmark and closed on another known benchmark to achieve the standard accuracy, the following method is adopted.

5.3.2.1 Automatic leveling instrument of B2O of 32X magnification is used.

5.3.2.2 Imported metallic telescopic leveling staves provided with bubbles to maintain the verticality of staff is observed to.

5.3.2.3 The longest permissible shot is limited to 50 meters provided the staff graduations could clearly be seen. The shots are reduced to 30 meters and even shorter for accurate reading after the day temperature rose high thus eliminating the effect of shimmering.

5.3.2.4 Two Survey Engineer observe the leveling line in fore and back directions connecting all the traverse stations of the main traverse line enroute and establishing their own temporary benchmarks on permanent structures at suitable intervals.

5.3.2.5 The permissible discordance between "fore" and "back" leveling at any benchmark is ± 0.002meter (2mm) which is strictly followed. Relevelments are done where discordance exceeded this tolerance.

5.3.2.6 The accuracy of main / double leveling line is 0.002 $\sqrt{k}$, m where K is the length of line in kilometer.

5.4 Detail Topographical Survey with Total Station

The invention of total station has resulted into revolutionary changes in surveying technology; it has capability of developing topo drawings on any desired scale, three dimensional outputs of every feature points along with on-screen plotting of them. The use of total station has not only accelerated the pace of site work but has also increased the speed of drafting since the data entered in the total station at site and can be directly downloaded to the computer and thereafter transferred to AutoCAD system through DXF File. The quality drawing has also improved. The benefits of the system are discussed as under:

The automated technique of survey is very affluent of benefits because it reduces the possibility of human errors and increases the probability of accurate analysis, most optimal design and automatic production of presentable drawings in short time. We are capable to utilize all state of the art computer aided techniques with latest instruments for survey. Detail topographical survey has been conducted by our automated survey team equipped with most sophisticated total station of Sokkia SET 630RK is very dedicated and updated.


5.4.1 Computerized Data Processing

The result of computer-aided survey is X,Y,Z information of ground features with unique labels of them and these results are processed for further analysis. At the end of each working day, the data is transferred to a computer through communication applications from total station. The data is then processed using SDRmap & design software, which enables the surveyor to plot the whole work, conducted during the day on computer monitor or on paper. So by comparing the ground sketch with the plotted map, errors, if any, are automatically detected which can then be corrected either in the field if it is an observational error, or in the office, if it is coding error.

After removal of errors a unique model of detail and traverse is developed for further analysis from SDRmap software and DXF (Data Exchange Format) file is produced for enhancement, labeling and further analysis on AutoCAD software in order to produce the map.

5.4.2 Computer Aided Drawing

The processing and analyzing of data as received from site have been described in sub-Para's, together with the advantages of total station survey. The DXF files are then transferred into AutoCAD, very sophisticated software where drawings are edited with the help of field sketches which generally consists of detailed features, writing names, destinations and other descriptive remarks.

6 ESTABLISHMENT OF PERMANENT BENCHMARKS

Permanent Benchmarks have been established at safe and sound locations for the use of construction phase, described, as BM1 – BM4 shown in benchmark photographs.

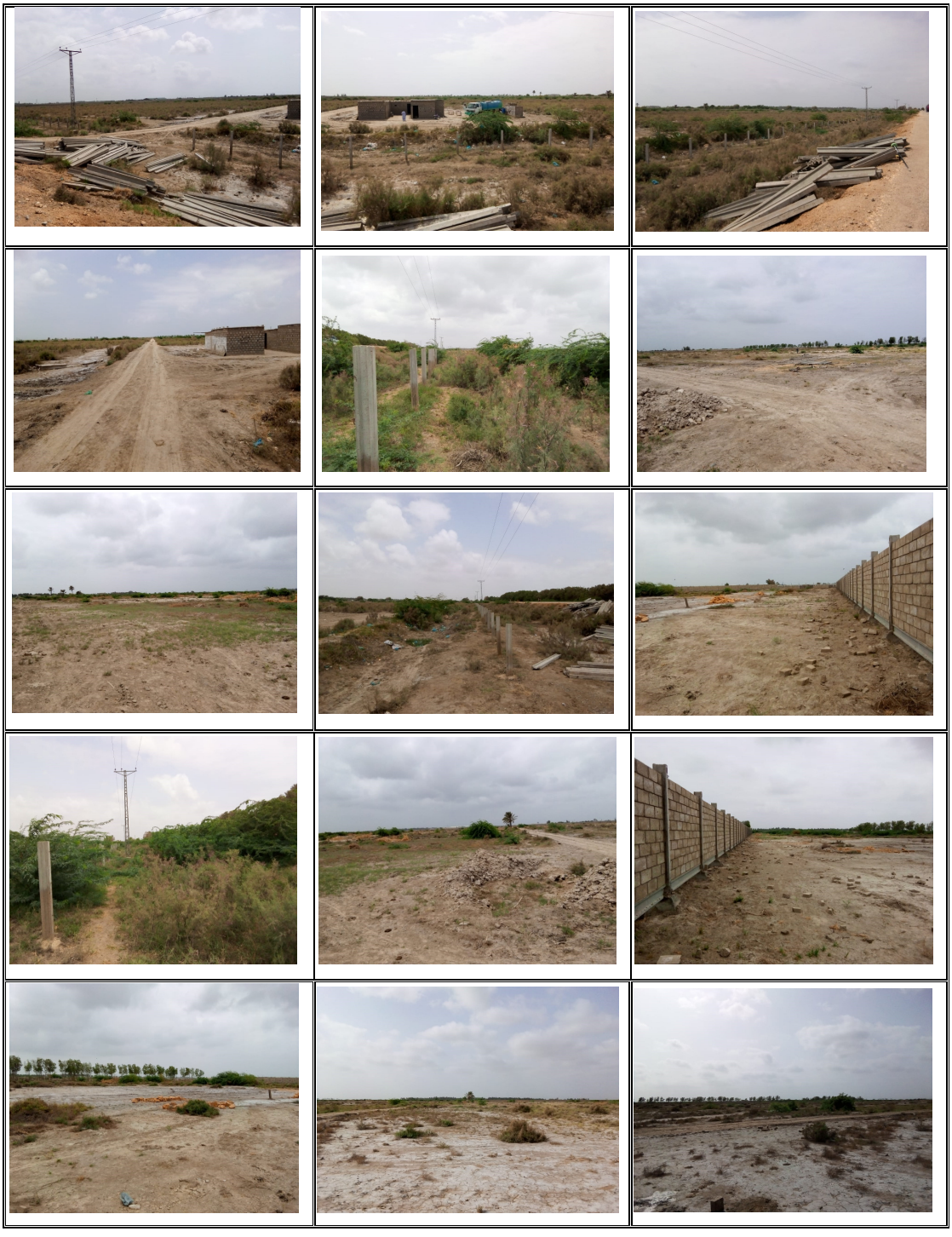
List of Benchmarks with coordinates is on page no.10 of this survey report.

7. PHOTOGRAPHS OF BENCHMARKS

8. COORDINATES OF PERMANENT BENCHMARKS

BM	EASTING	NORTHING	LEVEL	DESCRIPTION
BM1	357515.619	2733652.389	2.323	IRON ROD EMBEDDED IN CEMENTED MONUMENT
BM2	357326.905	2733655.973	2.322	IRON ROD EMBEDDED IN CEMENTED MONUMENT
BM3	357117.988	2733692.482	2.869	IRON ROD EMBEDDED IN CEMENTED MONUMENT
BM4	356932.646	2733668.954	2.802	IRON ROD EMBEDDED IN CEMENTED MONUMENT
TBM1	357587.172	2733656.978	4.414	STEEL NAIL EMBEDDED ON GHARO-KETI BUNDER ROAD
TBM2	357594.681	2733790.054	4.622	STEEL NAIL EMBEDDED ON GHARO-KETI BUNDER ROAD

9. PROJECT PHOTOGRAPHS



10. TOPOGRAPHICAL SURVEY DRAWING