

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

MEGA MOTOR COMPANY ELECTRIC VEHICLE PLANT

NOVEMBER - 2024



EMC Pakistan
Private Limited

MEGA
MOTOR
CO

	Environmental & Social Impact Assessment		
	MEGA MOTOR COMPANY – ELECTRIC VEHICLE PLANT AT GHARO, SINDH		
	Doc. No.: MMCL/ESIA/001	Rev.: 00	Revision Record

REPORT ISSUE & REVISION RECORD

REVISION RECORD					
Description	Issue	Revision	Date	Changes made	Approved By
Environmental & Social Impact Assessment	01	00	18/11/2024	--	Syed Nadeem Arif, Project Manager
Environmental & Social Impact Assessment	01	00	01/12/2024	Revisions in line with data provided	Syed Nadeem Arif, Project Manager



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1. Introduction

EMC Pakistan (Private) Limited has been commissioned by Mega Motor Company Pvt. Ltd. (MMCL) to conduct an Environmental and Social Impact Assessment (ESIA) study for the establishment of an automotive assembly plant dedicated to assembling electric vehicles (EVs) in Gharo, Sindh. The project has been proposed for development through a joint venture of Mega Motor Company (Private) Limited and BYD Auto Industry Company Limited in Pakistan. The project will involve the development of a plant for the assembly of environmentally friendly electric vehicles, including, plug in hybrid vehicles and hybrid electric vehicles, and shall oversee the development of a warehouse, a weld unit, a paint unit, an assembly line, logistics unit, and a Completely Built Up (CBU) yard for assembled vehicles. To address the potential environmental and social impacts of this project, this Environmental and Social Impact Assessment (ESIA) has been prepared in accordance with the guidelines of the Sindh Environmental Protection Agency (SEPA) for their scrutiny and approval.

1.1 Project Proponent

The proponent for this project is Mega Motor Company (Private) Limited, in June 2024 under HUBCO, through its wholly owned subsidiary HPHL (Hub Power Holdings Limited), entered into a new line of business in electric vehicles with BYD Auto Industry Company Limited in Pakistan¹. MMCL is a pioneering automotive company which was established with a commitment to revolutionize the transportation industry by offering high-performance vehicles.

BYD, a Chinese EV company, which currently is also the largest producer of electric vehicles in the world, was founded in February 1995, devoted to leveraging technological innovations for a better life, which following 29 years of growth, has played a significant role in industries related to electronics, auto, renewable energy and rail transit. With a focus on energy acquisition, storage, and application, BYD offers comprehensive zero emission new energy solutions. The company aims to drive innovation through world class, clean and reliable technology, to provide zero emission energy solutions, where it has developed the Blade Battery and dual-mode hybrid power technology, accelerating the once-in-a-century transition from fossil fuel powered vehicles to electric vehicles².

This new venture by MMCL marks a significant milestone as it ventures into the assembly and manufacturing of BYD's cutting-edge electric cars, aiming to cater to the growing demand for sustainable and eco-friendly transportation solutions. With this partnership, MMCL seeks to leverage BYD's expertise in EV technology and align with global trends toward greener automotive solutions.

1.2 Background

The Government of Pakistan (GoP) as a Party to the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) has performed its role to support the global efforts in combating climate change worldwide. As part of this, in 2021 the GoP submitted their Nationally Determined Contributions (NDCs) which highlight sectors in the country where the Government is willing to work to reduce their carbon emissions. Here, the GoP has set ambitious conditional targets of overall 50% reduction of its projected emissions by 2030. To reach this target,

¹ <https://hubpower.com/mega-motor/>

² <https://byd-mega.com/about-byd>



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the country aims to shift to 60% renewable energy, and 30% electric vehicles by 2030 and completely ban imported coal³.

Overall, following the devastating floods of 2020 and 2022, and the inflationary scenarios that prevailed in the country thereafter, the Pakistani vehicle market in September 2024 grew for the 6th consecutive month, registering 10,294 new sales⁴. Coupling this with the increasing population scenario across the country, and the steady decline in inflation, it can be expected that car sales will only continue to increase moving ahead.

Currently, despite the institutional push for the adoption of electric vehicles, and the demand for automobiles in general, the market for electric vehicles in Pakistan is still virtually non-existent, with entirely all vehicles in the country still running on gasoline and diesel. This leaves a huge opportunity in the market to be seized for the production and supply of electric vehicles.

1.3 Project Overview

Currently, the project involves the development of a plant in Gharo, Sindh, over an area of 73.59 acres of land, that will oversee the assembly of environmentally friendly electric vehicles, including, plug in hybrid vehicles and hybrid electric vehicles, and shall oversee the development of a warehouse, a weld unit, a paint unit, an assembly line, logistics unit, and a Completely Built Up (CBU) yard for assembled vehicles.

The plant will produce a number of 25,000 vehicles each year.

1.4 Location of the Project

The Proposed project will be located along the N-110, Gharo-Keti Bunder Highway, Sindh in Southeast of the Karachi City. The project location is 1 km on north from Satellite Tower Gharo and 1.3 km on East of Armstrong ZE (Pvt) Ltd. Gharo. The project site comprises of 73.9 Acres of land surrounded by Agricultural, Barren, and Vacant Land. Armstrong ZE Pvt. Ltd., a significant industrial facility close to the factory, is involved in the manufacture of tyres.

The site is located about 10 km from Deltaic Region, 2 km from National Highway (N5) and about 32 km from commercial downtown of Karachi city, where the coordinates of the proposed project site are as follows;

Table 1.1 - Co-ordinates of the Project Site

Point	Co-ordinates	
P1	24°43'30.32"N	67°35'23.51"E
P2	24°43'30.32"N	67°35'57.33"E
P3	24°43'20.10"N	67°35'57.40"E
P4	24°43'19.75"N	67°35'26.31"E

Source: Mega Motor Company Pvt. Ltd.

A detailed project location map is also shown in Fig 1.1. below:

³ Government of Pakistan (2021), Updated Nationally Determined Contributions

⁴ Carlo. (2024, October 21). *Focus2Move| Pakistani vehicles sales - Facts & Data 2024*. Focus2Move. <https://www.focus2move.com/pakistani-vehicles-sales/>



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Figure 1.1 - Project Location Map



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1.5 Need for ESIA

This Environmental and Social Impact Assessment (ESIA) of EV Plant Project has been carried out in compliance with the mandatory requirement of Section 17 of Sindh Environmental Protection Act (SEPA), 2014 which requires that:

“No Proponent of a 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.”

Subsequently, the Sindh EPA (Review of Environmental Assessment Regulations) 2021 also provides the necessary details pertaining to the preparation, submission, and review of different environmental assessment, including ESIA reports, along with categorization of projects into different kinds of assessments that would be required. The categorization of the proposed project falls under the following category in the regulation:

Schedule III – Project Requiring an ESIA

Category C – Manufacturing and Processing

Sub Category (6) – Establishment of Industrial Estates & Export Processing Zones

The Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2021 define Schedules (II & III) of projects falling under the requirement of IEE or EIA. This EIA Study has, for environmental classification of the Project into Category A or B, taken account of the requirements of the Sindh Environmental Protection Agency (Review of EIA/IEE) Regulations 2021 which define Schedules (II & III) as follows:

Schedule II: A project falls in Schedule II if it is likely to have adverse environmental impacts, but of lesser degree or significance than those for category ‘A’ and all the mitigation measures to handle the impact is manageable. Such types of projects need IEE report including EMP.

Schedule III: Projects are categorized in Schedule III if they generate significant adverse environmental impacts that require a comprehensive management plan, or if the project is located within or passes through: a) Areas declared by the Government of Pakistan as environmentally sensitive (National Parks/Sanctuaries/Game Reserve), b) Areas of international significance (e.g. protected wetland as designated by the RAMSAR Convention), or c) Areas designated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) as cultural heritage sites.

1.6 Objective of ESIA Study

The prime objective of the ESIA study is to identify and assess the anticipated impacts and risks of the proposed project, and to accordingly recommend adequate mitigation measures to prevent/minimize the identified impacts on the surrounding physical, biological, and social environment. This is done through adopting changes and practices, which ameliorate the environmental and social performance of a project during its different stages (pre-construction, construction, and operation):

- Facilitate the Mega Motor Company Pvt. Ltd. in ensuring the environmental and social sustainability of the project.
- Establish a baseline of the existing environmental and social conditions in the project area prior to project initiation, by collecting secondary and primary data/ information on physical, biological, and socio-economic conditions.



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- Identify potentially significant environmental and social impacts (positive and negative) during the different stages of the project.
- Conduct, record, and report public consultations and participation with major stakeholders.
- Devise an Environmental and Social Management Plan (ESMP) for all stages of the project as a tool for the implementation of the suggested measures, along with a monitoring and evaluation mechanism with adequate resources including capacity building of the implementing agencies.

1.7 Methodology Adopted for ESIA

The Environmental and Social Impact Assessment is based on comparative evaluation approach. Initially, the baseline or the profile of the project area was developed by gathering data, records and information on 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 (includes Engineering, Procurement and Contracting (EPC)), and 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 are projected. Then the Environmental and Social Management Plan (ESMP) & Environmental Monitoring Program, which will be implemented during the construction and operation phases, are framed.

As such, the following methodology and steps were adopted for the ESIA process:

1.7.1 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 generic description of the activities relevant to this environmental assessment was 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 the earlier studies conducted in the study area, 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: An initial stakeholder consultation was undertaken to document the concerns of the local community and other stakeholders, and to identify issues that may require additional assessment in order 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 project
 - To identify relevant potential issues, including the socioeconomic impact of the project, and corresponding mitigation measures.



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

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

1.7.2 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. Sindh Environmental Protection Act 2014 and EIA/IEE Regulations, 2021 used during the study. This Review of legislations included but was 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.
- Administration: identification of relevant organization with its role and responsibility and make clear the approval process with its average time schedule through visit to relevant organization and reviewing documents.

1.7.3 Delineation of Area of Influence (AOI)

The Area of Influence of a project encompasses the primary project site(s) and related facilities such as the contractor camps, temporary material stacking areas and vehicle parking areas, where project impacts are perceived to take place. The Environmental and Social risks and impacts were analysed for all relevant stages of the project cycle, including pre-construction, construction, and operational phases of the project.

The AOI for the project area has been considered as 1 kilometer from the boundary of Assembly Plant Site. The rationale for selection of a 1 km buffer from the project boundaries was considered where any significant environmental and social impacts would likely occur within this specified space. The proposed location of the assembly plant, the different scattered settlement, agricultural land and the sensitive receptors in the AOI are briefly described below and in more detail in the upcoming baseline chapter:



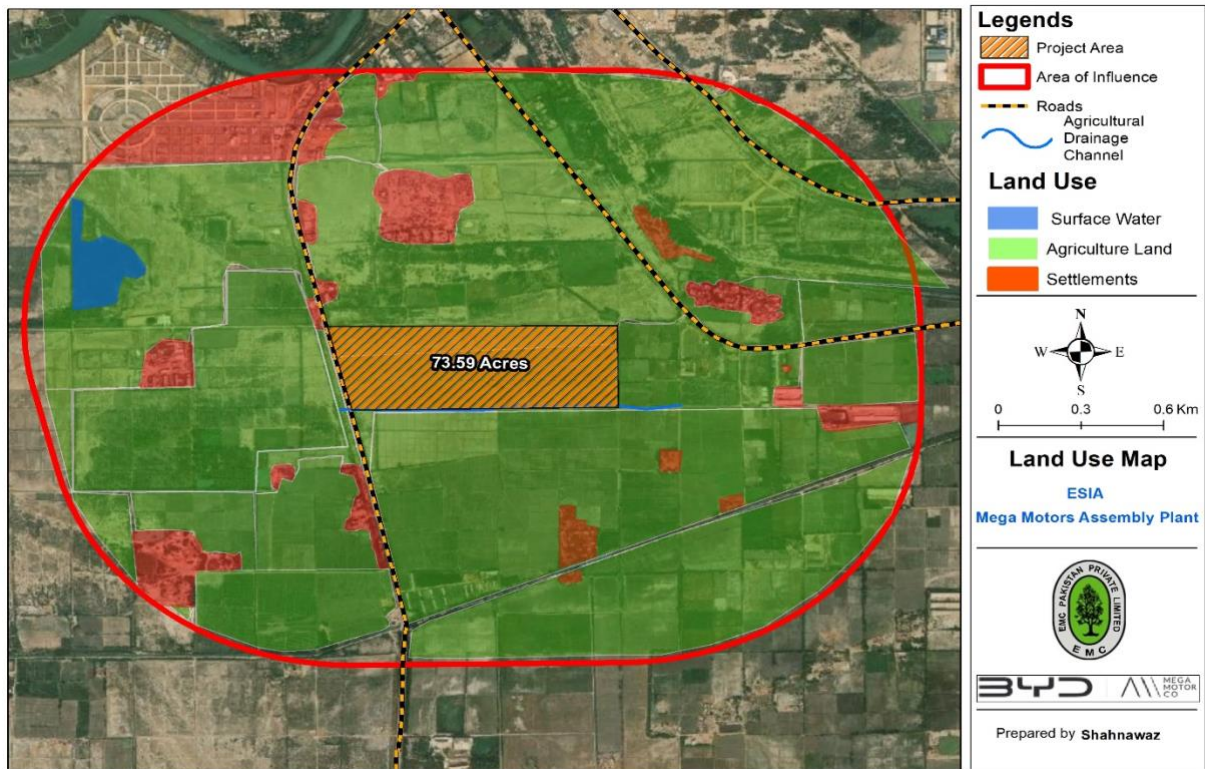


Figure 1.2 - Project Land Use & Area of Influence

Table 1.2 - Receptor Identification within AOI of the Project Site

S.No.	Settlement/Receptor	Nature of Receptor	Sensitivity of Project	Proximity to Boundary of Project Site
1.	Satellite Town Gharo	A residential development activity prior to project site.	Non-sensitive, as it is an empty plot currently where one phase is already developed and further construction is yet to begin.	Approximately 783 meters on north from proposed project.
2.	Chian Town Gharo	A proposed residential development project near proposed project.	Non-sensitive, as it is an empty plot currently where construction is yet to begin.	Approximately at distance of 579 meter on north-east from project boundary.
3.	Agricultural Drainage Channel	An Agricultural Drainage channel along with boundary of project site.	Sensitive	Approximately 2-meter-long agricultural drainage.
3.	Sindh Abadgar Forum Secretariat	A governmental organization office within AOI of proposed project.	Non-Sensitive	Approximately at distance of 579 meter on north from project location.
4.	Agha Cattle Farm	A cattle farm close to project site.	Sensitive	Approximately at 410 meter north from project area.
5.	Thatta Chamber of Commerce & Industry	A proposed industry in AOI of project site.	Non-Sensitive	Approximately at 927 meter north-east from project boundary
6.	Small scale and Scattered Settlements	Informal Settlement residing around project site.	Sensitive	Small settlements inform of villages around project location

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1.7.4 Screening of Project Alternatives

It is a mandatory requirement for the ESIA study to analyse each potential alternative available that could have been developed to meet the objectives and recommend the most environmentally, socially, and economically feasible option.

To select the most viable technology option moving forward for the management of waste, keeping in view the environmental, economic, and social constraints, the analysis of different alternatives was carried out. Moreover, the No Project Option (NPO) was also discussed with reference to the commitments made by Pakistan in its Nationally Determined Contributions. This exercise confirmed the justification for the need of the project.

1.7.5 Baseline Data Collection

Following the selection of the most feasible alternative, along with the mapping of the AOI, detailed environmental and social surveys were conducted within the AOI for environmental parameters on which any adverse or positive impacts are envisaged by the implementation of the proposed project. Prior to the start of field activities, comprehensive checklists, proformas, and maps were developed covering the following main parameters:

A) Physical Environment

The information acquired for the establishment of the physical environment baseline included the following parameters:

- Land Resources (including land use pattern, soil composition, contamination of soil and soil erosion, etc.)
- Water resources (including available surface and groundwater resources and natural streams, hydrology, spring water, water supply, water contamination, etc.)
- Climate data (including temperature, rainfall, humidity, wind speed, and direction, etc.)
- Ambient air quality and noise level monitoring data; and

B) Environmental Monitoring, Sampling, Testing & Modelling

Environmental Monitoring has the key role to assess the status of the existing environment that changes spatially and temporally. However, the goals, sample collection strategies, and methods of analysis used in monitoring must be well defined in advance to obtain robust results. In the preparation of a sampling plan, goals, strategies, and methods must be considered in conjunction with an understanding of the target environment, including the physical, chemical, and biological variables and processes involved. Environmental Monitoring has been conducted for the following parameters:

- Ambient Air Quality Monitoring (08-24 hours)
- Noise Measurements (24 hours)
- Sampling & Analysis of Drinking Water, Municipal wastewater, and groundwater

C) Ecological Environment

Information collected through primary (field surveys) and secondary data sources for the establishment of the ecological baseline included the following main parameters:

- Flora (trees, shrubs, herbs, grasses, and overall vegetation including valuable or rare trees and their loss due to implementation of the project, etc.)



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- Fauna/ Wildlife (mammals, reptiles, amphibians, and avifauna)
- Agriculture and livestock
- Protected Areas, Natural Parks, Game Reserves, Wildlife Sanctuaries or any other ecologically important areas (surveys confirmed that no such areas were found in the AOI of the project sites)
- Migratory birds' corridors (survey confirmed that no migratory birds' corridors are found in and around the AOI)
- Endangered species (both flora and fauna)

D) Socio-Economic Environment

Despite being located along a highway where there is a sparse residential footprint, there are numerous up and coming developments in the area.

To understand the existing socio-economic conditions in the area of the masses, socio-economic surveys were conducted amongst residents and people found in the area.

1.7.6 Stakeholder Consultations

Stakeholder identification and consultations were also conducted as part of the ESIA. The project stakeholders were identified during the inception/ scoping stage and meetings were conducted with them during field surveys to receive feedback on the anticipated environmental and social issues related to the project impacts and suggested mitigation measures. Meetings were also carried out with primary stakeholders, and relevant departments to discuss the issues/ constraints and get their views and feedback to mitigate the potential environmental and social impacts associated with the implementation and operation of the project.

1.7.7 Impact Assessment & Mitigation Measures

A logical and systemic approach was adopted for impact identification and assessment. The process began during the screening and continued through scoped which identified the key issues and classified them into different categories. The tools, which were used for impact assessment, are:

- Checklists to identify the impacts during field investigations/ surveys;
- Matrices for Qualitative assessment of the identified impacts; and
- Overlays for the quantification of significant impacts of land use based aspect on images from Google Earth and field verification.

The assessment of potential environmental and social impacts in terms of their nature, extent, location, timing, and duration were carried out. The severity of the assessed impact was determined considering the magnitude and likelihood, along with the sensitivity of the receptor. The impacts were correlated to the project location, design, construction, and operational stages. Based on the impacts prediction and as a result of public/ stakeholder consultations, the ESIA team screened the adverse environmental and social impacts for inclusion in the mitigation measures and ESMP. Public consultations (which provided feedback of the impacts from the stakeholder's viewpoint) were used to screen out the insignificant impacts. Matrices and overlays were used for the evaluation of temporal and spatial impacts respectively.

The Consultants proposed pragmatic, economically feasible, and socially acceptable mitigation measures for the significant adverse environmental and social impacts. These measures were based on exploring the ways to achieve the project objectives causing least disturbance to the existing environment by alternative ways, proposing changes in the project design, through



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improved monitoring and management practices (storage of construction materials, labor camps, waste disposal, disposal of construction debris etc.).

1.7.8 Environmental & Social Management Plan

An ESMP has also been prepared to ensure the adequacy and effectiveness of the proposed measures by clearly identifying the roles and responsibilities of the agencies responsible for implementation, monitoring, and auditing of ESMP activities, existing and suggested framework, necessary approvals, training needs and the required further studies. The ESMP also includes an organizational setup, a monitoring mechanism, monitoring plan, where environmental monitoring, ecological and social component/ social mitigation measures were also introduced as part of the ESMP. Environmental monitoring, evaluation, auditing, and reporting mechanisms were also proposed as part of the ESMP.

1.8 Report Organization

This report contains nine chapters, where the contents of chapters are described as follows:

- **Chapter 1**– “Introduction” describes introduction, location of project, objective and purpose of the ESIA report;
- **Chapter 2** - “Project Description” furnishes an overall description of the project, including its background, features and key components, timeframe and cost;
- **Chapter 3** – “Relevant Legislative Requirements and Framework” elucidates the current legal framework including national requirements which are applicable to the proposed project in the context of environment and sustainable development;
- **Chapter 4** – “Analysis of Alternatives” looks into and compares the various alternatives available in the development and implementation of the project, narrowing down on the most sustainable alternative
- **Chapter 5** – “Description of the Environment / Baseline Data” comprises a detailed narrative of the existing (baseline) conditions of the project area, with respect to its physical, biological and socio-economic environment;
- **Chapter 6** – “Anticipated Environmental Impacts and Mitigation Measures” elaborates the likely impacts of the project on the physical, biological and socio-economic environment during the construction and operation stages and lays down the proposed measures to mitigate the adverse impacts of the project;
- **Chapter 7** – “Stakeholder Consultations” provides summary of consultative sessions with the local community as well as with other stakeholders including local politicians, local government officials, policy makers and NGOs for their opinions and suggestions on the project;
- **Chapter 8** – “Environmental and Social Management Plan” provides the mechanism to be adopted for the implementation of measures and monitoring the environment during all stages.
- **Chapter 9** - “Conclusion & Recommendations” outlines the conclusions from the assessment and the overall recommendation for the project.



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2. Project Description

Mega Motor Company (Private) Ltd., an associated company of Hub Power Holding Limited (HPhL), in collaboration with BYD Auto Industry Company Limited Pakistan, is planning to establish an Electric Vehicle (EV) assembly plant at Gharo, Sindh. The plant will cover an expansive area of 73.59 acres, strategically located along the Gharo-Keti Bunder National Highway (N110). The site benefits from excellent accessibility, being directly connected to National Highway (N-5) to the south via the Gharo-Keti Bunder Highway (N110). The immediate surroundings of the proposed plant area include agricultural fields, which are situated in close proximity. Opposite the site, a line of palm trees enhances the natural landscape, while a developing housing society lies approximately 700 meters to the northwest of the project location. The geographical coordinates of the site are provided for reference, and a detailed map of the project area is illustrated in Figure 1.1. This location not only provides logistical advantages but also integrates the industrial plant within a diverse and evolving landscape. The nearby infrastructure and ongoing development will further enhance the project's connectivity and potential socioeconomic impact.

2.1 Production Capacity & Types of Vehicles

Once complete, the plant will produce a number of 25,000 vehicles each year.

2.2 Duration of Project

The time frame for the project is estimated at 02 years for the completion of construction activities.

2.3 Plant Details

The proposed factory layout for the Electric Vehicle (EV) plant encompasses several key areas, each designed to optimize assembly processes and enhance overall efficiency.

- The **Body Welding & Assembly Unit** is critical for structural integrity, utilizing automated welding robots to ensure precision and consistency, followed by quality inspections.
- The **Paint Area** applies protective and aesthetic coatings, incorporating advanced technologies like automated spray booths while addressing safety and environmental concerns through effective ventilation and waste management systems.
- The **Warehouse** and its **Extension** facilitate the storage of raw materials, components, and finished products, strategically located near the assembly line for efficient workflow and inventory management.
- The **Energy Center** supplies the necessary power for the entire plant, potentially integrating renewable energy sources and storage systems to enhance sustainability.
- A **Container Yard** supports the storage and management of shipping containers, ensuring efficient logistics for incoming and outgoing materials.
- The **Vehicle Development Center (VDC)** focuses on the design, engineering, testing, and validation of new models, equipped with resources for rapid prototyping and performance assessments, and well-connected to other areas for seamless communication.
- The **Parking Area** accommodates vehicles for employees and visitors while incorporating electric vehicle charging stations to promote sustainability.
- Finally, the **Office Area** serves administrative functions, featuring spaces that encourage collaboration and easy access to the factory floor. This comprehensive layout is designed to support efficient production, promote safety and sustainability, and ensure high-quality electric vehicles.

The proposed factory layout is presented in fig 2.1 below:



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2.4 Automotive Manufacturing Process Flow

The assembly process of Electric Vehicles (EVs) begins with **component sourcing and logistics**, where manufacturers coordinate with various suppliers to ensure timely delivery of essential components such as batteries, electric motors, and chassis parts. This is followed by **body construction**, which includes stamping large sheets of metal into body parts and welding these components together in the Body Welding & Assembly Unit to form the vehicle's chassis and body. After welding, the body undergoes rigorous inspection for structural integrity before proceeding to the **painting stage**, where it is cleaned, primed, painted in automated spray booths, and cured to achieve a durable finish.

Once the body is complete, the **powertrain assembly** phase begins with the installation of the battery pack and electric motor, along with the necessary wiring harnesses to connect the battery, motor, and electronic control units (ECUs). The assembly of additional components follows, incorporating interior features such as seats and dashboards, as well as exterior elements like doors and lights, with ongoing quality checks to ensure proper installation. The **final assembly** stage involves fluid filling, tire installation, and calibration of systems, ensuring all components function optimally.

Subsequently, the vehicle undergoes **testing and quality assurance**, which includes static testing of electrical systems and dynamic testing for performance metrics such as acceleration and braking. After passing all tests, the vehicle is deemed ready for delivery and is prepared for shipment, including secure packaging and necessary documentation. Finally, post-delivery support is provided, which encompasses customer service, maintenance, and warranty services, along with a feedback loop to inform future vehicle designs and improvements in the assembly process. This comprehensive flow ensures that each electric vehicle is manufactured to high quality and safety standards while meeting the growing demand in the automotive market.

Flow diagrams for each of the main processes are provided on the next page:



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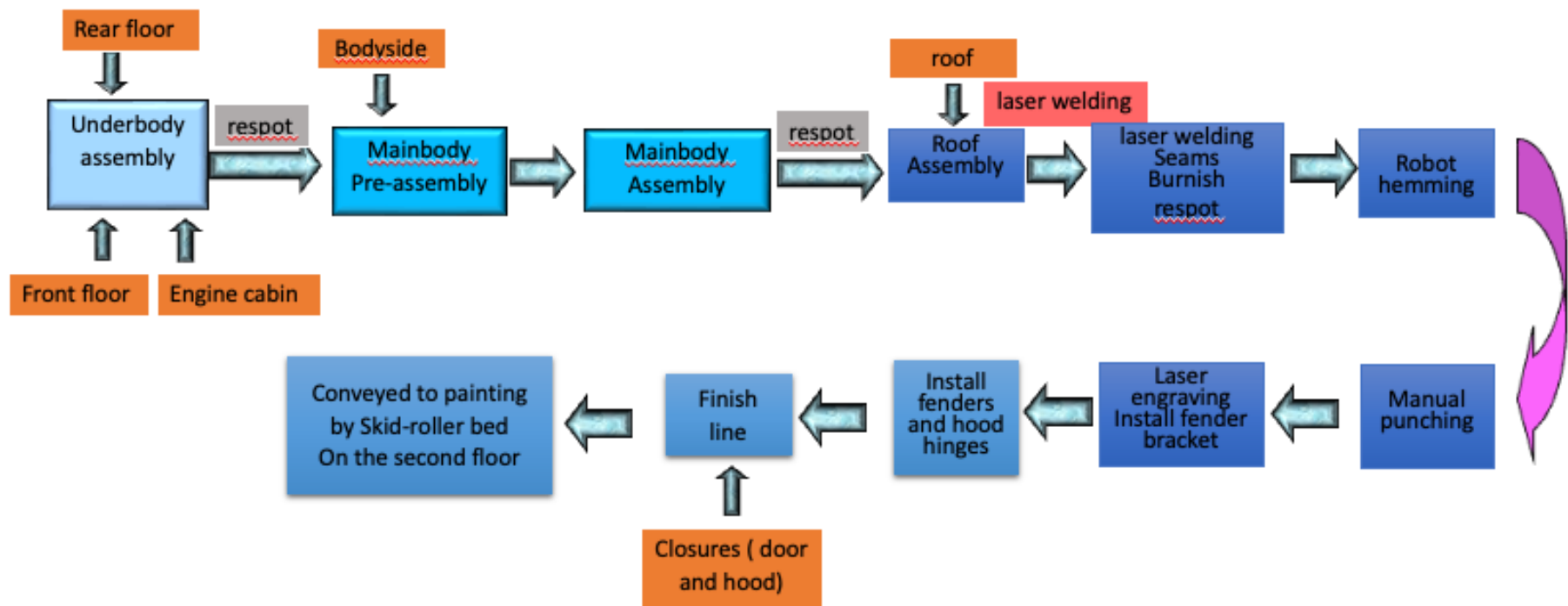


Figure 2.2 - Body Welding Shop Process Flow

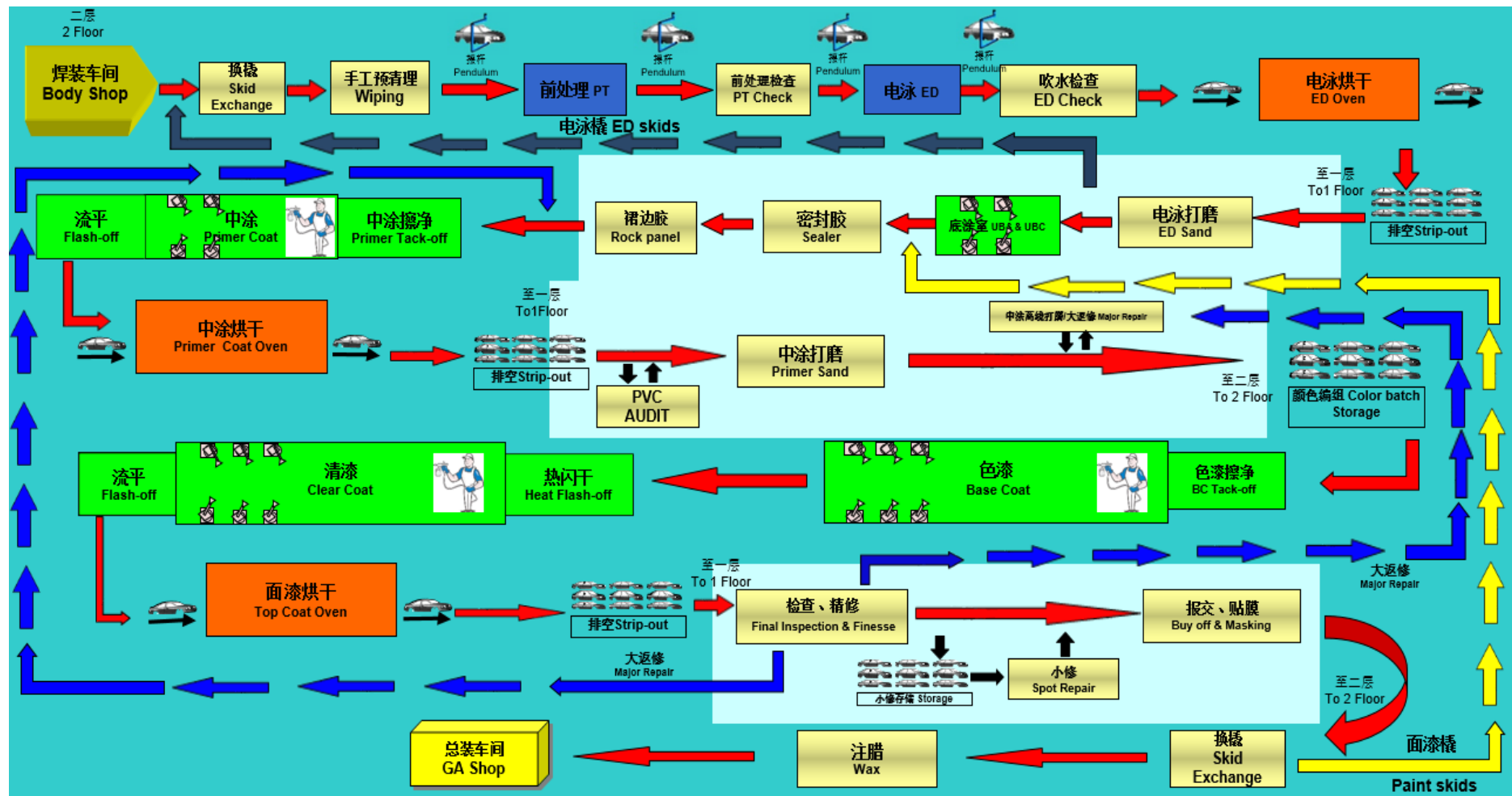


Figure 2.3 - Body Paint Shop Process Flow

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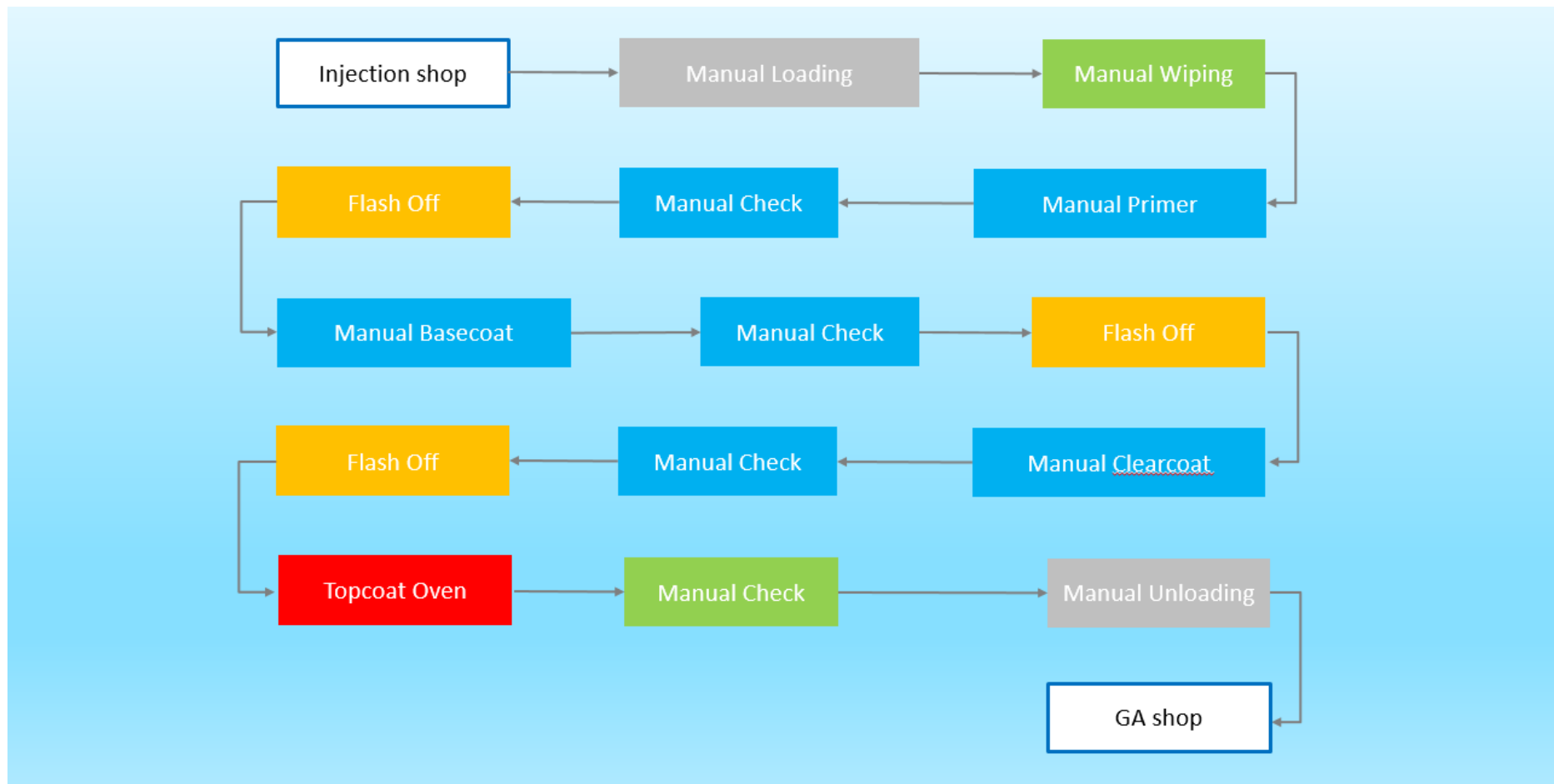


Figure 2.4 - Plastic Paint Shop Process Flow

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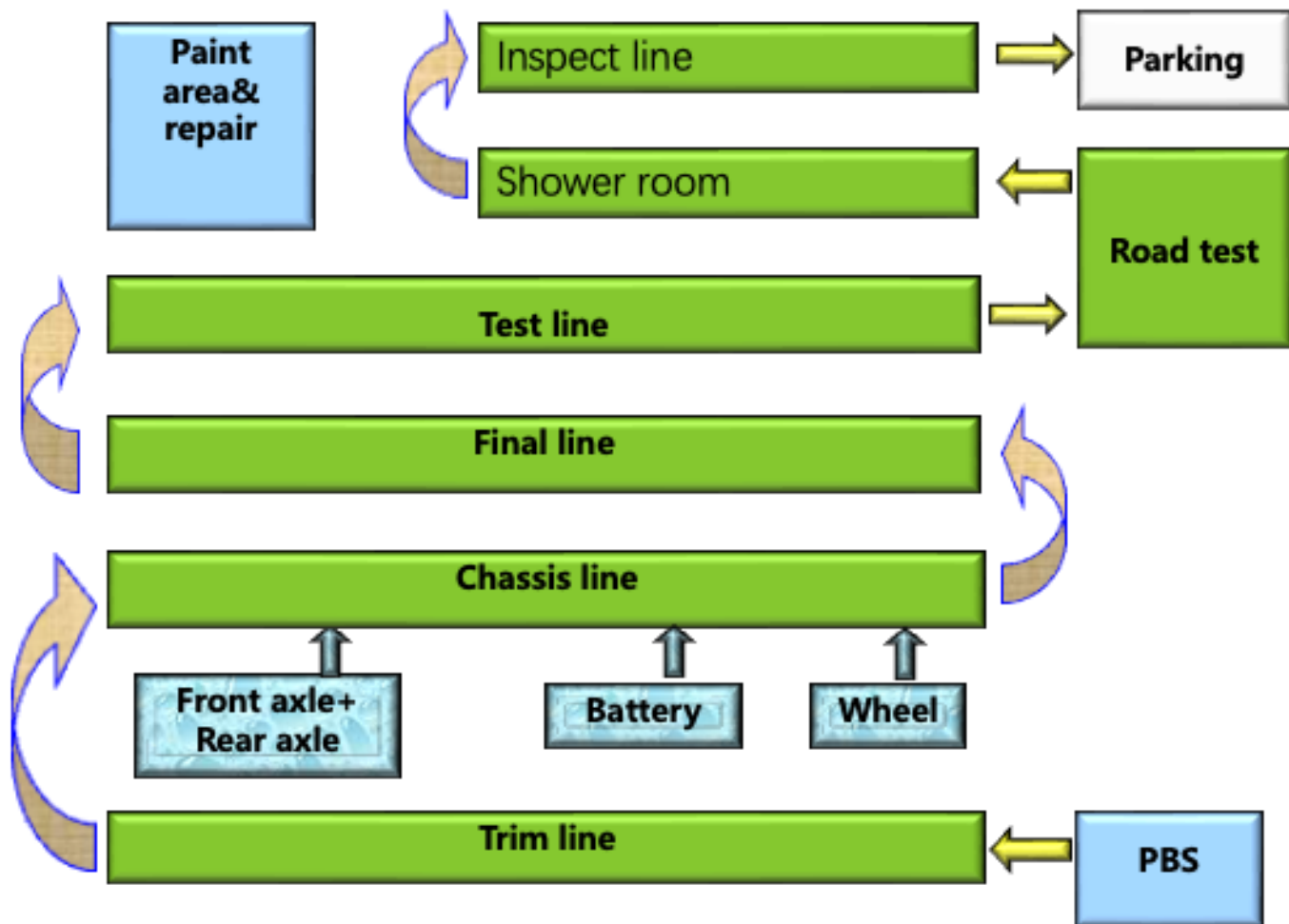


Figure 2.5 - General Assembly Shop Process Flow

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2.5 Project Work Force & Construction Camps

2.5.1 Construction Work Force

Manpower demand estimation is an essential component to facilitate deployment of manpower. The project involves professional, administrative, skilled, and unskilled labor which will be deployed for the construction activities. Based on numbers obtained from the proponent, a peak number of 200 skilled and unskilled labourers are estimated to be employed for the development of the project site. The actual number of labourers shall ultimately, however, depend on the contractor's activity schedule at the time when contract is awarded. The contractor will hire unskilled labor from the local communities and a training program will be conducted these workers.

2.5.2 Construction Camps

Camp sites will be selected with careful consideration of various factors to ensure the smooth operation of construction activities while minimizing any negative impact on the surrounding areas. The contractor is responsible for identifying suitable construction camp sites in accordance with the following guidelines:

Land Acquisition and Resettlement

- The establishment of contractor camps should not involve any land acquisition process.
- Resettlement issues should not arise due to the location of the camps.

Distance from Settlements

- Camp sites should be situated away from existing settlements.
- Consideration should be given to maintaining a considerable buffer zone between the camp site and residential areas or sensitive receptors, to the extent possible.

Proximity to Project Area

- Camp sites should be selected near the project area to ensure convenient access to the nearby main or link road.
- This proximity will facilitate transportation of materials, machinery, and personnel.

Workforce Management

- The contractor must maintain records of the number of deployed workforces at the camp sites.

Environmental Considerations

- Camp sites must not pose a threat to domestic or public water supplies, and care should be taken to prevent drainage from the camps from affecting water sources.
- The size of the camp site should be adequate to prevent overcrowding of necessary structures.
- Precautions should be taken to avoid any damage to property, vegetation, irrigation systems, and drinking water supply systems.
- Camp sites should be in areas that are not prone to periodic flooding.
- Construction camp sites should not be situated near ecologically sensitive areas such as wildlife sanctuaries, game reserves, national parks, or forest areas.

Facilities at Camp Sites

- Camp sites must be equipped with proper resting areas, first aid boxes or trained medical personnel, and portable toilets/washrooms.
- Children and underage individuals should not be allowed in the construction camps.



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- The residences of the laborers should provide hygienic, ventilated, and civic facilities, including water supply, electricity, communication, medical facilities, a designated playing area, a community hall, and comfortable eating and living rooms.
- If there are female workers, comfortable and private accommodations should be provided for them, considering the local culture.

Code of Ethics and Cultural Considerations

- A code of ethics (including GBV awareness) is to be established for laborers to guide their interactions with the surrounding communities. Laborers at the construction camps must adhere to this Code of Conduct that promotes positive interactions with the surrounding communities and fosters a harmonious working environment among themselves.

2.5.3 Operations Work Force

Once the construction of the plant has been completed and the plant has been commissioned for operations, the number of workers involved during the operations phase of the plant are described below:

1. White Collar Workers – 105 persons
2. Blue Collar Workers – 719 persons
3. Total – 824 workers

2.6 Facilities and Utilities Consumption

2.6.1 Fire Fighting

The proposed plant will feature a comprehensive fire protection system, including fire hose reels, manual call points, push bar doors, fire hydrants, a fire pump, foam trolleys, and fire extinguishers. To ensure fire safety preparedness, the facility will have a trained firefighting team, an emergency plan with contact information, and a designated Main Fire Assembly Point located outside the building, all in line with the necessary National Fire Protection Association (NFPA) requirements.

2.6.2 Electrical Demand & Source

The electrical demand during the construction and operations phase is described below:

Construction Phase

During construction, electricity will be provided via diesel generators with a capacity of up to 125 kVA.

Operational Phase

During operations, whilst the company has applied to Karachi Electric (KE) for supply of power to the facility, this connection will only be used as a secondary source of power supply, where the facility will set up its own solar PV system with a capacity of 4.6 MW to serve as its primary source of energy and electricity.

2.6.3 Water Supply and Consumption



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This section will highlight the water demand for the construction and operational stages of the project, along with the potential source for this water

Construction Phase

The WHO defines between 50 and 100 liters of water person per day are needed to ensure that the most basic needs met, and few health concerns arise⁵. In this case, considering the average at 75 liters of water per day per workers⁶, the water consumption during the consumption phase will be equal to 15,000 liters/day for 200 workers during the construction phase, or 15 m³/day.

The source for this water will be through groundwater, which will be abstracted from bores dug within the site area, and then treated prior to consumption.

Operations Phase

During the operations phase, the water requirement will also be fulfilled through groundwater bores that will be established within the plant site and then treated prior to consumption.

The consumption of water in this phase will be divided into two categories: plant operations and municipal consumption. For municipal consumption, it is calculated that the 824 workers will consume approximately 61.8 m³/day of water. Similarly, for the plant's activities, it is estimated that over 624 m³ of water will be required daily.

In total, the water demand during the operations phase, including municipal consumption and plant consumption, is equal to approximately 686 m³/day.

2.6.4 Wastewater Management

The facility will generate wastewater in the form of sanitary wastewater and process wastewater from the proposed plant. A wastewater effluent treatment plant will be constructed to treat this effluent prior to its discharge. The quantity of wastewater is taken on the higher end of the spectrum where it is assumed that all water consumed will also end up as wastewater, hence, approximately 686 m³/day of wastewater is expected.

2.6.5 Gas Supplies

SNGPL has been applied with for a gas connection at the facility, where gas supplied will be used for hot water generators, and ovens.

2.6.6 Waste Disposal Methods

The plant will generate liquid waste from the Paint shop through use of Chemicals in the Pre-treatment and Painting processes, the same will be treated through a dedicated Waste Water Treatment Plant ("WWTP") of an estimated capacity of 1000 cubic meters 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 UN – Water Decade Programme on Advocacy and Communication and Water Supply and Sanitation Collaborative Council

⁶ Tentative workforce requirement – 200 (as per section 2.5.1) = 200*75 = 15,000 liters/day



- 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 incineration 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.

Table 2.1 - Types of Wastes & Their Disposal Methods

Category	Description of effluent	Quantity / Day	Mode of Pre-Treatment	Mode of Disposal
Effluent	Process effluent (Painting and pre-painting process in particular)	Approx.686 m ³ /day ⁷ .	Through Physical & Chemical Wastewater Treatment Plant	Treated Effluent will be reused within the facility to the extent possible, where treated water will be used for landscaping. Sludge will be disposed through SEPA certified waste contractor
Gaseous Emissions	Boiler Stack Emissions, Flue Gases, Painting Fumes, Baking Oven Flue Gases	Within SEQS prescribed limits for each type of Gaseous waste	Through Continuous Monitoring of daily Operations	Through high-rise Chimney after passing through pollution control devices
Solid Waste	Steel Scrap (Containers and Drums), Cardboard, component packing, Wood, Misc. Scrap	36,000 kilograms per day	Treated as per type of waste	Recyclable waste such as metal scrap, plastics and paper can be sold to the potential consumers. Non-recyclable waste will be disposed through SEPA certified contractor

2.6.7 Use of Chemicals and Flammable Liquids

Various chemicals and paints are used in the process. Gasoline and HSD are used in vehicle performance testing and are stored in reservoirs in the facility. Thinners, paints and other chemicals are also used in the manufacturing process which are stored in separate storage areas.

2.6.8 CSR Activities

Given the history of CSR activities that MMCL's parent company has been involved in, MMCL also has extensive plans of creating social uplift in the area where the proposed plant will be situated, where activities proposed include:

⁷ Assuming 365 days production days

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1. Employ locals for working at the plant, including providing them trainings for managerial positions
2. Partnering up with an organization like TCF to set up a school in the area for locals or if one present in the area, then aiding them by providing required resources through funding
3. Partnering up with a health facility and aiding them in setting up to tackle the issues in the area, or if none present, then aid in providing a fortnightly doctors visit to the area for addressing concerns of the locals
4. Setting up a proper ground water well and RO system to provide clean drinking water to people in the area
5. Potential provision of a miniature public transport system in the area for specific routes in the area
6. Vocational training centres for people in the area



3. Relevant Legislative Requirements & Framework

This chapter provides an overview of the relevant policy framework and legislation that applies to frame the environmental and social ramifications that may arise from the proposed project implementation and operation. The proposed project will need to comply with all the applicable environmental policies, laws, guidelines, acts, and legislations of GoS and the provincial government.

3.1 Environmental & Social Regulatory Authorities in Sindh

The key national regulatory agencies that are implementors of the applicable environmental and social policies are listed below:

Table 3.1 - Functions of Sindh's Environmental & Social Regulatory Authorities

Organization	Functions/Role
Sindh Environmental Protection Authority (SEPA)	- Regulating environmental issues - Reviewing and checking environmental assessment reports prepared as per the legal requirements. - Environmental approvals of the project - Ensuring compliance and reviewing the performance of environmental management plans implementation
Sindh Labor & Human Resources Department	Guaranteeing the rights of workers like the right to organize, the right to collective bargaining, participation in the affairs of the implementing agency, health & safety, minimum wages, compensation, etc. are followed in the project
Sindh Social Welfare Department & Women Development Department	- Transformation of the government into an organization that actively practices and promotes gender equality and women empowerment. - Mainstreaming gender equality perspective across public policies, laws, programs, and projects by departments and agencies of the government with a focus on women empowerment. - Looking after various marginalized segments of population such as poor persons with disabilities, orphans, victims of violence and specifically women to ensure the welfare and support the marginalized groups of society
Employees Old Age Benefit Institute (EOBI)	Make sure that workers are benefitted after retirement from the collected/ raised funds.

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3.2 Summary of Relevant Strategies, Policies, Acts and Legislation

A summary of the major relevant strategies, policies, acts, and legislation from the environmental perspective is briefly discussed in the table below:

Table 3.2 - National & Provincial Environmental Strategies/ Policies Relevant to the Project

Sr. No.	Policy/Strategy	Brief Coverage	Relevance to Project	Regulatory Requirement from Project
1.	National Climate Change Policy, 2021	The National Climate Change Policy 2021 of Pakistan is a strategic framework that addresses the urgent need for adaptation and mitigation in response to climate change. The policy focuses on enhancing climate resilience, reducing vulnerability, and minimizing greenhouse gas emissions across various sectors, including energy, transportation, and industry. It emphasizes actions such as promoting renewable energy, improving energy efficiency, and expanding forestation efforts. The Goal is to ensure that climate change is mainstreamed the economically and socially vulnerable sectors of the economy and to steer Pakistan towards climate compatible development ⁸ .	This regulation is very important for an environmentally friendly electric vehicle (EV) assembly facility since it encourages the transition to low-emission technology and greener energy sources. The plant's operations could be in line with this policy to support sustainable growth and lesser the country's carbon footprint.	Requires compliance to ensure mitigation measures, where it mandates reducing greenhouse gas emissions, utilizing renewable energy sources, and integrating energy-efficient practices. The project is also obligated to conduct regular monitoring and reporting of emissions and energy consumption to ensure compliance with national climate objectives.
2.	National Electric Vehicle Policy, 2019	The National Electric Vehicle Policy (NEVP) of Pakistan, launched in 2019, aims to transition the country towards sustainable transportation, reducing reliance on fossil fuels and cutting down greenhouse gas emissions. The policy outlines goals to	This policy is very relevant for electric vehicle assembly plant proposal since it encourages the development of local EV production and construction of infrastructure for charging stations. This policy	Requires to comply with national goals for expanding local EV production, establishing charging infrastructure, and meeting emissions reduction targets, where it mandates the adoption

⁸ National Climate Change Policy, 2021



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		increase electric vehicle (EV) adoption, targeting 30% of all passenger vehicles and 90% of two and three-wheelers by 2030. By fostering local EV manufacturing and assembly, the policy hopes to mitigate Pakistan's significant oil import expenses and stimulate economic growth, potentially creating thousands of jobs and decreasing urban air pollution ⁹	alignment with project to develop and run more smoothly, especially when it comes to the environmental benefits (emission reductions and increased energy efficiency, for example) that are prioritized within the policy framework ¹⁰ .	of sustainable manufacturing processes and energy-efficient technologies.
3.	National Conservation Strategy, 1992	The National Conservation Strategy (NCS) of 1992 focuses on sustainable development by balancing economic growth with environmental preservation. Its 14 core goals include improving resource management, preventing environmental degradation, enhancing energy efficiency, promoting renewable energy use, and reducing pollution. The strategy emphasizes the importance of policy reforms, institutional strengthening, and public awareness to achieve environmental sustainability ¹¹	The NCS is highly relevant to the electric vehicle assembly plant, as it promotes with objectives of energy efficiency, renewable energy deployment, and pollution prevention, the project supports sustainable transportation and reduces the environmental impact of vehicle manufacturing, contributing to the nation's long-term conservation and green development goals.	Require to compliance with environmental standards, which mitigation measure to control pollution, energy efficiency and renewable energy sources. The project should adhere to support sustainable development goals.
4.	Biodiversity Action Plan, 2000	Pakistan created the Biodiversity Action Plan (BAP) in 2000 with the goal of conserving the vast biological diversity of the nation by putting policies in place to safeguard species, ecosystems, and genetic resources. It places a strong emphasis on community engagement, sustainable use, efficient management of protected areas,	The project's advocacy of sustainable development is in line with the BAP's objectives. The project's reduction of pollution and greenhouse gas emissions will help to preserve ecosystems and species. It also helps achieve the goals of the plan by limiting the	The project shall ensure to limit its impacts on biodiversity, integrated waste management and emissions control

⁹ National Electric Vehicle Policy (2019)

¹⁰ <https://policy.asiapacificenergy.org/node/4501>

¹¹ National Conservation Strategy (NCS), 1992



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		and the incorporation of biodiversity conservation into economic planning and national policies. The strategy also discusses the necessity of strengthening legislative frameworks, developing capacity, and implementing awareness campaigns in order to safeguard biodiversity ¹² .	plant's negative effects on the local biodiversity while promoting environmental conservation through the use of energy-efficient manufacturing techniques and renewable energy sources.	
5	National Environmental Policy, 2005	The act is to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development ¹³ .	The project is applicable with policy as it promotes the objective of conservation, restoration and efficient management of environmental resource.	
6.	Pakistan Penal Code, 1860	The Code deals with the offences where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions, and disposal of effluents ¹⁴ .	The provisions of the Penal Code, 1860 are applicable to the Project in terms of penalties for effecting human lives and public property. It also addresses the control of noise, air emissions and effluent disposal.	Requires adherence to the law of the land, where it defines the need to comply with aspects affecting the environment and other humans.
7.	Building Code of Pakistan, 2007	The provision of Building Code of Pakistan shall apply for engineering design of building-like structure and related components. The construction in violation of the building code shall be deemed as violation of professional engineering work. Moreover, a certificate for the proposed action will be obtained from Provincial Building Control Authority	These codes shall be used in structural design of building area components constructed under this under the assembly plant.	Requires that the codes defined therein are used in the construction of any buildings constructed for the sub-project.

¹² <https://portals.iucn.org/library/efiles/documents/2000-081.pdf>

¹³ <https://pbit.punjab.gov.pk/system/files/National%20Environmental%20Policy%202005.pdf>

¹⁴ <https://www.pakistani.org/pakistan/legislation/1860/actXLVof1860.html>



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Provincial Environmental Strategies/Policies Relevant to the Project				
Sr. No.	Policy/Strategy	Brief Coverage	Relevance to Project	Regulatory Requirement from Project
1.	Sindh Strategy for Sustainable Development, 2007	The Sindh Strategy for Sustainable Development (SSSD) proposed a ten-year sustainable development agenda for Sindh. The main focus of SSSD is to promote the sustainable use of natural resources. It targets to reduce poverty and enhance social development through the participation of the people of Sindh. SSSD recommends for the sustainable development and environmentally complying operations of industries: incentive mechanisms for reducing pollution; awareness raising of industrialists and stakeholders; promote cleaner production; enforce pollution charges as per SEPA 2014; prepare baseline of all industrial estates and sites to establish the pollution levels, waste disposal practices, air emissions, generation of hazardous waste for the preparation of environmental management plans for complying SEPA 2014; preparation of EIAs for all industrial development and infrastructure projects¹⁵.	The SSSD policy is applicable to the proposed project which involves the environmentally friendly electric vehicles (EV) followed by SDG 7, SDG 8, SDG 9 and SDG 13 that promotes cleaner energy to protect the planet.	No regulatory requirement (Is the overarching strategy under which the Sindh Environmental Protection Act 2014 was made).
2.	Sindh Drinking Water Policy, 2017	This policy is to provide safely managed drinking water whose supply is adequate, well maintained, and sustainable; and to enhance public awareness about health, nutrition and hygiene related to safe drinking	This policy is applicable for the Project in terms of quality of drinking water to be provided to laborers.	Ensure that clean water is provided to laborers and staff working on project.

¹⁵ <https://portals.iucn.org/library/sites/library/files/documents/2007-049.pdf>

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		water. The basic objective of this policy is to 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 ¹⁶ .		
3.	Sindh Sanitation Policy, 2017	The goal of the Provincial Sanitation policy is to ensure that the population of Sindh has access to a safely managed sanitation service and sanitary environment that is nutrition sensitive and hygienic. The policy touches upon important facets of infrastructure where extensive work is required to be able to achieve this goal, i.e., sanitation coverage, wastewater collection and treatment, domestic solid waste management, hazardous and industrial waste management, along with measures required, and the key players responsible ¹⁷ .	The relevance of KSDP is to cater the economic and other related interventions in Karachi city. The plan is applicabale for the project in term to reduce emission that seeks toward economic growth, environment and urban infrastructure.	No regulatory requirements, however, it has a section and recommendations on how the waste management of the city should be carried out.
4.	Sindh Environmental Protection Act, 2014	Sindh Environmental Protection Agency as a part of Sindh Act No. VIII of 2014 prepared Sindh Environmental Protection Act (SEPA), 2014 which was passed by the provincial assembly of Sindh on 24th February 2014 and asserted by the Governor of Sindh on 19th March 2014 and notified on 20th March 2014. It is a fairly comprehensive legislation and provides legislative framework for protection, conservation, rehabilitation, and improvement of the environment. It contains	The proposed Project is located mainly in Gharo so it falls under the jurisdiction of the SEPA that will be the responsible authority for governing the environmental compliance of the project with local guidelines.	Prior to project construction, an Environmental Impact Assessment must be conducted against which an approval has to be obtained from the department.

¹⁶ <https://irrigation.sindh.gov.pk/files/PagesContent/SindhWaterPolicy/SWP.pdf>

¹⁷ <https://phenrd.sindh.gov.pk/storage/notification/aq1z2GjHZIF35QjlokrLdY8U2xka1abx1QCR16v.pdf>



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		concrete action plans and programs for the prevention of pollution and promotes sustainable development. Act has 11 parts with 37 Sections followed by sub-sections and clauses. Part VI is related to the environmental examinations and assessments while part X is related to the public participation ¹⁸ .		
5.	Sindh Protection Agency Regulation, 2021	These regulations set out¹⁰: • Key policy and procedural requirements for filing an EIA. • The purpose of environmental assessment. • The goals of sustainable development. • The requirement that environmental assessment be integrated with feasibility studies. • The jurisdiction of the Provincial EPA and Planning & Development (P&D) Departments. • The responsibilities of proponents. • Duties of responsible authorities. • Provides schedules of proposals that the Project requires either EC, IEE, or an EIA. • The environmental screening process of the projects under schedule I, II and III; and	Defines the categories for different projects, where the type of study/assessment required (Checklist, IEE, EIA) against each category of project is defined to fulfil local environmental compliance.	As per the categories defined, the following project falls into the category of an EIA based on: Schedule III – Projects Requiring an EIA Category C – Manufacturing and Processing Sub Category (6) – Establishment of Industrial Estates & Export Processing Zones.

¹⁸ <https://epa.sindh.gov.pk/>

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		The procedure for the environmental approval for filing the case with the Sindh EPA for the granting of the NOC.		
6.	Sindh Environmental Quality standard (2016)	SEPA has formulated the Sindh Environmental Quality Standards (SEQS) as per Clause (g) of sub-section (1) of Section 6 of SEPA Act 2014. The SEQS were promulgated in 2016 which includes standards for liquid effluent, industrial gaseous emissions, ambient air, drinking water quality, noise levels and standards for motor vehicle exhaust, diesel vehicle, and petrol vehicles ¹⁰ .	Defines acceptable standards for the construction and operation of different projects in Sindh with respect to ambient air quality, vehicular and exhaust emissions, drinking water quality, and effluent quality.	All projects to be implemented in Sindh must conform to SEQS during all the phases i.e., construction and operation
7.	Guidelines for the Preparation and Review of Environmental Reports, 1997	These guidelines describe the format and content of IEE/EIA reports to be submitted to Environmental Protection Agency (EPA) or obtaining NOC/approval. The guidelines present¹⁹: - The environmental assessment report format. - Assessing impacts. - Mitigation and impact management and preparing an environmental management plan. - Reporting. - Review and decision making. - Monitoring and auditing; - Project Management.	These guidelines serve to describe the format, practices, and procedures to be employed when reporting environmental assessments.	No requirements, only guidelines for items to be included in assessments.
8.	Guidelines for Environmental Assessment	Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the	These guidelines serve to describe the format, practices, and procedures to be employed when	No requirements, only guidelines for items to be included in assessments.

¹⁹ <https://www.commissiomer.nl/docs/mer/diversen/pakistan-eia-guidelines.pdf>

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		environmental management of different types of development Projects. The guidelines that are relevant to the proposed Project are listed below¹¹: • Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997. • Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May 1997; • Sectoral Guidelines: Pakistan Environmental Assessment Procedures, Pakistan Environmental Protection Agency, October 1997.	conducting environmental assessments.	
9.	Sindh Solid Waste Management Act, 2021	The Sindh Solid Waste Management Act, 2021 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 or his nominee and constitutes of thirteen other ex-officio members of other relevant departments ²⁰ .	This Act is applicable as the main Act of the implementing agency of the project. It will define the boundaries in which the project must take place, and continue operations in.	No requirements, only defines the ambit of SSWMB's operations.
10.	The Sindh Local Government Act 2013 and Sindh Local Government	Under the Sindh Local Government Act 2013 (SLGA), Chapter VI, land use planning; implementation of building by laws; management of environmental and health hazards; food adulteration; provision and maintenance of water supply schemes and	This Act is applicable for the proposed Project due to its location and nature of use during construction stage of the proposed Project.	Act demands provision of utilities and municipal services to the population in an environmentally friendly manner, which this project would be contributing towards after development.

²⁰ <https://faolex.fao.org/docs/pdf/pak220786.pdf>



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	(Amendment) Act, 2021	public sources of drinking water; and mobilization of communities for the upgrade of local infrastructure (transportation, landscaping, and removal of encroachments) are the responsibilities of municipal corporations/committees. The 2021 amendment served to define municipal corporations and committees, along with establishing a relationship between elected councils and provincial departments working in administrative boundaries ²¹ .		
11.	Sindh Factories (Amendment) Act, 2021	The Act deals with regulations related to Project Area workers and workplace EHS requirements. The Factories Act also provides regulations with provision for general health and safety of the work force in their work area. Conditions are specified for clean workplace, toilets, waste handling, provision of drinking water quality, worker health and hygiene etc. Under the Act, no occupier of a factory shall be allowed to start manufacturing process unless he has obtained factory registration certificate from the Directorate of Labor. The Act does not allow a child below the age of 14 years to work in a factory in any case. The new Law restricts the employment of contractual labor in manufacturing process. The amendment 2021 is specifically related to the provision of safe transportation facility to women	This Act is applicable for the Project workers as well as belonging community including men, adults, women, adolescent working in and near the construction industry (during construction phase).	Requires that the occupational health and safety, along with labor regulations defined therein are complied with during project implementation.

²¹ http://sindhlaws.gov.pk/Setup/Publications_SindhCode/PUB-NEW-23-000062.pdf



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		workers, working hours and working periods of seasonal and whole year factories ²² .		
12.	The Sindh Occupational Safety and Health Act, (2017)	The Act makes provisions for occupational safety and health conditions at all workplaces in the province for the protection of workers during work. Under the Act, an Occupational Safety and Health Council will be established in Sindh with secretary of Sindh government's Labor and Human Resources Department as its chairperson. The proposed council lays down penalties in case of death and injury due to violation. In case of death sub-section 01 of section 38 will accord 2 years' imprisonment or a fine of PKR 100,000 or both. Similarly, in case of injury the imprisonment may extend to six months or a fine up to PKR 20,000 or both ²³ .	The Act applies in any Project situation where worker's rights and protections are enforced. This law is applicable to construction and Project workers and will be complied during construction and operation phases.	Requires that the occupational health & safety regulations defined therein are complied with during project implementation. Applicability and requirements defined further in the separately prepared Labor Management Procedures.
13.	The Sindh Transparency and Right to Information Act, 2016	The purpose of this Act to provide transparency and freedom of information to ensure that all citizens have better access to public information, to make the government more accountable to citizens, to enforce the fundamental right to information in all matters of public importance, to ensure transparency in all Government matters. Transparency and access to information are essential principles of democracy which not only enable the citizens to hold the Government and their institutions	This Act is applicable as the proposed Project will be cost saving and lead towards economic growth and shall be transparent for public.	Defines how the project must operate in a transparent manner to the public.

²² <https://clr.org.pk/Labour-Laws/Sindh/Sindh%20factories%20act%202021%20amend%202.pdf>

²³ <https://www.pec.org.pk/wp-content/uploads/2021/05/Sindh-Occupational-Safety-and-Health-Act-2017.pdf>



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		accountable but also help in improving the system of governance ²⁴ .		
14.	Hazardous Substance Rule, 2014	These Rules were notified to stream line procedures for issuance of licenses to industries / businesses that generate hazardous waste, safety precautions for workers and devices them methods for the removal of hazardous wastes in an environmentally friendly manner. 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 ²⁵ .	Following the Hazardous Substance Rule is essential in the setting of an eco-friendly electric vehicle assembly factory. In order to prevent environmental pollution and safeguard the health of workers, the project must guarantee that any hazardous materials utilized in the production process—such as batteries or chemical solvents—are treated properly. Respecting this rule will support the plant's commitment to lessening its environmental effect and improve its sustainability initiatives.	The proponent shall ensure the proper handling of hazardous material through SEPA certified contractor.
15.	Sindh Wildlife Protection Act, 2008	The Sindh Wildlife Protection Act, 2008, aims to conserve and protect the wildlife and its habitats in Sindh Province, Pakistan. The Act establishes a legal framework for the protection of wildlife species and their ecosystems, prohibiting hunting, capturing, or killing of protected species without prior permission from authorities. It also emphasizes the importance of preserving biodiversity and promoting sustainable practices in land and resource use ²⁶ .	The Sindh Wildlife Protection Act's goals are furthered by the construction of an ecologically friendly electric vehicle assembly factory, which lessens pollution from conventional vehicle manufacturing and encourages sustainable development. By following the Act's regulations, the project can help save the local species and their habitats by making sure that the	

²⁴ <https://shehri.org/rti/foi%20laws/Sindh%20Transparency%20&%20Right%20To%20Information%20Bill%202016.pdf>

²⁵ http://sindhlaws.gov.pk/setup/publications_SindhCode/PUB-15-000256.pdf

²⁶ Sindh Wildlife Protection Act, 2008. [Pakistan Environmental Protection Agency](#)



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			plant's operations don't negatively impact the environment.	
16.	Sindh Factories Act, 2015	The Sindh Factories Act, 2015 regulates the establishment and operation of factories in Sindh, Pakistan, ensuring the health, safety, and welfare of workers. It mandates compliance with safety standards, the provision of clean working conditions, and the implementation of measures to prevent workplace accidents and health hazards. The Act also outlines the responsibilities of employers regarding worker rights, working hours, and compensation, promoting a balanced work environment ²⁷ .	The Sindh Factories Act, 2015 is very important for an environmentally friendly electric car assembly factory since it establishes the legal basis for maintaining environmental requirements while guaranteeing a safe and healthy working environment. Encouraging worker safety, which is critical in manufacturing operations, will depend on compliance with this Act.	The project must comply with the registration requirements stipulated in the Sindh Factories Act. The assembly plant must adhere to established safety measures to protect workers.
17.	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 ²⁸ .	By encouraging a healthy working environment for employees and upholding health and safety requirements, the construction of an environmentally friendly electric car assembly factory complies with the Sindh Factories Rules.	
18.	Land Acquisition Act, 1894	The Land Acquisition Act, 1894, is a legislative framework that governs the process of acquiring private land for public	For an environmentally-friendly electric vehicle assembly plant, land acquisition is a key initial step. This	The land for this was owned by the proponent in order to develop manufacturing plant

²⁷ http://sindhlaws.gov.pk/setup/publications_SindhCode/PUB-NEW-18-000110.pdf

²⁸ <https://hsepk.com/wp-content/uploads/2019/07/Sind-Factory-Rules-1975-Minor-Edit-Required.pdf>



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		purposes or for companies in India. It outlines procedures for notifying landowners, determining compensation, and the mechanisms for land acquisition disputes ²⁹ .	project requires compliance with legal protocols for acquiring land, including fair compensation and due process, to ensure that landowners' rights are respected.	
19.	The Sindh Irrigation Act, 1879 and the Canal and Drainage Act, 1873	The Sindh Irrigation Act, 1879 This Act governs the regulation, management, and usage of irrigation water from rivers, streams, and canals within the province. It empowers the Provincial Government to ensure the proper distribution and use of water resources for agricultural and public purposes, focusing on preventing unauthorized water usage³⁰. The Canal and Drainage Act, 1873 This Act provides a legal framework for the construction, maintenance, and regulation of canals and drainage systems. It addresses water rights, maintenance responsibilities, and land acquisition for canal-related projects³¹.	The Act emphasizes how crucial it is to manage water resources responsibly. The facility is responsible for making sure that all water utilized for cooling or cleaning throughout the manufacturing process conforms with the Act. By following the Act's guidelines, the EV assembly facility must make sure that it doesn't have an adverse effect on nearby canal systems. This includes any water that the plant releases, which has to adhere to quality requirements to avoid contaminating canals.	The plant will need to manage water resources sustainably and treat any wastewater before discharge, adhering to the Sindh Environmental Quality Standards (SEQS).
20.	Self-Monitoring and Reporting by Industry Rules, 2014	The Self-Monitoring and Reporting by Industry Rules, 2014 mandate industries to regularly monitor and report their environmental impacts to the relevant regulatory authorities. These rules require industries to collect data on parameters such as emissions, waste management, and resource usage. The reporting aims to	In accordance with the project's objectives of pollution avoidance and sustainable operation, adherence to these requirements will guarantee that the assembly plant continuously monitors and reports on its emissions, waste, and energy usage. The project can show	The project must comply with the Self-Monitoring and Reporting by Industry Rules, 2014, which requires regular monitoring and reporting of emissions and resource usage to support transparency and regulatory compliance.

²⁹ <https://sindhzameen.gos.pk/pdf/final/LandAcquiAct1894.pdf>

³⁰ <http://sindhlaws.gov.pk/setup/publications/PUB-14-000091.pdf>

³¹ <https://faolex.fao.org/docs/pdf/pak64507.pdf>



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		improve transparency, compliance, and accountability, enabling regulators to ensure industries adhere to environmental standards and take corrective actions if needed ³² .	that it is committed to environmental responsibility and regulatory compliance by following these guidelines.	

³² http://sindhlaws.gov.pk/setup/publications_SindhCode/PUB-15-000261.pdf



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3.3 Screening and Review Process – Sindh Environmental Protection Agency

The Review of Environmental Assessment Regulations, 2021 of Sindh Environmental Protection Agency (SEPA) provides the necessary details on the preparation, submission, and review of the EC, IEE and the EIA reports. Categorization of projects for IEE and EIA is one of the main components of these regulations. Projects have been classified on the basis of expected degree of adverse environmental impact.

The ESIA prepared will be submitted to SEPA to initiate the process of approval, prior to the commencement of any construction works.

The regulations stipulate that within ten (10) working days of the EIA study having been submitted, SEPA will confirm that the document submitted is complete for the purpose of review. During this time, should the agency require the proponent to submit additional information, it will return the EIA to the proponent for revision, clearly listing those aspects that need further discussion. Subsequently, SEPA would make every effort to complete an IEE review within forty-five (45) days and an EIA review within ninety (90) days of filing (refer **Figure 2.1**).

The prescribed procedure for review of EIA by the SEPA is described in Review of EC, IEE and EIA Regulations, 2021. Article 17(4) of SEPA Act 2014 binds the agency to communicate its approval or otherwise within a period of two months from the date that the initial environmental examination is filed, and within a period of four months from the date that the environmental impact assessment is filed complete in all respects in accordance with the regulations, failing which the initial environmental examination or, as the case may be, the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations.

3.4 Sindh Environmental Quality Standards (SEQS)

On June 28, 2016, the Sindh Environmental Industrial Waste Water, Effluent, Domestic, Sewerage, Industrial Air Emission and Ambient Air, Noise for Vehicles, Air Emissions for Vehicles and Drinking Water Quality Standards, 2015 have been notified by Sindh EPA. The different standards for the different parameters defined under the SEQS are listed below:

Table 3.3 - SEQS for Ambient Air

Table 3.3 - SEQs for Ambient Air			
Pollutant	Time-weighted average	Concentration in Ambient Air	Method of Measurement
Sulfur Dioxide (SO ₂)	Annual Average*	80 µg/m ³	Ultraviolet Fluorescence Method
	24 hours**	120 µg/m ³	
Oxides of Nitrogen as (NO)	Annual Average*	40 µg/m ³	Gas Phase Chemiluminescence
	24 hours**	40 µg/m ³	
Oxides of Nitrogen as (NO ₂)	Annual Average*	40 µg/m ³	Gas Phase Chemiluminescence
	24 hours**	80 µg/m ³	
Ozone (O ₃)	1 hour	130 µg/m ³	Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m ³	High volume Sampling, (Average flow rate not less than 1.1m ³ /minute)
	24 hours**	500 µg/m ³	
Respirable Particulate Matter (PM ₁₀)	Annual Average*	120 µg/m ³	B Ray absorption method
	24 hours**	150 µg/m ³	
Respirable Particulate Matter (PM _{2.5})	Annual Average*	40 µg/m ³ ***	B Ray absorption method
	24 hours**	75 µg/m ³	
Lead (Pb)	Annual Average*	1 µg/m ³	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5 µg/m ³	
Carbon Monoxide (CO)	8hours**	5 mg/m ³	Non Dispersive Infra Red (NDIR) method
	1hours	10 mg/m ³	
*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 days.			
*** or 9 µg/m ³ plus baseline, whichever is low			

Table 3.4 - The Motor Vehicle Ordinance (1965) and Roles (1969)

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

Table 3.5 - SEQS for Noise

S. No.	Category of Area / Zone	Effective from 1 st January, 2015	
		Limit it in dB(A) Leq*	
		Day Time	Night Time
1	Residential area (A)	55	45
2	Commercial area (B)	65	55

S. No.	Category of Area / Zone	Effective from 1 st January, 2015	
		Limit it in dB(A) Leq*	
		Day Time	Night Time
3	Industrial area (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 6.00p. 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.		

Table 3.6 - SEQS for Municipal & Industrial Liquid Effluents

S. #	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	1.0	1.0	1.0	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⁻)	1.0	1.0	1.0	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)	1.0	1.0	1.0	mg/l
19	Copper	1.0	1.0	1.0	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	1.0	1.0	1.0	mg/l
24	Silver	1.0	1.0	1.0	mg/l
25	Total toxic metals	2.0	2.0	2.0	mg/l
26	Zinc	5.0	5.0	5.0	mg/l
27	Arsenic	1.0	1.0	1.0	mg/l
28	Barium	1.5	1.5	1.5	mg/l
29	Iron	8.0	8.0	8.0	mg/l
30	Manganese	1.5	1.5	1.5	mg/l
31	Boron	6.0	6.0	6.0	mg/l

S. #	Parameter	Into Inland Waters	Into Sewage Treatment	Into Sea	unit
32	Chlorine	1.0	1.0	1.0	mg/l

Table 3.7 - SEQS for Drinking Water

S.#	Properties / Parameters	Standard Values for Pakistan	S.#	Properties / Parameters	Standard Values for Pakistan
Bacterial			Chemical		
1	All water intended for drinking (E.Coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Essential Inorganics (mg/liter)		
			3	Aluminum (Al) mg/l	≤ 0.2
2	Treated water entering the distribution system (42xponenor thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	4	Antimony (Sb)	≤ 0.005
			5	Arsenic (As)	≤ 0.05
			6	Barium (Ba)	0.7
			7	Boron (B)	0.3
3	Treated water in the distribution system (E.42xponenor 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/liter)		
			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			

3.5 International Protocols & Conventions

As Pakistan is a member of a number of international organizations such as United Nations Organization (UNO), Organization of the Islamic Cooperation (OIC), South Asian Association for Regional Cooperation (SAARC), Economic Cooperation Organization (ECO) etc., so it has to follow the international protocols and obligations related to the environment. The major protocols,

ratification dates by Pakistan and obligations related to the proposed Project are provided in the **Table 3.8** below:

Table 3.8 - International Agreements/ Conventions Relevant to the Project

Sr. No.	Agreement/ Convention	Ratification	Description	Relevance to Project
1.	The Rio Declaration, 1992 Web Link: http://www.unesco.org/education/pdf/RIO_E.PDF	Pakistan signed the treaty on 13 Jun 1992 and ratified on 1 June 1994	The Rio Declaration comprises 27 principles which address important issues such as; sustainable development to integrate environmental protection into the development process; common but differentiated responsibilities to conserve, protect and restore the earth's ecosystems; public participation and information access at the national level, reduce and eliminate unsustainable patterns of production and consumption.	This declaration will be applicable to ensure the use of renewable and non-renewable resources in sustainable manner during construction phase as well as public participation and disclosure of information to local population.
	Stockholm Convention (SC) Web Link: https://www.pops.int/	Pakistan signed convention on 06 December 2001, ratified the Convention on 17 April 2008 which entered into force in July 2008.	The SC imposes a worldwide ban or control on the production and trade of Persistent Organic Pollutants (POP) pesticides and POPs used in industrial processes and consumer goods, and requires the reduction and minimization of the unintentional production and release of POPs formed as unintentional by-products in industrial and combustion processes.	The declaration will be applicable to ensure, no POPs are being used in project
2.	Kyoto Protocol, 1992 Web Link: https://unfccc.int/kyoto_protocol	Pakistan has ratified Kyoto Protocol in 2005	The Kyoto Protocol is a protocol to reduce Greenhouse gases that cause climate change. It was agreed on 11th December, 1997 at the 3rd Conference of the countries to the treaty when they met in Kyoto, and entered into force on 16th February, 2005. As of November 2007, 175 countries have ratified the protocol. One hundred and thirty-seven (137) developing countries have ratified the protocol, including Brazil, China, India and Pakistan but have no obligation beyond monitoring and reporting emissions.	The implementation of the proposed Project will emit greenhouse gases (GHG) in the atmosphere due to the construction activities.

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Sr. No.	Agreement/ Convention	Ratification	Description	Relevance to Project
3.	Convention on Biological Diversity, 1994 Web Link: https://www.cbd.int/	Pakistan signed this treaty in 1992 and it was ratified by cabinet in 1994.	The Convention on the Biological Diversity (CBD) has three main goals: Conservation of biological diversity (or biodiversity); sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources.	This convention is applicable to ensure the protection, conservation and sustainable use of biological resources during construction phase
4.	The Basel Convention, 1989 Web Link: http://www.basel.int/theconvention/overview/tabid/1271/default.aspx	Ratified 26 th July 1994	Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to Less Developed Countries (LDCs). It does not, however, address the movement of radioactive waste. The Convention is also intended to minimize the amount and toxicity of wastes generated, for environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate. The provisions of this convention imply to minimize the amount of waste generated and its management during construction and O&M phases.	This convention may be applicable as there is a possibility of import of material for the construction of project.
5.	Sustainable Development Goals (SDGs) – 2015-2030 Web Link: https://sustainabledevelopment.un.org/focussdgs.html	Pakistan was the first country to adopt SDGs 2030 agenda through a unanimous resolution of the Parliament of Pakistan.	The Sustainable Development Goals (SDGs) are a good collection of 17 global goals set by the United Nations in 2015. Pakistan has recently committed to Agenda 2030 and has become signatory to SDGs where Goal 6 calls, among others, for ensuring availability and sustainable management of water and sanitation for all, water use efficiency and integrated water resources management. The SDG 5 on gender equality and women's empowerment emphasizes to	The implementation of the proposed Project will adhere to the SDG by providing affordable and clean energy, reducing reliance on fossil fuel and diverting waste from landfill which will ultimately protect terrestrial ecosystem and biodiversity.



Sr. No.	Agreement/ Convention	Ratification	Description	Relevance to Project
			ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.	
6.	United Nation Framework Convention on Climate Change (UNFCCC), 1992 Web Link: https://unfccc.int/process-and-meetings/the-convention/status-of-ratification/status-of-ratification-of-the-convention	Signed on 13 Jun 1992 and ratified on 1 Jun 1994.	The UN Framework Convention on Climate Change (UNFCCC) is a multilateral agreement to address the issue of climate change. The Convention, was sets out and opened for signature at the June 1992 UN Conference on Environment and Development (UNCED), also known as the Rio Earth Summit. The UNFCCC entered into force on 21 March 1994. Pakistan being signatory of this treaty is bound to control the GHG emissions and climate change. Recent conference of parties (COP) for UNFCCC was held from 6 to 17 Nov, 2017 in Bonn Germany.	The convention is applicable as the implementation of the proposed Project will reduce the greenhouse gas emission such as methane and will provide renewable energy source
7.	Paris Agreement, 2016 Web Link: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement	Paris Agreement was signed on 22 April 2016 and ratified on 10 November 2016.	The Paris Agreement's long-term temperature goal is to keep the increase in global average temperature to well below 2 °C above pre-industrial levels; and to pursue efforts to limit the increase to 1.5 °C, recognizing that this would substantially reduce the risks and impacts of climate change. It also aims to increase the ability of parties to adapt to the adverse impacts of climate change, and make "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development." Under the Paris Agreement, each country must determine, plan, and regularly report on the contribution that it undertakes to mitigate global warming.	The agreement is applicable as the implementation of the proposed Project will emit greenhouse gases (GHG) in the atmosphere due to the construction activities.

4. Analysis of Alternatives

The identification and assessment of feasible alternatives for project design and implementation are critical to the Environmental & Social Impact Assessment (ESIA). Alternatives provide a comparison of the environmental implications and outcomes associated with different options for achieving the project's objectives. This process enables both the project proponent and the authorities responsible for making well informed decisions.

The selection of a preferred alternative is influenced by a range of factors, including cost, delivery timelines, environmental and social impacts, and the expenses associated with mitigating these impacts. Key drivers that shape potential alternatives and scenarios include the availability of project sites, current technologies, necessary design modifications, operational conditions, capital and operational costs, environmental and social considerations, their potential impacts, and mitigation costs. The "No Project" alternative is also evaluated to underscore the project's necessity. Considering these various drivers, the potential alternatives within the project are limited to the following aspects:

- No Project Option
- Location Alternatives
- Technology selection

4.1 No Project Alternative

The "no project" alternative implies that the plan for establishing an electric vehicle (EV) factory will not move forward, resulting in the cancellation of this project. Without this development, Pakistan's automotive sector would remain limited to the existing fossil fuel automotive manufacturers, discouraging new players in the EV market. Consequently, the anticipated investment of millions of rupees in the EV industry would be forfeited. Additionally, not advancing towards electric vehicles would hinder the country's efforts to reduce greenhouse gas emissions and combat air pollution, which are critical for public health and environmental sustainability, and would also deter the country from its path on meeting the agreed upon Nationally Determined Contributions. The absence of a dedicated EV factory would also prevent the nation from becoming part of the global shift toward cleaner transportation, resulting in a reliance on fossil fuels that could exacerbate energy insecurity and economic instability. Furthermore, introducing new entrants could stimulate competition, fostering advancements in electric vehicle technologies, particularly in areas such as energy efficiency and emissions reduction. However, these potential benefits in environmental and technological progress would be unattainable if the proposed EV factory does not proceed.

Hence, the No Project Alternative is deemed as being detrimental in this scenario, and not possible moving forward.

4.2 Location Alternatives

The selected location for the electric vehicle (EV) factory is along the Gharo-Keti Bandar Coastal Highway in District Thatta. Alternative locations, such as the Karachi, come with challenges.

While Karachi offers strategic advantages, it also presents notable disadvantages. High population density and urbanization drive up land and property costs, which would significantly increase the initial investment. Additionally, Karachi's infrastructure issues could cause logistical delays, potentially impacting the timely movement of goods and raising operational expenses. Frequent

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power shortages and load-shedding in Karachi could disrupt manufacturing, necessitating costly backup power solutions. The city's high levels of pollution and industrial emissions would require additional environmental compliance measures, adding complexity and cost. Security risks and political instability further increase operational costs due to the need for heightened security measures.

After assessing these factors, the Gharo location was chosen for its strategic benefits. Situated along the Gharo-Keti Bandar Road—a vital trade route part of CPEC with significant future potential—it provides a balance of accessibility and operational ease. The area has few existing industries, simplifying construction and reducing operational constraints. The project is closer to National Highway, providing easier route for logistics. Its proximity to the Karachi port allows for efficient access to raw materials, minimizing logistical costs. The assembly facility will also lie in the middle of Karachi and Hyderabad, allowing easier distribution of both mega cities of Sindh. Overall, Gharo presents an optimal location for the EV factory, balancing costs, accessibility, and future growth potential.

4.3 Technological Options

Electrical vehicles (EV) are the new norm in the wake of sustainable development and climate change management. Despite of their newer introduction to the market, EV manufacturing, assembly and production is increasing in number with the passage of time. Despite of this, other technological alternatives are still available, coming up with their own set of advantages, while coming up short when it comes to critical issues of the 21st century, mainly exhaust emissions and the problems caused through it. They are as follows:

4.3.1 Petrol and Diesel Vehicles

Petrol and diesel vehicles are advantageous for their well-established infrastructure, quick refueling, and the high torque that diesel engines offer, especially beneficial for heavy-duty applications. These engines are refined technologies, with available parts and expertise worldwide, making maintenance and repairs accessible and cost-effective. However, they emit greenhouse gases like carbon dioxide and pollutants such as nitrogen oxides and particulate matter, which contribute to climate change and health issues, particularly with diesel vehicles. Furthermore, the finite nature of fossil fuels and the increasing cost of compliance with emission standards raise concerns about their long-term sustainability.

4.3.2 Hybrid Vehicles

Hybrid vehicles provide improved fuel efficiency and lower emissions by switching between an electric motor and an internal combustion engine, which reduces fuel consumption and pollution. The use of regenerative braking also enhances energy efficiency, while the availability of an ICE alleviates range anxiety for drivers. However, the dual powertrain adds weight and complexity, increasing manufacturing costs. Battery degradation over time and the need for replacement, as well as the limited capacity of the electric motor, add to these concerns, and the continued reliance on fossil fuels means hybrids still emit pollutants.

4.3.3 Hydrogen Fuel Cell Vehicles (FCVs)

FCVs present another alternative, generating electricity through a chemical reaction between hydrogen and oxygen, with water vapor as the only emission. FCVs offer fast refueling times and long driving ranges, similar to Internal Combustion Engine (ICE) vehicles, making them suitable for long-haul transportation. However, hydrogen production and distribution infrastructure remain



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limited and expensive, slowing their adoption. Additionally, most hydrogen is currently produced from natural gas, which has its own environmental impact, although green hydrogen, derived from renewable energy sources, is gaining momentum. **Biofuel-powered vehicles** use fuels derived from organic materials, such as ethanol from corn or biodiesel from vegetable oils. These fuels can be used in modified ICE vehicles, reducing net carbon emissions by recycling carbon from the atmosphere. While biofuels offer some environmental benefits, large-scale production competes with food production and can contribute to deforestation, limiting their viability as a primary solution.

Electric vehicles (EVs) offer a more sustainable answer to both emissions and the complexities of traditional engines. Producing zero tailpipe emissions, they are the cleanest option for cutting down on air pollution and combating climate change. The simplicity of electric motors translates into lower operating costs and minimal maintenance needs, and EVs can be powered by renewable energy sources, aligning with a clean energy future. While the high cost of batteries, the need for extensive charging infrastructure, and range limitations for long trips present some challenges, advances in battery technology are addressing these issues with longer ranges and faster charging. This positions EVs as a powerful solution for sustainability.

EVs represent a transformative shift from fossil fuels, operating entirely on rechargeable battery power. Modern advancements in battery tech have brought competitive driving ranges and faster charging times, easing some of the range anxiety that affected earlier models. Beyond emissions reduction, EVs boast higher efficiency, converting up to 80% of grid electricity into power at the wheels, compared to the mere 20–30% efficiency in ICE vehicles, where much energy is lost to heat and friction. The environmental advantages of EVs extend beyond lower emissions: they reduce dependency on oil, support energy security, and integrate seamlessly with renewable sources like wind, solar, and hydropower, creating potential for a truly sustainable future. With fewer moving parts than traditional engines, EVs also demand less maintenance, resulting in lower long-term costs, making them the best possible alternative moving forward.

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5. 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, whereas the social environment covers the area's socioeconomic environment including population distribution, demographics, education, healthcare, etc. The chapter also describes the ecological features of the project district, mainly the flora and fauna incorporated in the area. Furthermore, to determine the baseline of the project location, a microenvironment baseline is also detailed in the following section, including the socio-economic components.

5.1 The Macro-environment: District Thatta

The proposed project is in Gharo, Mirpur Sakro Taluka of District Thatta. The project is planned in the environs of multiple farms, mills, small to medium scale industries and agricultural lands facing the main Gharo - Ketu Bunder Highway (N110). The project site can be easily accessed through National Highway (N-5) in the south, via Gharo - Ketu 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.

5.2 The Microenvironment of the Project

Immediately adjacent to the project area are agricultural fields, where growth of crops such as wheat, cotton and vegetables happens across the year. Across the road, there are a few private properties which are used as independent farm house and coconut orchids. Gharo Creek flows near the project area, which is connected to a network of water streams, discharging into the Indus Delta.

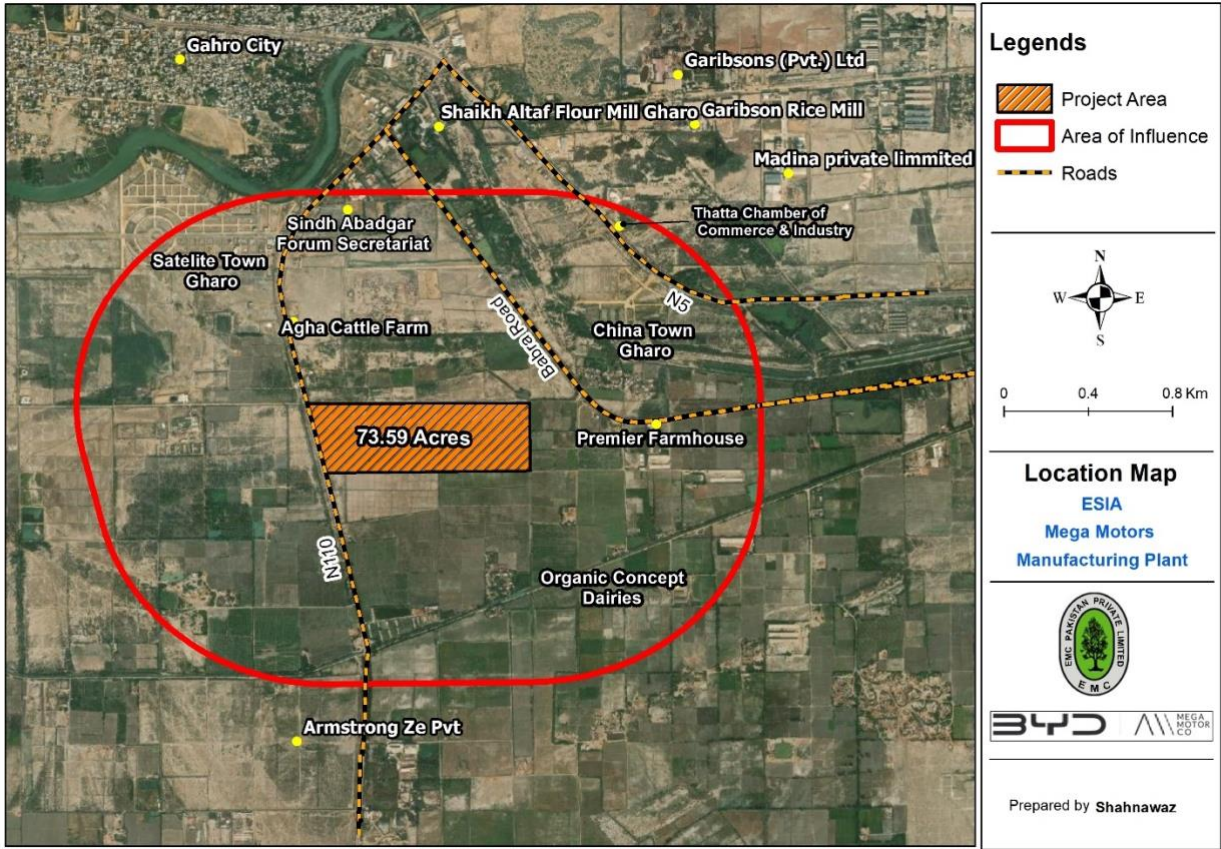


Figure 5.1 - Project Area of Influence

Table 5.1 - Existing Topography of the Project Site



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5.2.1 Physical Environment

5.2.1.1 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.

In order to analyze the climatic parameters of the project microenvironment, data of last 30 years was collected, modelled and graphically visualized with respect to the project area's macro environment.

5.2.1.2 Temperature and Precipitation

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 mean daily maximum temperatures were recorded in April-May which was 38 C while the mean daily minimum was recorded at 27 C in January.

Thatta receives rainfall from July to September in the form of summer monsoon, which pours the country due to the uneven heating of the landmasses and the seasonal shifts in atmospheric circulation. 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. On average, the highest rainfall is mainly received during August, where mean precipitation is up to 64 mm

Thatta
 24.75°N, 67.92°E (17 m asl).
 Model: ERA5T.

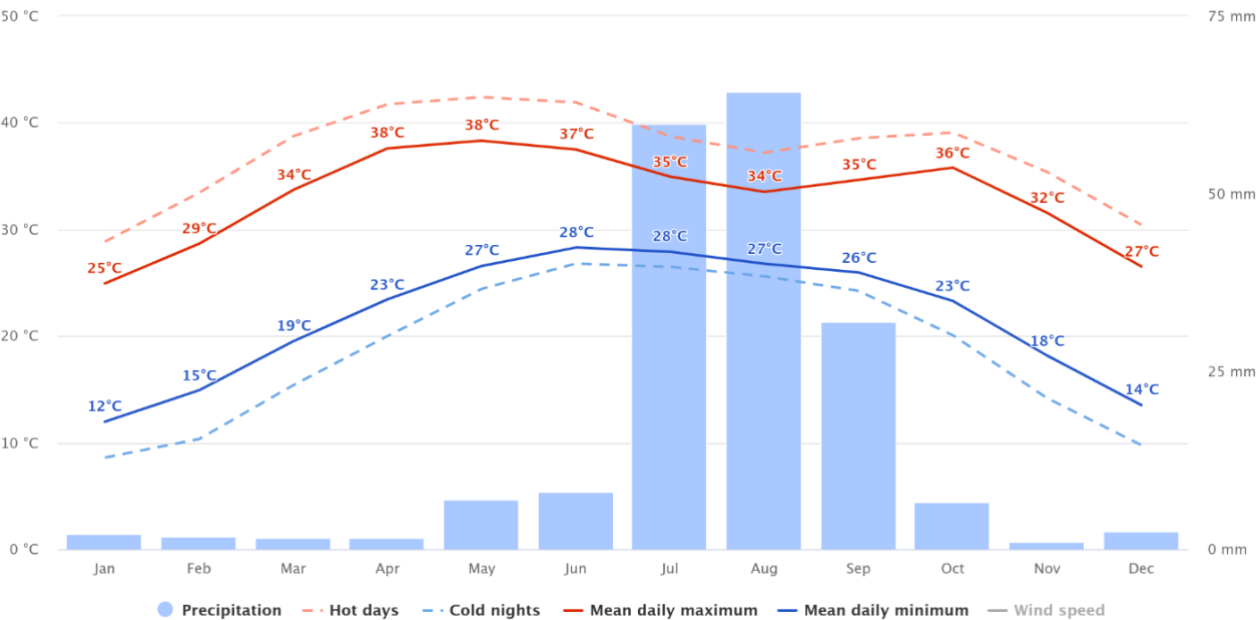


Figure 5.2 - Average Temperatures & Precipitation of District Thatta

With the recent talks about climate change, it is essential to recognize the effects of the alarming situation in terms of the project’s macroenvironment. In order to analyze the situation, the temperature and precipitation graphs showing the change is depicted. According to the graph, the overall mean temperature has shown an increase with respect to time, showing a noticeable effect of climate change.

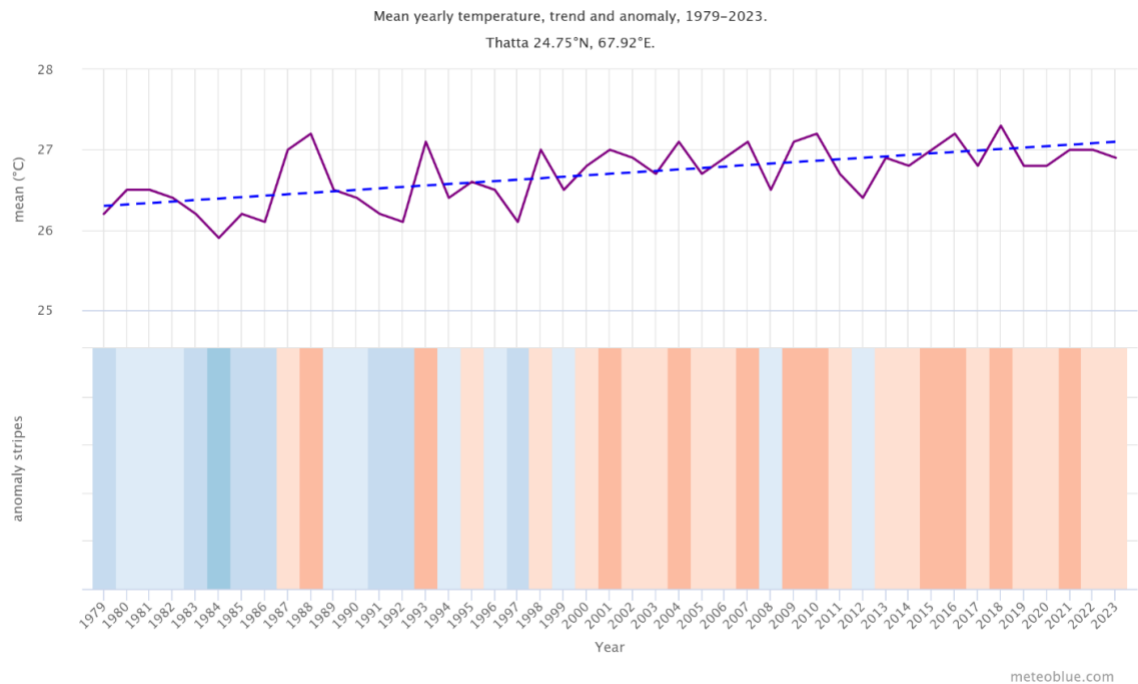


Figure 5.3 - Mean Yearly Change in Temperature in District Thatta



5.2.1.3 Wind Speed and Direction

The average hourly wind speed in Thatta experiences extreme seasonal variation over the course of the year. The district lies in a wind corridor, experiencing high winds. Primarily, its location along the Arabian Sea coast exposes it to consistent sea breezes and occasional high-wind events from monsoonal patterns. The windier part of the year lasts for 5.0 months, from May to September.

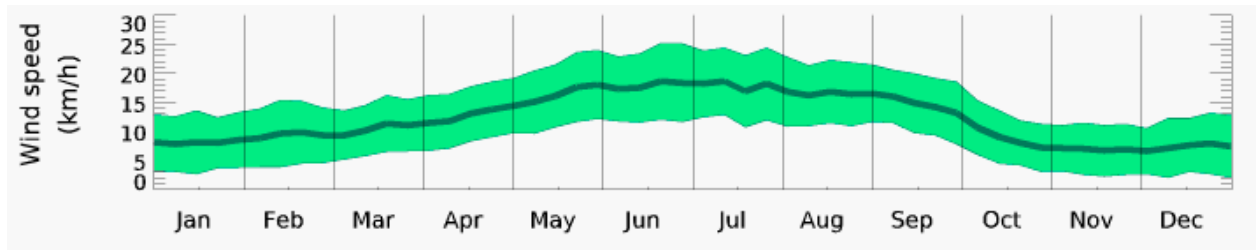


Figure 5.4 - Wind Speed in District Thatta

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. The graph below depicts the different directions from which the wind flows, with respect to different hours of the day.

Thatta

24.75°N, 67.92°E (17 m asl).
Model: ERA5T.

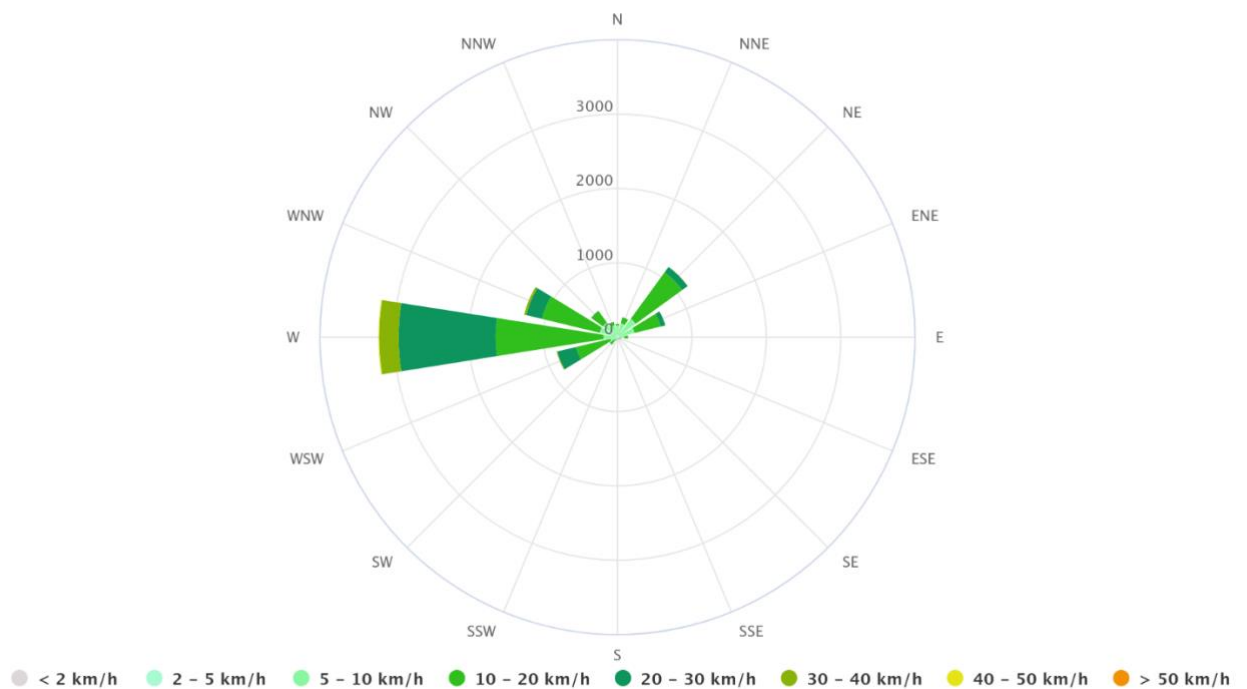


Figure 5.5 - Wind Direction & Speed in District Thatta

5.2.1.4 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

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is muggy, oppressive, or miserable. The muggiest day of the year is August, with muggy conditions.

5.2.1.5 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.

5.2.1.6 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.

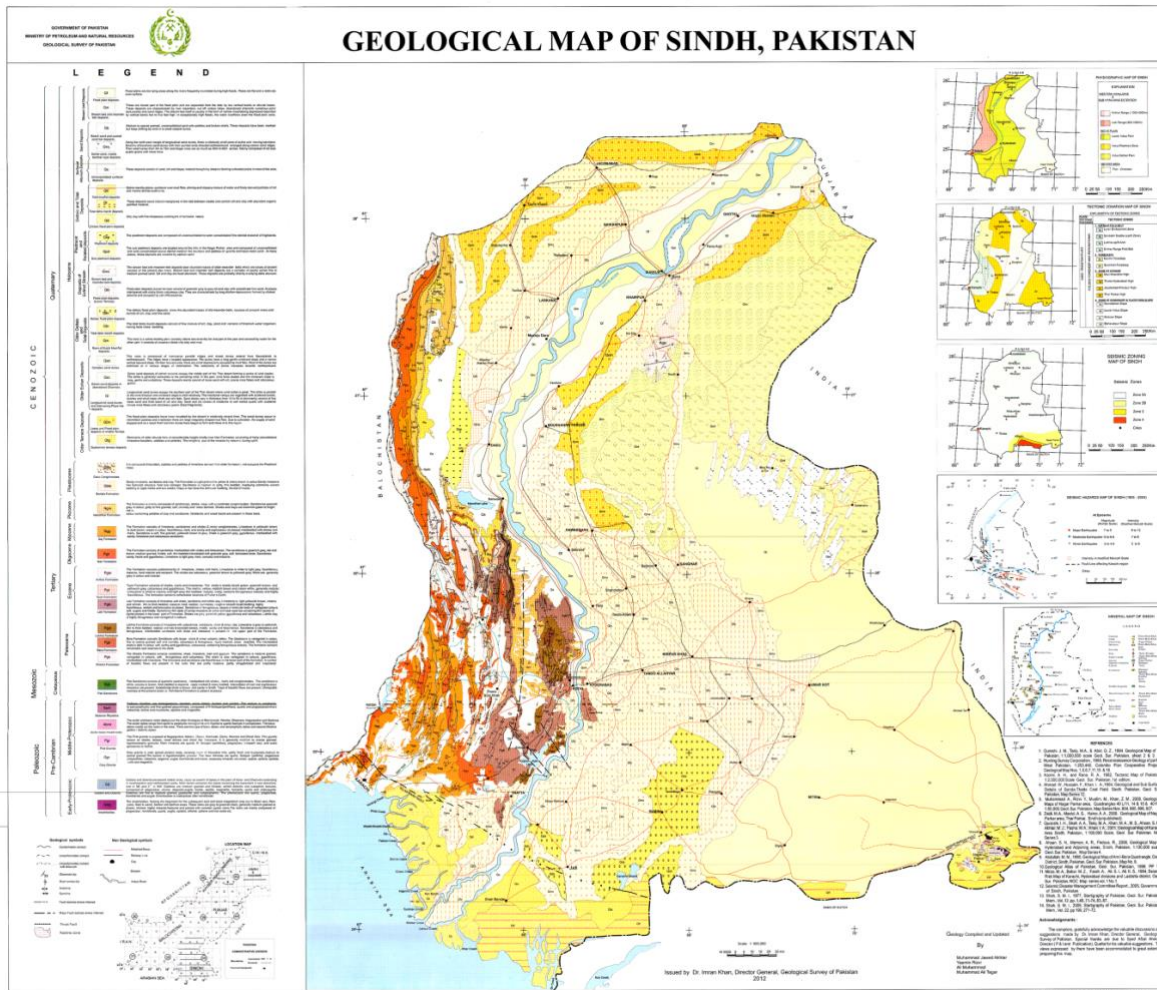


Figure 5.6 - Geological Map of Sindh

5.2.1.7 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 coarse sand.

5.2.1.8 Groundwater

District Thatta lies in the Indus Deltaic region, where groundwater quality remains saline due to seawater intrusion. With the increasing industrialization and improper industrial waste management, the seawater usually remains contaminated with trace metals, further affecting the groundwater quality. Furthermore, rising sea levels and lack of coastal resilient methods further causes increased sea water intrusion. Groundwater quality in Thatta District, Sindh, is generally poor, with many areas experiencing high levels of salinity and contamination by various pollutants, including arsenic. Studies indicate that the district's reliance on shallow aquifers is problematic due to contamination from organic matter in the soil and frequent saltwater intrusion. This issue is further exacerbated by the district's proximity to the Arabian Sea, which makes it vulnerable to

seawater mixing into freshwater sources, leading to high total dissolved solids (TDS) and salinity beyond World Health Organization (WHO) safe limits. In addition, agricultural practices in the area contribute nitrates and other chemical pollutants to groundwater sources, raising concerns for safe drinking water supplies. One of the alarming parameters found in the ground water of Thatta is arsenic. Groundwater analysis in Thatta District has revealed that around 20% of samples are contaminated with arsenic concentrations as high as 150 parts per billion (ppb)³³. This far exceeds the World Health Organization's (WHO) safe limit for arsenic in drinking water, which ranges between 5-10 ppb. The inconsistency in arsenic levels across locations highlights a critical health risk for residents reliant on this water for drinking. Elevated arsenic exposure can lead to severe health issues, including cancer and liver damage, emphasizing the need for immediate measures to address contamination in affected areas.

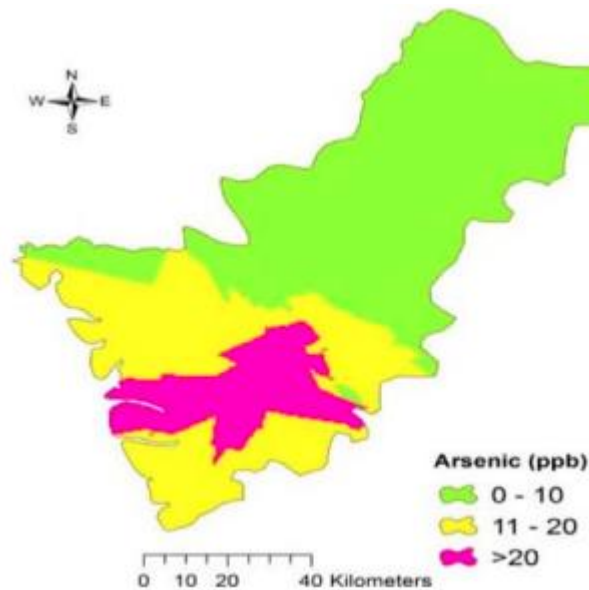


Figure 5.7 - Thatta Groundwater Conditions

Groundwater quality analysis in Thatta District revealed that 55% of samples have a bitter, salty taste, while 85% exceed the permissible total dissolved solids (TDS) limit of 500 mg/L, indicating high salinity. Additionally, 30% of samples show turbidity levels above the safe threshold of 5 NTU, and chloride and calcium levels are beyond WHO limits. Only three samples are classified as "soft" water, with the majority being hard or very hard. While odor and pH are generally within acceptable limits, arsenic levels exceed safe limits in 20% of samples, posing a significant health risk to residents who rely on this water for drinking.³⁴

5.2.1.9 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.

³³ Ghulam Shabir Solangi, Altaf Ali Siyal, Muhammad Munir Babar, Pirah Siyal. Groundwater Quality Mapping using Geographic Information System: A Case Study of District Thatta, Sindh. Mehran University Research Journal of Engineering and Technology, 2017

³⁴ Balakrishnan, P., Saleem, A., and Mallikarjun, N.D., "Groundwater Quality Mapping Using Geographic Information System (GIS): A Case Study of Gulbarga City, Karnataka, India", African Journal of Environmental Science and Technology, Volume 5, No. 12, pp. 1069-1084, 2011.

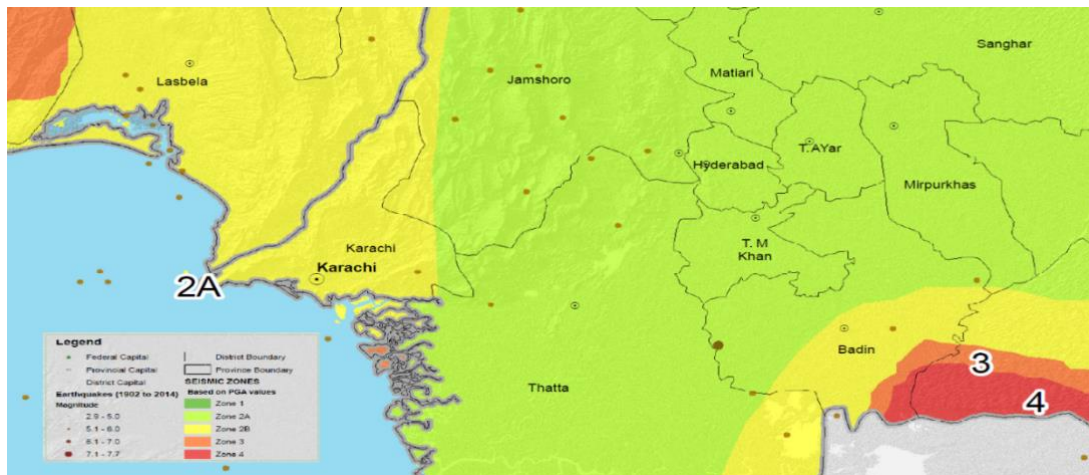


Figure 5.8 - Seismic Zones of Karachi & Thatta

5.2.1.10 Surface Water Hydrology

Within the macro-environment of district Thatta, surface water availability is ample, mainly because of the presence of some of the most important lakes, and the dependence on those lakes. District Thatta is home to Lake Keenjhar, which is the second largest lake in the country. The lake not only serves as an important source of water and energy to nearby cities, but also allows thriving of communities nearby, who earn their income through fishing. Thatta is also home to other important fresh water lakes like Hadero and Haleji. Gharo Creek flows across the macroenvironment of the project. The creek connects to major lakes of the district by a network of small channels. The creek discharges into the Indus Delta.

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. The Distry receives water from a network of different streams and channels, which connects Distry to Haleji Lake. Khari Seer Distry outflows into Gharo Creek, an intertidal zone part of the Indus River Delta. The availability of fresh water in the district serves as an important tool for the agricultural dynamics, as fresh water is the major source of irrigation. Other than the existence of creek in the nearby vicinity, the district also has rainwater catchment basins, acting as a source of clean water in case of unavailability of water.

5.2.1.11 Environmental Monitoring

In order to identify the existing environmental conditions of the area, it is essential to know the baseline parameters of the area. These parameters help us identify what kind of contamination is found in the environmental system and what are the potential sources. The baseline environmental monitoring is necessary in order to set a standard prior to the construction and the operation of the project. This is so that comparisons can be carried out for between the different timelines and understand the environmental impacts caused by the project's comparison.

5.2.1.11.1 Ambient Air and Noise Quality

Ambient Air and Noise Quality monitoring was carried out to obtain an understanding of the existing airshed and noise conditions in the project area. Results obtained from the monitoring are provided below:

Table 5.2 - Results from Ambient Air & Noise Monitoring

Parameter	Unit	SEQS	Location 1	Location 2	Location 3	Location 4
Carbon Monoxide (CO)	mg/m ³	5.0	1.03	0.88	0.68	0.59
Nitrogen Oxide (NO)	µg/m ³	40.0	28.2	20.4	16.9	15.5
Nitrogen Dioxide (NO ₂)	µg/m ³	80.0	39.2	28.0	23.0	19.4
Sulphur Dioxide (SO ₂)	µg/m ³	120.0	18.9	12.4	10.2	14.9
Ozone (O ₃)	µg/m ³	130.0	17.5	19.4	20.9	22.4
Particulate Matter (PM ₁₀)	µg/m ³	150.0	118.7	110.9	115.5	99.9
Particular Matter (PM _{2.5})	µg/m ³	75.0	68.2	47.6	53.1	49.1
Suspended Particulate Matter (SPM)	µg/m ³	500.0	365.0	313.1	235.6	270.0
Lead (Pb)	µg/m ³	1.5	BDL	BDL	BDL	BDL
Noise	dB(A)	75	64.3	60.1	60.5	59.2

Table 5.3 - Pictures from Ambient Air & Noise Monitoring





The baseline environmental monitoring data indicates that air quality and noise levels in the assessed locations are within the Sindh Environmental Quality Standards (SEQS) limits, demonstrating compliance with regulatory standards. Key pollutants such as carbon monoxide, nitrogen oxides, sulfur dioxide, and ozone show values well below SEQS thresholds, indicating low levels of gaseous pollutants. Particulate matter (PM₁₀ and PM_{2.5}) levels are also within acceptable limits, though relatively closer to the maximum allowable levels, suggesting a need for periodic monitoring. Lead levels are below detectable limits, implying negligible contamination. Noise measurements across the locations are within permissible limits, reflecting minimal noise pollution. Overall, the data presents a favorable environmental condition with minimal pollution impact, though continuous monitoring, particularly for particulate matter, may be beneficial to maintain these standards.

5.2.1.11.2 Groundwater

In order to determine the baseline conditions of the groundwater in the project area of influence (AOI), four samples of water were taken. The results of the groundwater analysis were then conducted out in SEPA certified lab, and are given in the table:

Table 5.4 - Groundwater Quality Testing Results

Sr.	Parameters	Units	SSDWQ	Ground Water 1	Ground Water 2	Ground Water 3	Ground Water 4
Coordinates				24°43'22.9"N 67°35'42.7"E	24°43'34.2"N 67°36'09.3"E	24°43'04.0"N 67°35'52.7"E	24°43'42.5"N 67°35'36.2"E
1	pH value	pH Unit	6.5 – 8.5	6.98	7.25	7.21	7.70
2	Odor	-	Non-Objectionable/ Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
3	Taste	-	Non-objectionable /Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
4	Color	Pt-Co	15	BDL	BDL	BDL	BDL
5	Turbidity	NTU	5	NIL	NIL	NIL	NIL
6	Total Dissolved Solids (TDS)	mg/L	1000	1480	546	575	336
7	Total	mg/L	500	745	288	200	126

	Hardness as CaCO ₃						
8	Fluoride (as F ⁻)	mg/L	1.5	0.23	0.22	0.23	0.24
9	Chloride (as Cl ⁻)	mg/L	250	444	142	144	71
10	Nitrate (NO ₃)	mg/L	50	2.12	2.10	2.14	2.14
11	Nitrite (NO ₂)	mg/L	3	0.010	0.011	0.011	0.013
12	Cyanide (as CN ⁻) total	mg/L	0.05	BDL	BDL	BDL	BDL
13	Phenolic Compound as (Phenols)	mg/L	-	BDL	BDL	BDL	BDL
14	Aluminum (Al)	mg/L	0.2	BDL	BDL	BDL	BDL
15	Antimony (Sb)	mg/L	0.005	BDL	BDL	BDL	BDL
16	Arsenic	mg/L	0.05	BDL	BDL	BDL	BDL
17	Cadmium	mg/L	0.01	BDL	BDL	BDL	BDL
18	Chromium, Total	mg/L	0.05	0.022	0.023	0.023	0.020
19	Copper	mg/L	2	2.23	2.22	2.22	2.21
20	Lead	mg/L	0.05	BDL	BDL	BDL	BDL
21	Mercury	mg/L	0.001	BDL	BDL	BDL	BDL
22	Selenium	mg/L	0.01	BDL	BDL	BDL	BDL
23	Nickel	mg/L	0.02	BDL	BDL	BDL	BDL
24	Boron	mg/L	0.3	BDL	BDL	BDL	BDL
25	Residual Chlorine	mg/L	0.2-0.5	0.012	0.014	0.012	0.011
26	Zinc	mg/L	5.0	0.15	0.13	0.13	0.14
27	Manganese	mg/L	0.5	0.54	0.58	0.55	0.51
28	Barium	μg/L	0.7	0.56	0.56	0.54	0.50
29	Total Coliform	mg/L	0cfu/100ml	NIL	NIL	2	NIL
30	Fecal Coliform	mg/L	0cfu/100ml	94	NIL	NIL	NIL
31	Escherichia Coli(E-Coli)	CFU/10 0ml	0cfu/100ml	NIL	NIL	NIL	NIL

Overall, the groundwater quality in the microenvironment was reasonable, as most of the parameters fell under the Sindh Standard Drinking Water Quality (SSDWQ). However, samples did show high concentration of heavy metals such as copper and manganese, which may have been present due to industrial discharges and agricultural runoff.

Groundwater 1 sample is considered to be the worst in terms of water quality due to the presence of fecal coliform and high levels of TDS and Hardness, making it unacceptable to drink.

5.2.1.11.3 Wastewater

To determine the quality of wastewater, two samples of wastewater were taken, where the findings from the testing carried out are provided below:

Table 5.5 - Wastewater Quality Testing Results

S. No.	Parameters	Standards	UNITS	Wastewater 1	Wastewater 2
		SSDWQ - limits			
Coordinates				24°43'19.6"N 67°35'26.3"E	24°43'20.2"N 67°36'04.6"E
1	pH value	6.5 – 8.5	-	6.98	30.1
2	Odor	Non-Objectionable /Acceptable	Physical	Acceptable	7.61



3	Taste	Nonobjection able /Acceptable	Physical	Acceptable	11
4	Color	≤ 15	TCU	BDL	29.84
5	Turbidity	< 5	NTU	NIL	19
6	Total Dissolved Solids (TDS)	< 1000	mg/L	1480	354
7	Total Hardness as CaCO ₃	< 500	mg/L	745	78
8	Fluoride (as F ⁻)	≤ 1.5	mg/L	0.23	20
9	Chloride (as Cl ⁻)	< 250	mg/L	444	BDL
10	Nitrate (NO ₃)	≤ 50	mg/L	2.12	0.011
11	Nitrite (NO ₂)	≤ 3	mg/L	0.010	1.22
12	Cyanide (as CN ⁻) total	≤ 0.05	mg/L	BDL	BDL
13	Phenolic Compound as (Phenols)	-	mg/L	BDL	BDL
14	Aluminum (Al)	≤ 0.2	mg/L	BDL	0.12
15	Antimony (Sb)	≤ 0.005	mg/L	BDL	0.44
16	Arsenic	≤ 0.05	mg/L	BDL	0.20
17	Cadmium	0.01	mg/L	BDL	0.012
18	Chromium, Total	≤ 0.05	mg/L	0.022	33
19	Copper	2	mg/L	2.23	BDL
20	Lead	≤ 0.05	mg/L	BDL	NIL
21	Mercury	≤ 0.001	mg/L	BDL	0.65
22	Selenium	0.01	mg/L	BDL	2.54
23	Nickel	≤ 0.02	mg/L	BDL	0.18
24	Boron	0.3	mg/L	BDL	1.87
25	Residual Chlorine	0.2-0.5 at Consumer End	mg/L	0.012	112
26	Zinc	5.0	mg/L	0.15	BDL
27	Manganese	≤ 0.5	mg/L	0.54	0.010
28	Barium	0.7	mg/L	0.56	0.21
39	Total Coliform	0cfu/100ml	cfu	NIL	BDL
3	Fecal Coliform	0cfu/100ml	cfu	94	0.02
35	Escherichia Coli(E-Coli)	0cfu/100ml	cfu	NIL	BDL

The wastewater 1 sample saw a few parameters exceeded the SEQS limits. The results shows that the Total Dissolved Solids and Total Hardness is high, mainly due to the presence of chlorides and manganese. Wastewater 2 sample generally has reasonable results.

5.2.1.12 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 droughts' resistant trees.

The land use of the immediate macro environment i.e. along the Gharo-Keti Bunder Highway, comprises of the following items:

- 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
- Residential Projects

5.2.1.13 Traffic Conditions

Once the operation phase of the project commences, manufactured cars 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 Gharo – Ketu 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 day³⁵.

Table 5.6 - Road Access along the Project Site



5.2.2 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. This gives the area an edge in terms of biodiversity. Although, urbanization and industrialization has resulted in the flora and fauna to be restricted, a few species can still be found.

5.2.2.1 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 project site, a mainly agricultural field comprised of vegetation of various species of grass, bushes, shrubs and few species of trees such as Khajoor, Conocarpus and Eucalyptus. In the overall microenvironment, coconut orchids were also found, which are a source of income for the locals. Here are a few of these species found in the microenvironment of the project:

Table 5.7 - List of Floral Species in the Microenvironment

S. No	Botanical Name	Local Name
Trees and Shrubs		
1.	<i>Capparis aphyla</i>	Kirir

³⁵ Environmental Management Consultants – Environmental Impact Assessment for KEE, 2007

2.	<i>Salvadora oleoides</i>	Khabar
3.	<i>Acacia Senegal</i>	Kunbhat
4.	<i>Prosopis cineraria</i>	Kandi
5.	<i>Prosopis juliflora</i>	Mesquit, devi
6.	<i>Tecoma undulata</i>	Lohiro
7.	<i>Euphorbia caudicifolia</i>	Thuar
8.	<i>Tamarix aphylla</i>	Lai
9.	<i>Ziziphus nummularia</i>	Ber
10.	<i>Cocos nucifera</i>	Nariyal
11.	<i>Eucalyptus Hybrida</i>	Safeda
12.	<i>Conocarpus</i>	Cono
13.	<i>Acacia nilotica</i>	Babur
Grass		
1.	<i>Aristida adscenciones</i>	Lumb
2.	<i>Aristida funiculate</i>	Lumb
3.	<i>Cenchrus biflorus</i>	Bhurt
4.	<i>Cenchrus ciliaris</i>	Dhaman
5.	<i>Chrysopogon aucheri</i>	Putar
6.	<i>Cymbopogon jawarncusa</i>	Poi
7.	<i>Desmostachya bipinnata</i>	Dubh
8.	<i>Dicanthium annulatum</i>	Sheda Grass
9.	<i>Lasiurus indicus</i>	Sain
10.	<i>Lasiurus hirsutus</i>	Sewan Grass



5.2.2.2 Fauna of Project Area

Due to sparse vegetation and increased interventions of humans, 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 5.8 - List of Fauna Species in the Microenvironment

S No.	Scientific name	Common name
Large Mammal		
1.	<i>Canis aureus</i>	Asiatic Jackal
2.	<i>Sus Scrofa</i>	Indian Wild Boar
3.	<i>Felis chaus</i>	Jungle Cat
4.	<i>Manis crassicaudata</i>	Indian Pangolin
5.	<i>Herpestes Javanica</i>	Small Indian Mongoose
Small Mammals		
1.	<i>Funambulus pennant</i>	Palm Squirrel
2.	<i>Ratus norvegicus</i>	Screw Rat
3.	<i>Mus musculus</i>	House Mouse
4.	<i>Tetra Indica</i>	Indian Gebril
5.	<i>Meriones hurrianae</i>	Indian Desert Jird
6.	<i>Gerbillus nanus</i>	Balochistan Gerbil
S. No.	Scientific name	Common name
1.	<i>Milvus migrans</i>	Common Kite
2.	<i>Francolinus francolinus</i>	Black Partridge
3.	<i>Ardeola grayii</i>	Indian Pond Heron
4.	<i>Bubulcus ibis</i>	Cattle Egret
5.	<i>Egretta garzetta</i>	Little Egret

6.	<i>Egretta gularis</i>	Reef Heron
7.	<i>Centropus sinensis</i>	Crow Pheasant
8.	<i>Psittacula krameri</i>	Rose Ringed Parakeet
9.	<i>Galerida cristata</i>	Crested lark
10.	<i>Acridotheres tristis</i>	Indian Myna

5.2.3 Socio-Economic Baseline

5.2.3.1 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 the project.

International best practice for ESIA 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.

5.2.3.2 Macro-environment: District Thatta

5.2.3.2.1 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, Ketu Bunder, Mirpursakro and Thatta. The proposed project is located in Gharo, Mirpursakro Taluka of District Thatta.

5.2.3.2.2 Demography

According to the latest national census of 2023, there are a total of 982,138 people in District Thatta. The district saw an average annual growth of 2.63% between the 2017 and 2023 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 2023 census. Moreover, the dominant rural lifestyle is evident from the fact that nearly 82% of the population resides in rural areas.

Table 5.10 - Population Census Results 2023 - Thatta

Administrative Units		Population 2023				Population 2017	Sex Ratio 2017	2017 - 2023 Average Annual Growth Rate
		Male	Female	Trans-gender	All Sexes			
Thatta District	Total	555,252	527,895	44	1,083,191	982,138	105.18	1.65
	Rural	457,107	432,373	32	889,512	805,662	105.72	1.67
	Urban	98,145	95,522	12	193,679	176,476	102.75	1.57
Source: PBS- 2023 Census Final Results								

5.2.3.2.3 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 Mirpur Sakro Taluka, according to the 2023 census conducted by Pakistan Bureau of Statistics.

Table 5.11 - Gender Wise Population Gharo TC - 2023

Taluka	Gharo TC	Total	Male	Female	Transgender
Mirpur Sakro	Urban	323,404	193,082	25,990	5
	Rural	52,674	166,403	156,981	20
	Total	376,078	49,848	182,971	25
Source: PBS- 2023 Census					

5.2.3.2.4 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 Deewan 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 District Thatta will become an important district with regards to industrial development.

5.2.3.2.5 Education Profile

According to Pakistan Bureau of Statistics 2023 census, the population aged 5 and above is 747,148, with 601,443 being 10 or older. Among those aged 10 and above, only 136,266 are literate, reflecting a literacy rate of 22.65%. School attendance data shows that 151,624 people have attended school, with 35,830 completing primary education. Enrollment numbers drop significantly at higher levels, with 27,055 in primary, 10,183 in middle, 3,386 in matric, 2,358 in intermediate, and only 2,783 in graduation or higher education. Educational exclusion remains a major concern, as 360,466 people have never attended school, including 221,703 children aged 5-16 who have never enrolled and 12,037 who have dropped out. This results in a total of 233,767 out-of-school children in Thatta, indicating substantial barriers to educational access and completion.

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

Table 5.12 - Population Literacy Ratio

District	Total	Male	Female	Transgender
Thatta	26.88	33.89	19.63	16.22
Rural	22.99	29.25	16.29	9.38
Urban	44.20	51.25	36.91	-
Source: PBS- 2023 Final Census Result				

5.2.3.2.6 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 5.13 - 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)

5.2.3.3 Micro Environment

In the micro-environment of the proposed project, the project is located on Gharo-Keti Bunder Highway (N110). Nearby, Amstrong ZE Tyre factory and Nova Foods are located about 1 km away from the project site. The road also holds a newly constructed Satellite Town Gharo, a residential society which is still under construction. The neighborhood also contains coconut orchid farms and agricultural lands owned by private land owners, which hires local farmers.

5.2.3.3.1 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. Agricultural crops mainly grown in the area are cotton, wheat and rice. However, other agricultural activities such as vegetables are also grown. There are also coconut orchids in the project area from where the coconut is taken and sold to vendors in Karachi.

5.2.3.3.2 Social Services

It was observed that there are no education facilities in the surrounding of project area. There is only an eye care facility near the project area. People of these areas suffer huge problems when someone gets sick so the people go to healthcare centers in Gharo city. 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.

	Environmental & Social Impact Assessment		
	MEGA MOTOR COMPANY– ELECTRIC VEHICLE PLANT AT GHARO, SINDH		
	Doc. No.: MMCL/ESIA/001	Rev.: 00	E&S BASELINE

5.2.3.3.3 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 are 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, and people are resorting to Solar Energy to cater their electrical needs. There is no gas connection in the villages so people use firewood for cooking purpose.

5.2.3.3.4 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.

6. Potential Environmental Impacts and Mitigation Measures

This chapter presents the overall risks and impacts (both beneficial and adverse) of construction, and operational phases of the proposed sub-project on the physical, ecological, and socio-economic environment. In addition to this, it also covers the mitigation measures of the identified potential adverse environmental and social impacts.

The Environment & Social (E&S) impacts arising from each phase of the proposed sub-project have been identified and assessed based on field data, secondary data, expert opinions, and examining similar projects. These include effects on physical, biological, and socio-economic environment.

The risk of each E&S impact was assessed using a semi-quantitative analysis. The risk was computed using the formula below:

$$\text{RISK} = \text{MAGNITUDE OF IMPACT} \times \text{SENSITIVITY TO RECEPTORS}$$

a) Impact Magnitude

The potential impacts of the subproject have been categorized as major, moderate, minor, or nominal based on consideration of parameters such as:

- Duration of effect
- Spatial extent of the impact
- Reversibility
- Likelihood
- Legal standards and established professional criteria.

The magnitude of each potential impact for each of the sites has been identified according to the categories outlined in Table 6.1 below:

Table 6.1 - Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Minimal
Duration of potential impact	Long term (beyond the project life)	Medium Term Lifespan of the project (within the project life span)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond next project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Environmental or social parameter needs a year or so with some response to come back to baseline	Baseline returns naturally or with limited response within a few months	Baseline remains constant
Legal standards and established professional criteria.	Breaches national standards and or international	Complies with limits given in national standards but violates	Meets minimum national standard limits	Not applicable

Parameter	Major	Moderate	Minor	Minimal
	guidelines/obligations	international lender guidelines in one or more parameters	or international guidelines	
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions. (Certain)	Happens under worst case (negative consequences) or best case (positive impact) working conditions (Likely)	Occurs under abnormal, exceptional, or emergency conditions (occasional)	Unlikely to happen

b) Receptor Sensitivity

The sensitivity of a receptor has been determined based on a review of the population (including proximity/ numbers/ vulnerability) and the presence of features on the site or the surrounding area. For each potential impact of the subproject at the sites, sensitivity of the receptors was determined using the criteria outlined in Table 6.2.

Table 6.2 - Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very Severe	Vulnerable receptor with little or no ability to absorb proposed changes or minimal opportunities for mitigation.
Severe	Vulnerable receptor with little or no ability to absorb proposed changes or limited opportunities for mitigation.
Mild	Vulnerable receptor with some ability to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good ability to absorb proposed changes or/and excellent opportunities for mitigation

Following the assessment of magnitude, the quality and sensitivity of the receiving environmental or potential receptor has been determined and the significance of each potential impact established using the impact significance criteria matrix as shown below. Most of the potential impacts can be mitigated by implementation of various types of mitigation measures. However, some residual environmental impacts may remain after mitigation.

Table 6.3 - Scale for Sensitivity of Receptors

Magnitude of Impact	Sensitivity of Receptors			
	Very Severe (4)	Severe (3)	Mild (2)	Low (1)
Major (4)	16	12	8	4
Moderate (3)	12	9	6	3
Minor (2)	8	6	4	2
Minimal (1)	4	3	2	1

Score	Impact Significance
1	Negligible
2 – 4	Low
5 – 8	Medium
9 – 12	Substantial
> 12	High

6.1 Risk Assessment

The results of the E&S risk assessment conducted for the development of the subject project are presented below:



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Table 6.4 - E&S Risk Assessment for Project

Environmental and Social Risks and Impact	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
Construction Phase				
Seismic Impact	Medium	The project is planned in area which has seismic rating of Zone 2B.	The construction of the project will adhere to seismic categorization as per relevant zoning regulations. The building materials selected will enhance the load-bearing capacity of the underlying soil.	Low
Air quality	Substantial	The land, previously used for agriculture, will require clearing and preparation to accommodate the proposed project. This process will generate dust emissions. Additionally, the use of equipment and machinery on the site could lead to pollution if appropriate mitigation measures are not implemented.	The contractor will implement a dust abatement program, including measures such as installing enclosures, spraying water, and using personal protective equipment. Materials will be stored and transported properly to prevent dust emissions. Construction traffic will be regulated, and construction equipment will be maintained to minimize exhaust emissions. Additionally, regular monitoring of ambient air quality and emission testing of equipment and machinery will be conducted to monitor and control uncontrolled emissions.	Medium
Noise impact	Medium	Noise during construction can be significant, with sources including construction equipment, machinery, gate installations, welding and cutting, and frame installations. The operation of such equipment is expected to	To mitigate noise pollution, temporary noise barriers and deflectors will be used during impact activities. Construction machinery will be maintained in good condition to reduce noise generation, and the contractor will ensure that machinery is adequately silenced.	Low



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		produce noise levels between 70 and 80 dB(A). All machinery will adhere to relevant local and international noise protection standards. Additionally, the timing and conditions of operation will be coordinated with the appropriate authorities, as needed. The noise and vibration generated during the construction phase will be temporary and limited to a short duration.		
Soil Contamination	Medium	Soil contamination can occur during construction due to chemical spills, oil leaks, and improper disposal of wastewater. These contaminants can hinder plant growth and soil quality. While the impact of soil contamination is generally minor and temporary, it is crucial to implement proper waste management practices to prevent long-term environmental damage.	Material Safety Data Sheets (MSDS) for all chemical additives, reagents, and compounds will be maintained on-site. Any spills will be cleaned, and the site restored to its original condition. Oils, lubricants, chemicals, and hazardous materials will be securely stored in designated areas, protected from rainfall and fire hazards. Septic tanks of appropriate capacity will be constructed for treating wastewater from temporary worksite toilets and offices, ensuring no untreated discharge onto surrounding land. All machinery and materials will be stored in designated areas, and washout from equipment cleaning will be drained into septic tanks or sand-gravel beds to filter contaminants.	Low



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Environmental and Social Risks and Impact	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
Waste management	Medium	Various types of solid waste will be generated, including construction waste such as effluents containing sand, cement, silt, or other suspended or dissolved materials. Chemical waste, such as lubricants and oils, as well as any other waste or refuse, must not be deposited anywhere on-site or on adjacent land.	To minimize environmental impact, products with minimal or no environmental harm will be selected, and waste generation will be reduced by improving practices and design. Materials will be reused to avoid disposal, and strict controls will regulate the storage, labeling, transport, and disposal of chemical wastes like paint residues and lubricants. Construction waste will be sorted on-site into inert and non-inert materials, with non-inert waste like wood, glass, plastics, and metals sent to landfill, while inert materials such as soil and sand will be disposed of separately. Waste-carrying vehicles will have secure coverings, and work areas will be cleaned daily, with general refuse stored in enclosed bins separate from construction or chemical waste. Burning refuse on-site will be prohibited, and reusable dishware will be used in food service areas whenever feasible.	Low
Impact on water resources	Medium	Short-term water extraction for project activities may temporarily reduce groundwater availability for local communities, potentially affecting both the quantity and, indirectly, the quality of water. However, this is not expected to impact the long-term water	Water usage during proposed project activities will be minimized through prudent conservation measures, with records of water consumption maintained by the project proponent. Abstraction from surface water sources will be avoided unless no alternative is available, and prior government approval will be required. If a new water well is installed, it will be located at least 500	Low



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		resources of the area. In this context, "short-term" refers to a period lasting from a few hours to a few days.	meters from existing local wells and will preferably draw from deeper aquifers not used by the community. Water abstracted from local wells will be compensated at market rates, and new wells installed for project activities may also benefit the community. Contamination of surface and groundwater resources will be strictly avoided.	
Occupational health & safety	High	Construction projects involve numerous risks and hazards, including those associated with hazardous substance handling and storage, slip and fall accidents due to poor housekeeping, and the risk of being struck by objects and working at heights. These hazards can lead to serious injuries or fatalities if not properly addressed. It is crucial to implement effective safety measures to mitigate these risks and create a safe working environment for all personnel involved in the project.	To ensure chemical safety, proper handling, storage, and disposal procedures must be followed. Containers should be in good condition, compatible with the contents, and closed when not in use. Flammable liquids must be stored in designated areas, and electrical pumps should not be used for transfers. Toxic and explosive chemicals require specific storage and handling methods. To prevent slips and falls, good housekeeping practices, regular cleanups, and the use of slip-resistant footwear are essential. Traffic management, PPE, and well-maintained lifting devices are crucial for preventing accidents involving vehicles, machinery, and falling objects. To prevent the spread of infectious diseases, comprehensive disinfection, staff screening, and reporting of outbreaks are necessary.	Medium



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Community health & safety	Medium	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.	Access to the site will be restricted through a combination of institutional and administrative controls. 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	Low
Impact on ecology	High	Within project area, there are currently 25 trees, comprising 10 species of Conocarpus, 12 Eucalyptus trees, and 3 Date Palms. Alongside these trees, various shrubs, herbs, and grasses will also be cleared as part of the project activities. This clearing may have implications for local biodiversity and ecosystem services. Therefore, it is essential to consider the ecological impacts of this land alteration and implement measures to mitigate potential negative effects on the surrounding environment	A green buffer zone will be established within the project area to compensate for any trees uprooted during construction, with a compensatory planting ratio of 1:10, utilizing only native species. All new plantings will consist of species well-suited to the local environment, promoting habitat restoration and supporting local wildlife. The health of the newly planted trees will be regularly monitored to ensure successful restoration, with maintenance practices such as watering, weeding, and pest management applied as necessary. Additionally, the construction crew will receive increased awareness training regarding local biological resources, and a strict 'no-hunting, no-trapping, no-harassment' policy will be enforced on-site. Firewood, woody plants, and shrubs will not be used as fuel during construction, and	Medium



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			personnel and vehicle movements will be limited to designated areas, including the construction site, camp, and approved roads	
	Operation Phase			
Impact on water usage	Substantial	Chapter 2 discusses the water requirements and environmental impacts of a manufacturing plant. Water is used for various processes like painting, coating, metalworking, and assembly line cooling. However, this water usage can contaminate water bodies with heavy metals, toxins, and chemicals. The plant must have a water treatment system to manage wastewater and prevent pollution. Additionally, cooling towers and sanitation facilities generate wastewater that also requires proper treatment.	To reduce water consumption and minimize wastewater pollution in manufacturing plants, several strategies can be implemented. These include recycling paint and water, using high-efficiency spray systems, switching to powder coating, installing advanced wastewater treatment systems, implementing zero-liquid discharge, recycling coolants, using dry machining practices, employing biodegradable coolants, utilizing closed-loop washing systems, using biodegradable detergents, considering waterless cleaning techniques, installing efficient cooling systems, recycling treated wastewater, implementing spill prevention measures, using oil-water separators, using modular treatment systems, reusing greywater, and installing composting toilets. By adopting these measures, manufacturing plants can significantly reduce their water footprint and protect the environment	Low



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Air quality impact due to battery production & battery powering	High	The production of electric vehicles (EVs) can have environmental impacts, despite their potential to reduce tailpipe emissions. The extraction of minerals for batteries, application of paints and coatings, and improper waste disposal can release pollutants into the air. Additionally, the electricity used to power EVs can contribute to greenhouse gas emissions if generated from fossil fuels. While battery production is currently more energy-intensive than ICEV production, advancements in battery technology and increased use of renewable energy can mitigate these impacts	The production of electric vehicles (EVs) can have environmental impacts, but these can be mitigated through various strategies. To reduce energy consumption in manufacturing plants, energy-efficient machinery, automation systems, heat recovery systems, and lean production practices can be implemented. Additionally, installing solar panels or other renewable energy systems can reduce reliance on fossil fuels. Battery production can be made more sustainable by using cleaner technologies, recycling raw materials, and exploring new battery technologies. To reduce emissions from paint, coatings, and adhesives, water-based or low-VOC paints, powder coating, and advanced filtration systems can be used. Addressing indirect emissions from electricity use involves advocating for increased renewable energy capacity and implementing sustainable waste management practices. By implementing these measures, the manufacturing of EVs can become more environmentally friendly.	Medium
Indoor Air Quality in body shops and component manufacturing Shop	Substantial	EV assembly plants differ from conventional automotive plants in their use of lightweight materials and specialized joining processes. While welding	Mitigating air pollution in EV assembly plants requires a comprehensive approach that addresses the unique materials and processes involved in EV production. Ventilation systems, fume extraction, HEPA	Medium



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Environmental and Social Risks and Impact	Risk Rating	Description	Mitigation Measure(s)	Residual Risk Rating
with welding and joining operations		remains a common practice, alternative techniques like laser welding and adhesive bonding are gaining prominence. Welding processes can produce fumes, gases, and airborne particles that require proper ventilation and emission control. Battery assembly welding poses specific concerns due to hazardous byproducts and heat management challenges. To mitigate these impacts, it is crucial to implement appropriate safety measures, ventilation systems, and emission controls.	filters, and general ventilation are crucial for capturing harmful emissions. To manage heat, automated cooling systems and thermal shields can be implemented. For adhesive and sealer fumes, proper ventilation, low-VOC materials, and VOC scrubbers are essential. Laser welding requires enclosed stations and fume extraction, while arc welding needs specialized extractors. Personal protective equipment (PPE) is crucial for workers, especially in battery assembly areas. Proper material handling and pre-treatment can reduce fume generation. Air quality monitoring, training, and safety protocols are also essential for ensuring a safe working environment.	
Effluent discharge from paint shop and effluent treatment	Substantial	The effluent contains oils, grease, dyes, chromium, phosphate from the washing products and coloring, and a myriad of volatile dissolved organics, thus tiring the BOD or COD load at varied stages of production.	The effluent should be treated in wastewater treatment plant till tertiary treatment to remove heavy metals.	Low
Solid and hazardous waste	Substantial	Solid wastes may arise from several sources during assembly and the majority of wastes by volume result from	The mitigation measures include recycling packaging wherever possible and developing and implementing a waste	Low



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		packaging - reusable or disposable	management plan covering all aspects of waste treatment on site	
Noise	Medium	The cumulative noise level within the automotive plant is higher as there are several high noise impact activities during the processes of assembly, welding, painting etc.	Mitigation measures include: - 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.	Low
Soil Contamination	Medium	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	To prevent chemical spills and contamination, materials should never be poured directly from drums to small containers. Secondary containment should be provided, and spigots or pumps should be used for transferring waste materials. Avoid handling chemicals with bare hands and wash hands thoroughly after handling them. When working with chemicals that produce fumes or dusts, use a well-ventilated area and containment devices. Avoid eating, drinking, smoking, or lighting matches near flammable chemicals. Use appropriate devices when transferring or mixing chemicals, and maintain clean work surfaces and containers. Use corrosion-resistant tools and equipment to prevent damage and spills.	Low



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Waste stream & Sludge	Substantial	The painting operation generates waste streams in which paints solids are combined with the wastewater from the cleaning operations. Spray-paint booths produce paint-laden air filter which collect overspray. Cleaning and maintenance of the paint spray guns produces hazardous sludge.	Mitigation measures include: - Ensure no wastewater run out from the Paint booth 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 environmentally friendly with the third-party certification.	Low
Surface water & ground water	Substantial	While there are no surface bodies within the project's area of influence (AOI), an agricultural runoff channel run parallel to plant boundary. This channel could potentially receive wastewater from the plant if a wastewater treatment plant is not available. To establish a baseline and monitor potential impacts, environmental samples were collected from both the beginning and end of the plant boundary. There remains a risk of contaminating the agricultural runoff channel, either through intentional discharges from the	To mitigate environmental impacts from wastewater discharge, construct and operate a wastewater treatment plant that meets Sindh Environmental Quality Standards. Ensure proper maintenance and operation of the plant, including regular inspections and monitoring of effluent quality. Develop an emergency response plan and implement a system for regular inspection and maintenance of equipment. Install spill containment measures and adhere to best practices for handling chemicals. Provide training to employees and establish an emergency response team. Ensure the plant has adequate emergency equipment.	Low



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		plant or accidental releases of chemicals or toxic substances.		
Transportation and traffic	Medium	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 National Highway N110. The additional trucks would use the established routes currently in place. 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		Low
Hazardous substance on site	Substantial	Inadequate control or accidental releases of hazardous substances on site or in transit may result in significant environmental impacts in	To ensure safe handling and storage of hazardous chemicals, it is crucial to implement several measures. These include substituting hazardous chemicals with less hazardous alternatives, labeling chemicals	Low



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		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.	appropriately, storing chemicals in a secure facility, preventing spills, monitoring groundwater, managing solvent/hazardous materials, following procedures for transportation, storage, and disposal, preventing fires, responding to spills, protecting workers, and providing training and safety equipment. By adhering to these guidelines, you can significantly reduce the risks associated with handling and storing hazardous chemicals.	
Occupational health & safety aspects	High	The assembly of electric vehicles (EVs) involves the use of hazardous chemicals, which can pose risks of inhalation, skin contact, and ingestion. Noise and vibration from machinery can also lead to health issues like hand-arm vibration syndrome. Additionally, workers face risks of accidents from moving machinery, manual handling injuries, and slips, trips, and falls. Long working hours can contribute to fatigue and decreased well-being	The mitigation measures for hazardous conditions in EV assembly plants include: using personal protective equipment (PPE), conducting regular health monitoring, reducing noise and vibration exposure, training workers on machinery safety, redesigning manual processes, and implementing safety measures to prevent slips, trips, and falls. Additionally, the plants should remove asbestos and PCBs using licensed contractors.	Medium
Transportation of produced vehicle units	Substantial	Moderate increase in vehicular load on M9 and N5 is envisaged which may lead to increased traffic congestion. There are	To mitigate the impacts of increased vehicular load on highways, several measures can be implemented. Route planning and scheduling can help avoid	Low



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		also risk of accidents, including rear-end collisions, lane changes, and head-on crashes. During inclement weather, such as rain or fog (especially in winter), which may impair visibility and traction, leading to an increased risk of accidents involving heavy vehicle.	peak traffic hours and reduce congestion. Enforcing weight limits for trucks and trailers can prevent overloading and minimize road wear. Training drivers in defensive driving techniques and accident prevention strategies can improve road safety. Regular safety inspections of transport vehicles can ensure they are in good working condition. Implementing strict policies regarding working hours and rest breaks can prevent fatigue-related accidents. By implementing these measures, the negative impacts of increased vehicular load on highways can be significantly reduced.	
Socio-economic impact	Positive impact	The Proposed Project would result in hundreds of new jobs during the construction and even when the plant is fully operational. For semi-skilled and non-skilled job, locals will be preferred which will result in positive socio-economic impact. 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. Mega motos will have a real impact on employment opportunities and will generate direct employment as well as will create multiple indirect jobs in downstream industries.		



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6.2 Screening of Impacts during the Construction Phase

The activities during construction phase generally comprise site preparedness, civil works, mechanical installations, electrical work etc. Proposed assembly 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

6.2.1 Seismic Impact

According to Building Code of Pakistan, Seismic Provision 2007, the study area lies in Zone 2A which presents a low seismic hazard potential for earthquake activity. Therefore the risk rating for the project is low.

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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.2.2 Impacts on Air Quality

Site preparation activities involve excavation, earth and fill movement, concrete foundations, 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 (NO_x), Carbon Monoxide (CO) and Hydrocarbons.

A marginal increase in the levels of oxides of nitrogen, carbon monoxide and hydrocarbons are 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



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movement of trucks bringing in construction materials is therefore not expected to create significant dust nuisance.

The predominant wind direction in winter is north east whereas in summer it is south west. There are few settlements within the AOI but at a distance of more than 500 m. 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.



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- 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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be medium adverse.

6.2.3 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 6.5 - 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 well maintained.
- Implement an equipment maintenance program to ensure regular upkeep of all machinery according to a scheduled plan.

Residual Impacts

- With the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

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6.2.4 Soil Contamination

Soil contamination can occur due to spilling of chemicals during construction or during transportation from one container to another. During the construction phase, contamination of soil is primarily due to spillage of oil and materials dissolved and transported through water at the construction site.

Leakages of oils, lubricants, chemicals, and other similar substances from their storage sites and from engines of the generators, machines, equipment, and vehicles can spoil the receiving soils and may undermine ability of the spoiled soils to support growth of vegetation and plants; further contaminate the soil.

Non-provision of septic tanks with the temporary worksite toilets, constructed for the labour and others, effluent can contaminate the receiving soils because of raw nature of the effluents. Also washing of the gadgets, machinery, and equipment without proper drainage of the washout water can adversely affect the soil quality. This impact is, however, temporary, and minor negative in nature.

Mitigation Measures

- Material Safety Data Sheets (MSDS) for purchased chemical additives, reagents and compounds will be kept at the work site.
- All spills to be cleaned and removed from the site, where the site will be restored back to its original conditions.
- Oils, lubricants, chemicals, and other listed hazardous materials should be stored safely at designated spots, enclosures, or storerooms, which should be safe from rainfall and away from any potential source of fire.
- Septic tanks of adequate capacities should be constructed for receiving and treating wastewater from all temporary worksite toilets and at the temporary container offices, if any. The toilet wastewater should not be discharged untreated onto the adjacent lands.
- All machineries and materials should be stored at the designated areas and compounds.
- Washout from washing of equipment and gadgets should be drained into either a septic tank or a sand-gravel bed for removal of the grit and contaminants.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.2.5 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.



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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 paint 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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.2.6 Impact on Water Availability

The extraction of water for project activities can affect groundwater availability in the short term, which implies that the groundwater immediately available to the communities may fall. This should not however, affect the long-term availability of the area's water resources. Short-term water extraction may affect the quantity and, indirectly, the quality of water available to local communities. In this discussion, 'short-term' refers to a time period ranging from a few hours to a few days.

Mitigation measures

- The quantity of water used during proposed project activities will be kept to the minimum required by taking prudent water conservation measures on site. A complete record of water consumption will be maintained by project proponent.
- Avoid abstraction of water from surface water resources. If there is no other source of water available, then for abstraction of water from surface water body, prior approval from relevant government department.
- If a new water well is to be installed for project activities, the well should not be located with 500 meters from existing local wells and will be designed to abstract water preferably from a deeper aquifer not being used by local communities.
- For all water obtained from local wells, the owner will be paid for water abstracted at the market rate.
- The use of new wells installed or to be installed by project proponent for community benefits will be allowed.

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- The quantity of water used during construction phase of project will be kept to the minimum required by taking prudent water conservation measures on site.
- Contamination of surface and groundwater resources will be avoided.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.2.7 Impact on Water Resources

A. Ground water

Automotive 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 vehicle 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.

Residual Impacts

- With the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.2.8 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



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- 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.



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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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be medium adverse.



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6.2.9 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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.2.10 Impacts on Ecology

The project site, covering an area of 73.59 acres, is predominantly vacant land that was formerly utilized for agricultural purposes. Within this area, there are currently 25 trees, comprising 10



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species of Conocarpus, 12 Eucalyptus trees, and 3 Date Palms. Alongside these trees, various shrubs, herbs, and grasses will also be cleared as part of the project activities. This clearing may have implications for local biodiversity and ecosystem services. Therefore, it is essential to consider the ecological impacts of this land alteration and implement measures to mitigate potential negative effects on the surrounding environment.

Mitigation Measures

- Within the project area, create a green buffer zone, to compensate for any trees that are uprooted during the project, a 1:10 ratio of compensatory plantation will be implemented. Only native species will be selected for planting in the green belt.
- Ensure that all new plantings consist of native species that are well-adapted to the local environment, promoting habitat restoration and supporting local wildlife.
- Regularly monitor the health of newly planted trees to ensure the success of restoration efforts. Maintenance practices such as watering, weeding, and pest management should be implemented as needed.
- 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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be Substantial adverse.

6.3 Screening of Potential Impacts during Operation Phase

6.3.1 Impact on Water Usage

Chapter 2 outlined technical details on the water requirement during the production process and other general sanitation and maintenance measures. Major processing areas requiring water supply during operation include painting, coating, metalworking, and component manufacturing, assembly line cooling, hydraulics, and the heating, ventilation, and air conditioning system. Apart from that, water is also to be used for basic sanitation, washrooms, kitchens, and friendly staff facilities in the plant.

To some extent, this usage of water will have environmental impact-the all-encompassing considerations of water life cycle streams from treatment to discharge. Wastewater from the painting and coating operation contains heavy metals and toxins that will need an entire plant's water treatment. In the same vein, the water-based cooler used in metalworking and component manufacturing will bear chemicals and metal particulates. Water required for assembly line cooling and hydraulics has considerable water waste discharge; and, should harm accidents occur, hydraulic fluid or oils, whose disposal raises potential contamination risks, may leak into water bodies.

Cooling towers may harbor Legionella bacteria, posing health concerns due to contamination through water. Moreover, cooling water-dispensing chemicals to prevent scale, corrosion, or biological growth-will end up contaminating waters if not properly managed and treated. Finally,



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nursing homes will generate sewage and wastewater from sanitation effluent for which due treatment is also necessary.

Mitigation measures

- Paint recycling systems should be set up that will collect and reuse excess paint and water accrued during the course of the painting process. The effect of this is the great reduction in the volume of water and paint wastage needing treatment.
- High-efficiency, low-pressure spray systems should be used to limit paint overspray to that more cleaning flush with water is required.
- Powder coating: When feasible, switch to powder coating technology instead of water-based paints. It avoids water for application and cleaning, which substantially reduces water demand.
- Install advanced wastewater treatment systems, like reverse osmosis and chemical precipitation, which will remove heavy metals, VOCs, and other toxic chemicals off rinse water before discharge.
- Implement a zero-liquid discharge system, which captures all wastewater and treats it by reuse within the plant, thus minimizing wastewater released to the environment.
- Install coolant recycling systems that filter and reuse water-based coolants in metalworking, thus reducing both the consumption of makeup water and wastewater.
- Establish dry machining practices as much as possible, which will eliminate the need for coolants. This method employs advanced cutting tools, designed to withstand higher temperatures, thereby minimizing water and chemical use.
- Biodegradable and non-toxic coolants should be used to reduce the environmental impacts when water is necessary within metalworking operations.
- Closed-loop washing systems continuously cleaning and filtering the wash water will enable reuse, hence reducing overall water consumption.
- Switching to biodegradable and eco-friendly detergents in the washing process would reduce the chemical load in the wastewater.
- Whenever possible, apply waterless cleaning techniques, such as ultrasonic or vapor degreasing, which can reduce or eliminate the requirement for water.
- For cooling, few systems consume much water with evaporative cooling methods or have some form of cooling with minimal water consumption. This can be very advantageous for cooling applications where water is now used.
- Install cooling towers with drift eliminators, water treatment systems, and energy-efficient pumps. This will minimize evaporation and enhance efficiency.
- Water treatment systems could be installed to allow water recycling into hydraulic systems and conveyors to minimize freshwater extraction.
- Comprehensive spill prevention measures and constant maintenance of hydraulic systems should be put into place to avoid oil or hydraulic fluid leaks that might allow for water sources to be contaminated.
- Oil-water separators should be installed in runoff systems to capture and treat any accidental leaks before they reach the wastewater stream.
- Modular and scalable treatment systems are to be used which can be suited to the requirements of chemical precipitation, biological treatment, and membrane filtration of varying processes upon meeting the need of different processes as they shall be carried out.
- Treated wastewater for non-potable applications could partly replace freshwater requirements for landscaping, cooling, and floor cleaning, thereby conserving freshwater use.
- Real-time monitoring of effluent quality is going to be put into place for regulatory compliance purposes and adjustments over treatment methods. Thereby, this will obstruct pollution of usable water sources by other harmful pollutants.



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- Any sludge generated in water treatment should be safely disposed of for the environment, therefore converting that sludge into useful byproducts (such as compost) or further treating and neutralizing hazardous waste components.
- Research on energy or other reuse of resources converted from sludge, such as anaerobic digestion or incineration, should be explored.
- The closed-loop HVAC systems will be installed to minimize water consumption in cooling towers, especially in water-scarce areas. This recirculation of cooling water reduces water loss from evaporation.
- They may be installed to minimize water consumption in cooling towers, especially in water-scarce areas. Modular and scalable treatment systems are to be used which can be suited to the requirements of chemical precipitation, biological treatment, and membrane filtration of varying processes upon meeting the need of different processes as they shall be carried out.
- Treat and reuse greywater from sinks and showers for flushing toilets or landscaping purposes. This will reduce the demand for fresh water.
- Where feasible, consider installing composting toilets that require little to no water, further reducing the plant's water footprint.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.2 Impact on Air Quality due to Battery Production & Battery Powering

While electric vehicles (EVs) are a significant step towards reducing tailpipe emissions, the production process itself can contribute to air pollution. Electric vehicle assembly plants are often touted as environmentally friendly alternatives to traditional automotive manufacturing facilities. However, their operations can still have significant impacts on air quality, particularly during certain stages of the manufacturing process such as the extraction of mineral for battery manufacturing, application of paints, coatings, and adhesives in the EV assembly process can release Volatile Organic Compounds (VOCs) into the air. These compounds can contribute to smog formation and respiratory problems.

Similarly, improper handling and disposal of manufacturing waste, such as battery scrap and paint sludge, can lead to the release of Particulate Matter (PM) into the air. PM can cause respiratory problems and contribute to overall air pollution. While EVs themselves reduce tailpipe emissions, the electricity used to power them must be generated. If the electricity comes from fossil fuel-powered power plants, the manufacturing process could contribute to indirect greenhouse gas emissions.

EV assembly plants, like all manufacturing facilities, consume significant amounts of energy. However, the specific energy requirements for EV production can differ from conventional Internal Combustion Engine Vehicles (ICEV) vehicles, particularly because of the need to produce large lithium-ion batteries. Many Life Cycle Analysis (LCAs) of Battery Engine Vehicle (BEV) technologies find that battery production is potentially responsible for the largest proportion of energy use and subsequent environmental effects that occur during the manufacturing stage. Estimates range between 10% to 75% of manufacturing energy and 10% to 70% of manufacturing GHG emissions, depending on the approach taken and the electricity generation source (e.g., coal-

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fired, natural gas-fired, or renewable)³⁶. As for other BEV components, LCAs estimate contributions from the electric motor production to be 7% to 8% of total production-related emissions (including raw material extraction and processing) due to a high copper and aluminum content; and from the power train production to be 16% to 18% due to a high aluminum content³⁷. When comparing the GHG emissions from the production of BEVs and ICEVs (including those emissions from raw material extraction and processing), LCA practitioners generally find the impact of BEV production is greater than that of ICEV production. When GHG emissions of similarly sized BEVs and ICEVs are compared in the production phase, the GHG emissions of BEV production are commonly estimated to be between 1.3 and 2 times those of ICEV production³⁸. This is largely due to the energy-intensive process of battery manufacturing and the current mix of sources for electricity generation in the manufacturing sector.

Material Use and Mining Impacts of Battery Production

EV batteries contain come combination of lithium, cobalt and nickel. The mining and extraction of these material has high environmental cost, a factor that inevitably makes the EV manufacturing process more energy intensive than that of an ICEV. The environmental impact of battery production comes from the toxic fumes released during the mining process and the water-intensive nature of the activity. The assembly of EVs, particularly the batteries, requires substantial amounts of raw materials such as lithium, cobalt, and nickel. The extraction of these materials can have serious environmental impacts.

However, Concerns about lithium-ion batteries may be short-lived, as battery technology is advancing quickly, and EV battery components may be very different in the near future. Companies are investing enormous resources in the development of new battery technologies, including solid state batteries, sodium ion, iron air and silicon anode and other materials.

Impact due to Battery Powering

In addition to environmental impacts of battery manufacturing, powering batteries also contributes to environmental degradation, especially in developing economies like Pakistan. This is because the source of electricity used to power them determines how eco-friendly an EV really is. As per report issued by Finance division, Government of Pakistan, as of the end of March 2024, the country's total installed electricity capacity stands at 42,131 MW. The percentage shares of hydel, nuclear, renewable, and thermal are 25.4 percent, 8.4 percent, 6.8 percent, and 59.4 percent, respectively, whereas the share of thermal power as a dominant source of electricity supply has declined over the past few years. To ensure emission-free mobility, renewable sources of power are required to power batteries, however, currently it only accounts for 6.8% in Pakistan.

Mitigation Measures

Mitigating the air pollution and environmental impacts associated with the manufacturing of electric vehicles (EVs) requires a multi-faceted approach, addressing the sources of emissions at different stages of the production process. The mitigation measures should focus on reducing direct emissions from the manufacturing plant, minimizing the impact of battery production, and ensuring

³⁶ A. Nordelöf, M. Messagie, A. Tillman, M. L. Söderman, J. Van Mierlo, “Environmental Impacts of Hybrid, Plug-In Hybrid, and Battery Electric Vehicles—What Can We Learn from Life Cycle Assessment?” International Journal of Life Cycle Assessment, vol. 19 (2014), pp. 1866–1890; R. Nealer and T. Hendrickson, “Review of Recent Lifecycle Assessments of Energy and Greenhouse Gas Emissions for Electric Vehicles,” Current Sustainable/ Renewable Energy Reports, vol. 2 (2015), pp. 66-73; and EEA Report No. 13/2018, p. 24.

³⁷ Hawkins et al., 2013; and EEA Report No. 13/2018, pp. 24-27.

³⁸ Ellingsen et al., 2018; Kim et al., 2016; and EEA Report No. 13/2018, pp. 24-27



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cleaner energy sources for EV operation, especially in countries like Pakistan where renewable energy capacity is limited. Below are detailed mitigation strategies:

Energy Efficiency in Manufacturing

- Energy efficient machinery and production processes should be used in order to reduce the realistic demand of energy in EV manufacturing plants.
- New technologies and automation systems have dramatically reduced energy consumption during vehicle assembly.
- Implementing heat recovery systems to reuse energy lost by industrial processes for heating or electric generation in plants can reduce the need for external energy sources (if possible).
- Lean production is the business management approach of production process with the ideology of minimum waste and minimum use of energy for production. It involves re-engineering work processes to eliminate non-productive times and improve workflows.
- Install solar panels or other renewable energy systems in plants to reduce reliance on fossil fuels and GHG emissions. For instance, a portion of a plant's electricity can be supplied by rooftop solar arrays.
- Incorporation of energy storage systems, such as batteries, can help buffer demand when there is limited solar or wind generation.
- Battery production is one of the stages of manufacture of EVs with the highest impact in energy use and environmental influence. Cleaner technologies and better recycling regimes must now be employed to mitigate these effects.
- Working with suppliers employing sustainable mining techniques can help reduce their impacts on the environment. Sustainable practices are those in which measures and technologies are applied to reduce water use, increased habitat destruction, and decrease toxic emissions from mining operations.
- When possible, utilize recycled raw materials—such as recycled lithium, cobalt, and nickel—in the process of battery manufacture to further diminish the demand for virgin materials.
- Battery recycling mitigates the impact of mining on the environment and lessens the air pollution caused by smelting and extraction processes.
- Explore the development of batteries that require less energy for production and less toxic materials can greatly minimize the environmental footprint of EV manufacturing.

Battery Recycling and Reuse

- Closed-loop recycling systems that recover valuable metals from used batteries and reintroduce them into the manufacturing process can suppress emissions from raw material extraction and cut down waste.
- Old EV batteries can be refurbished for energy storage in renewable energy systems before going through the recycling process. This prolongs battery life and reduces the need to manufacture new batteries.

Reducing VOCs and Particulate Matter (PM) Emissions

VOCs and PMs emissions from paint, coatings, and adhesives used in the assembly of EVs can be mitigated through the following strategies:

- The assembly process involves the application of water-based paints or low-VOC paints, adhesives with a view to reducing the release of VOCs that contribute not only to the formation of smog but also adversely affect the respiratory system.

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- Powder coating uses a dry powder applied to surfaces and baked on. Solvents that emit VOCs are not used in this process, making it environmentally friendly, reducing waste and lowering pollution levels.

Improved Ventilation and Emission Control Systems

- Using state-of-the-art filtration such as high-efficiency particulate air (HEPA) filters and activated carbon filters in industrial facilities such as manufacturing plants can capture VOCs and particulates before they are released to the environment.
- Closed-loop systems within paint booths and coating processes are used to capture emissions.

Addressing Indirect Emissions from Electricity Use

In countries like Pakistan, where the majority of electricity is still generated from fossil fuels, the environmental benefits of EVs can be undermined by the carbon intensity of the grid. To address this:

- Engage with policymakers to advocate for increasing the share of renewable energy in the national energy mix. Subsidies and incentives for renewable energy projects from government can accelerate the transition to cleaner energy sources.

Sustainable Waste Management

Improper handling of manufacturing waste, including battery scrap, paint sludge, and chemical waste, can lead to the release of harmful pollutants.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be medium adverse.

6.3.3 Indoor Air Quality in Body Shops and Component Manufacturing Shops with Welding and Joining Operations

EV assembly plants incorporate much that is similar to conventional automotive plants, but they differ through processes built more on lightweight materials, such as aluminum and composites. In welding processes, thinner materials such as aluminum alloys are often much better represented in construction, such as lightweight structures aimed at better efficiency in EVs. Additional, battery adhesions are subjected to specialized joining procedures as well.

Resistance spot welding and seam welding can also be considered conventional in EV manufacturing of bodywork with traditional assembly plants. Conventional manufacturing is more proficient in using aluminum alloys and composite materials than steel for making body parts for EVs, therefore producing inherently different fumes and environmental contaminants. The low melting points of aluminum increase the potential for ejected materials and fumes, particularly in high-volume operations.

In the assembly of EV, welding processes also often use adhesives and sealers, especially around battery enclosures and electric motor components that may decompose on exposure to welding heat, which further fascinates the discussion of poor indoor air quality.

Among leading airborne contaminants produced by welding processes in EV body shops are:

- Fumes and gases from welding aluminum alloys.



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- Burning sealants and adhesives used during battery casings and vehicle panel assemblies.
- Airborne particles from grinding down, polishing aluminum and composite materials.
- Airborne emissions from welding thin aluminum panels with automated robots, generally represented in EV.

While traditional arc welding still has its place in fabricating some structural components in EVs, alternative practices such as laser welding and adhesive bonding are gaining supremacy along with a continued need become weight-reduction oriented on precision-engineered lightweight materials.

Other than conventional resistance welding, the manufacture of other weighty elements in electric vehicles might occur through laser welding, among other means, to join battery modules or even battery cells forming other unique harmful experiences, such as burning active metallic materials upon material interaction.

Specific Concerns in EV Manufacturing

Battery Assembly Emissions

Fumes from battery assembly welding may contain hazardous byproducts of any oily substances from the electrolyte compound that must be managed with suitable room ventilation; used in battery casing, adhesives and sealants, on heating during a joining process, liberate volatile organic compounds.

Heat Management

Resistance welding and other high-temperature joining processes, laser welding for instance, will create heat that may be felt in the shop environment-since the materials are very light-weight (such as aluminum), the heat acquired by them may be far less than similar processes on traditional steel sections. Welding of battery packs generates huge heat, particularly for copper and aluminum, requiring special heat-management through cooling systems.

Ventilation Requirements

Welding on aluminum alloys produces fumes of aluminum oxide, entirely different from the iron oxide that accompanies steel welding.

Laser welding in EV production creates minimal fumes relative to arc welding but still requires adequate ventilation because of particulate emissions from the base metals.

Fume and Heat from Battery Component Welding

Consistent safety measures should be taken due to the difficulties surrounding the welding of battery parts involving temperature-sensitive material with additional concerns about a possible exposure to hazardous gases such as hydrogen fluoride, emanating from the electrolyte compound.

Mitigation Measures

For EV assembly plants, stepping inside air quality control, especially in body shops and component manufacturing shops that involve welding and joining operations, shall consist of broad-spectrum interdisciplinarity supplemented with a thorough understanding of materials involved and processes of EV production. Below are a list of mitigation measures duly tailored to the specific processes involved in EV manufacturing, for example, working with aluminum alloys, battery pack assembly, and welding technologies.

Ventilation Systems



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- Install advanced local exhaust ventilation (LEV) systems to capture fumes, gases, and particulates at the source, which, depending on the location of the ventilator system, keeps these gases from diffusing onto the workers working near the welding zones, especially where aluminum welding occurs, to effectively filter out aluminum oxide fumes and airborne metal particles.
- Dedicated extraction systems would be installed near the battery pack assembly lines where laser welding or thermal joining is used. This will prevent the escape of hazardous electrolyte vapors or volatile organic compounds (VOCs) from adhesives and sealants applied to battery casing.
- Use HEPA-filters to capture ultrafine particulates and laser welding operations producer ultrafine particles, many of which, in fact, are submicron.
- There shall also be a general ventilation setup to contain the dilution of residual contaminants that may not be collected by the LEV system, especially in the vicinity of excessively high rates of work with welding, grinding, and polishing.

Fume Extraction for Aluminum Welding-

- As the process of welding aluminum alloys generates fine particles and aluminum oxide fume, the installation of specialized fume extraction systems focusing on high capture efficiency will be carried out in order to gain better control over these emissions.
- Install real-time fume monitoring systems to assess the concentration of harmful gases (e.g., ozone, nitrogen oxides) and make any necessary adjustments to ventilation rates.
- Down-Draft Tables in the areas where manual welding is taking place for the purpose of pulling the fumes away from the breathing zone of operators working lighter weight aluminum or composite pieces.
- For EV assembly plants, mitigating indoor air quality issues, especially in body shops and component manufacturing shops with welding and joining operations, requires a comprehensive approach that addresses the unique materials and processes involved in EV production. Below are detailed mitigation measures tailored to the specific processes used in EV manufacturing, such as working with aluminum alloys, battery assembly, and welding technologies.

Heat and Temperature Management

- Since resistance welding and laser welding of aluminum and battery-related components generate heat, automated cooling systems (like chilled water systems) should be integrated into the production line to reduce heat build-up. These systems should provide effective cooling without introducing additional contaminants or moisture into the shop environment.
- For welding near temperature-sensitive areas (such as battery packs), implement thermal shields and barriers to prevent excessive heat transfer to nearby sensitive components and workstations.

Mitigation of Adhesive and Sealer Fumes

- When welding around battery casings or structural components that use adhesives and sealers, ensure the plant has proper ventilation to capture VOCs, which are released when adhesives decompose under high temperatures. VOC scrubbers or dedicated exhaust hoods should be used near these workstations.
- Select low-VOC adhesives and thermal-resistant sealants to minimize harmful fume generation during the welding process.

Laser Welding and Arc Welding Mitigations



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- Install enclosed laser welding stations with fume extraction systems capable of removing fine particulates and harmful gases. The use of particulate filters in conjunction with vacuum systems will prevent harmful particles from spreading to other parts of the shop.
- For arc welding (used in structural EV components), use specially designed extractors that focus on capturing welding fumes, which contain nickel, chromium, copper, and other alloying elements. This minimizes the spread of harmful contaminants across the shop.

Personal Protective Equipment (PPE)

- Workers involved in manual welding operations, particularly around battery casings or other sensitive areas, should be equipped with PAPRs to protect them from fumes, gases, and particulate matter.
- Full-Face Welding Masks with air supply units to ensure complete protection from aluminum oxide and other harmful fumes emitted during welding processes.

Material Handling and Pre-Treatment

- Before welding, surfaces should be cleaned to remove oil films and lubricants, which can generate more fumes during welding. This minimizes the potential for increased fume generation and harmful by-products.
- Utilize robotic arms and automated fixtures to limit direct human exposure to harmful fumes during material handling, welding, or adhesive application in sensitive areas like battery compartments or lightweight aluminum panels.

Air Quality Monitoring

- Conduct periodic air quality assessments, especially in battery assembly areas and aluminum welding zones, to ensure that exposure limits for chemicals like ozone, nitrogen oxides, and volatile fumes remain within acceptable limits.

Work Practices and Engineering Controls

- Optimize welding processes (e.g., using low-heat welding techniques) to reduce the production of fumes and contaminants. For example, using laser welding over traditional arc welding where feasible to reduce emissions.
- Create enclosed welding booths for high-contaminant-generating processes like battery welding and aluminum panel welding to isolate them from other workers in the shop.

Training and Safety Protocols

- Train workers to recognize the hazards of aluminum oxide, VOCs, and battery fumes. They should be familiar with the proper use of ventilation systems and PPE, and know how to identify signs of exposure.
- Implement and regularly update protocols for handling exposure incidents, especially in battery assembly areas where unique hazards like electrolyte leaks or battery pack fires may occur.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be medium adverse.

6.3.4 Effluent Discharge from Paint Shop and Effluent Treatment



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The effluent contains oils, grease, dyes, chromium, phosphate from the washing products and coloring, and a myriad of volatile dissolved organics, thus tiring the BOD or COD load at varied stages of production.

The preliminary cleaning and coating process historically utilized various metals such as chromium and nickel to create finish coats historically, on objects possessing chrome bumpers. These are coatings applied by plating process which sometimes consists of various baths where the parts used are immersed. The metal plating plants tend to be a major troubling source of toxicity. Chlorinated hydrocarbons may be released from the precleaning or degreasing of metal parts, and from the actual electroplating process caustic mists, cyanides, and metals are emitted. Of particular concern is hexavalent chromium, classified as a carcinogen, in relation to its exposure of workers and the public.

Effluent Treatment involves a complex act demanding a project-specific design. Most plants do not have an option to discharge their effluents into the municipal system without treatment. Therefore, the treatment of effluents generated would be inevitable in consideration of the laws laid down by provincial and national standards.

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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.



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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 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, 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.



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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

Paint sludge will be disposed through SEPA certified contractor.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.5 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.

Other solid wastes include:

- Scrap metal from the press shop, which is normally recycled off-site.
- Metal-rich dust generated by the abrasive disc smoothing of welds and soldered joints.
- Sludge generated by wastewater treatment facilities of equipped vehicle 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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.6 Noise

The cumulative noise level within the automotive plant is higher as there are several high noise impact activities during the processes of assembly, welding, painting etc.

Mitigation Measures

- Noise control devices will be used such as noise barriers and deflectors for high noise impact activities.



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- Ensure the strict compliance of Personal Protective Equipment (Ear muff, ear plugs, etc.) in high noise areas.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.7 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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.8 Waste Stream & Sludge

The painting operation generates waste streams in which paints solids are combined with the wastewater from the cleaning operations. Spray-paint booths produce paint-laden air filter which collect overspray. Cleaning and maintenance of the paint spray guns produces of hazardous sludge.

Mitigation Measures

- Ensure no wastewater run out from the Paint booth 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 environmentally friendly with the third-party certification.



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Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.9 Surface Water and Groundwater

While there are no surface bodies within the project's area of influence (AOI), an agricultural runoff channel run parallel to plant boundary. This channel could potentially receive wastewater from the plant if a wastewater treatment plant is not available.

To establish a baseline and monitor potential impacts, environmental samples were collected from both the beginning and end of the plant boundary. There remains a risk of contaminating the agricultural runoff channel, either through intentional discharges from the plant or accidental releases of chemicals or toxic substances.

Mitigation Measures

- Construct and operate a wastewater treatment plant to treat the plant's effluent before discharging it into the runoff channel. The treatment plant should be designed to remove pollutants such as organic matter, suspended solids, heavy metals, and other contaminants up to the limits specified in Sindh Environmental Quality Standards.
- Ensure proper maintenance and operation of the wastewater treatment plant, including regular cleaning, inspections, and monitoring of effluent quality.
- Develop and implement an emergency response plan to address accidental spills or leaks of hazardous substances.
- Implement a system for regular inspection and maintenance of pipes, valves, and other equipment to detect and repair leaks promptly.
- Install spill containment measures, such as berms or secondary containment structures, to prevent accidental releases of chemicals or toxic substances.
- Adhere to best practices for handling and storing chemicals and other hazardous materials to minimize the risk of spills.
- Provide training to employees on proper handling and disposal of chemicals and waste materials.
- Establish an emergency response team to handle spills or other emergencies.
- Ensure that the plant has adequate emergency equipment, such as spill kits, protective gear, and communication devices.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.10 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 National Highway N110. The additional trucks would use the established routes currently in place.



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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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.11 Possible Impacts due to Hazardous Substances on Site

Hazardous chemicals and process gases may be used in the assembly process of motor vehicles. 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.
- Consider feasibility of substitution of hazardous chemicals such as solvent based paints with less hazardous alternatives. Label chemicals with appropriate, internationally recognized, hazard symbols.
- 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 paint chemical 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.



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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



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- 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



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- 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.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be medium adverse.

6.3.12 Occupational Health and Safety Aspects

Hazardous chemicals and process gases may be used in the assembly process of motor vehicles. 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

EV assembly involves the use of hazardous chemicals, especially during the application of coatings, adhesives, and surface treatments. The risks related to inhalation, skin contact, or accidental ingestion of chemicals like organic solvents, coating powders, and curing agents are similar to traditional vehicle assembly. These chemicals can cause skin and eye irritation, respiratory issues, or even chronic conditions with prolonged exposure.

Noise and Vibration

EV assembly plants can be noisy, particularly in areas where heavy machinery and conveyor systems are used. Although EV motors themselves may operate more quietly than combustion engines, the assembly process for batteries and electric drivetrains still involves machinery that can generate high noise levels.

Hand-arm vibration syndrome from the use of power tools during assembly processes is also a concern. Workers who frequently operate vibrating tools may experience symptoms like "vibration white finger" (VWF) and nerve damage

Machinery

Just like in traditional vehicle assembly, the EV plant involves machinery with moving parts that can cause entanglement, entrapment, or cuts. Metalworking processes (e.g., cutting, welding) and handling metal parts during assembly introduce risks from sharp edges and heavy components. Battery pack installation involves handling large, heavy units, which adds to the risks of machinery accidents.



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

Mitigation Measures

Chemical exposure

- **PPE & Training:** PPE is critical in handling chemicals used in EV production, such as adhesives, coatings, and battery-related substances. Workers should be trained in using PPE, including gloves, goggles, and respirators.
- **Routine Monitoring:** Regular health assessments for workers exposed to hazardous chemicals (e.g., solvents or battery materials) ensure early detection of potential chronic health effects. This is particularly important in areas like battery production, where workers may be exposed to toxic or corrosive materials.

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 Falls

- 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 Hazardous waste licensed contractors. This should be carried out in controlled conditions to ensure that there is no release of substances or materials to the environment.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be medium adverse.

6.3.13 Transportation of Produced Vehicle Units

Vehicles after the final assembly and testing will be shipped to regional distribution units, spread across the country, mainly through National highway N 5 and M-9 Motorway in heavy duty trucks or trailers, such as shown in figure below:



Figure 6.1 - Typical EV Transportation Truck

With Inland transportation of vehicles, several impacts arise;

Moderate increase in vehicular load on M9 and N5 is envisaged which may lead to increased traffic congestion. There are also risk of accidents, including rear-end collisions, lane changes, and head-on crashes. During inclement weather, such as rain or fog (especially in winter), which may impair visibility and traction, leading to an increased risk of accidents involving heavy vehicle.



Figure 6.2 - Typical Automobile Transporter Accidents

Mitigation Measures

- Route planning and scheduling to avoid peak traffic hours and reduce congestion on highway.
- Strict enforcement of weight limits for trucks and trailers to avoid overloading and reduce road wear.
- Train drivers in defensive driving techniques and accident prevention strategies, particularly for handling large, heavy loads.
- Conduct regular safety inspections of transport vehicles to ensure they are in good working condition, especially focusing on brakes, lights, and tires.
- Implement strict policies regarding working hours and mandatory rest breaks for drivers to prevent fatigue-related accident.

Residual Impacts

- Through the implementation of the above mitigation measures, the residual impact is likely to be low adverse.

6.3.14 Socioeconomic Impacts

The Proposed Project would result in hundreds of new jobs during the construction and even when the plant is fully operational. For semi-skilled and non-skilled job, locals will be preferred which will result in positive socio-economic impact.

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. Mega motos will have a real impact on employment opportunities and will generate direct employment as well as will create multiple indirect jobs in downstream industries.

7. 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 assessment. Local communities, their representatives, government departments, national and international NGOs and the civil society at large may all be 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 ESIA 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 ESIA study.

7.1 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:

1. **Local People/Neighbourhood:** 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.
2. **Proponents:** The main aim of the project proponent “Mega Motor Company 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 to achieve the project objectives. Therefore, the proponent has to 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.
3. **Government Agencies:** The government agencies involved in the ESIA 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 ESIA review, the most important concern for Sindh Environment Protection Agency (SEPA) is a transparent public consultation process and a strong stakeholder engagement plan that can address the concerns and suggestions of all stakeholders.
4. **NGOs/Interest groups:** Comments from NGOs and specific interest groups often provide a useful policy perspective on the project’s methodology and implementation mechanisms. For example, due to the vast exposure of certain NGOs and interest groups, alternative measures for reaching the project goals may be advised that is more environmentally friendly and socially acceptable.

7.2 Primary and Secondary Stakeholders

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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.

7.3 Consultations

At the time of the consultations, stakeholders were informed of the proposed project to construct an automotive assembly plant dedicated to electric vehicles (EVs) in Gharo, Sindh, as part of a joint venture between Mega Motor Company Pvt. Ltd. and BYD Auto Industry Ltd. They were briefed on the location of the project site and the significance of their role as stakeholders, emphasizing how their input and collaboration are essential for the project's success and the surrounding community.

7.3.1 Sindh Environmental Protection Agency (SEPA)

7.3.1.1.1 Brief Description of SEPA:

The Sindh Environmental Protection Agency (SEPA) is responsible for administering and implementing the Sindh Environmental Protection Act of 2014. It focuses on pollution control, environmental conservation, and sustainable development.

7.3.1.1.2 Summary of Consultation

Stakeholder	Location	Date	Key Informant
SEPA	Korangi	24-10-2024	Imran Sabir, Technical Deputy Director

Mr. Imran Sabir outlined SEPA's critical role in enforcing environmental laws and regulations, including the assessment and approval processes for Initial Environmental Examinations (IEE) and Environmental Impact Assessments (EIA). He confirmed that SEPA's involvement in the project stems from the EIA submission, which SEPA will review for compliance and issue a No Objection Certificate (NOC) as necessary. SEPA will monitor the project continuously, with the authority to halt any activities found in violation of environmental regulations.

Mr. Sabir emphasized the importance of adherence to SEPA's regulatory framework, noting that an Environmental Management Plan (EMP) will be essential to support ongoing monitoring. While endorsing the project's focus on electric vehicles as beneficial for long-term environmental impact, he recommended establishing a green cover by planting trees around the project site. He advised that any hazardous materials used should receive prior approval, and stressed the importance of careful monitoring of wastewater to ensure compliance with environmental standards.

7.3.2 Institute of Engineers of Pakistan

7.3.2.1.1 Brief Description of IEP

Founded in 1948, the Institution of Engineers Pakistan (IEP), originally headquartered in Dhaka, relocated to Lahore in 1971 following the separation of East Pakistan. It promotes the dissemination of knowledge and advances engineering and scientific development through its local and international centers.



7.3.2.1.2 Summary of Consultation

Stakeholder	Location	Date	Key Informant
Institute of Engineers Pakistan (IEP)	Shahre-Faisal	24-10-24	Ashkar Dawar, Board Member

During the Key Informant Interview (KII), Mr. Dawar noted that the Institution of Engineers, Pakistan (IEP) serves as a professional body representing engineers across Pakistan, supporting their professional development through technical publications, training, and membership services. While IEP has no direct involvement with the project or its location, Mr. Dawar expressed willingness to provide training and awareness programs for skilled and unskilled labor throughout various stages of the project. He highlighted three positive impacts of the project: its environmental friendliness, economic boost, and potential for local employment. Mr. Dawar reported no prior issues with similar projects and emphasized that SEPA is mandated to take strict action should any environmental harm occur. IEP is open to offering training and awareness sessions for engineers engaged in the project.

7.3.3 Bahria University Karachi

7.3.3.1.1 Brief Description of BUKC

Bahria University is a multi-campus institution in Pakistan with locations in Islamabad, Karachi, and Lahore. The university, affiliated with the Pakistan Navy, offers a range of undergraduate, graduate, and doctoral programs across disciplines such as environmental studies, engineering, computer science and social sciences.

7.3.3.1.2 Summary of Consultation

Stakeholder	Location	Date	Key Informant
Bahria University Karahi Campus	KARSAZ	25-10-24	Muhammad Idrees, Assistant Professor

During the KII, Mr. Idrees explained that the Environmental Department of Bahria University focuses on education, research, and student-led research compilation under faculty guidance. While not directly involved in the project, he expressed support for its sustainable efforts in electric vehicle production and indicated the department's willingness to assist in research if needed. He noted that similar projects have proceeded without issues and observed that this initiative would generate significant employment opportunities for both skilled and unskilled labor in the area.



7.3.4 National Forum for Environment and Health

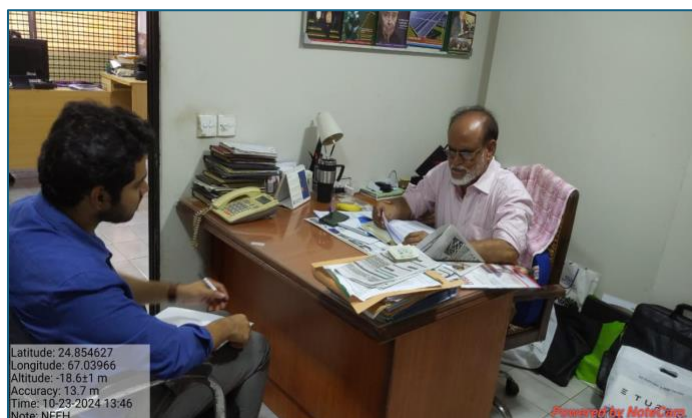
7.3.4.1.1 Brief Description of NFEH

The National Forum for Environment and Health (NFEH) in Karachi, Pakistan, is a non-governmental organization that promotes environmental awareness, sustainable practices, and public health initiatives.

7.3.4.1.2 Summary of Consultation

Stakeholder	Location	Date	Key Informant
National Forum for Environment and Health	KARSAZ	23-10-24	Naeem Qureshi, President

The National Forum for Environmental Health (NFEH) is dedicated in environmental health and advancing health-focused initiatives through promotional activities. During the KII, Mr. Naeem acknowledged the project's sustainable goals but advised against establishing the assembly plant in Gharo, citing the area's fertile soil and rich agricultural value, which he believes should be preserved. He raised concerns about potential pollution impacts in the area and recommended promoting agriculture by reserving land for local use and protecting biodiversity. He suggested introducing CSR activities to improve the livelihoods of surrounding communities. However, he did not propose an alternative location for the plant.



7.3.5 Shehri-CBE (Citizens for a Better Environment)

7.3.5.1.1 Brief Description of Shehri-CBE

Shehri-CBE (Citizens for a Better Environment) is a non-profit organization based in Karachi, Pakistan, focused on urban environmental issues and sustainable development. Established in 1988, it aims to promote public awareness and advocacy regarding environmental conservation, urban planning, and sustainable resource management.

7.3.5.1.2 Summary of Consultation

Stakeholder	Location	Date	Key Informant
Shehri-CBE	PECHS	28-10-2024	Pervaiz Sadiq, Executive Member

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During the KII, Mr. Sadiq noted that Shehri has no direct involvement in the project, as it does not focus on renewable energy initiatives. However, Shehri has collaborated with HUBCO and consulted on similar projects previously. Mr. Sadiq acknowledged the project's overall positive impact but raised concerns about high water consumption and potential displacement of local communities. To mitigate these risks, he recommended effective management strategies, training locals through Technical and Vocational Education and Training (TVET) programs, and prioritizing localized employment.



7.3.6 Karachi University

7.3.6.1.1 Brief Description of KU

The University of Karachi, established in 1951, is one of Pakistan's largest public universities, offering a wide range of undergraduate, graduate, and doctoral programs. Known for its research output and comprehensive academic offerings.

7.3.6.1.2 Summary of Consultation

Stakeholder	Location	Date	Key Informant
Karachi University	KU Circular Road	25-10-2024	Kaneez Fatima, Associate Professor

During the KII, Ms. Kaneez stated that the Department of Sociology at KU conducts case studies on various projects to analyze their environmental and social impacts. She expressed the department's willingness to assist with case studies involving the general public in the area and in data analysis. However, she also indicated that, in her view, the project may not be feasible due to its high energy requirements. Ms. Kaneez also expressed concerns about the potential increase in pollution due to the plant's installation and possible quality control issues associated with its operations. Despite these challenges, she acknowledged the project's sustainable objectives. To mitigate impacts, she recommended ensuring that traffic flow remains unaffected and that local livelihoods are not disrupted during the plant's construction phase. She highlighted the importance of monitoring environmental standards to protect community well-being.



7.3.7 WWF Pakistan

7.3.7.1.1 Brief Description of WWF Pakistan

WWF-Pakistan is a leading environmental conservation organization focused on preserving Pakistan's natural resources and biodiversity. It works on various initiatives, including wildlife protection, sustainable water management, climate action, and community-based conservation efforts.

7.3.7.1.2 Summary of Consultation

Stakeholder	Location	Date	Key Informant
WWF Pakistan	PECHS	29-10-2024	Altaaf Sheikh, Senior Manager Conservation

Mr. Shaikh from WWF-Pakistan emphasized the importance of assessing the plant according to IFC standards to ensure compliance with international environmental and social guidelines. He stressed the need to prevent habitat destruction, avoid land acquisition conflicts, and protect cultural heritage sites. He also recommended conducting a thorough emissions study to project the plant's environmental impact accurately.

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8. Environmental & Social Management Plan

This Chapter presents an environmental and social management plan (ESMP) as the implementation mechanism to manage environmental and social issues and mitigation measures identified in Chapter 6 on screening potential environmental impacts and mitigation measures.

8.1 Objectives of Environmental & Social Management Plan

The ESMP shall help Mega Motor Private 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 ESMP

The purpose of the ESMP 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 ESMP Process

The ESMP 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 ESMP, 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 ESMP

ESMP 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 Health, Safety & Environmental Management

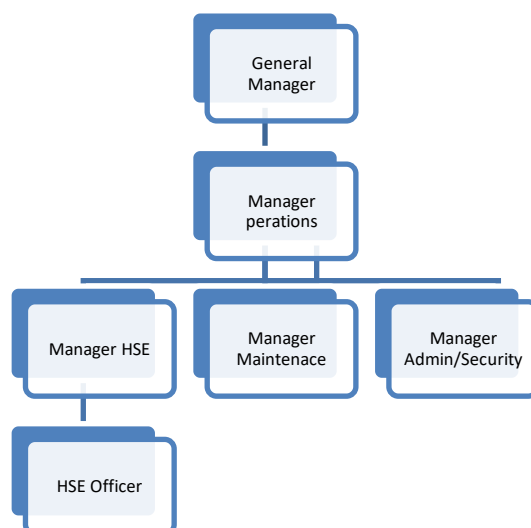


Figure 8.1 - Organizational Structure for Environmental Management

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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 MMCL while daily management will be supervised under the direction of HSE Manager. It is recommended that at least one HSE Officer shall be working under the head of the HSE 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/She will be responsible to report to the General Manager, 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 HSE 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 HSE, if appropriate.

8.7.2 HSE Manager

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

The role of HSE officer will be authorized by the HSE Manager. The key responsibilities of the HSE 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.



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8.7.4 Independent Monitoring Consultant (IMC)

The Third-Party Verification (TPV) process will involve the engagement of an independent monitoring consultant. These specialists will be responsible for monitoring environmental and social factors and conducting field surveys at the construction sites to assess the level of compliance. Their role will entail conducting external and independent monitoring of the ESMP implementation. The external monitoring agency will perform monthly, quarterly, and annual evaluations of the ESMP implementation and provide recommendations for necessary changes to the client.

Roles and responsibilities of the third-party consultant will include:

- Conduct autonomous monitoring at crucial sites throughout the construction phase and oversee the implementation of the Environmental and Social Management Plan (ESMP) within the project area.
- Promptly notify the of any significant impacts that arise during the construction process.
- Observe and revise or prepare corrective action plans as necessary.
- Monitor the implementation of the plans in collaboration with the client

8.7.5 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.

8.7.6 Identification of Safe Environmental Aspects



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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) from Painting operations,
- Discharges of liquid effluent including oily waste and seepage to land
- Consumption of natural resources and energy

8.7.7 Environmental Management

Environmental management will be the key priority of the administration of MMCL, with a 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 paint shop extension 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 paint shop extension 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.

8.7.8 Emergency Response Plan

MMCL would implement the Emergency Response Plan during the construction and operation stages. 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.

8.7.9 Environmental Management Program



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The following environmental aspects would require planned intervention by EMP for the proposed project by MMCL.



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Table 8.1 - Design Phase Mitigation Matrix

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 73.59 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	In case a mature tree is removed, it will be replanted in ratio 1:10 with native trees. - Green buffer zone will be established within the project area to compensate tree plantation. - Regularly monitor the health of newly planted trees to ensure the success of restoration efforts. - 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	Proponent
	Drainage System	-The drainage system will be designed to accommodate the waste water generated the plant processes, it should be connected to wastewater treatment plant before discharging into any water body ensuring it meets SEQS limits.	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	Proponent / Design Consultant



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- HVAC equipment selection

Table 8.2 - Construction Phase Mitigation Matrix

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/ <i>Construction Contractor</i>
	Air Quality	▪ 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	proponent/ <i>Construction Contractor</i>



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Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		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. - The Contractor will need to ensure that machinery is well maintained. - Implement an equipment maintenance program to ensure regular upkeep of all machinery according to a scheduled plan.	Proponent / Construction Contractor
	Soil Contamination	- Material Safety Data Sheets (MSDS) for purchased chemical additives, reagents and compounds will be kept at the work site. - All spills to be cleaned and removed from the site, where the site will be restored back to its original conditions.	Proponent/Construction Contractor



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Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		▪ Oils, lubricants, chemicals, and other listed hazardous materials should be stored safely at designated spots, enclosures, or storerooms, which should be safe from rainfall and away from any potential source of fire. ▪ Septic tanks of adequate capacities should be constructed for receiving and treating wastewater from all temporary worksite toilets and at the temporary container offices, if any. The toilet wastewater should not be discharged untreated onto the adjacent lands. ▪ All machineries and materials should be stored at the designated areas and compounds. ▪ Washout from washing of equipment and gadgets should be drained into either a septic tank or a sand-gravel bed for removal of the grit and contaminants	
	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 paint 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.	Proponent / Construction Contractor



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Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		General refuse may be generated by food service activities on site, so reusable rather than disposable dishware shall be used if feasible.	
	Water Availability	- The quantity of water used during proposed project activities will be kept to the minimum required by taking prudent water conservation measures on site. A complete record of water consumption will be maintained by project proponent. - Avoid abstraction of water from surface water resources. If there is no other source of water available, then for abstraction of water from surface water body, prior approval from relevant government department. - If a new water well is to be installed for project activities, the well should not be located with 500 meters from existing local wells and will be designed to abstract water preferably from a deeper aquifer not being used by local communities. - For all water obtained from local wells, the owner will be paid for water abstracted at the market rate. - The use of new wells installed or to be installed by project proponent for community benefits will be allowed. - The quantity of water used during construction phase of project will be kept to the minimum required by taking prudent water conservation measures on site. - Contamination of surface and groundwater resources will be avoided.	Construction Contractor/Proponent
	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.	Construction Contractor/Proponent



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Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
	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. 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	Construction Contractor/Proponent



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Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		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: - 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	Construction Contractor/Proponent



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Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
		- 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 - Operational Phase Mitigation Matrix

Table 7.3: Mitigation Matrix for the Operational Phase of the Proposed Project			
Project Activity	Environmental Impacts	Proposed Mitigation Measures	Responsibilities
	Water Usage	- Paint recycling systems should be set up that will collect and reuse excess paint and water accrued during the course of the painting process. The effect of this is the great reduction in the volume of water and paint wastage needing treatment. - High-efficiency, low-pressure spray systems should be used to limit paint overspray to that more cleaning flush with water is required. - Powder coating: When feasible, switch to powder coating technology instead of water-based paints. It avoids water for application and cleaning, which substantially reduces water demand.	Proponent



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		• Install advanced wastewater treatment systems, like reverse osmosis and chemical precipitation, which will remove heavy metals, VOCs, and other toxic chemicals off rinse water before discharge. • Implement a zero-liquid discharge system, which captures all wastewater and treats it by reuse within the plant, thus minimizing wastewater released to the environment. • Install coolant recycling systems that filter and reuse water-based coolants in metal-working, thus reducing both the consumption of makeup water and wastewater. • Establish dry machining practices as much as possible, which will eliminate the need for coolants. This method employs advanced cutting tools, designed to withstand higher temperatures, thereby minimizing water and chemical use. • Biodegradable and non-toxic coolants should be used to reduce the environmental impacts when water is necessary within metalworking operations. • Closed-loop washing systems continuously cleaning and filtering the wash water will enable reuse, hence reducing overall water consumption. • Switching to biodegradable and eco-friendly detergents in the washing process would reduce the chemical load in the wastewater. • Whenever possible, apply waterless cleaning techniques, such as ultrasonic or vapor degreasing, which can reduce or eliminate the requirement for water. • For cooling, few systems consume much water with evaporative cooling methods or have some form of cooling with minimal water consumption. This can be very advantageous for cooling applications where water is now used. • Install cooling towers with drift eliminators, water treatment systems, and energy-efficient pumps. This will minimize evaporation and enhance efficiency. • Water treatment systems could be installed to allow water recycling into hydraulic systems and conveyors to minimize freshwater extraction.	



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		• Comprehensive spill prevention measures and constant maintenance of hydraulic systems should be put into place to avoid oil or hydraulic fluid leaks that might allow for water sources to be contaminated. • Oil-water separators should be installed in runoff systems to capture and treat any accidental leaks before they reach the wastewater stream. • Modular and scalable treatment systems are to be used which can be suited to the requirements of chemical precipitation, biological treatment, and membrane filtration of varying processes upon meeting the need of different processes as they shall be carried out. • Treated wastewater for non-potable applications could partly replace freshwater requirements for landscaping, cooling, and floor cleaning, thereby conserving freshwater use. • Real-time monitoring of effluent quality is going to be put into place for regulatory compliance purposes and adjustments over treatment methods. Thereby, this will obstruct pollution of usable water sources by other harmful pollutants. • Any sludge generated in water treatment should be safely disposed of for the environment, therefore converting that sludge into useful byproducts (such as compost) or further treating and neutralizing hazardous waste components. • Research on energy or other reuse of resources converted from sludge, such as anaerobic digestion or incineration, should be explored. • The closed-loop HVAC systems will be installed to minimize water consumption in cooling towers, especially in water-scarce areas. This recirculation of cooling water reduces water loss from evaporation. • They may be installed to minimize water consumption in cooling towers, especially in water-scarce areas. Modular and scalable treatment systems are to be used which can be suited to the requirements of chemical precipitation, biological treatment, and membrane filtration of varying processes upon meeting the need of different processes as they shall be carried out. • Treat and reuse greywater from sinks and showers for flushing toilets or landscaping purposes. This will reduce the demand for fresh water.	



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		Where feasible, consider installing composting toilets that require little to no water, further reducing the plant's water footprint	
	Impact on Air Quality due to Battery Production & Battery Powering	Energy Efficiency in Manufacturing - Energy efficient machinery and production processes should be used in order to reduce the realistic demand of energy in EV manufacturing plants. - New technologies and automation systems have dramatically reduced energy consumption during vehicle assembly. - Implementing heat recovery systems to reuse energy lost by industrial processes for heating or electric generation in plants can reduce the need for external energy sources (if possible). - Lean production is the business management approach of production process with the ideology of minimum waste and minimum use of energy for production. It involves re-engineering work processes to eliminate non-productive times and improve workflows. - Install solar panels or other renewable energy systems in plants to reduce reliance on fossil fuels and GHG emissions. For instance, a portion of a plant's electricity can be supplied by rooftop solar arrays. - Incorporation of energy storage systems, such as batteries, can help buffer demand when there is limited solar or wind generation. - Battery production is one of the stages of manufacture of EVs with the highest impact in energy use and environmental influence. Cleaner technologies and better recycling regimes must now be employed to mitigate these effects. - Working with suppliers employing sustainable mining techniques can help reduce their impacts on the environment. Sustainable practices are those in which measures and technologies are applied to reduce water use, increased habitat destruction, and decrease toxic emissions from mining operations. - When possible, utilize recycled raw materials—such as recycled lithium, cobalt, and nickel—in the process of battery manufacture to further diminish the demand for virgin materials. - Battery recycling mitigates the impact of mining on the environment and lessens the air pollution caused by smelting and extraction processes.	Proponent



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		- Explore the development of batteries that require less energy for production and less toxic materials can greatly minimize the environmental footprint of EV manufacturing. Battery Recycling and Reuse - Closed-loop recycling systems that recover valuable metals from used batteries and reintroduce them into the manufacturing process can suppress emissions from raw material extraction and cut down waste. - Old EV batteries can be refurbished for energy storage in renewable energy systems before going through the recycling process. This prolongs battery life and reduces the need to manufacture new batteries. Reducing VOCs and Particulate Matter (PM) Emissions VOCs and PMs emissions from paint, coatings, and adhesives used in the assembly of EVs can be mitigated through the following strategies: - The assembly process involves the application of water-based paints or low-VOC paints, adhesives with a view to reducing the release of VOCs that contribute not only to the formation of smog but also adversely affect the respiratory system. - Powder coating uses a dry powder applied to surfaces and baked on. Solvents that emit VOCs are not used in this process, making it environmentally friendly, reducing waste and lowering pollution levels. Improved Ventilation and Emission Control Systems - Using state-of-the-art filtration such as high-efficiency particulate air (HEPA) filters and activated carbon filters in industrial facilities such as manufacturing plants can capture VOCs and particulates before they are released to the environment. - Closed-loop systems within paint booths and coating processes are used to capture emissions. Addressing Indirect Emissions from Electricity Use - In countries like Pakistan, where the majority of electricity is still generated from fossil fuels, the environmental benefits of EVs can be undermined by the carbon intensity of the grid. To address this: - Engage with policymakers to advocate for increasing the share of renewable energy in the national energy mix. Subsidies and incentives for renewable	



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		energy projects from government can accelerate the transition to cleaner energy sources. Sustainable Waste Management Improper handling of manufacturing waste, including battery scrap, paint sludge, and chemical waste, can lead to the release of harmful pollutants.	
	Indoor Air Quality in Body Shops and Component Manufacturing Shops with Welding and Joining Operations	Ventilation Systems • Install advanced local exhaust ventilation (LEV) systems to capture fumes, gases, and particulates at the source, which, depending on the location of the ventilator system, keeps these gases from diffusing onto the workers working near the welding zones, especially where aluminum welding occurs, to effectively filter out aluminum oxide fumes and airborne metal particles. • Dedicated extraction systems would be installed near the battery pack assembly lines where laser welding or thermal joining is used. This will prevent the escape of hazardous electrolyte vapors or volatile organic compounds (VOCs) from adhesives and sealants applied to battery casing. • Use HEPA-filters to capture ultrafine particulates and laser welding operations producer ultrafine particles, many of which, in fact, are submicron. • There shall also be a general ventilation setup to contain the dilution of residual contaminants that may not be collected by the LEV system, especially in the vicinity of excessively high rates of work with welding, grinding, and polishing. Fume Extraction for Aluminum Welding- • As the process of welding aluminum alloys generates fine particles and aluminum oxide fume, the installation of specialized fume extraction systems focusing on high capture efficiency will be carried out in order to gain better control over these emissions. • Install real-time fume monitoring systems to assess the concentration of harmful gases (e.g., ozone, nitrogen oxides) and make any necessary adjustments to ventilation rates.	Proponent



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		• Down-Draft Tables in the areas where manual welding is taking place for the purpose of pulling the fumes away from the breathing zone of operators working lighter weight aluminum or composite pieces. • For EV assembly plants, mitigating indoor air quality issues, especially in body shops and component manufacturing shops with welding and joining operations, requires a comprehensive approach that addresses the unique materials and processes involved in EV production. Below are detailed mitigation measures tailored to the specific processes used in EV manufacturing, such as working with aluminum alloys, battery assembly, and welding technologies. Heat and Temperature Management • Since resistance welding and laser welding of aluminum and battery-related components generate heat, automated cooling systems (like chilled water systems) should be integrated into the production line to reduce heat build-up. These systems should provide effective cooling without introducing additional contaminants or moisture into the shop environment. • For welding near temperature-sensitive areas (such as battery packs), implement thermal shields and barriers to prevent excessive heat transfer to nearby sensitive components and workstations. Mitigation of Adhesive and Sealer Fumes • When welding around battery casings or structural components that use adhesives and sealers, ensure the plant has proper ventilation to capture VOCs, which are released when adhesives decompose under high temperatures. VOC scrubbers or dedicated exhaust hoods should be used near these workstations. • Select low-VOC adhesives and thermal-resistant sealants to minimize harmful fume generation during the welding process. Laser Welding and Arc Welding Mitigations • Install enclosed laser welding stations with fume extraction systems capable of removing fine particulates and harmful gases. The use of particulate filters in conjunction with vacuum systems will prevent harmful particles from spreading to other parts of the shop.	



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	- For arc welding (used in structural EV components), use specially designed extractors that focus on capturing welding fumes, which contain nickel, chromium, copper, and other alloying elements. This minimizes the spread of harmful contaminants across the shop. Personal Protective Equipment (PPE) - Workers involved in manual welding operations, particularly around battery casings or other sensitive areas, should be equipped with PAPRs to protect them from fumes, gases, and particulate matter. - Full-Face Welding Masks with air supply units to ensure complete protection from aluminum oxide and other harmful fumes emitted during welding processes. Material Handling and Pre-Treatment - Before welding, surfaces should be cleaned to remove oil films and lubricants, which can generate more fumes during welding. This minimizes the potential for increased fume generation and harmful by-products. - Utilize robotic arms and automated fixtures to limit direct human exposure to harmful fumes during material handling, welding, or adhesive application in sensitive areas like battery compartments or lightweight aluminum panels. Air Quality Monitoring - Conduct periodic air quality assessments, especially in battery assembly areas and aluminum welding zones, to ensure that exposure limits for chemicals like ozone, nitrogen oxides, and volatile fumes remain within acceptable limits. Work Practices and Engineering Controls - Optimize welding processes (e.g., using low-heat welding techniques) to reduce the production of fumes and contaminants. For example, using laser welding over traditional arc welding where feasible to reduce emissions. - Create enclosed welding booths for high-contaminant-generating processes like battery welding and aluminum panel welding to isolate them from other workers in the shop. Training and Safety Protocols	



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Plant Operations		- Train workers to recognize the hazards of aluminum oxide, VOCs, and battery fumes. They should be familiar with the proper use of ventilation systems and PPE, and know how to identify signs of exposure. - Implement and regularly update protocols for handling exposure incidents, especially in battery assembly areas where unique hazards like electrolyte leaks or battery pack fires may occur.	
	Solid hazardous waste &	- 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	Proponent
	Noise	- 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
	Effluent Discharge from Paint Shop & effluent treatment	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; Primary Treatment <i>Fine Screening</i> It involves fine screening using filters. Discfilters: ► 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.	Proponent



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Drumfilters:

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.

Beltfilter:

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-filltration

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).



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		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 <i>Heavy Metals Removal without Sludge Generation:</i> 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 Paint sludge will be disposed through SEPA certified contractor.	
	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. • 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.	proponent



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		- 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 from the Paint booth 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 environmentally friendly with the third-party certification.	Proponent
	Surface Water and Groundwater	- Construct and operate a wastewater treatment plant to treat the plant's effluent before discharging it into the runoff channel. The treatment plant should be designed to remove pollutants such as organic matter, suspended solids, heavy metals, and other contaminants up to the limits specified in Sindh Environmental Quality Standards. - Ensure proper maintenance and operation of the wastewater treatment plant, including regular cleaning, inspections, and monitoring of effluent quality. - Develop and implement an emergency response plan to address accidental spills or leaks of hazardous substances. - Implement a system for regular inspection and maintenance of pipes, valves, and other equipment to detect and repair leaks promptly. - Install spill containment measures, such as berms or secondary containment structures, to prevent accidental releases of chemicals or toxic substances.	Proponent



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		- Adhere to best practices for handling and storing chemicals and other hazardous materials to minimize the risk of spills. - Provide training to employees on proper handling and disposal of chemicals and waste materials. - Establish an emergency response team to handle spills or other emergencies. - Ensure that the plant has adequate emergency equipment, such as spill kits, protective gear, and communication devices.	
	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 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.	Proponent
	Proponent	During operations, mitigation measures would include appropriate training of all employees in the safe handling and storage of chemicals onsite.	Proponent



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	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. Kia Lucky will have a real impact on employment opportunities and will generate direct employment as well as will create multiple indirect jobs in downstream industries.	1.1.1



8.8 Environmental Monitoring Program

Monitoring of different activities will be required to assess the impacts of activities on the environment during construction. For this purpose, Mega Motor Private 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 and operations Phase of the Project:

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S. No	Parameter/ Receptor	Monitoring parameters / Performance indicator	Location	Monitoring Mechanism	Monitoring and Reporting frequency	Responsibility	Cost (PKR)
Construction Phase							
1.	Water Resources/ Water Quality	Monitoring of all parameters of effluent from construction sites as per SEQS.	At agricultural run-off drain at location setup in baseline	Laboratory testing of waste water samples by SEPA approved Lab	Monthly basis	Contractor, Proponent, IMC	40,000 PKR per sample for 1 sample from septic tank. 40,000 PKR
2.	Drinking water	Monitoring of all parameters of drinking water as per stringent environmental quality standards	- Construction camp - Construction site	Laboratory testing of drinking water samples by SEPA approved Laboratory for monitoring.	Monthly basis.	Contractor, Proponent, IMC	40,000 PKR per sample for 1 sample from contractor camp 40,000 PKR
3.	Soil Contamination	Soil contamination, uncontrolled solid waste disposal activities at sites	- Construction Camp. - Equipment washing yards. - Spillage points of fuel, chemicals, and lubricants.	Visual observations	Daily basis	Contractor, Proponent, IMC	-
4.	Air emissions	Monitoring of ambient air on parameters mentioned in SEQS	Construction site	Onsite Ambient Air Monitoring equipment from SEPA certified lab	Monthly basis	Contractor, Proponent, IMC	35,000 PKR per sample for 02 samples at the site 70,000 PKR
5.	Dust Emission	Monitoring of PM ₁₀ PM _{2.5} as per SEQS	Construction site	Visual checks and Onsite Ambient Air	Monthly basis	Contractor, Proponent, IMC	-



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S. No	Parameter/ Receptor	Monitoring parameters / Performance indicator	Location	Monitoring Mechanism	Monitoring and Reporting frequency	Responsibility	Cost (PKR)
				Monitoring equipment			
6.	Noise Pollution	Day and night-time noise monitoring in dBA Leq. as per SEQS	Construction site	Monitoring of noise level at site.	Monthly basis	Contractor, Proponent, IMC	2,000 PKR per sample for 06 samples at project site. 12,000 PKR
7.	Generator & Vehicular emissions	Monitoring of parameters mentioned in SEQS for new vehicles and For heavy duty diesel engines and large goods vehicles	Generators and vehicles used at site	Onsite monitoring from SEPA certified lab	Monthly basis	Contractor, Proponent, IMC	5,000 PKR per sample for 06 samples at the project site. 30,000 PKR
8.	Waste Management	Inspection of waste and spoil disposal in accordance with Waste Management Plan	Project area, camps and Offices. • Equipment yards	Visual Observations, Monitoring and Audits	Review the waste management stream before start of the project. Monitoring and reporting on monthly basis during the construction stage;	Contractor, Proponent, IMC	Tentative Cost of 25,000 PKR per month
9.	OHS accidents and incidents	As per OHS plan which include but not limited to the inspection of	Main project area	Visual Observations and consultations,	Monitoring and reporting on monthly	Contractor, Proponent, IMC	Tentative Cost of PKR 50,000 per month



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S. No	Parameter/ Receptor	Monitoring parameters / Performance indicator	Location	Monitoring Mechanism	Monitoring and Reporting frequency	Responsibility	Cost (PKR)
		working areas, work permits, provision and availability of mandatory PPEs, Community complaints on H&S		Grievance Redress/Social Complaint Register, Incident/accident register, Monitoring and Audits	basis during the construction stage		
10.	Chemical Storage and Handling	Safety Data Sheets, Leakage and spills, Segregated handling and storage of chemicals, availability of fire extinguishers,	Main project area	Visual Observations, Chemical Storage inventory, Incident/accident register, Monitoring and Audits	Monitoring and reporting on monthly basis during the construction stage	Contractor, Proponent, IMC	Tentative cost of PKR 50,000 per month
Construction Phase (Sub-Total) PKR							3,804,000 PKR for 12 months monitoring as per above schedule. Total cost of 7,608,000 PKR for 2 years of monitoring as per construction schedule
Operations Phase							
1.	Drinking water	Monitoring of all parameters of drinking water as per stringent environmental quality standards	Project Area	Laboratory testing of drinking water samples by SEPA approved Laboratory for monitoring.	Monthly basis.	Proponent, IMC	40,000 PKR per sample for 1 sample from water system at project 40,000 PKR
2.	Soil Contamination	Soil contamination, uncontrolled solid waste	Project Area	Visual observations and Sampling and laboratory	As and when needed	Proponent, IMC	-



	Environmental & Social Impact Assessment		
	MEGA MOTOR COMPANY– ELECTRIC VEHICLE PLANT AT GHARO, SINDH		
	Doc. No.: MMCL/ESIA/001	Rev.: 00	E&S MANAGEMENT PLAN

S. No	Parameter/ Receptor	Monitoring parameters / Performance indicator	Location	Monitoring Mechanism	Monitoring and Reporting frequency	Responsibility	Cost (PKR)
		disposal activities at sites		testing for soil samples (In case of large spill).			
3.	Indoor air quality	• CO • SO₂ • NO_x • PM • VOC	• Paint shop • Battery assembly area	Onsite monitoring from SEPA certified lab	Monthly	Proponent, IMC	35,000 PKR per sample for 02 samples 70,000 PKR
4.	Air emissions (Stack / Exhaust)	(a) For Stack emissions (PM _{2.5} , PM ₁₀ , VOCs, NO _x , CO, CO ₂ , Lead, Cadmium, HF, HCL) (b) For Generator and Vehicle Monitoring of parameters mentioned in SEQs for new vehicles and For heavy duty diesel engines and large goods vehicles	• Generator Exhaust • Stacks • Fork lifter • Equipment • Vehicles	Onsite monitoring from SEPA certified lab	Monthly	Proponent, IMC	5,000 PKR per sample for 10 samples 50,000 PKR
5.	Ambient air quality	Monitoring of ambient air on parameters mentioned in SEQs	Upstream and Downstream of wind direction	Onsite Ambient Air Monitoring equipment from SEPA certified lab	Quarterly basis	Proponent, IMC	35,000 PKR per sample for 02 samples 70,000 PKR



	Environmental & Social Impact Assessment		
	MEGA MOTOR COMPANY– ELECTRIC VEHICLE PLANT AT GHARO, SINDH		
	Doc. No.: MMCL/ESIA/001	Rev.: 00	E&S MANAGEMENT PLAN

S. No	Parameter/ Receptor	Monitoring parameters / Performance indicator	Location	Monitoring Mechanism	Monitoring and Reporting frequency	Responsibility	Cost (PKR)
6.	Noise Pollution	Day and night-time noise monitoring in dBA Leq. as per SEQS	Construction site	Monitoring of noise level at site.	Monthly	Proponent, IMC	2,000 PKR per sample for 10 samples 20,000 PKR
7.	Wastewater	Monitoring of 32 wastewater parameters mentioned in SEQS	Outlet of the wastewater treatment system	Laboratory testing of waste water samples by SEPA approved Lab	Monthly	Proponent, IMC	40,000 PKR per sample for 1 sample 40,000 PKR
8.	Waste Management	Implementation on waste management plan	Project area	Visual Observations, Monitoring and Audits	Quarterly	Proponent, IMC	Tentative Cost of 50,000 PKR per quarter
9.	Transportation of Produced Vehicle Units	Training of drivers on defensive driving techniques Safety inspection of transport vehicles, Policies regarding working hours and mandatory rest breaks for drivers.	Transport vehicles	Trainings, Safety inspection and policies	Regular basis	Proponent, IMC	-
10.	OHS accidents and incidents	As per OHS plan which include but not limited to the inspection of working areas, work permits, provision and	Main project area	Visual Observations and consultations, Grievance Redress/Social Complaint	Monitoring and reporting on monthly basis during the	Proponent, IMC	Tentative Cost of 50,000 PKR per quarter



	Environmental & Social Impact Assessment		
	MEGA MOTOR COMPANY– ELECTRIC VEHICLE PLANT AT GHARO, SINDH		
	Doc. No.: MMCL/ESIA/001	Rev.: 00	E&S MANAGEMENT PLAN

S. No	Parameter/ Receptor	Monitoring parameters / Performance indicator	Location	Monitoring Mechanism	Monitoring and Reporting frequency	Responsibility	Cost (PKR)
		availability of mandatory PPEs, Community complaints on H&S		Register, Incident/accident register, Monitoring and Audits	operations stage		
11.	Battery, Chemical Storage and Handling	Safety Data Sheets, Leakage and spills, Segregated handling and storage of chemicals, availability of fire extinguishers and fire prevention system	Main project area	Visual Observations, Chemical Storage inventory, Incident/accident register, Monitoring and Audits	At regular interval	Proponent, IMC	Tentative Cost of 50,000 PKR per quarter
Operations Phase (Sub-Total) PKR for one year							3,520,000 PKR for 01 year of monitoring during the operations phase, where this cost will be renewed each year in line with prevailing rates.
Construction and Operation Monitoring Cost (PKR)							3,520,000 PKR + 7,608,000 PKR = 11,128,000 PKR for 02 years of construction and 01 year of operations monitoring.



	Environmental & Social Impact Assessment		
	MEGA MOTOR COMPANY– ELECTRIC VEHICLE PLANT AT GHARO, SINDH		
	Doc. No.: MMCL/ESIA/001	Rev.: 00	CONCLUSION

9. Conclusion

The ESIA study for proposed Plant has identified potential impacts that are likely to arise during construction and operational phases of the project. Potential environmental impacts are associated with air quality, solid waste, Wastewater, water quality, soil quality, terrestrial ecology, health and safety, as well as socio-economic impacts. The project is expected to bring a positive change in the socioeconomic setup of the area through short to medium term employment creation and providing an alternative to fossil fuel based cars.

Potential Project impacts have been identified related to the project construction and operation phases. Impact predictions are based on the consultants' previous experiences on similar projects; professional judgment; data collected in the field; discussions with local communities, relevant government officials and relevant technical specialists. Many of the mitigation measures are related to good design practices, others with good construction and housekeeping practices.

A series of mitigation and monitoring measures have been included to address the concerns for these measures. Assuming effective implementation of the mitigation measures and monitoring requirements as outlined in the Environmental & Social Management Plan, the adverse environmental and social impacts of the proposed Project are envisaged to be within the acceptable limits.

The implementation of the mitigation measures detailed in the Environmental & Social Impact Assessment report and listed in the Environmental & Social Management Plan (EMP) of the ESIA Report, including monitoring, will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the development are enhanced and mitigated to a level which is deemed adequate for the development to proceed.

In summary, based on the findings of this assessment there is no reason why the facility proposed for the site should not be authorized, contingent on the mitigations and monitoring for potential environmental and socio-economic impacts as outlined in the ESIA and ESMP being implemented.

APPENDICES

APPENDIX I - ENVIRONMENTAL MONITORING RPEORTS

Lab Report Ref. No.: QTS/BYD/2024/1167-A

Reporting Date: 9/10/2024

Report to: **Mega Motors Manufacturing Plant Gharao Sindh**

SAMPLE DESCRIPTION

Sample ID: Ground Water no:1
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 24°43'22.9"N 67°35'42.7"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 02/10/2024

ANALYTICAL TEST REPORT

S. NO.	PARAMETERS TO BE ANALYZED	STANDARDS	LDL	UNITS	RESULTS	TEST METHOD
		SSDWQ - LIMITS				
1	pH value	6.5 – 8.5	0.01	-	6.98	USEPA 150.1
2	Oduor	Non-Objectionable /Acceptable	-	Physical	Acceptable	Physical
3	Taste	Nonobjection able /Acceptable	-	Physical	Acceptable	Physical
4	Color	≤ 15	1.0	TCU	BDL	APHA-2020 B/C
5	Turbidity	< 5	0.01	NTU	NIL	APHA-2130 B
6	Total Dissolved Solids (TDS)	< 1000	1.0	mg/L	1480	Hach 8160
7	Total Hardness as CaCO ₃	< 500	0.1	mg/L	745	EDTA Titration.Hach-8213
8	Fluoride (as F ⁻)	≤ 1.5	0.01	mg/L	0.23	USEPA 340.1
9	Chloride (as Cl ⁻)	< 250	0.1	mg/L	444	Hach 8206
10	Nitrate (NO ₃)	≤ 50	0.01	mg/L	2.12	Hach -8039
11	Nitrite (NO ₂)	≤ 3	0.001	mg/L	0.010	Hach - 8153
12	Cyanide (as CN ⁻) total	≤ 0.05	0.001	mg/L	BDL	Hach 8027
13	Phenolic Compound as (Phenols)	-	0.001	mg/L	BDL	USEPA-420.1
14	Aluminum (Al)	≤ 0.2	0.001	mg/L	BDL	APHA-3111 D
15	Antimony (Sb)	≤ 0.005	0.001	mg/L	BDL	APHA-3111 B
16	Arsenic	≤ 0.05	0.01	mg/L	BDL	APHA-3120 B
17	Cadmium	0.01	0.001	mg/L	BDL	ASTM D-3557
18	Chromium, Total	≤ 0.05	0.01	mg/L	0.022	ASTM D-1687
19	Copper	2	0.01	mg/L	2.23	Hach 8506
20	Lead	≤ 0.05	0.001	mg/L	BDL	ASTM D-3559
21	Mercury	≤ 0.001	0.001	mg/L	BDL	ASTM D-3223
22	Selenium	0.01	0.001	mg/L	BDL	ASTM D-3859
23	Nickel	≤ 0.02	0.01	mg/L	BDL	ASTM D-1886
24	Boron	0.3	0.01	mg/L	BDL	ASTM D-3082
25	Residual Chlorine	0.2-0.5 at Consumer End	0.01	mg/L	0.012	Hach - 8167
26	Zinc	5.0	0.01	mg/L	0.15	USEPA 3500 Zn B
27	Manganese	≤ 0.5	0.01	mg/L	0.54	Hach 8034
28	Barium	0.7	0.01	mg/L	0.56	Hach 8014
39	Total Coliform	0cfu/100ml	0	cfu	NIL	APHA-SM9221B
3	Fecal Coliform	0cfu/100ml	0	cfu	94	APHA-SM9221E
35	Escherichia Coli(E-Coli)	0cfu/100ml	0	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standard for Drinking Water Quality

USEPA = United State Environmental Protection Agency method

Hach USA, method

BDL= Below Detection Limit

ND= Not Detected

LDL= Least Detectable Value

- 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

Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge: _____
Name: **Haseeb Arshad**



Lab Report Ref. No.: QTS/BYD/2024/1167-B

Reporting Date: 9/10/2024

Report to: **Mega Motors Manufacturing Plant Ghoro Sindh**

SAMPLE DESCRIPTION

Sample ID: Ground Water no:2
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 24°43'34.2"N 67°36'09.3"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 02/10/2024

ANALYTICAL TEST REPORT

S. NO.	PARAMETERS TO BE ANALYZED	STANDARDS SSDWQ - LIMITS	LDL	UNITS	RESULTS	TEST METHOD
1	pH value	6.5 – 8.5	0.01	-	7.25	USEPA 150.1
2	Odour	Non-Objectionable /Acceptable	-	Physical	Acceptable	Physical
3	Taste	NonObjectionable /Acceptable	-	Physical	Acceptable	Physical
4	Color	≤ 15	1.0	TCU	BDL	APHA-2020 B/C
5	Turbidity	< 5	0.01	NTU	NIL	APHA-2130 B
6	Total Dissolved Solids (TDS)	< 1000	1.0	mg/L	546	Hach 8160
7	Total Hardness as CaCO ₃	< 500	0.1	mg/L	288	EDTA Titration.Hach-8213
8	Fluoride (as F ⁻)	≤ 1.5	0.01	mg/L	0.22	USEPA 340.1
9	Chloride (as Cl ⁻)	< 250	0.1	mg/L	142	Hach 8206
10	Nitrate (NO ₃)	≤ 50	0.01	mg/L	2.10	Hach -8039
11	Nitrite (NO ₂)	≤ 3	0.001	mg/L	0.011	Hach - 8153
12	Cyanide (as CN ⁻) total	≤ 0.05	0.001	mg/L	BDL	Hach 8027
13	Phenolic Compound as (Phenols)	-	0.001	mg/L	BDL	USEPA-420.1
14	Aluminum (Al)	≤ 0.2	0.001	mg/L	BDL	APHA-3111 D
15	Antimony (Sb)	≤ 0.005	0.001	mg/L	BDL	APHA-3111 B
16	Arsenic	≤ 0.05	0.01	mg/L	BDL	APHA-3120 B
17	Cadmium	0.01	0.001	mg/L	BDL	ASTM D-3557
18	Chromium, Total	≤ 0.05	0.01	mg/L	0.023	ASTM D-1687
19	Copper	2	0.01	mg/L	2.22	Hach 8506
20	Lead	≤ 0.05	0.001	mg/L	BDL	ASTM D-3559
21	Mercury	≤ 0.001	0.001	mg/L	BDL	ASTM D-3223
22	Selenium	0.01	0.001	mg/L	BDL	ASTM D-3859
23	Nickel	≤ 0.02	0.01	mg/L	BDL	ASTM D-1886
24	Boron	0.3	0.01	mg/L	BDL	ASTM D-3082
25	Residual Chlorine	0.2-0.5 at Consumer End	0.01	mg/L	0.014	Hach - 8167
26	Zinc	5.0	0.01	mg/L	0.13	USEPA 3500 Zn B
27	Manganese	≤ 0.5	0.01	mg/L	0.58	Hach 8034
28	Barium	0.7	0.01	mg/L	0.56	Hach 8014
39	Total Coliform	0cfu/100ml	0	cfu	NIL	APHA-SM9221B
3	Fecal Coliform	0cfu/100ml	0	cfu	NIL	APHA-SM9221E
35	Escherichia Coli(E-Coli)	0cfu/100ml	0	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standard for Drinking Water Quality

USEPA = United State Environmental Protection Agency method

Hach USA, method

BDL= Below Detection Limit

ND= Not Detected

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- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge: _____
Name: Haseeb Arshad



Lab Report Ref. No.: QTS/BYD/2024/1167-C

Reporting Date: 9/10/2024

Report to: **Mega Motors Manufacturing Plant Ghoro Sindh**

SAMPLE DESCRIPTION

Sample ID: Ground Water no:3
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 24°43'04.0"N 67°35'52.7"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 02/10/2024

ANALYTICAL TEST REPORT

S. NO.	PARAMETERS TO BE ANALYZED	STANDARDS SSDWQ - LIMITS	LDL	UNITS	RESULTS	TEST METHOD
1	pH value	6.5 – 8.5	0.01	-	7.21	USEPA 150.1
2	Odour	Non-Objectionable /Acceptable	-	Physical	Acceptable	Physical
3	Taste	NonObjectionable /Acceptable	-	Physical	Acceptable	Physical
4	Color	≤ 15	1.0	TCU	BDL	APHA-2020 B/C
5	Turbidity	< 5	0.01	NTU	NIL	APHA-2130 B
6	Total Dissolved Solids (TDS)	< 1000	1.0	mg/L	575	Hach 8160
7	Total Hardness as CaCO ₃	< 500	0.1	mg/L	200	EDTA Titration.Hach-8213
8	Fluoride (as F ⁻)	≤ 1.5	0.01	mg/L	0.23	USEPA 340.1
9	Chloride (as Cl ⁻)	< 250	0.1	mg/L	144	Hach 8206
10	Nitrate (NO ₃)	≤ 50	0.01	mg/L	2.14	Hach -8039
11	Nitrite (NO ₂)	≤ 3	0.001	mg/L	0.011	Hach - 8153
12	Cyanide (as CN ⁻) total	≤ 0.05	0.001	mg/L	BDL	Hach 8027
13	Phenolic Compound as (Phenols)	-	0.001	mg/L	BDL	USEPA-420.1
14	Aluminum (Al)	≤ 0.2	0.001	mg/L	BDL	APHA-3111 D
15	Antimony (Sb)	≤ 0.005	0.001	mg/L	BDL	APHA-3111 B
16	Arsenic	≤ 0.05	0.01	mg/L	BDL	APHA-3120 B
17	Cadmium	0.01	0.001	mg/L	BDL	ASTM D-3557
18	Chromium, Total	≤ 0.05	0.01	mg/L	0.023	ASTM D-1687
19	Copper	2	0.01	mg/L	2.22	Hach 8506
20	Lead	≤ 0.05	0.001	mg/L	BDL	ASTM D-3559
21	Mercury	≤ 0.001	0.001	mg/L	BDL	ASTM D-3223
22	Selenium	0.01	0.001	mg/L	BDL	ASTM D-3859
23	Nickel	≤ 0.02	0.01	mg/L	BDL	ASTM D-1886
24	Boron	0.3	0.01	mg/L	BDL	ASTM D-3082
25	Residual Chlorine	0.2-0.5 at Consumer End	0.01	mg/L	0.012	Hach - 8167
26	Zinc	5.0	0.01	mg/L	0.13	USEPA 3500 Zn B
27	Manganese	≤ 0.5	0.01	mg/L	0.55	Hach 8034
28	Barium	0.7	0.01	mg/L	0.54	Hach 8014
39	Total Coliform	0cfu/100ml	0	cfu	2	APHA-SM9221B
3	Fecal Coliform	0cfu/100ml	0	cfu	NIL	APHA-SM9221E
35	Escherichia Coli(E-Coli)	0cfu/100ml	0	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standard for Drinking Water Quality

USEPA = United State Environmental Protection Agency method

Hach USA, method

BDL= Below Detection Limit

ND= Not Detected

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Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge: _____
Name: **Haseeb Arshad**



Lab Report Ref. No.: QTS/BYD/2024/1167-D

Reporting Date: 9/10/2024

Report to: **Mega Motors Manufacturing Plant Ghoro Sindh**

SAMPLE DESCRIPTION

Sample ID: Ground Water no:4
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 24°43'42.5"N 67°35'36.2"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 02/10/2024

ANALYTICAL TEST REPORT

S. NO.	PARAMETERS TO BE ANALYZED	STANDARDS	LDL	UNITS	RESULTS	TEST METHOD
		SSDWQ - LIMITS				
1	pH value	6.5 – 8.5	0.01	-	7.70	USEPA 150.1
2	Oduor	Non-Objectionable /Acceptable	-	Physical	Acceptable	Physical
3	Taste	Non-Objectionable /Acceptable	-	Physical	Acceptable	Physical
4	Color	≤ 15	1.0	TCU	BDL	APHA-2020 B/C
5	Turbidity	< 5	0.01	NTU	NIL	APHA-2130 B
6	Total Dissolved Solids (TDS)	< 1000	1.0	mg/L	336	Hach 8160
7	Total Hardness as CaCO ₃	< 500	0.1	mg/L	126	EDTA Titration.Hach-8213
8	Fluoride (as F ⁻)	≤ 1.5	0.01	mg/L	0.24	USEPA 340.1
9	Chloride (as Cl ⁻)	< 250	0.1	mg/L	71	Hach 8206
10	Nitrate (NO ₃)	≤ 50	0.01	mg/L	2.14	Hach -8039
11	Nitrite (NO ₂)	≤ 3	0.001	mg/L	0.013	Hach - 8153
12	Cyanide (as CN ⁻) total	≤ 0.05	0.001	mg/L	BDL	Hach 8027
13	Phenolic Compound as (Phenols)	-	0.001	mg/L	BDL	USEPA-420.1
14	Aluminum (Al)	≤ 0.2	0.001	mg/L	BDL	APHA-3111 D
15	Antimony (Sb)	≤ 0.005	0.001	mg/L	BDL	APHA-3111 B
16	Arsenic	≤ 0.05	0.01	mg/L	BDL	APHA-3120 B
17	Cadmium	0.01	0.001	mg/L	BDL	ASTM D-3557
18	Chromium,Total	≤ 0.05	0.01	mg/L	0.020	ASTM D-1687
19	Copper	2	0.01	mg/L	2.21	Hach 8506
20	Lead	≤ 0.05	0.001	mg/L	BDL	ASTM D-3559
21	Mercury	≤ 0.001	0.001	mg/L	BDL	ASTM D-3223
22	Selenium	0.01	0.001	mg/L	BDL	ASTM D-3859
23	Nickel	≤ 0.02	0.01	mg/L	BDL	ASTM D-1886
24	Boron	0.3	0.01	mg/L	BDL	ASTM D-3082
25	Residual Chlorine	0.2-0.5 at Consumer End	0.01	mg/L	0.011	Hach - 8167
26	Zinc	5.0	0.01	mg/L	0.14	USEPA 3500 Zn B
27	Manganese	≤ 0.5	0.01	mg/L	0.51	Hach 8034
28	Barium	0.7	0.01	mg/L	0.50	Hach 8014
39	Total Coliform	0cfu/100ml	0	cfu	NIL	APHA-SM9221B
3	Fecal Coliform	0cfu/100ml	0	cfu	NIL	APHA-SM9221E
35	Escherichia Coli(E-Coli)	0cfu/100ml	0	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standard for Drinking Water Quality

USEPA = United State Environmental Protection Agency method

Hach USA, method

BDL= Below Detection Limit

ND= Not Detected

LDL= Least Detectable Value

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
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Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge: _____
Name: Haseeb Arshad



Lab Report Ref. No.: QTS/BYD/24/1168-A
Report to: Mega Motors Manufacturing Plant Ghoro Sindh

Reporting Date: 9/10/2024

SAMPLE DESCRIPTION

Sample ID: Waste water no:1
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample coordinate: 24°43'19.6"N 67°35'26.3"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 02/10/2024

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SEQS	LDL	UNITS	RESULTS	TEST METHOD
1	Temperature	40	1.0	°C	30.3	Thermometer
2	pH value	6-9	0.01	-	8.5	USEPA 150.1
3	Biochemical Oxygen Demand (BOD) ₅ at 20°C	200	0.1	mg/L	15.57	Hach 8043
4	Chemical Oxygen Demand (COD)	400	1.0	mg/L	33	Hach 8000
5	Total Suspended Solids (TSS)	200	1.0	mg/L	21	Hach 8006
6	Total Dissolved Solids (TDS)	3500	1.0	mg/L	2940	Hach 8160
7	Cyanide (as CN ⁻) total	1	0.001	mg/L	0.029	Hach 8027
8	Ammonia (NH ₃)	40	0.1	mg/L	22	Hach 10031
9	Cadmium	0.1	0.001	mg/L	BDL	ASTM D-3557
10	Chromium (trivalent & hexavalent)	1	0.01	mg/L	0.017	ASTM D-1687
11	Copper	1	0.01	mg/L	1.26	Hach 8506
12	Lead	0.5	0.001	mg/L	BDL	ASTM D-3559
13	Nickel	1	0.001	mg/L	BDL	ASTM D-1886
14	Zinc	5	0.01	mg/L	0.13	USEPA 3500 Zn B
15	Oil & Grease	10	0.001	mg/L	0.54	APHA 5520-D
16	Fluoride (as F ⁻)	10	0.01	mg/L	0.21	USEPA 340.1
17	Phenolic compounds (as phenol)	0.1	0.001	mg/L	0.014	USEPA 420.1
18	Chloride (as Cl ⁻)	-	0.01	mg/L	747	Hach 8206
19	Mercury	0.01	0.001	mg/L	BDL	ASTM D-3223
20	Iron	8	0.01	mg/L	NIL	Hach 8008
21	An-ionic detergents (as MBAS)	20	0.001	mg/L	0.94	Method 5540 C
22	Manganese	1.5	0.1	mg/L	4.22	Hach 8034
23	Boron	6	0.01	mg/L	0.21	ASTM D-3082
24	Barium	1.5	0.1	mg/L	2	Hach 8014
25	Sulphate (SO ₄ ²⁻)	-	1.0	mg/L	125	USEPA 375.4
26	Selenium	0.5	0.01	mg/L	BDL	ASTM D-3859
27	Total toxic metals	2	-	mg/L	0.011	-
28	Sulphide (S ²⁻)	1	0.001	mg/L	0.25	Hach 8131
29	Silver	1	0.001	mg/L	BDL	ASTM D-3866
30	Arsenic	1	0.01	mg/L	0.010	Hach method
31	Chlorine	1	0.01	mg/L	BDL	Hach 80021

SEQS=Sindh Environmental Quality Standards

USEPA=United State Environmental Protection Agency method

Hach USA, method

BDL=Below Detection Limit

APHA-SM = American Public Health Association- Standard Methods for Water & Waste water Examination

LDL= Least Detectable Value

NoGL=No Guideline Limits Available

- 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

Sample Analyzed by: AFAQ AHMED

Signature of Laboratory In charge:
Name: Haseeb Arshad



Lab Report Ref. No.: QTS/BYD/24/1168-B
Report to: **Mega Motors Manufacturing Plant Ghara Sindh**

Reporting Date: 9/10/2024

SAMPLE DESCRIPTION

Sample ID: Waste water no:2
Sampling Method: APHA 1060-A &
Sample Type: Grab Sample
Sample coordinate: 24°43'20.2"N 67°36'04.6"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 02/10/2024

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SEQS	LDL	UNITS	RESULTS	TEST METHOD
1	Temperature	40	1.0	°C	30.1	Thermometer
2	pH value	6-9	0.01	-	7.61	USEPA 150.1
3	Biochemical Oxygen Demand (BOD) ₅ at 20°C	200	0.1	mg/L	11	Hach 8043
4	Chemical Oxygen Demand (COD)	400	1.0	mg/L	29.84	Hach 8000
5	Total Suspended Solids (TSS)	200	1.0	mg/L	19	Hach 8006
6	Total Dissolved Solids (TDS)	3500	1.0	mg/L	354	Hach 8160
7	Cyanide (as CN-) total	1	0.001	mg/L	78	Hach 8027
8	Ammonia (NH ₃)	40	0.1	mg/L	20	Hach 10031
9	Cadmium	0.1	0.001	mg/L	BDL	ASTM D-3557
10	Chromium (trivalent & hexavalent)	1	0.01	mg/L	0.011	ASTM D-1687
11	Copper	1	0.01	mg/L	1.22	Hach 8506
12	Lead	0.5	0.001	mg/L	BDL	ASTM D-3559
13	Nickel	1	0.001	mg/L	BDL	ASTM D-1886
14	Zinc	5	0.01	mg/L	0.12	USEPA 3500 Zn B
15	Oil & Grease	10	0.001	mg/L	0.44	APHA 5520-D
16	Fluoride (as F ⁻)	10	0.01	mg/L	0.20	USEPA 340.1
17	Phenolic compounds (as phenol)	0.1	0.001	mg/L	0.012	USEPA 420.1
18	Chloride (as Cl ⁻)	-	0.01	mg/L	33	Hach 8206
19	Mercury	0.01	0.001	mg/L	BDL	ASTM D-3223
20	Iron	8	0.01	mg/L	NIL	Hach 8008
21	An-ionic detergents (as MBAS)	20	0.001	mg/L	0.65	Method 5540 C
22	Manganese	1.5	0.1	mg/L	2.54	Hach 8034
23	Boron	6	0.01	mg/L	0.18	ASTM D-3082
24	Barium	1.5	0.1	mg/L	1.87	Hach 8014
25	Sulphate (SO ₄ ²⁻)	-	1.0	mg/L	112	USEPA 375.4
26	Selenium	0.5	0.01	mg/L	BDL	ASTM D-3859
27	Total toxic metals	2	-	mg/L	0.010	-
28	Sulphide(S ²⁻)	1	0.001	mg/L	0.21	Hach 8131
29	Silver	1	0.001	mg/L	BDL	ASTM D-3866
30	Arsenic	1	0.01	mg/L	0.02	Hach method
31	Chlorine	1	0.01	mg/L	BDL	Hach 80021

SEQS=Sindh Environmental Quality Standards

USEPA=United State Environmental Protection Agency method

Hach USA, method

BDL=Below Detection Limit

APHA-SM = American Public Health Association- Standard Methods for Water & Waste water Examination

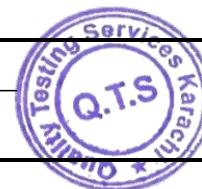
LDL= Least Detectable Value

NoGL=No Guideline Limits Available

- 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

Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge:
Name: **Haseeb Arshad**



Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Ghare Sindh</u>	Test Report No:	QTS/BYD/24/1178-A
Sample Description:	Ambient Air Quality Test	Sample Duration:	24hr's
		Location: 01 Up wind	24°43'21.8"N 67°35'31.7"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m³)	NO ₂ (µg/m³)	SO ₂ (µg/m³)	PM ₁₀ (µg/m³)	PM _{2.5} (µg/m³)	SPM (µg/m³)	Noise	Lead (µg/m³)
02.10.2024	10:00	24.7	37.2	14.6	108.2	49.2	344.3	62.2	ND
	11:00	25.3	37.3	15.2	109.3	51.6	349.5	63.1	
	12:00	27.6	38.2	15.4	109.9	55.3	351.1	63.8	
	01:00	28.9	38.9	15.9	110.3	57.8	355.2	64.6	
	02:00	29.2	40.1	16.2	111.4	58.1	360.7	65.0	
	03:00	30.3	40.3	16.7	112.2	59.4	361.2	65.3	
	04:00	31.2	40.6	16.9	112.9	63.6	362.1	65.4	
	05:00	31.7	40.8	17.7	113.3	66.8	362.6	65.8	
	06:00	32.3	41.1	18.8	114.6	68.5	363.3	65.9	
	07:00	32.6	41.4	19.4	115.7	69.0	365.5	70.3	
	08:00	32.8	42.5	20.2	117.7	27.1	367.4	70.5	
	09:00	33.0	43.3	20.8	118.8	74.4	368.9	71.1	
	10:00	33.1	44.2	21.1	120.2	77.2	370.1	68.3	
	11:00	29.8	42.9	22.5	121.7	78.7	372.2	67.1	
03.10.2024	00:00	29.4	41.4	22.0	123.3	79.9	378.9	65.5	
	01:00	28.5	39.8	21.8	124.8	82.4	380.3	64.3	
	02:00	27.1	39.4	21.7	125.5	86.7	382.2	63.3	
	03:00	26.6	38.8	21.1	127.8	91.2	381.9	62.9	
	04:00	24.4	37.6	20.9	123.9	83.1	377.5	61.6	
	05:00	23.3	37.2	19.9	123.0	82.2	371.0	61.0	
	06:00	23.2	35.5	19.6	121.1	80.6	367.6	59.9	
	07:00	24.8	35.1	19.3	120.6	78.8	362.2	58.8	
	08:00	25.1	34.9	19.4	118.8	71.1	360.3	59.3	
	09:00	25.9	35.3	18.5	123.7	67.9	357.7	60.2	
	10:00	26.3	36.8	18.0	129.9	64.3	355.9	61.3	
MIN		23.2	34.9	14.6	108.2	27.1	344.3	58.8	
MAX		33.1	44.2	22.5	129.9	91.2	382.2	71.1	
AVG		28.2	39.2	18.9	118.7	68.2	365.0	64.3	
SEQS		40	80	120	150	75	500	75 dB	1.5
LDL-Limits		0	0	0	10	2.5	1	35 dB	-

Ambient Air Quality Test Report

Client Name:	Mega motors Manufacturing Plant Gharo Sindh	Test Report No:	QTS/BYD/24/1178-A
Sample Description:	Ambient Air Quality Test	Sample Duration:	24hr's
		Location: 01 Up wind	24°43'21.8"N 67°35'31.7"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	1.03	5.0	0.0	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	24 Hours	28.2	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	24 Hours	39.2	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	24 Hours	18.9	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	17.5	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	24 Hours	118.7	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	24 Hours	68.2	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	24 Hours	365.0	500.0	1.0	
Lead (Pb)	µg/m ³	24 Hours	BDL	1.5	-	ASS Method
Noise	dB(A)	24 Hours	64.3	75	35	SLM

*SEQS= Sindh Environmental Quality Standards.
(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
LDL=Least Detection Limit

Remarks:

The average concentration calculated for the 24 hours are well within guideline values set by SEQs.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory In charge : Name : <u>Haseeb Arshad</u>



Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Ghare Sindh</u>	Test Report No:	QTS/BYD/24/1178-B
Sample Description:	Ambient Air Quality Test	Sample Duration:	24hr's
		Location: 02 Down wind	24°43'33.8"N 67°36'07.7"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m³)	NO ₂ (µg/m³)	SO ₂ (µg/m³)	PM ₁₀ (µg/m³)	PM _{2.5} (µg/m³)	SPM (µg/m³)	Noise	Lead (µg/m3)
03.10.2024	10:30	18.2	26.6	11.1	79	27	288	58.8	ND
	11:30	18.8	26.8	11.5	82	29	293	59.0	
	12:30	19.0	27.0	11.7	84	33	303	60.2	
	01:30	19.2	27.3	11.9	88	35	306	60.6	
	02:30	19.4	27.6	12.2	91	37	309	60.9	
	03:30	19.5	27.8	12.5	95	39	312	61.1	
	04:30	19.7	28.0	12.6	99	43	314	61.4	
	05:30	19.9	28.3	12.8	103	45	317	61.6	
	06:30	20.0	28.6	13.0	105	47	319	61.9	
	07:30	20.2	28.9	13.1	108	49	324	62.3	
	08:30	20.4	29.0	13.2	110	53	325	62.7	
	09:30	20.6	29.1	13.4	114	55	326	62.9	
	10:30	20.8	29.3	13.6	117	58	328	61.1	
	11:30	21.1	29.4	13.8	119	61	333	61.0	
04.10.2024	12:30	21.4	29.7	13.7	123	66	337	59.9	
	01:30	21.6	29.9	13.5	127	60	331	59.7	
	02:30	21.8	30.1	13.0	129	59	327	59.5	
	03:30	22.2	29.7	12.9	133	58	322	59.8	
	04:30	22.0	29.3	12.7	138	52	319	59.9	
	05:30	21.9	28.8	12.5	131	49	316	59.2	
	06:30	21.4	26.7	12.2	127	56	310	59.0	
	07:30	20.9	26.3	11.8	120	52	301	58.8	
	08:30	20.6	26.0	11.4	124	47	299	58.6	
	09:30	20.3	25.8	11.1	118	44	288	56.6	
	10:30	19.9	25.9	10.9	114	40	286	57.4	
MIN		18.2	25.8	10.9	79	27	286	56.6	
MAX		22.2	30.1	13.8	138	66	337	62.9	
AVG		20.4	28.0	12.4	110.9	47.6	313.1	60.1	
SEQS		40	80	120	150	75	500	75 dB	1.5
LDL-Limits		0	0	0	10	2.5	1	35 dB	-

Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Gharo Sindh</u>	Test Report No:	QTS/BYD/24/1178-B
Sample Description:	Ambient Air Quality Test	Sample Duration:	24hr's
		Location: 02 Down wind	24°43'33.8"N 67°36'07.7"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	0.88	5.0	0.0	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	24 Hours	20.4	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	24 Hours	28.0	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	24 Hours	12.4	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	19.4	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	24 Hours	110.9	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	24 Hours	47.6	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	24 Hours	313.1	500.0	1.0	
Lead (Pb)	µg/m ³	24 Hours	BDL	1.5	-	ASS Method
Noise	dB(A)	24 Hours	60.1	75	35	SLM

*SEQS= Sindh Environmental Quality Standards.
(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
LDL=Least Detection Limit

Remarks:

The average concentration calculated for the 24 hours are well within guideline values set by SEQs.

Sample Analyzed By: <u>Ather Adil</u>	Signature of Laboratory In charge : Name : <u>Haseeb Arshad</u>



Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Ghare Sindh</u>	Test Report No:	QTS/BYD/24/1178-C
		Sample Duration:	24hr's
Sample Description:	Ambient Air Quality Test	Location: 03	24°43'03.5"N 67°35'52.4"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m³)	NO ₂ (µg/m³)	SO ₂ (µg/m³)	PM ₁₀ (µg/m³)	PM _{2.5} (µg/m³)	SPM (µg/m³)	Noise	Lead (µg/m³)
04.10.2024	11:30	14.7	21.1	8.8	95	36	213	61.1	ND
	12:30	14.8	21.5	8.9	98	37	215	61.4	
	01:30	14.9	21.7	9.2	99	39	217	61.6	
	02:30	15.1	21.8	9.4	103	43	219	61.8	
	03:30	15.2	22.0	9.5	105	45	222	61.9	
	04:30	15.4	22.3	9.7	107	46	225	62.0	
	05:30	15.5	22.5	9.9	109	48	226	62.5	
	06:30	15.7	22.7	10.0	111	49	229	62.7	
	07:30	15.9	22.9	10.2	113	53	232	62.5	
	08:30	16.0	23.0	10.3	114	56	234	61.8	
	09:30	16.2	23.3	10.4	116	57	237	61.6	
	10:30	16.5	23.4	10.6	118	59	239	61.1	
	11:30	16.6	23.6	10.7	119	63	243	60.7	
	12:30	16.9	23.9	10.8	123	66	245	60.2	
05.10.2024	01:30	17.0	24.4	11.0	125	67	248	59.9	
	02:30	17.3	24.1	11.1	126	69	256	59.7	
	03:30	17.7	23.9	11.4	131	68	250	59.4	
	04:30	17.9	23.7	11.6	133	63	254	59.2	
	05:30	18.2	23.4	11.3	130	60	251	59.0	
	06:30	18.5	23.1	10.9	128	58	249	58.8	
	07:30	18.8	22.8	10.6	126	59	246	58.6	
	08:30	18.9	23.2	10.3	122	54	242	58.4	
	09:30	19.3	23.7	10.0	118	49	238	58.2	
	10:30	19.5	24.4	9.9	113	44	234	58.8	
	11:30	19.8	24.9	9.7	109	42	230	59.7	
MIN		14.7	21.1	8.8	95	36	213	58.2	
MAX		19.8	24.9	11.6	133	69	256	62.7	
AVG		16.9	23.0	10.2	115.5	53.1	235.6	60.5	
SEQS		40	80	120	150	75	500	75 dB	1.5
LDL-Limits		0	0	0	10	2.5	1	35 dB	-

Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Gharo Sindh</u>	Test Report No:	QTS/BYD/24/1178-C
Sample Description:	Ambient Air Quality Test	Sample Duration:	24hr's
		Location: 03	24°43'03.5"N 67°35'52.4"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	0.68	5.0	0.0	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	24 Hours	16.9	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	24 Hours	23.0	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	24 Hours	10.2	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	20.9	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	24 Hours	115.5	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	24 Hours	53.1	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	24 Hours	235.6	500.0	1.0	
Lead (Pb)	µg/m ³	24 Hours	BDL	1.5	-	ASS Method
Noise	dB(A)	24 Hours	60.5	75	35	SLM

*SEQS= Sindh Environmental Quality Standards.
(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
LDL=Least Detection Limit

Remarks:

The average concentration calculated for the 24 hours are well within guideline values set by SEQs.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory In charge : Name : <u>Haseeb Arshad</u>



Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Ghare Sindh</u>	Test Report No:	QTS/BYD/24/1178-D
		Sample Duration:	24hr's
Sample Description:	Ambient Air Quality Test	Location: 04	24°43'42.0"N 67°35'34.3"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m³)	NO ₂ (µg/m³)	SO ₂ (µg/m³)	PM ₁₀ (µg/m³)	PM _{2.5} (µg/m³)	SPM (µg/m³)	Noise	Lead (µg/m³)
05.10.2024	12:00	11.9	17.2	12.2	77	26	234	58.8	ND
	01:00	12.2	17.4	12.6	79	29	237	59.0	
	02:00	12.7	17.7	12.9	80	32	239	59.2	
	03:00	12.9	17.9	13.0	83	34	243	59.4	
	04:00	13.3	18.0	13.3	85	35	244	59.7	
	05:00	13.6	18.2	13.5	88	37	247	59.8	
	06:00	13.8	18.3	13.7	91	39	249	60.0	
	07:00	14.0	18.5	13.8	93	43	256	60.3	
	08:00	14.4	18.6	14.4	95	45	258	60.5	
	09:00	14.7	18.8	14.6	97	46	259	60.8	
	10:00	14.8	19.0	14.7	99	47	263	61.1	
	11:00	15.5	19.3	15.0	101	48	266	61.5	
	00:00	15.7	19.6	15.2	104	49	268	59.9	
06.10.2024	01:00	15.9	19.9	15.5	106	50	272	59.4	
	02:00	16.2	20.2	15.7	108	54	277	59.0	
	03:00	16.4	20.6	15.9	110	56	286	58.8	
	04:00	16.6	20.8	16.0	113	58	288	58.6	
	05:00	17.0	21.3	16.3	115	59	293	58.4	
	06:00	17.2	21.6	16.6	117	62	297	58.3	
	07:00	17.6	21.3	16.9	119	66	299	58.0	
	08:00	17.7	21.0	17.2	114	67	303	57.9	
	09:00	18.0	20.9	16.8	111	69	301	57.6	
	10:00	18.2	20.5	16.4	108	64	295	57.7	
	11:00	18.4	20.0	15.8	107	60	291	58.3	
	12:00	19.0	19.8	15.6	103	58	288	59.6	
MIN		11.9	17.2	12.2	77	26	234	57.6	
MAX		19	21.6	17.2	119	69	303	61.5	
AVG		15.5	19.4	14.9	99.9	49.1	270.0	59.2	
SEQS		40	80	120	150	75	500	75 dB	1.5
LDL-Limits		0	0	0	10	2.5	1	35 dB	-

Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Ghara Sindh</u>	Test Report No:	QTS/BYD/24/1178-D
Sample Description:	Ambient Air Quality Test	Sample Duration:	24hr's
		Location: 04	24°43'42.0"N 67°35'34.3"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	0.59	5.0	0.0	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	24 Hours	15.5	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	24 Hours	19.4	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	24 Hours	14.9	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	22.4	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	24 Hours	99.9	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	24 Hours	49.1	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	24 Hours	270.0	500.0	1.0	
Lead (Pb)	µg/m ³	24 Hours	BDL	1.5	-	ASS Method
Noise	dB(A)	24 Hours	59.2	75	35	SLM

*SEQS= Sindh Environmental Quality Standards.
(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
LDL=Least Detection Limit

Remarks:

The average concentration calculated for the 24 hours are well within guideline values set by SEQs.

Sample Analyzed By: <u>Ather Adil</u>	Signature of Laboratory In charge : Name : <u>Haseeb Arshad</u>



Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Ghare Sindh</u>	Test Report No:	QTS/BYD/24/1178-E
Sample Description:	Ambient Air Quality Test	Sample Duration:	24hr's
		Location: 05	24°43'03.52"N 67°35'10.25"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m³)	NO ₂ (µg/m³)	SO ₂ (µg/m³)	PM ₁₀ (µg/m³)	PM _{2.5} (µg/m³)	SPM (µg/m³)	Noise	Lead (µg/m³)
06.10.2024	12:30	13.5	18.3	7.8	63	32	188	57.2	ND
	01:30	13.8	18.8	8.0	65	34	193	57.3	
	02:30	14.0	19.0	8.2	67	36	194	57.7	
	03:30	14.4	19.2	8.3	69	37	197	57.9	
	04:30	14.6	19.3	8.5	70	39	202	58.0	
	05:30	14.7	19.5	8.6	71	42	204	58.2	
	06:30	14.9	19.9	8.8	73	44	206	58.4	
	07:30	15.0	20.2	8.9	74	45	209	58.6	
	08:30	15.4	19.7	9.0	75	47	211	58.8	
	09:30	15.7	19.3	9.2	78	49	213	59.0	
	10:30	15.8	18.8	9.4	79	53	216	59.3	
	11:30	16.0	18.6	9.6	83	50	218	59.3	
07.10.2024	12:30	16.3	18.2	9.7	88	48	219	59.0	
	01:30	16.5	18.0	9.4	90	46	220	58.8	
	02:30	16.8	17.7	9.1	93	41	222	58.7	
	03:30	17.0	17.3	8.9	95	38	226	58.5	
	04:30	17.2	17.1	8.7	97	36	228	58.3	
	05:30	17.3	16.8	8.4	99	34	234	58.2	
	06:30	17.7	16.6	8.2	102	36	230	58.0	
	07:30	17.9	16.3	7.7	103	38	226	57.7	
	08:30	18.0	16.1	7.5	107	40	221	57.4	
	09:30	18.2	15.8	7.1	111	39	218	57.3	
	10:30	18.5	15.5	6.8	113	42	215	57.1	
	11:30	18.8	15.3	6.6	115	46	210	57.6	
	12:30	19.2	15.2	6.3	110	49	209	57.9	
MIN		13.5	15.2	6.3	63	32	188	57.1	
MAX		19.2	20.2	9.7	115	53	234	59.3	
AVG		16.2	17.8	8.3	87.7	41.7	213.0	58.1	
SEQS		40	80	120	150	75	500	75 dB	1.5
LDL-Limits		0	0	0	10	2.5	1	35 dB	-

Ambient Air Quality Test Report

Client Name:	<u>Mega motors Manufacturing Plant Gharo Sindh</u>	Test Report No:	QTS/BYD/24/1178-E
Sample Description:	Ambient Air Quality Test	Sample Duration:	24hr's
		Location: 05	24°43'03.52"N 67°35'10.25"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	0.49	5.0	0.0	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	24 Hours	16.2	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	24 Hours	17.8	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	24 Hours	8.3	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	18.3	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	24 Hours	87.7	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	24 Hours	41.7	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	24 Hours	213.0	500.0	1.0	
Lead (Pb)	µg/m ³	24 Hours	BDL	1.5	-	ASS Method
Noise	dB(A)	24 Hours	58.1	75	35	SLM

*SEQS= Sindh Environmental Quality Standards.
(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
LDL=Least Detection Limit

Remarks:

The average concentration calculated for the 24 hours are well within guideline values set by SEQs.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory In charge : Name : <u>Haseeb Arshad</u>



**APPENDIX II -
SOIL
INVESTIGATION
REPORT**

MEGA MOTORS COMPANY (PVT) LTD.

CONSTRUCTION OF PRODUCTION
FACILITY AT GHARO SINDH

Report on Geotechnical Investigations (Interim)

J-875/GI-R00

July 2024



**Berkeley
Associates (Pvt.) Ltd.**
Consulting Engineers

CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH

00	27.07.2024	Report	MMR		KA			
Rev.	Date	Description	Initials	Signature	Initials	Signature	Initials	Signature
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REPORT ON GEOTECHNICAL INVESTIGATIONS (INTERIM)								
Document No. J-875/Rev. 00								

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1 INTRODUCTION

1.1 General

M/s Mega Motors Company (Pvt.) Ltd. intends to establish a Production Facility at Gharo Sindh. M/s Berkeley Associates (Pvt.) Ltd. (BAL) has been contracted to conduct geotechnical investigations for the proposed project.

To derive a coherent set of foundation design parameters, comprehensive geotechnical investigations were conducted. These investigations encompassed the drilling of boreholes, conducting in-situ testing within the boreholes, excavation of test pits, installation of standpipe piezometer, collecting samples of soil and water and performing laboratory testing, resulting in the submission of a geotechnical investigations report.

The entire fieldwork was carried out under the fulltime supervision of site geologists/supervisors of M/s Berkeley Associates (Pvt.) Ltd.

The fieldwork for these geotechnical investigations was carried out from July 05, 2024 to July 22, 2024

1.2 Scope of Work

Scope of work as provided by the Client, is summarized below;

- Drilling of total six (06) exploratory boreholes; each down 35m depth below existing ground level (EGL) using hydraulic feed straight rotary technique.
- Performance of Standard Penetration Tests (SPTs) in the boreholes along with the collection of SPT samples at 1.0m depth interval down to 35m depth including labelling, packing, storage & transportation to BAL testing laboratory.
- Collection of undisturbed soil samples from boreholes including labelling, packing, storage & transportation to testing laboratory.
- Excavation of five (05) test pits each down to 3.0m depth below EGL and performance of field density tests at 1.0m interval in each test pit.

- Obtaining pertinent groundwater information from the boreholes drilled during these investigations (if encountered)
- Performance of laboratory tests on selected soil/water samples in accordance with the laboratory testing program.
- Preparation and submission of comprehensive Geotechnical Investigations Report upon completion of fieldwork and laboratory testing.

1.3 Methodology

Field investigations were carried out in accordance with the scope of work. The exploratory borings were advanced using rotary wash boring technique. Standard Penetration Tests (SPTs) were performed in all the boreholes in accordance with ASTM D 1586.

Soil samples were collected from designated depths from each borehole for identification and subsequent laboratory testing. Selected soil samples were subjected to various laboratory tests for classification and estimation of shear strength.

The report has been compiled based on the geotechnical investigations conducted at the project site and the subsequent laboratory testing performed on the selected soil and water samples. It includes an assessment of the subsurface soil stratigraphy, foundation design parameters and recommendations regarding the allowable bearing capacity of shallow & deep foundations and chemical aggressivity of subsurface soil are also provided in this report. The locations of all boreholes, test pits & piezometers are shown on Fig 2-1 (Appendix A).

2 FIELD INVESTIGATIONS

2.1 General

The field investigations for geotechnical investigations report encompassed the following activities:

- Drilling of six (06) exploratory boreholes
- In-situ testing i.e Standard Penetration Test (SPT) in boreholes
- Collection of disturbed & undisturbed soil samples and groundwater samples from boreholes.
- Excavation of five (05) test pits.
- Field density tests (FDT) in test pits.
- Installation of six (06) standpipe piezometer

This chapter provides a discussion of the particulars of the fieldwork, while photographs depicting various field activities are appended in Appendix-D.

2.2 Drilling of Exploratory Boreholes

A total of six (06) exploratory boreholes were conducted at the site with maximum explored depth of 37 meters below EGL using straight rotary drilling rig. The boreholes drilled using straight rotary drilling rig were stabilized by circulating bentonite mud in the holes. The diameter of all the boreholes is approximately 150 mm. Split spoon sampler was used without liner and SPTs were performed in these boreholes at 1.0m depth interval down to maximum drilled depth of 37.0m. Undisturbed soil samples were collected from cohesive strata using Denison tubes in rotary holes.

Borehole logs were maintained to document all materials encountered during drilling and data from the Standard Penetration Tests (SPTs) conducted in each borehole were recorded on these logs. These borehole logs can be found in Appendix-B

The locations of the boreholes drilled during these investigations are depicted on the Geotechnical Investigations Plan, which is provided in Fig. 2-1 of Appendix-A.

2.3 Excavation of Test Pits

To investigate subsurface soil conditions at shallow depths, a total of five test pits were excavated. Four down to a depth of 1.0 meter while one down to 1.5 meters below EGL due to the presence of shallow groundwater table. Field density tests were conducted at various horizons. The test pits allowed for the recovery of large bulk samples of soil, as well as a thorough visual examination of the strata. The test pits were logged and the subsurface information obtained through these observations is extensively presented in the test pit logs, appended as Appendix B.

Table 2-1 Details of exploratory boreholes/test pits

Sr. No.	Borehole/ Testpit ID	Borehole/ Testpit depth	Easting	Northing	Elevation
		(m)	(m)	(m)	(m)
1	BH-01	37.0	357471.109	2735190.313	6.00
2	BH-02	35.0	357854.402	2735208.872	6.40
3	BH-03	36.0	358240.102	2735197.600	5.80
4	BH-04	37.0	357486.018	2734981.198	6.00
5	BH-05	35.0	357855.760	2734987.552	6.00
6	BH-06	35.0	358268.360	2734989.228	6.00
7	TP-01	1.0	357461.092	2735209.001	5.80
8	TP-02	1.0	357849.654	2735126.282	6.40
9	TP-03	1.5	358241.884	2735229.255	6.00
10	TP-04	1.0	357506.369	2734954.814	6.20
11	TP-05	1.0	358224.246	2734974.028	6.20

2.4 In-situ Testing

During these field investigations, in-situ Standard Penetration Test (SPT) was performed in each borehole. A brief discussion of the in-situ test in boreholes is provided below.

2.4.1 Standard Penetration Test (SPT)

For evaluating the consistency and compactness of foundation soils, Standard Penetration Tests (SPTs) were performed in all the exploratory boreholes at a general depth interval of at 1.0m depth interval to maximum drilled depth of 37.0m. SPTs were conducted in accordance with the procedures described in latest version of ASTM designation D-1586. A donut type hammer, weighing 63.5 kg, was used for the tests.

The hammer was lifted and dropped manually through a manila rope using a pulley hanged with the tripod stand. A split spoon sampler was used for all the tests. Disturbed soil samples were obtained through the split spoon sampler. Profiles of observed SPT (N_{55}) values and corrected SPT (N_1)₇₀ values are shown on Fig. 2-2 and Fig. 2-3, respectively. These figures are appended in Appendix-A.

2.5 Sampling

Disturbed soil samples were obtained from the boreholes through split spoon sampler while performing SPTs. The disturbed samples were placed in polythene bags and preserved in wide-mouthed plastic jars. The jars were clearly labelled to indicate the project name, project code, borehole designation and depth of sampling.

Undisturbed soil samples were obtained from the boreholes at designated depths by using Shelby/Denison samplers. The undisturbed soil samples were properly waxed and labelled to indicate the project name, project code, borehole designation and depth of sampling.

Field density tests (FDTs) were performed in test pits along with the collection of composite bulk sample. All soil samples were transported with care to the laboratory testing facility of M/s Berkeley Associates (Pvt) Ltd., located in Lahore, for subsequent laboratory testing.

2.6 Groundwater Observations

During the geotechnical investigations, groundwater levels were monitored using standpipe piezometers installed at six borehole locations. The groundwater readings, recorded during the month of July 2024, are presented below in Table 2-3.

Table 2-3 Groundwater observations in boreholes / piezometers

Sr. No.	Designation	Borehole No.	Ground Elevations ASML (m)	Groundwater Elevations AMSL (m)	Depth of Groundwater Table below EGL (m)
1	PZ-1	BH-03	5.80	5.02	0.78
2	PZ-2	BH-06	6.00	5.41	0.59
3	PZ-3	BH-02	6.40	5.52	0.88
4	PZ-4	BH-05	6.00	5.42	0.58
5	PZ-5	BH-04	6.00	5.31	0.69
6	PZ-6	BH-01	6.00	5.37	0.63

3 LABORATORY TESTING

3.1 General

For evaluation of physical, engineering and chemical characteristics of the subsoils, selected soil samples were tested in the laboratory. The laboratory testing was carried out at testing facility of Berkeley Associates (Pvt.) Ltd., Lahore. Following laboratory tests were performed on selected soil, rock and water samples;

- Particle size distribution
- Atterberg limits
- Specific gravity
- Bulk density
- In-situ moisture content
- Unconfined compression
- Direct shear
- Chemical analyses on soil and water samples

The following sections provide a brief description of these tests, while a summary of the laboratory test results is presented in Table 3-1 to Table 3-3, which can be found in Appendix-A.

3.2 Particle Size Distribution

For classifying the subsurface soils, forty-eight (48) selected soil samples were subjected to grain size analyses during these studies. The sieve analyses were performed in accordance with the procedures specified in ASTM D-422. The percentage of fines (passing sieve no. 200) and sand/gravel fractions of the tested soil samples are also indicated in Table 3-1 (Appendix-A). Results of grain size analyses were plotted in the form of gradation curves and are presented in Appendix-C.

3.3 Atterberg Limits

Atterberg limits were performed on twelve (12) selected soil samples. The tests were performed as specified in ASTM D-4318. The test results are summarized in Table 3-1 and Casagrande's Plasticity Chart has been attached as Fig. 3-1 in Appendix-A, respectively.

3.4 Specific Gravity

Seven (07) soil samples were tested for the estimation of specific gravity. The tests were carried out in accordance with ASTM D-854. The test results are provided in Table 3-1 (Appendix-A). Its value ranges from 2.70 to 2.75.

3.5 Bulk Density

Seven (07) soil samples were tested for the determination of bulk density. The test results are summarized in Table 3-1 (Appendix-A). Its value ranges from 18.06 kN/m³ to 20.47 kN/m³.

3.6 Direct Shear

In order to estimate shear strength characteristics of foundation soils, six (06) soil samples were subjected to direct shear tests. The tests were carried out in accordance with the procedure explained in ASTM D-3080. The test results are provided in Table 3-1 (Appendix-A). Its value ranges from 29.0 to 38.1 degrees. The corresponding laboratory test sheets are attached in Appendix-C.

3.7 Unconfined Compression

In order to estimate shear strength characteristics of fine-grained foundation soils five (05) undisturbed soil were subjected to unconfined compression test. The tests were carried out in accordance with the procedure explained in ASTM D-2166. The test results are summarized in Table 3-1 (Appendix-A). Its value ranges from 74.68 kPa to 208.27 kPa. The corresponding laboratory test sheets are attached in Appendix-C.

3.8 Chemical Analyses of Soil and Water

3.8.1 Soil Samples

In order to determine the chemical characteristics of the subsoil, two (02) selected soil samples were tested for the determination of chemical composition. The results are summarized below and also presented in Table 3-3 (Appendix-A).

Sulphate

The sulphate content of the tested soil samples varied from 0.01% to 0.03%

Chloride

The chloride content of the tested soil samples varied from 0.02% to 0.04%

Organic Matter

The organic content of the tested soil samples varied from 0.92% to 1.30%.

pH

The pH of the tested soil samples varied from 6.8 to 6.9.

3.8.2 Water Samples

In order to determine the chemical characteristics of groundwater, one (01) water sample collected from BH-06, was tested to determine the chemical composition. The results are summarized below and also presented in Table 3-3 (Appendix-A).

Sulphate

The sulphate content of the tested water sample was 72 mg/L.

Chloride

The chloride content of the tested water sample was 41 mg/L

pH

The pH of the tested water sample was 7.2.

Total Dissolved Solids

Total dissolved solids (TDS) in the tested water sample were 510 mg/L

4 GEOTECHNICAL CHARACTERIZATION OF SUBSOIL

4.1 General

The geotechnical investigations for the project involved a combination of field and laboratory work. The field and laboratory investigations were aimed at evaluating the engineering characteristics of the foundation soils/rock. The subsurface conditions and engineering and chemical characteristics of the soils existing at the proposed project site are discussed in the following sections.

4.2 Topography and Geology

During these geotechnical investigations the local ground elevations of all investigation points as provided by the Client, varied from EL 5.80m to EL 6.40m. The lithological units encountered at this site consist of dark brown silty clay as topsoil, underlain by grey to dark grey, loose to medium-dense Silty Sand. Rock units underlain by Silty Sand layer comprising interlayer Siltstone to Mudstone and Limestone were encountered in various boreholes, extending to a maximum explored depth of 37 meters.

4.3 Stratigraphy

During these investigations, the subsurface was explored to a maximum depth of 37m below the existing ground level (EGL). Taking into account the variation in stratigraphy across the project site, the entire area has been subdivided into two distinct zones, namely Zone-I & Zone-II. This delineation is visually represented in Fig. 2-1 and detailed in Table 4-1.

Table 4-1 Proposed zones and their relevant boreholes

Zone	Borehole Designation
ZONE I	BH-02, BH-03
ZONE II	BH-01, BH-04, BH-05, BH-06

4.3.1 Zone I

- Topsoil comprises dark brown, moist silty clay with abundant agricultural roots and gravel, varied in thickness from 0.0 to 0.25 m below EGL
- The 1st natural soil layer consists of **LEAN CLAY (CL)**, from 0.2 m below EGL. extending to a maximum depth of 6.0 m
- The 2nd natural soil layer consists of **SILTY SAND (SM)** to **POORLY GRADED SAND with SILT (SP-SM)**, extending from 6.0m to a maximum depth of 32.0 m below EGL.
- Below 32 m, a rock formation is encountered, comprising interlayer siltstone and mudstone that extends down to maximum explored depth of 36.0 m in this zone.

4.3.2 Zone II

- Topsoil comprises dark brown, moist silty clay with abundant agricultural roots and gravel, varied in thickness from 0.0 to 0.75 m below EGL.
- The natural soil layer comprises **Medium Dense to Very Dense SILTY SAND (SM) to POORLY GRADED SAND WITH SILT (SP-SM)**, extending from 0.75 m to a depth of 36m below EGL.
- Below 36 m, a rock formation was encountered, comprising mudstone to limestone that extends to maximum explored depth of 37.0 m in this zone.

The above information has been detailed on the respective borehole logs and linear subsurface profiles developed on the basis of borehole logs as shown in Fig. 4-1 to Fig 4-2 (Appendix-A).

4.4 Chemical Aggressivity

On the basis of concentrations of sulphates determined in the foundation soil samples, the exposure is classified as “**Class S0**” as explained in ACI 318M-19 Table 19.3.1.1. As per ACI 318M-19 Table 19.3.2.1 selection of cement has “No type Restriction”. Ordinary Portland Cement (OPC) should be used for the foundation construction. The concrete mix design should follow the recommendations of ACI 318M-19 accordingly.

4.5 Site Classification

In accordance with the Building Code of Pakistan (Ref. 7.4), the criteria for classification of uncemented soil profiles are to be based on;

- $\bar{v}_s$ = average shear wave velocity of the top 100 ft (30 m).
- or
- $\bar{N}$ or $\overline{N_{ch}}$ = average field SPT resistance for the top 100 ft (30 m).
- or
- $\bar{s}_u$ = average undrained shear strength for the top 100 ft (30 m).

Based on the average field standard penetration resistance ($\bar{N}$) observed down to 30m depth, the site soil as per Building Code of Pakistan (BCP-2021) and ASCE 7-16 (Ref. 7.5) should be classified as **Site Class D** (Stiff Soil).

4.6 Seismicity

According to the Building Code of Pakistan (BCP-2021) Table C-1 issued by Pakistan Engineering Council (Ref. 7.4), the spectral acceleration with ground motion level at 2% probability of exceedance in 50 years (2475 Years Return Period) for Thatta District is as follows:

$$\begin{aligned} \text{Short-Period Spectral Response acceleration (0.2-second),} & \quad S_s = 0.72 \\ \text{Long-Period Spectral Response acceleration (1-second),} & \quad S_1 = 0.18 \end{aligned}$$

4.7 Liquefaction Potential Assessment

The soil profile at the project site consists of layers of cohesionless material located beneath the groundwater table. These layers exhibit loose to very dense state of compactness. In order to evaluate the potential for liquefaction considering the prevailing seismic parameters, liquefaction potential assessment studies for the project site have been carried out using the procedure described in Ref. 7.3 for peak ground acceleration (PGA) of 0.20g caused by an earthquake of magnitude 6.0.

Factors of Safety (FS) against liquefaction for soil deposits for various boreholes have been evaluated using the available data. The minimum value of factor of safety ranged from 1.01 to 1.25 for boreholes (BH-02, BH-03 & BH-06). The factors of safety against liquefaction for borehole BH-02 to BH-03 and BH-06 are provided in Table 4-1 to Table 4-3 (Appendix-A), respectively. Based on the minimum factor of safety of 1.01 to 1.25 the structural foundations are safe against potential liquefaction failure.

4.8 Groundwater Observations

During the geotechnical investigations, groundwater levels were monitored using standpipe piezometers installed at six distinct locations, one in each of the six boreholes. The groundwater readings recorded during July 2024, are presented in Table 2-3 of Section 2.6.

5 FOUNDATION DESIGN

5.1 General

Design parameters have been selected on the basis of field and laboratory test results, literature and engineering judgement. Evaluations have been made for allowable bearing pressures for shallow and deep foundations which are discussed in the following sections.

5.2 Type of Foundation

Keeping in view the requirement of structural foundations and subsurface soil conditions present at the site, square / strip foundations have been evaluated as shallow foundations for lightly loaded structures. For heavily loaded structures, the bored cast in-situ piles have been evaluated. The design criteria, geotechnical design parameters, allowable bearing pressures and pile load carrying capacities are discussed in the following sections.

5.3 Foundation Design Parameters

Field and laboratory test data and engineering judgement have been utilized to determine the foundation design parameters. The following soil parameters are recommended for the design of foundations below existing ground level.

Table 5-1 Design Parameters for ZONE I

Sr. No.	Depth (m)	Material Type	Selected Parameters
1.	0.0 to -6.0	Lean Clay	Bulk Unit Weight (γ_b) = 18 kN/m ³ Undrained cohesion = 30 kPa Average SPT N_{55} = 9 Average SPT N'_{70} = 11 Modulus of Elasticity (E_s) = 9 MPa
2.	-6.0 to -18.0	Silty Sand / Poorly Graded Sand with Silt	Bulk Unit Weight (γ_b) = 18 kN/m ³ Average SPT N_{55} = 22 Average SPT N'_{70} = 17 Friction Angle (ϕ) = 33° Modulus of Elasticity (E_s) = 18 MPa
3.	-18.0 to -32.0	Silty Sand	Bulk Unit Weight (γ_b) = 19 kN/m ³ Average SPT N_{55} = 40 Average SPT N'_{70} = 23 Friction Angle (ϕ) = 35° Modulus of Elasticity (E_s) = 27.5 MPa

Table 5-2 Design Parameters for ZONE II

Sr. No.	Depth (m)	Material Type	Selected Parameters
1.	0.0 to -15.0	Silty Sand	Bulk Unit Weight (γ_b) = 18 kN/m ³ Average SPT N_{55} = 20 Average SPT N'_{70} = 18 Friction Angle (ϕ) = 33° Modulus of Elasticity (E_s) = 17.5 MPa
2.	-15.0 to -28.0	Silty Sand	Bulk Unit Weight (γ_b) = 18 kN/m ³ Average SPT N_{55} = 36 Average SPT N'_{70} = 22 Friction Angle (ϕ) = 35° Modulus of Elasticity (E_s) = 25.5 MPa
3.	-28.0 to -36.0	Silty Sand / Poorly Graded Sand with Silt	Bulk Unit Weight (γ_b) = 19 kN/m ³ Average SPT N_{55} = 44 Average SPT N'_{70} = 23 Friction Angle (ϕ) = 37° Modulus of Elasticity (E_s) = 29.5 MPa

5.4 Shallow Foundations

5.4.1 Depth of Foundations

Keeping in view the Client's requirements and subsurface stratigraphy, isolated square/strip footings for lightly loaded structures at EL 4.8m (i.e. 1.0m below EGL), were evaluated for various foundation sizes.

5.4.2 Design Criteria

For evaluation of allowable bearing pressures, the following two criteria are adopted;

- i- The allowable load should not initiate shear failure of the foundation soils, and
- ii- The total as well as differential settlements caused by the application of superimposed loads should be within specified tolerable limit of 25.4mm for square/strip foundations and 50.8mm for raft/mat foundations.

5.4.3 Allowable Bearing Pressures

The evaluations of bearing pressures are carried out by considering both the shear based as well as settlement-based criteria. The allowable bearing pressures have been computed based on shear criterion by using the *Brinch-Hansen's* approach (Ref. 7.1) and for settlement criterion by using *Meyerhof's approach* (Ref. 7.2).

The net allowable bearing pressures for isolated square and strip footings have been evaluated at 1.0m depth for various foundation sizes and are presented on Fig. 5-1 to Fig. 5-2 (Appendix-A).

The allowable bearing pressures as provided in this report are for normal axial loads on level ground. For eccentric loading conditions, the axial load, P_a will be:

$$P_a = q_a A_{\text{eff}}$$

where,

- P_a = gross allowable load
- A_{eff} = effective foundation area = $(L-2e_x)(B-2e_y)$
- q_a = allowable bearing pressure for axial loads, and
- L = length of foundation
- B = breadth of foundation
- e_x = magnitude of eccentricity along L
- e_y = magnitude of eccentricity along B

5.4.4 Modulus of Subgrade Reaction

Modulus of subgrade reaction K_s to be used in computer model for structural analysis can be evaluated from the basic definition of K_s by using the evaluated net allowable bearing pressure which causes the settlement under the maximum structural load and is as follows:

$$K_s \text{ (kN/m}^3\text{)} = \frac{\text{Evaluated Net Allowable Bearing Pressure} \times \text{FS}}{\text{Settlement under maximum structural pressure}}$$

5.5 Deep Foundations

5.5.1 Bored Cast in-place Piles

Piles as deep foundations have been evaluated for heavily loaded structures. Keeping in view the availability of pile construction equipment in the local market, bored cast in-place reinforced concrete piles are recommended as the deep foundations.

5.5.2 Length and Diameter

The load carrying capacities for single piles have been estimated for diameters of 610mm, 760mm and 1000mm for following different lengths i.e., 15m, 20m and 30m from an elevation of EL 5.30m (i.e., 0.5m below EGL) by keeping the pile tip embedded in cohesionless stratum.

5.5.3 Allowable Load Carrying Capacity

The allowable load carrying capacities of bored cast in-place concrete pile subjected to compression and uplift have been calculated according to procedure described in (Ref. 7.1 & 7.2). The load carrying capacities of pile in compression and uplift are presented on Fig. 5-3 to Fig. 5-6 (Appendix-A).

It is important to note that these capacities are based on numerical computations and must be confirmed through full scale pile load tests prior to the construction of working piles.

5.6 Construction Considerations

The soils at foundation level must be carefully inspected prior to placing the foundations to ensure that the soils are similar to those encountered in the borehole. Before placement of the foundation, 9" thick layer of well-graded gravel should be placed at the bottom of excavation followed by base compaction using plate compactor. The gravel layer should be compacted to at least 95% of modified proctor compaction.

Considering shallow groundwater table, dewatering and control of groundwater should be considered for the construction of foundations and excavation. The dewatering should be carried out to lower the groundwater down to 0.5m below the final formation/excavation level and bottom of excavated slopes. This is important to ensure the stability of excavated slopes and prevention of loss of material from the bottom of the slopes and the excavation.

The pile capacities and all recommendations are provided considering the use of bentonite slurry during drilling under proper construction supervision. The pile load carrying capacities are significantly influenced by the method of construction. Therefore, the pile capacities adopted in design must be confirmed through full scale pile load tests on piles constructed to the design depths using the same methodology as to be adopted for the working piles. The test piles shall be loaded to at least 3.0 times the theoretical design load carrying capacity of the pile or to failure.

Pile load tests shall be conducted on separate piles constructed outside the area of working piles. The length and diameter of the test piles should be the same as the designed working piles. The construction methodology and type of equipment used for the construction of test piles must also be same as envisaged for the working piles.

When several piles are clustered in a pile group it is reasonable to assume that the soil pressures produced from either skin friction or tip resistance will overlap. Therefore, in order to avoid excessive settlement and shear failure, the minimum centre-to-centre spacing between piles should be taken as $2.5D$. The proof load test shall be carried out on selected working piles with 1.5 times the design load. In order to ensure the quality of piling works the low strain integrity test (SIT) shall be carried out for the test piles as well as for all working piles to detect the irregularities.

6 CONCLUSIONS AND RECOMMENDATIONS

1. During these investigations, the subsurface was explored to a maximum depth of 37.0m below the existing ground level (EGL) using hydraulic feed straight rotary drilling technique.
2. During the period of these geotechnical investigations, groundwater was encountered at an average depth varied from 0.58m to 0.88m below existing ground level (EGL) in piezometers (PZ-1 to PZ-6) during the month of July 2024.
3. On the basis of average field standard penetration resistance ($\bar{N}$) observed down to 30m depth, the site soil as per Building Code of Pakistan (BCP-2021) and ASCE 7-16 should be classified as **Site Class D** (Stiff Soil).
4. For lightly loaded structures, the evaluated net allowable bearing pressures for different sizes of square/strip footings placed at EL 4.8, (i.e., at 1.0m below EGL), for various foundation sizes as shown in Fig. 5-1 to Fig. 5-2 (Appendix-A).
5. For heavily loaded structures, the allowable load carrying capacities of bored cast in-situ piles with a diameter of 610mm, 760mm and 1000mm for a length range of 15m to 30m subjected to compression and uplift are presented in Fig. 5-3 to Fig. 5-6 (Appendix-A).
6. On the basis of concentrations of sulphates determined in the foundation soil samples, the exposure is classified as "**Class S0**" as explained in ACI 318M-19 Table 19.3.1.1. As per ACI 318M-19 Table 19.3.2.1 selection of cement has "No type Restriction".
7. Results of liquefaction potential assessment for a PGA of 0.20g and magnitude of earthquake 6.0, indicated that the minimum value of factor of safety ranged from 1.01 to 1.25 for boreholes (BH-02, BH03 & BH-06). Based on the minimum factor of safety of 1.01, the structural foundations are safe against potential liquefaction failure. The results of liquefaction analyses are provided in Table 4-1 to Table 4-3 (Appendix-A),
8. Short-period and Long-period spectral response acceleration are provided in Section 4.6.

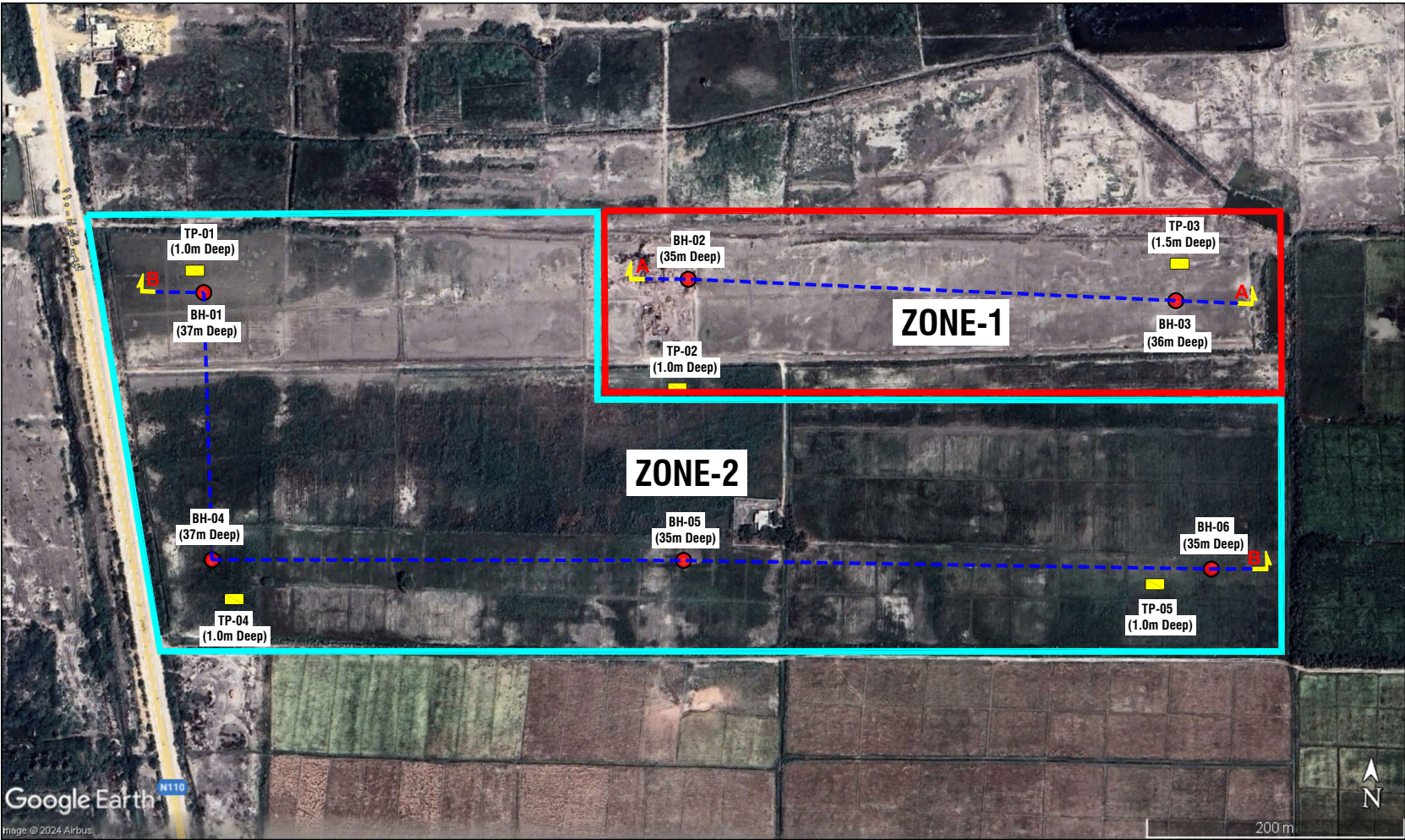
9. Important construction considerations, regarding the suitable geotechnical materials and compaction guidelines are detailed in Section 5.6 of this report.

7 REFERENCES

- 7.1 Bowles, J. E., *Foundation Analysis and Design*, McGraw Hill International Editions, Civil Engineering Series, 5th Edition, 1996.
- 7.2 Das, B. M. and Sivakugan, N., 2019. *Principles of Foundation Engineering*. 9th ed., Cengage Learning Inc., Boston, USA.
- 7.3 Youd, T. L. et al, "*Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils*", JGGE, Oct. 2001, pp 817-833.
- 7.4 BCP-2021, *Building Code of Pakistan (2021)*, Pakistan Engineering Council, 2021.
- 7.5 ASCE/SEI 7-16, *Minimum Design Load and Associated Criteria for Buildings and Other Structures*, American Society of Civil Engineers, 2017.

APPENDIX – A

(TABLES AND FIGURES)



SYMBOL	DESCRIPTION
	ROTARY BOREHOLE
	TEST PIT

CLIENT: MEGA MOTORS COMPANY (PVT) LTD.

PROJECT: CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH

TITLE: GEOTECHNICAL INVESTIGATIONS PLAN

DRAWN BY: Amir	 Berkeley Associates (Pvt) Ltd Consulting Engineers 24-D1, NESPAK Colony, Township, Lahore Contact: 042 35181331-3 E-mail: berkeley.associates@yahoo.com
CHECKED BY: M.R	
DATE: 27-07-2024	© COPYRIGHT THIS DRAWING REMAINS THE PROPERTY OF Berkeley Associates (Pvt) Ltd AND MAY NOT BE COPIED IN ANY WAY EXCEPT FOR FULFILLING THE SPECIFIC PURPOSE FOR WHICH IT IS ISSUED.
SCALE: N.T.S	JOB NO. J-875
	FIG. NO. 2-1

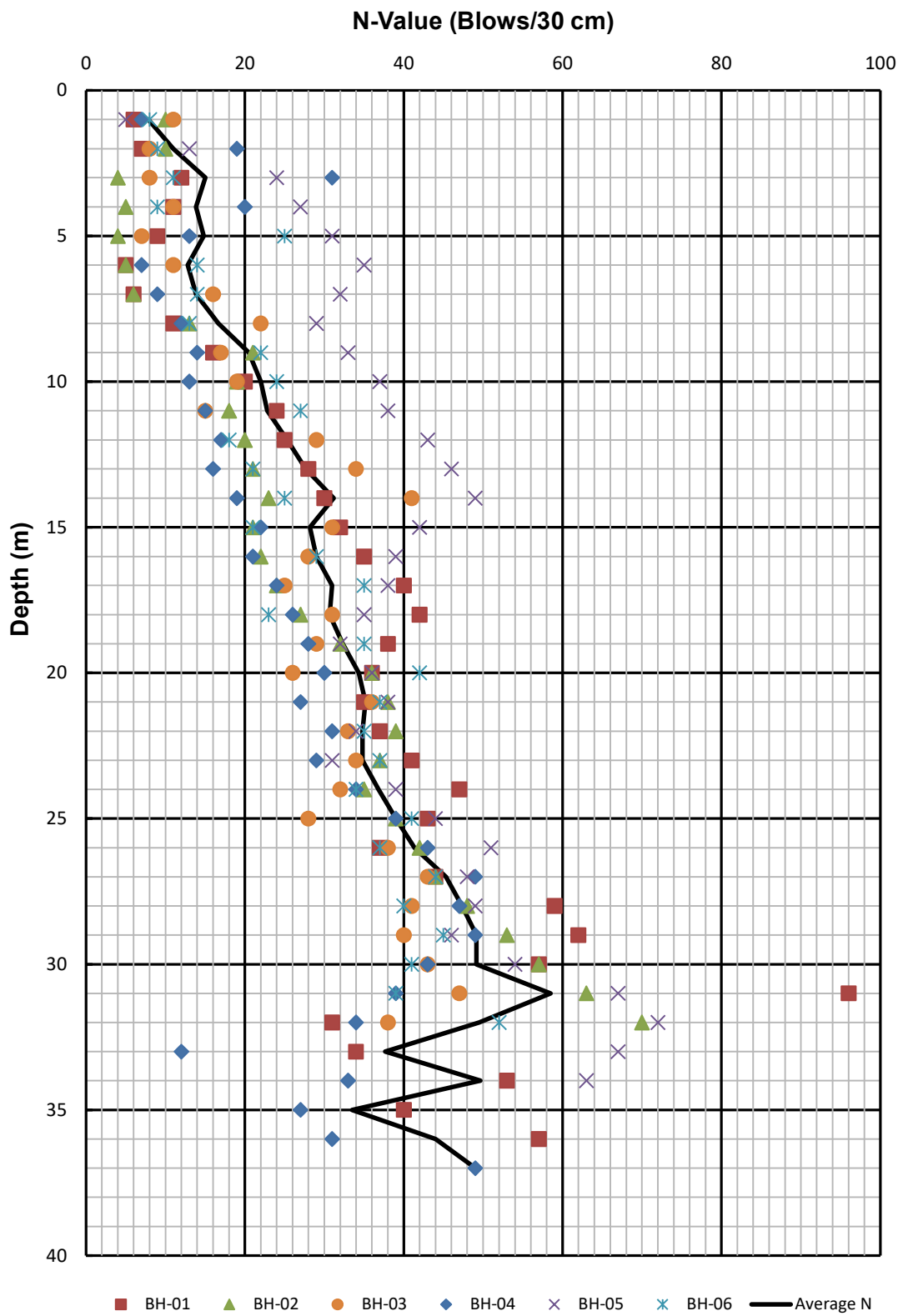
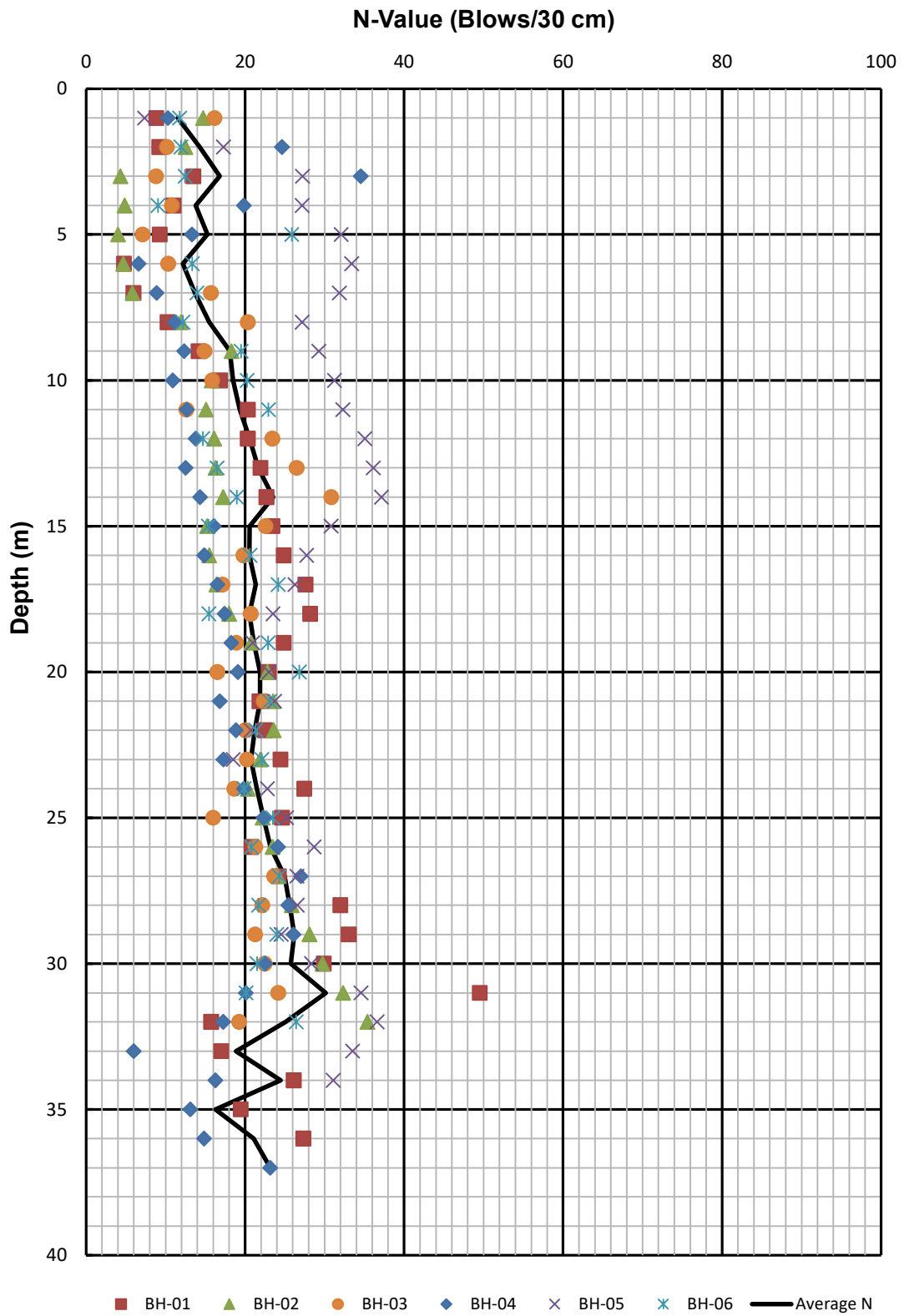


Fig. 2-2 Profile of Observed SPT N-values.



2-3 Profile of Corrected SPT N'_{70} values

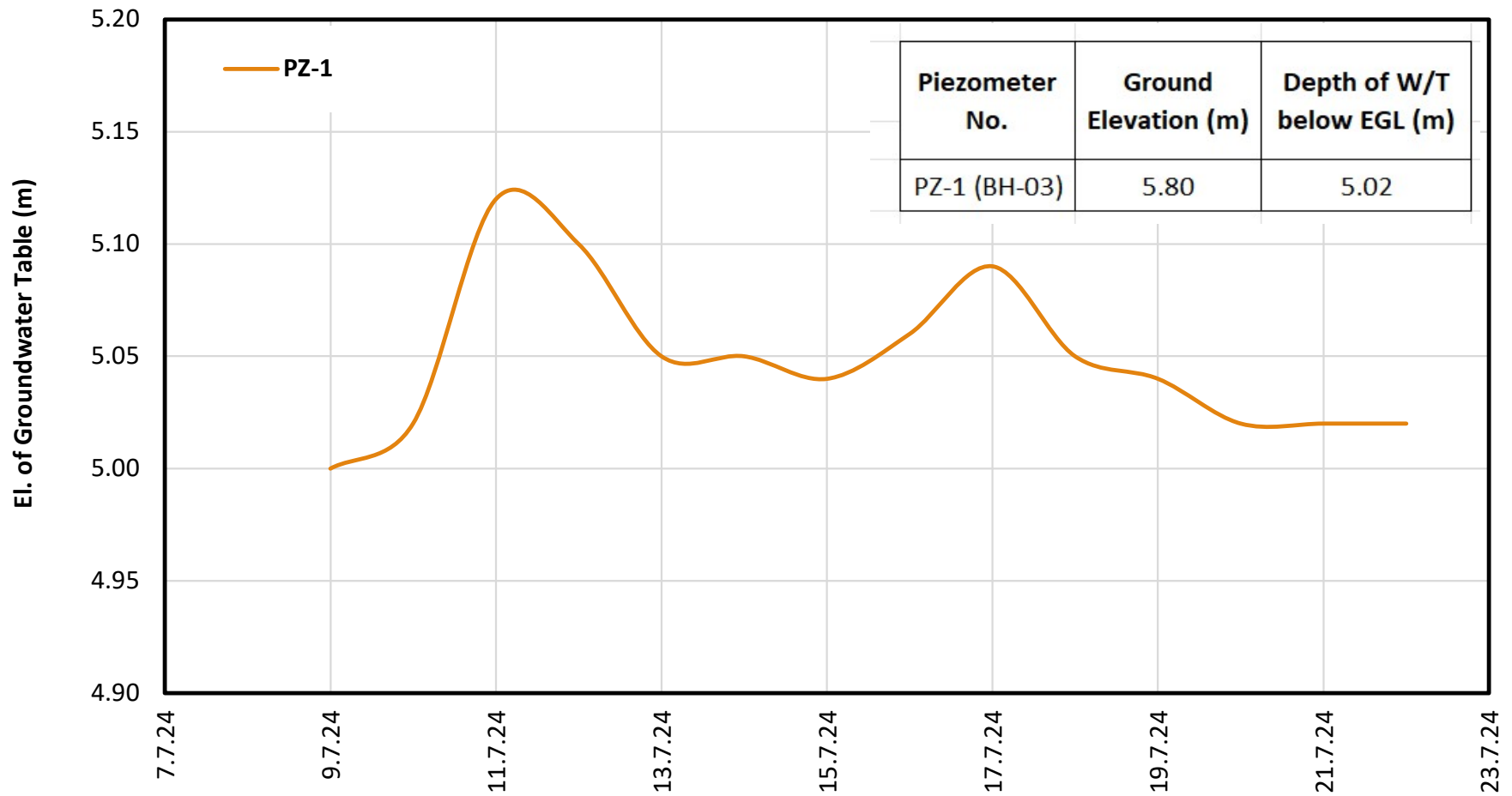


Fig. 2-4 Piezometric groundwater observation during the fieldwork period.

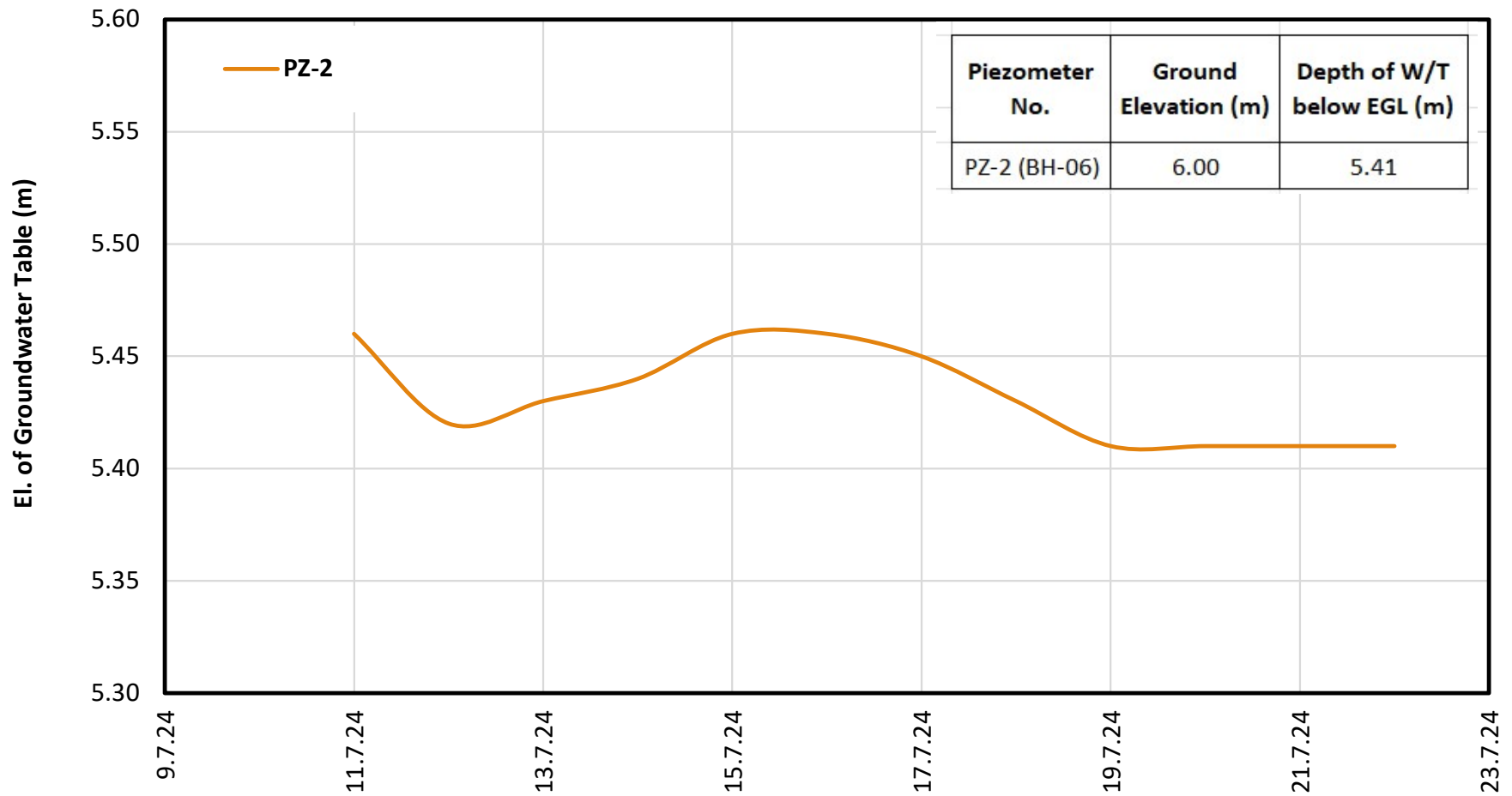


Fig. 2-5 Piezometric groundwater observation during the fieldwork period.

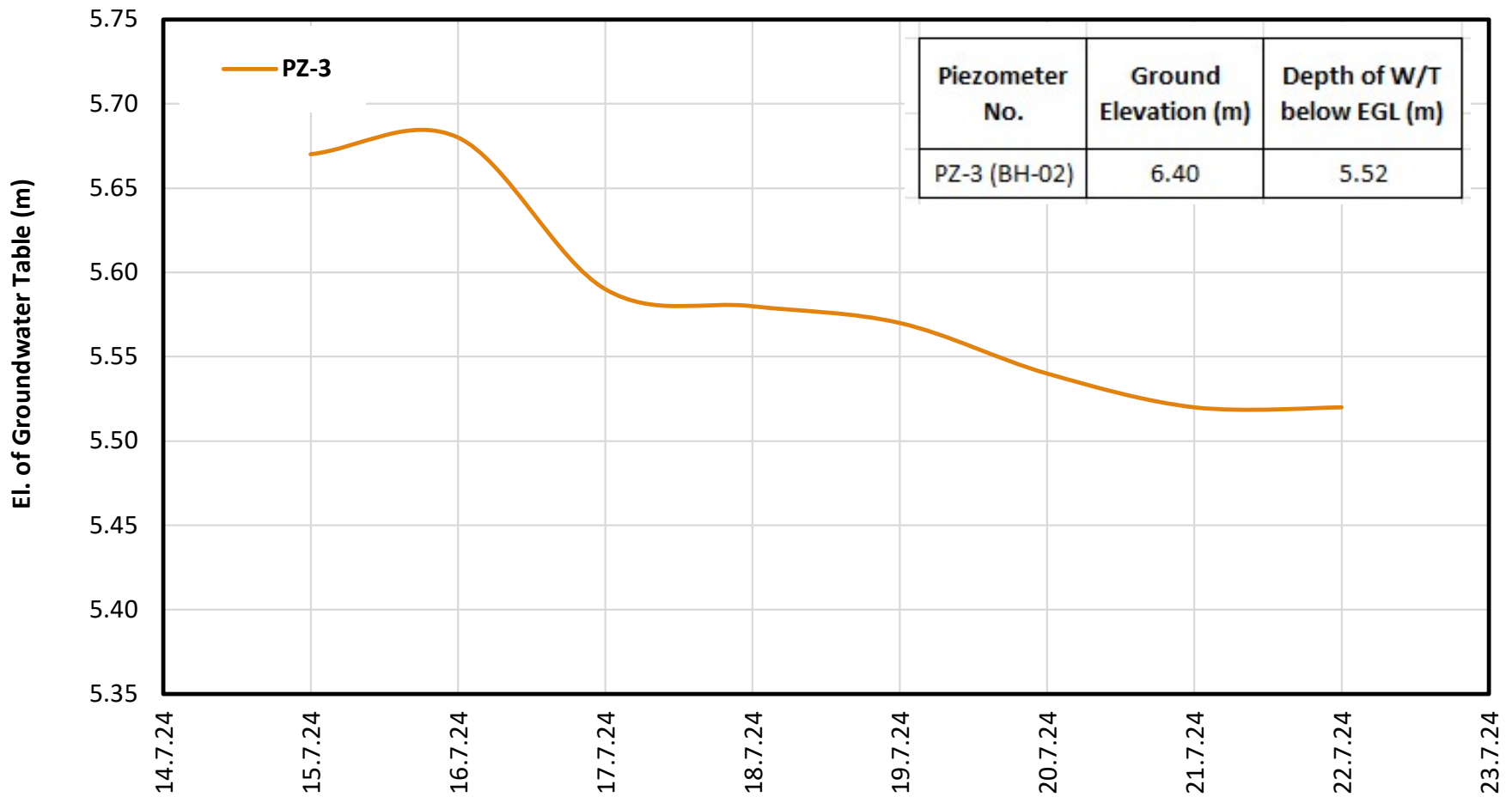


Fig. 2-6 Piezometric groundwater observation during the fieldwork period.

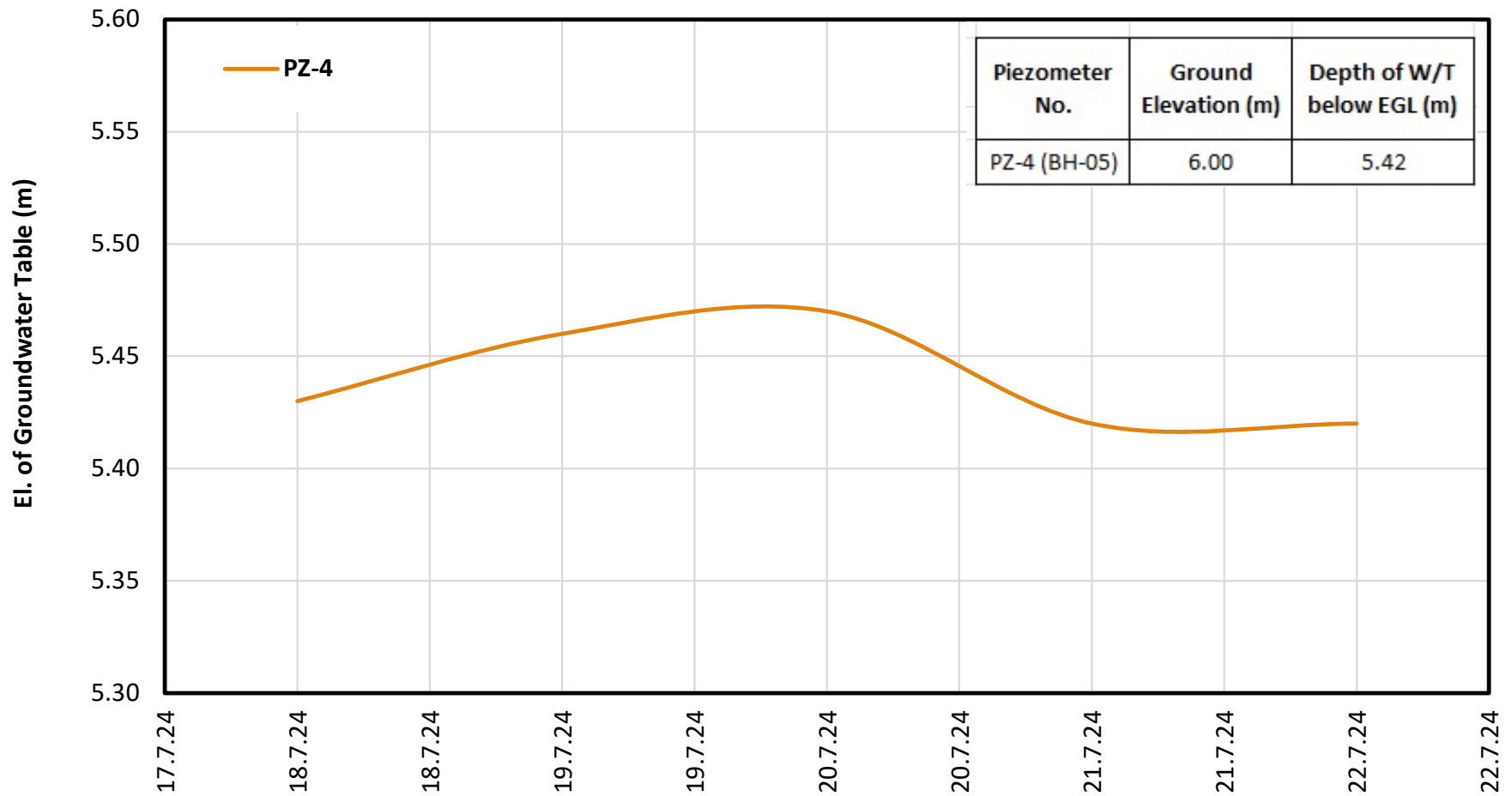


Fig. 2-7 Piezometric groundwater observation during the fieldwork period.

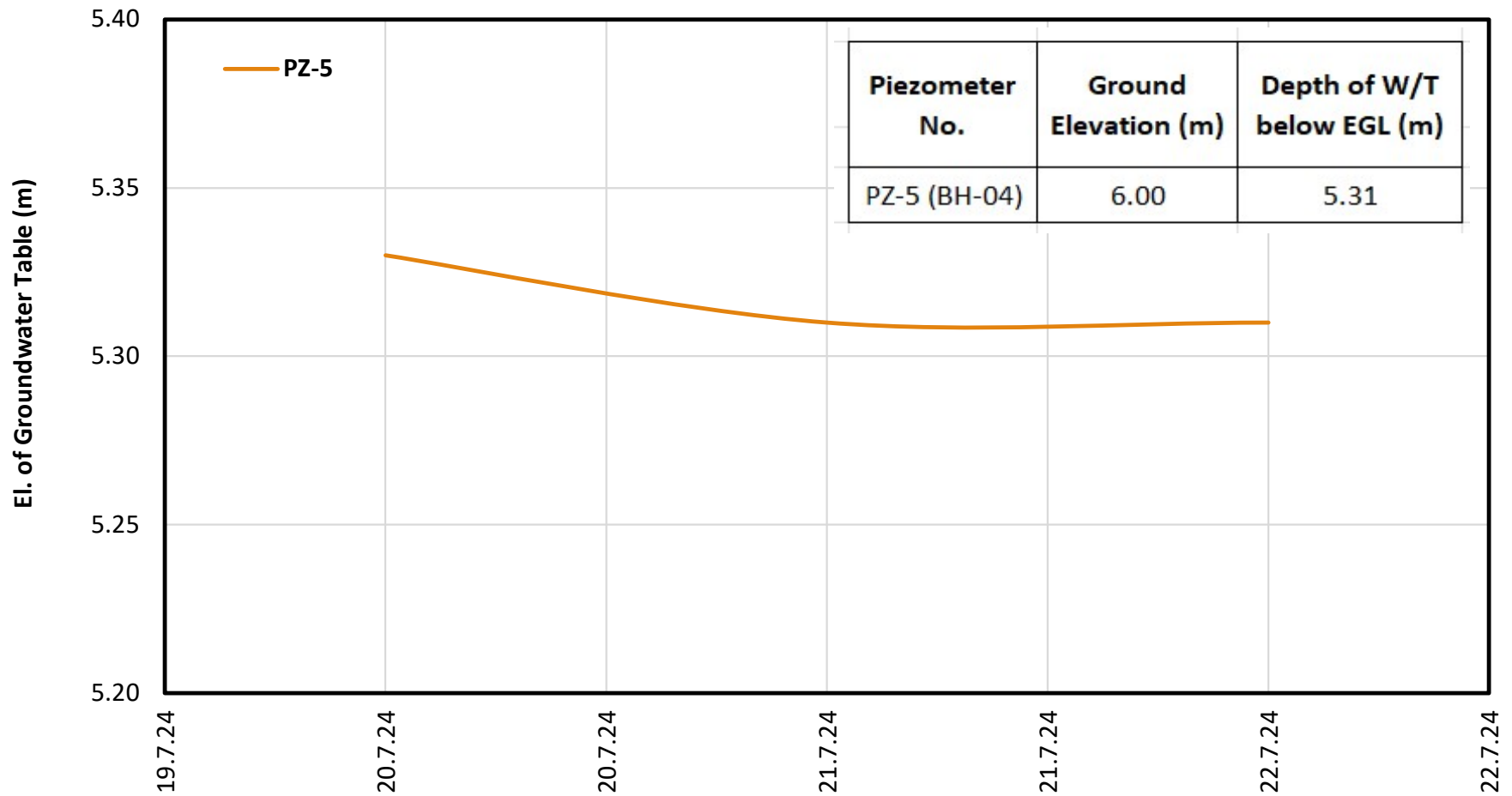
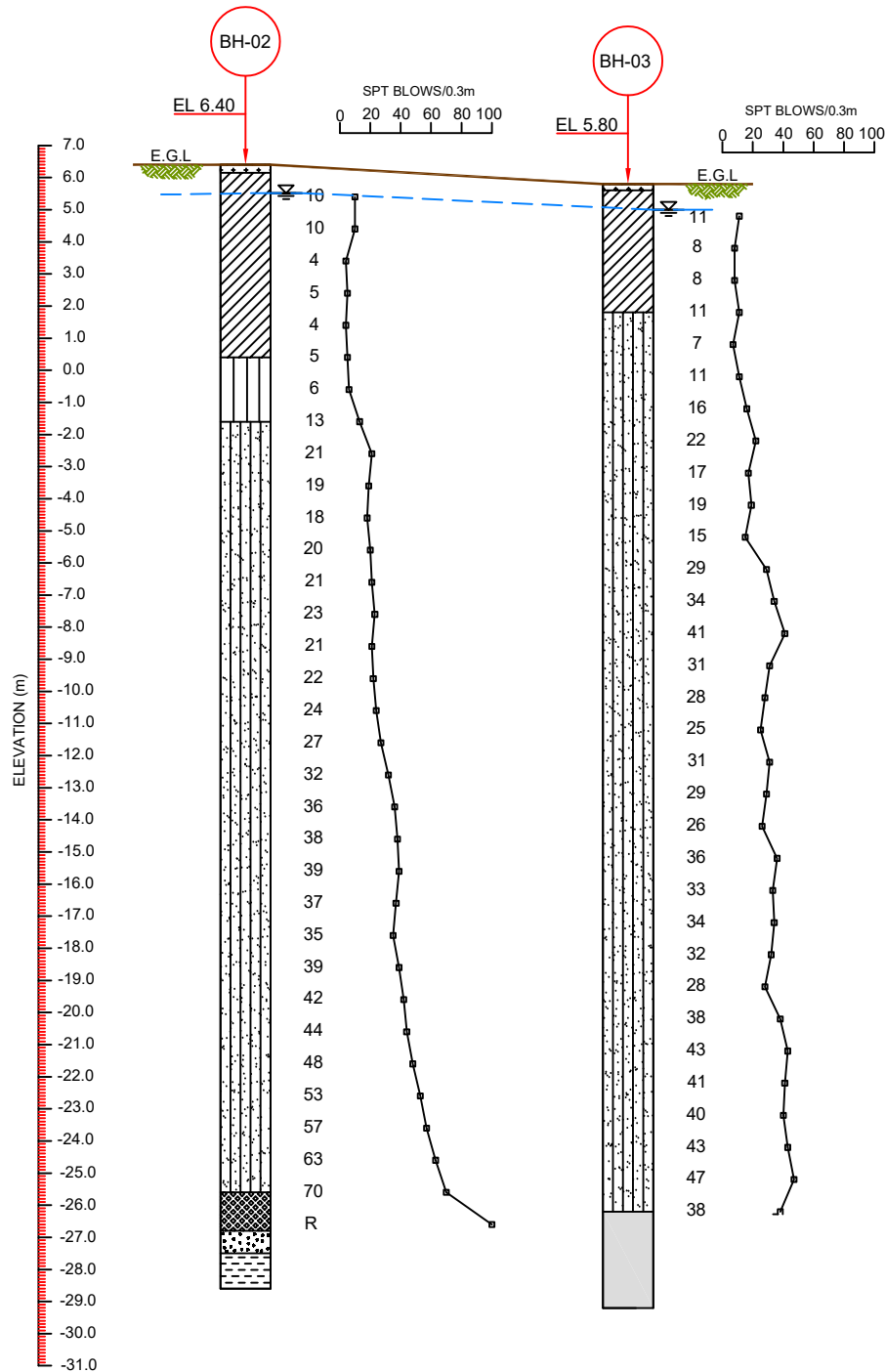


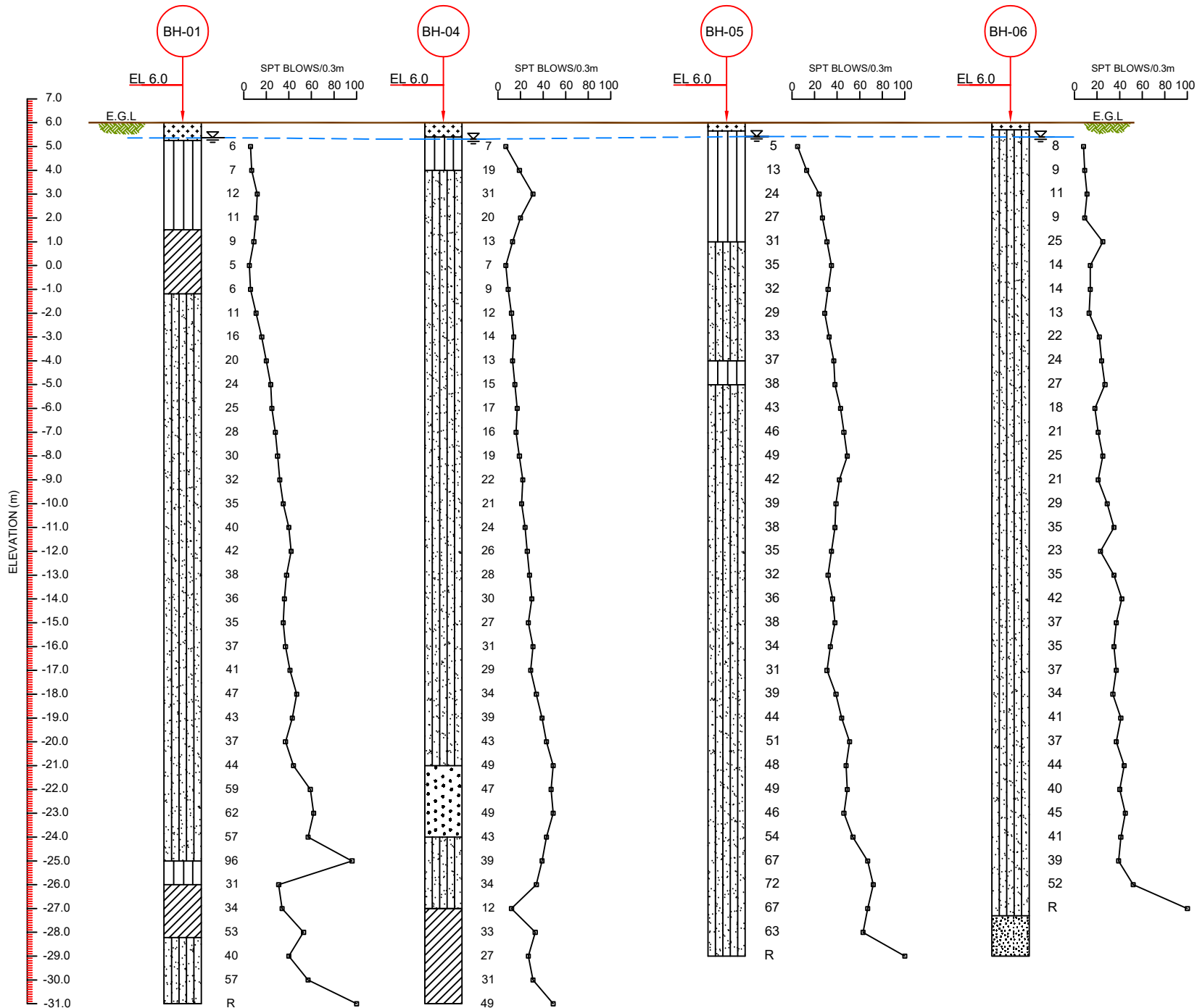
Fig. 2-8 Piezometric groundwater observation during the fieldwork period.



LEGEND:

- Topsoil
- Lean CLAY / Silty CLAY
- Silty SAND
- Sandy SILT
- Poorly-graded SAND
- SILTSTONE / LIMESTONE
- MARL
- Well-graded SAND with SILT
- MUDSTONE
- W.T
- SPT

CLIENT: MEGA MOTORS COMPANY (PVT) LTD.		
PROJECT: CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH		
TITLE: LINEAR SUBSURFACE PROFILE SECTION A-A (ZONE-I)		
DRAWN BY: AMIR	 Berkeley Associates (Pvt) Ltd Consulting Engineers	
CHECKED BY: M.R	24-D1, NESPAK Colony, Township, Lahore Contact: 042 35181331-3 E-mail: berkeley.associates@yahoo.com	
DATE: 27-07-2024	© COPYRIGHT THIS DRAWING REMAINS THE PROPERTY OF Berkeley Associates (Pvt) Ltd AND MAY NOT BE COPIED IN ANY WAY EXCEPT FOR FULFILLING THE SPECIFIC PURPOSE FOR WHICH IT IS ISSUED.	
SCALE: N.T.S	JOB NO. J-875	FIG. NO. 4-1



CLIENT: MEGA MOTORS COMPANY (PVT) LTD.		
PROJECT: CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH		
TITLE: LINEAR SUBSURFACE PROFILE SECTION B-B (ZONE-II)		
DRAWN BY: AMIR	 Berkeley Associates (Pvt) Ltd Consulting Engineers	
CHECKED BY: M.R	24-D1, NESPAK Colony, Township, Lahore Contact: 042 35181331-3 E-mail: berkeley.associates@yahoo.com	
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SCALE: N.T.S	JOB NO. J-875	FIG. NO. 4-2

Allowable Bearing Pressures Construction of Production Facility at Gharo Sindh

ZONE-I

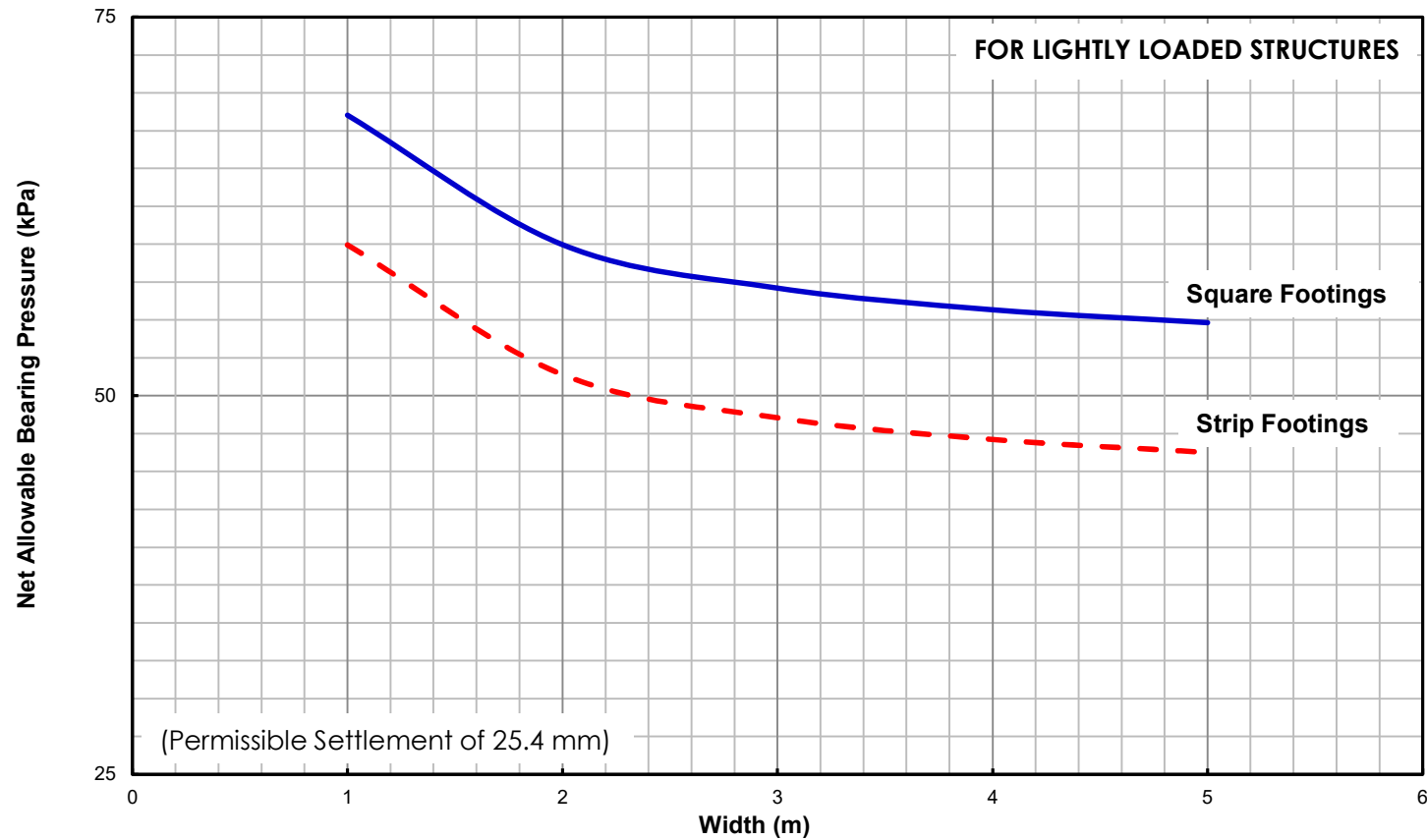


Fig. 5-1 Net Allowable Bearing Pressures for isolated Square / Strip footings placed at a depth of 1.0m below EGL (at EL 4.8m).



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Allowable Bearing Pressures
Construction of Production Facility at Gharo Sindh

ZONE-II

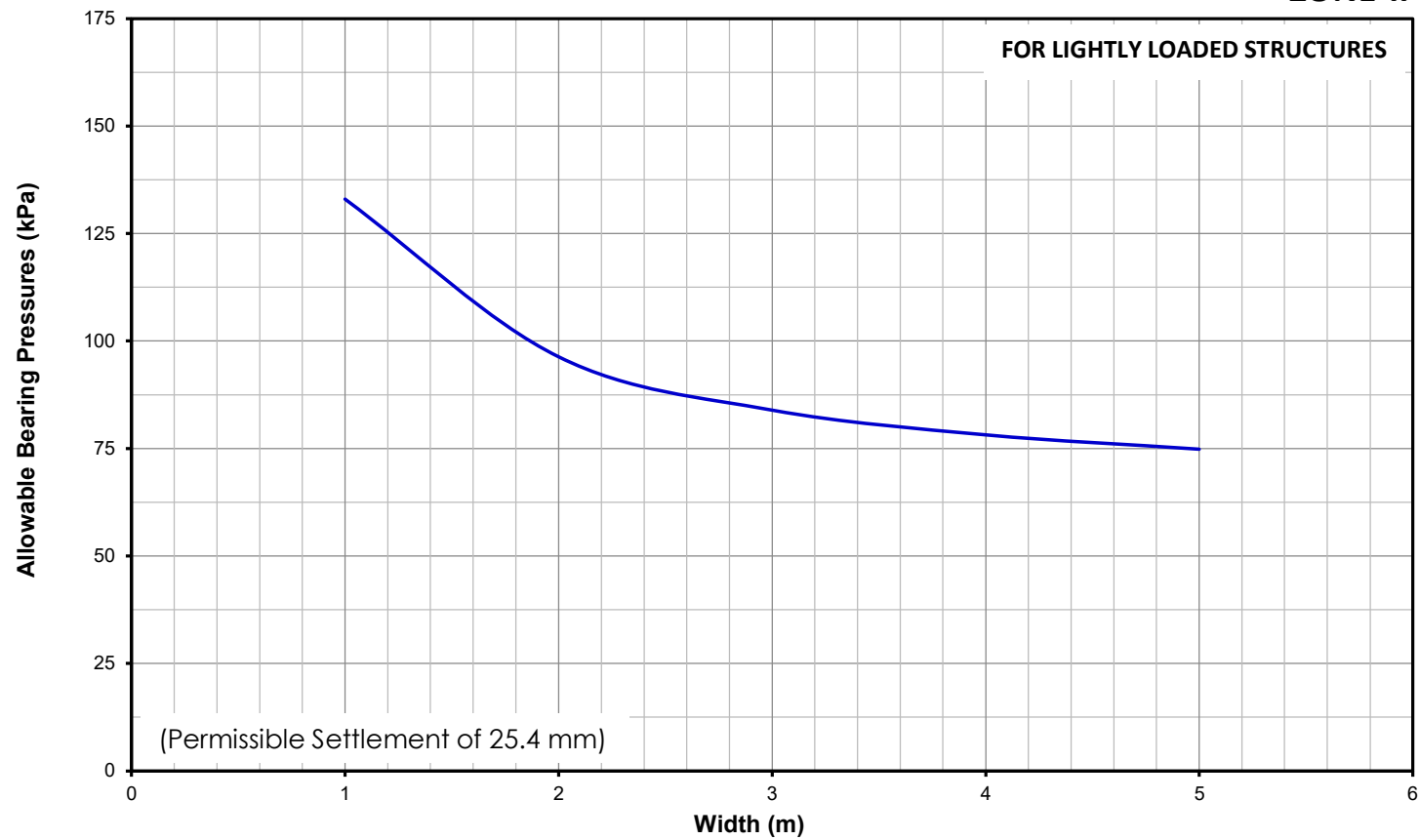


Fig. 5-2 Net Allowable Bearing Pressure for Isolated Square/ and Strip footings placed at 1.0m depth below EGL (i.e. at EL 4.8m).

Allowable Pile Carrying Capacities
Construction of Production Facility at Gharo Sindh

ZONE-I

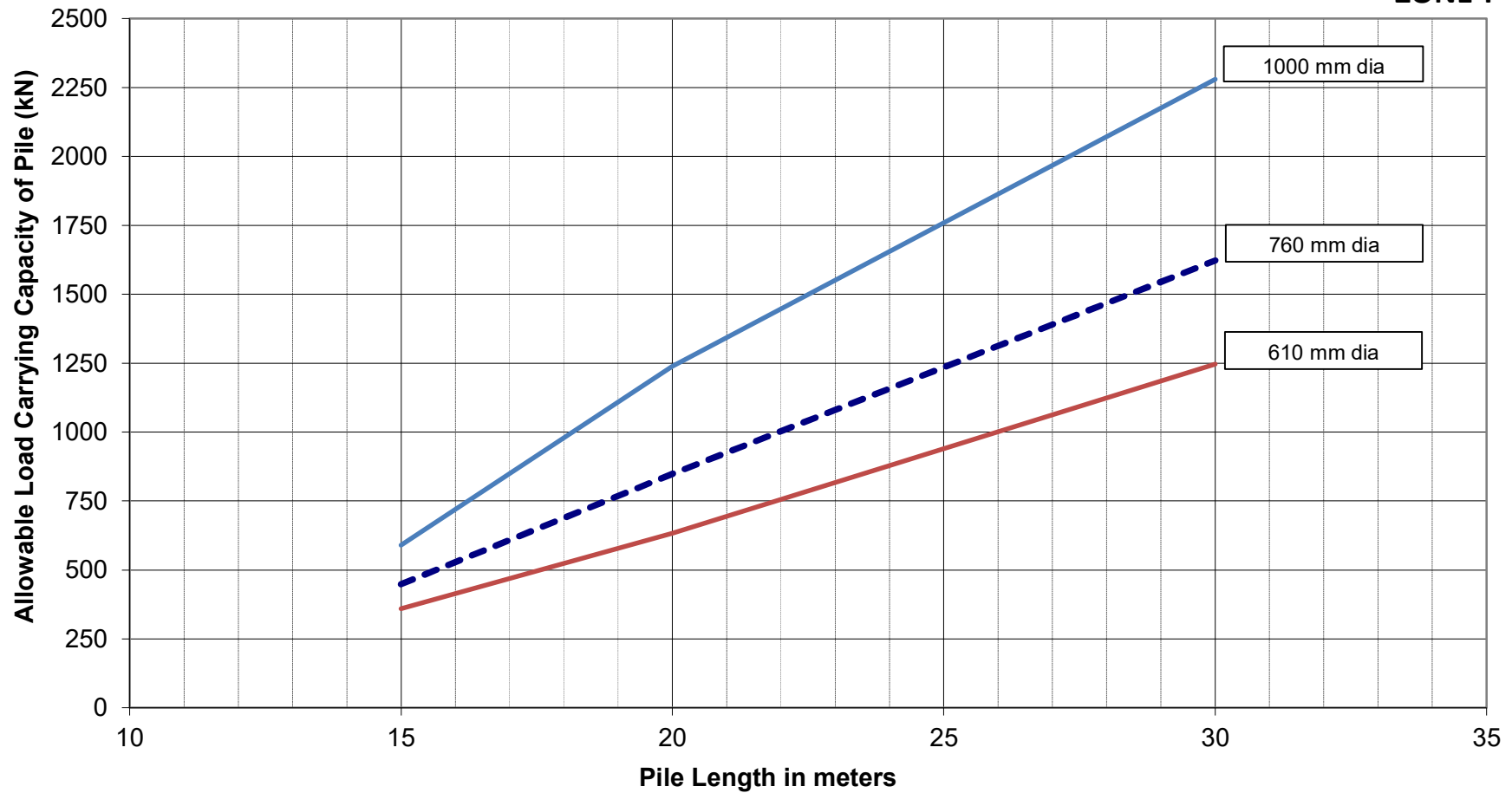


Fig. 5-3 Allowable Load Carrying Capacity of Piles in Compression from pile head at EL 5.3m (i.e., 0.5m below EGL).

Allowable Pile Carrying Capacities
Construction of Production Facility at Gharo Sindh

ZONE-I

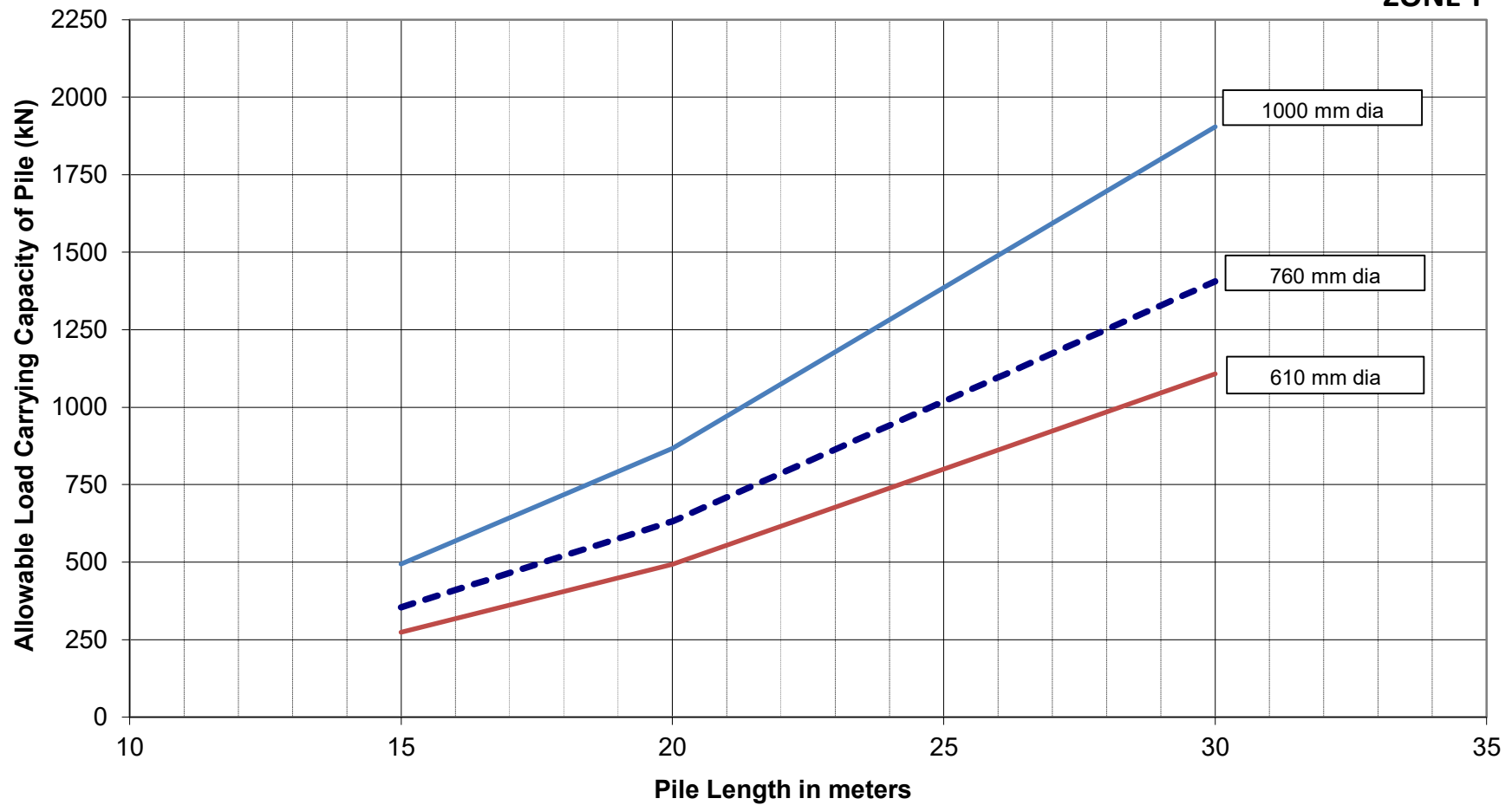


Fig. 5-4 Allowable Load Carrying Capacity of Piles in Uplift from pile heat at EL 5.3m (i.e., 0.5m below EGL).

Allowable Pile Carrying Capacities

Construction of Production Facility at Gharo Sindh

ZONE-II

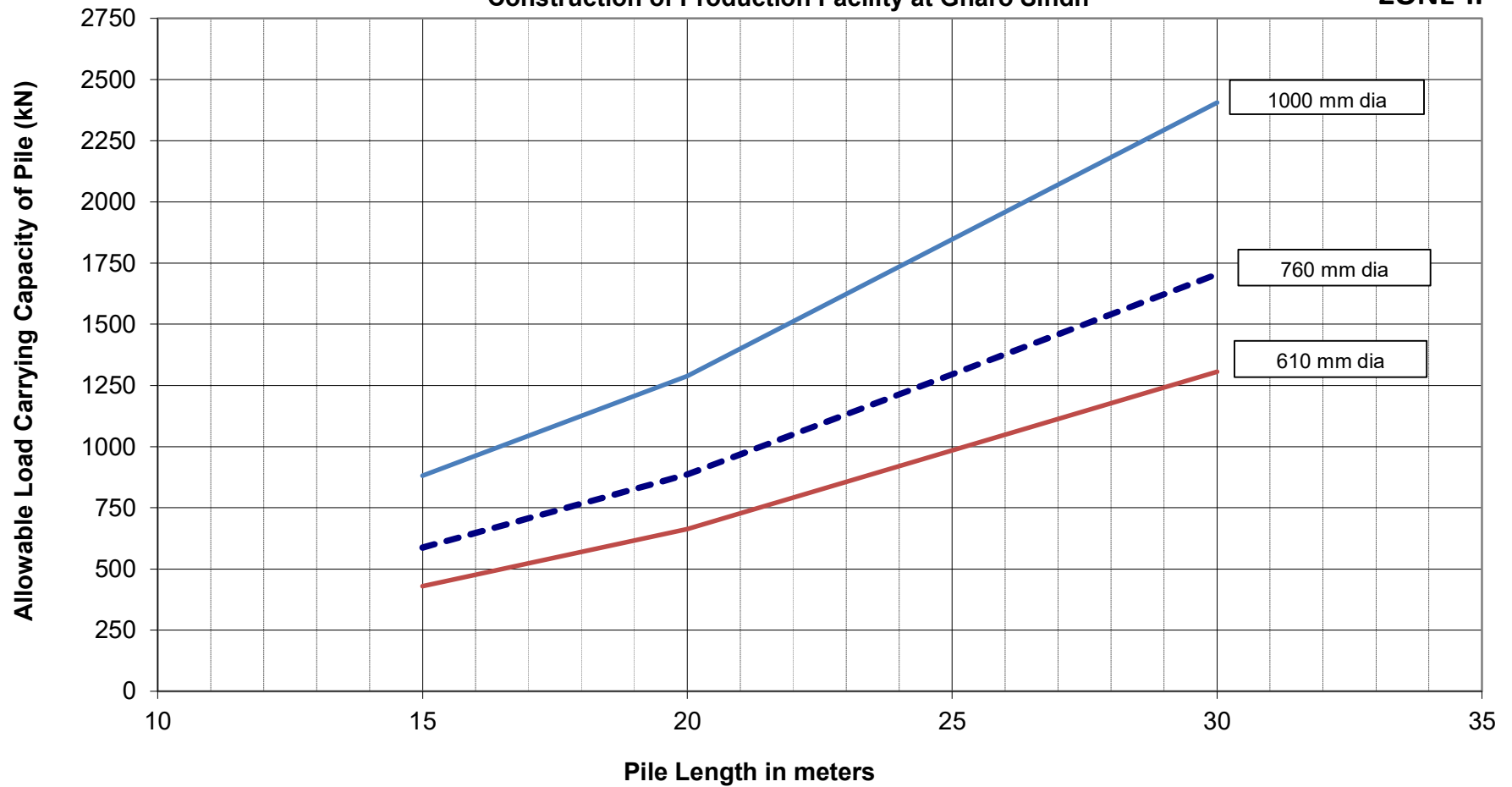


Fig. 5-5 Allowable Load Carrying Capacity of Piles in Compression from pile head at EL 5.3m (i.e., 0.5m below EGL).

Allowable Pile Carrying Capacities

Construction of Production Facility at Gharo Sindh

ZONE-II

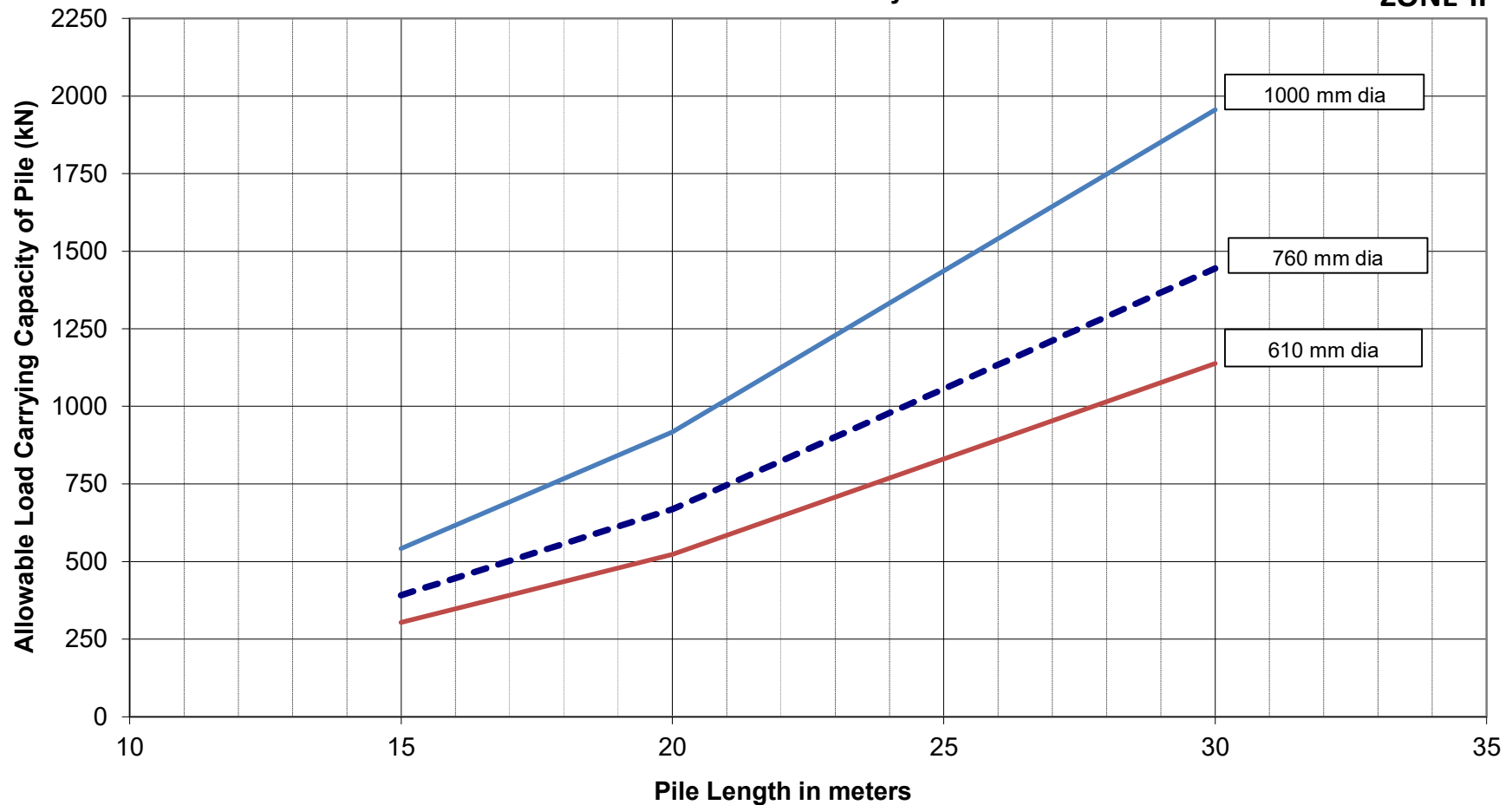


Fig. 5-6 Allowable Load Carrying Capacity of Piles in Uplift from pile head at EL 5.3m (i.e., 0.5m below EGL).



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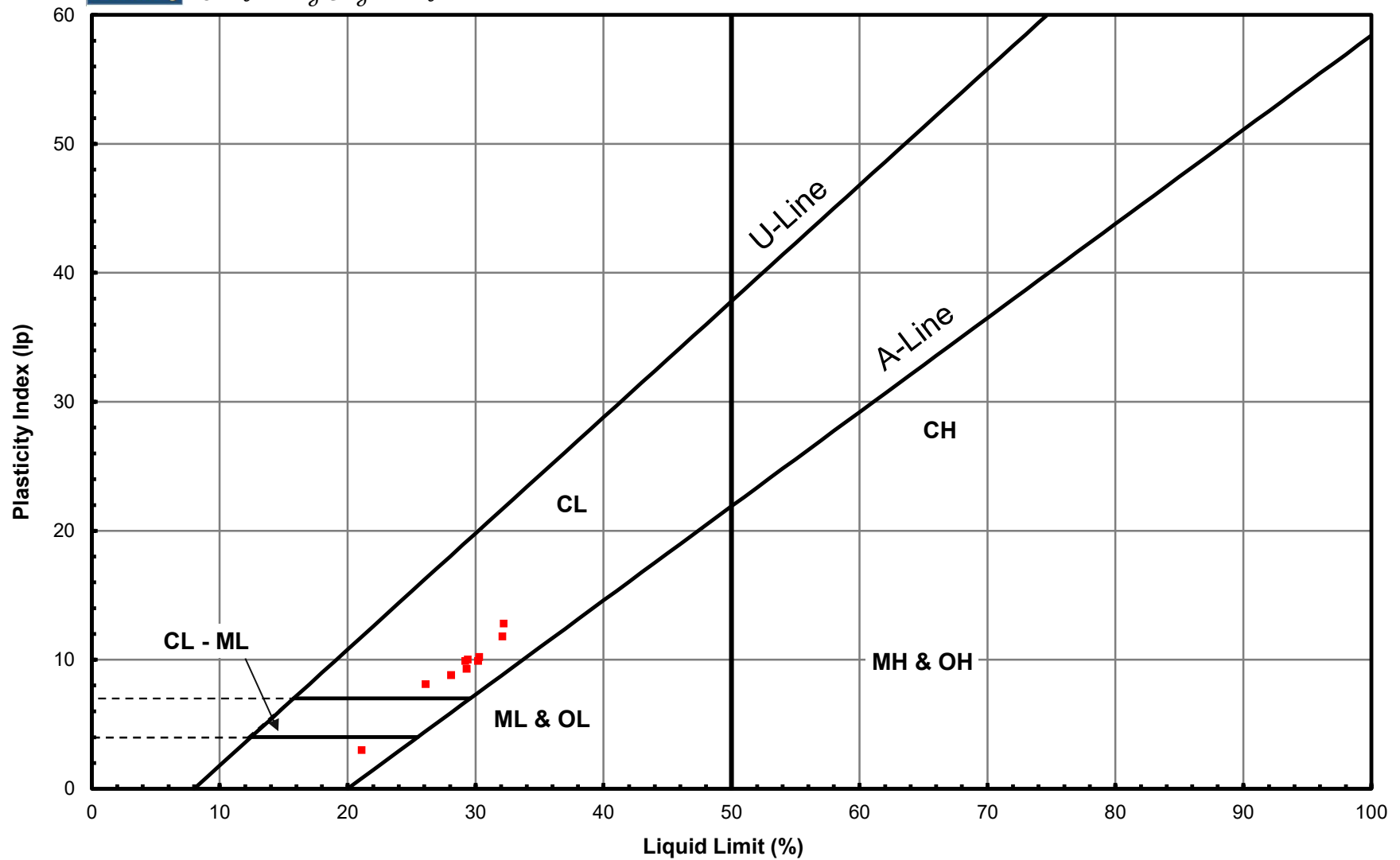


Fig. 3-1 Casagrande's Plasticity Chart.

Table 3-1 Summary of Laboratory Test Results

Project: Construction of a Production Facility, Gharo, Sindh

Sheet 1 of 2

[illegible]

Project: Construction of a Production Facility, Gharo, Sindh



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Table 3-2 Chemical Test Results on Soil Samples

Project: CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH

Borehole No.	Sample No.	Depth (meter)	Sulphate Content (%)	Chloride Content (%)	Organic Matter (%)
BH-03	UDS-1	1.50	0.03	0.04	0.92
BH-06	SPT-9	9.00	0.01	0.02	1.30

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



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Table 3-2 Chemical Test Results on Water samples

Project: CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH SHEET 02 OF 02

Borehole No.	Sample No.	Depth (m)	Sulphate Content (ppm)	Chloride Content (ppm)	Total Dissolve Solids (ppm)	pH Value
BH-06	WS	0.60	72	41	510	7.2

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



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Table 4-1 Results of Liquefaction Potential Analyses (BH-02)

Depth (m)	N_{Field}	N_{60}'	α	β	$(N_{60}')_{cs}$	r_d	σ_o	σ_o'	CSR	CRR	FS	Remarks
7.0	6	7	5.000	1.200	13.4	0.949	126.0	63.2	0.2458	0.1441	1.04	OK
8.0	13	14	1.888	1.037	16.9	0.937	144.0	71.4	0.2457	0.1798	1.29	OK
9.0	21	22	1.888	1.037	25.1	0.923	162.0	79.6	0.2442	0.2948	2.14	OK
10.0	19	21	1.888	1.037	23.2	0.905	180.0	87.8	0.2412	0.2595	1.90	OK
11.0	18	19	1.888	1.037	21.3	0.883	198.0	96.0	0.2368	0.2320	1.73	OK
12.0	20	20	1.888	1.037	22.6	0.857	216.0	104.2	0.2309	0.2515	1.93	OK
13.0	21	20	1.888	1.037	22.9	0.827	234.0	112.4	0.2238	0.2557	2.02	OK
14.0	23	21	1.888	1.037	24.1	0.794	252.0	120.5	0.2158	0.2758	2.26	OK
15.0	21	19	3.191	1.065	23.4	0.761	270.0	128.7	0.2074	0.2628	2.24	OK
16.0	22	19	3.191	1.065	23.7	0.728	288.0	136.9	0.1990	0.2675	2.38	OK
17.0	24	20	3.191	1.065	24.8	0.696	306.0	145.1	0.1908	0.2885	2.68	OK
18.0	27	22	3.191	1.065	26.8	0.667	324.0	153.3	0.1833	0.3330	3.22	OK
19.0	32	26	3.191	1.065	30.4	0.641	342.0	161.5	0.1765	0.4951	4.97	OK



Table 4-2 Results of Liquefaction Potential Analyses (BH-03)

[illegible]



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Table 4-3 Results of Liquefaction Potential Analyses (BH-04)

Depth (m)	N _{Field}	N ₆₀ '	α	β	(N ₆₀ ') _{cs}	r _d	σ_o	σ_o'	CSR	CRR	FS	Remarks
1.0	8	8	5.000	1.200	14.9	0.994	18.0	16.0	0.1451	0.1590	1.94	OK
2.0	9	9	4.600	1.142	14.6	0.987	36.0	24.2	0.1906	0.1560	1.45	OK
3.0	11	11	4.600	1.142	16.9	0.979	54.0	32.4	0.2121	0.1801	1.50	OK
4.0	9	9	4.600	1.142	14.8	0.973	72.0	40.6	0.2242	0.1578	1.25	OK
5.0	25	24	4.600	1.142	31.5	0.965	90.0	48.8	0.2315	0.6267	4.79	OK
6.0	14	14	4.600	1.142	20.7	0.958	108.0	57.0	0.2359	0.2237	1.68	OK
7.0	14	13	4.600	1.142	19.9	0.949	126.0	65.2	0.2384	0.2147	1.59	OK
8.0	13	12	4.600	1.142	18.2	0.937	144.0	73.4	0.2391	0.1945	1.44	OK
9.0	22	19	4.600	1.142	26.7	0.923	162.0	81.6	0.2383	0.3315	2.46	OK
10.0	24	21	5.000	1.200	30.7	0.905	180.0	89.7	0.2359	0.5235	3.93	OK
11.0	27	23	1.003	1.024	24.7	0.883	198.0	97.9	0.2320	0.2864	2.18	OK
12.0	18	15	1.003	1.024	16.2	0.857	216.0	106.1	0.2266	0.1728	1.35	OK
13.0	21	17	1.003	1.024	18.2	0.827	234.0	114.3	0.2200	0.1936	1.56	OK
14.0	25	19	1.003	1.024	20.7	0.794	252.0	122.5	0.2124	0.2248	1.87	OK
15.0	21	16	1.003	1.024	17.0	0.761	270.0	130.7	0.2043	0.1812	1.57	OK
16.0	29	21	1.003	1.024	22.4	0.728	288.0	138.9	0.1961	0.2485	2.24	OK
17.0	35	25	1.003	1.024	26.1	0.696	306.0	147.1	0.1883	0.3151	2.96	OK
18.0	23	16	1.003	1.024	17.0	0.667	324.0	155.3	0.1810	0.1808	1.77	OK
19.0	35	23	1.003	1.024	24.6	0.641	342.0	163.5	0.1743	0.2849	2.89	OK
20.0	42	27	1.003	1.024	28.6	0.618	360.0	171.6	0.1685	0.3911	4.11	OK

APPENDIX – B

(BOREHOLE / TEST PIT LOGS)



BOREHOLE LOG: BH-01

PROJECT:	Construction of Production facility at Gharo Sindh	STARTED :	July 20, 2024	FINAL DEPTH:	37 m
LOCATION:	Gharo Sindh	FINISHED :	July 22, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 357471.109 N : 2735190.313	DEPTH OF GWT:	0.63 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	1 OF 2

DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	SPT / 0.3 m	SPT PROFILE
0	6.0	HYDRAULIC FEED STRAIGHT ROTARY DRILLING			Topsoil, silty clay, brown, low-plastic, some plants roots, moist, trace gravel			20 40 60 80
1	5.0		SPT-1		SANDY SILT (ML), loose to medium dense, greenish gray, wet		6	
2	4.0		SPT-2				7	
3	3.0		SPT-3				12	
4	2.0		SPT-4				11	
5	1.0		SPT-5		Lean CLAY (CL), firm to stiff, dark gray, low to medium-plastic, wet		9	
6	0.0		SPT-6				5	
7	-1.0		UDS-01				6	
8	-2.0		SPT-7		SILTY SAND (SM), loose to very dense, brownish gray to dark gray, wet, trace mica, trace gravel		11	
9	-3.0		SPT-8				16	
10	-4.0		SPT-9				20	
11	-5.0		SPT-10				24	
12	-6.0		SPT-11				25	
13	-7.0		SPT-12				28	
14	-8.0		SPT-13				30	
15	-9.0		SPT-14				32	
16	-10.0		SPT-15				35	
17	-11.0		SPT-16				40	
18	-12.0		SPT-17				42	
19	-13.0		SPT-18				38	
20	-14.0		SPT-19				36	
			SPT-20					
					(CONTINUED)			

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-01

PROJECT:	Construction of Production facility at Gharo Sindh	STARTED :	July 20, 2024	FINAL DEPTH:	37 m
LOCATION:	Gharo Sindh	FINISHED :	July 22, 2024	LOGGED BY:	Zulqarnain
COORDS:	E: 357471.109 N : 2735190.313	DEPTH OF GWT:	0.63 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	2 OF 2

DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	SPT / 0.3 m	SPT PROFILE
								20 40 60 80
20	-14.0	HYDRAULIC FEED STRAIGHT ROTARY DRILLING	SPT-20		SILTY SAND (SM), medium dense to very dense, brownish gray to dark gray, wet, trace mica, trace gravel		36	
21	-15.0		SPT-21				35	
22	-16.0		SPT-22				37	
23	-17.0		SPT-23				41	
24	-18.0		SPT-24				47	
25	-19.0		SPT-25				43	
26	-20.0		SPT-26				37	
27	-21.0		SPT-27				44	
28	-22.0		SPT-28				59	
29	-23.0		SPT-29				62	
30	-24.0		SPT-30				57	
31	-25.0		SPT-31		SILT with SAND (ML), hard, dark gray, hard, wet		96	
32	-26.0		SPT-32		Lean CLAY (CL), hard, grayish brown, hard, moist		31	
	-26.5		UDS-02					
33	-27.0		SPT-33				34	
	-27.5		UDS-03		SILTY SAND (SM), dense to very dense, yellowish gray to brownish gray, moist, trace mica		53	
34	-28.0		SPT-34					
35	-29.0		SPT-35				40	
36	-30.0		SPT-36				57	
37	-31.0		SPT-37				R	
					(Bottom of the borehole at 37.0 m)			
38								
39								
40								

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-02

PROJECT:	Construction of Production facility at Gharo Sindh	STARTED :	July 13, 2024	FINAL DEPTH:	35 m
LOCATION:	Gharo Sindh	FINISHED :	July 14, 2024	LOGGED BY:	Zulqarnain
COORDS:	E: 357854.402 N : 2735208.872	DEPTH OF GWT:	0.88 m	CHECKED BY:	M.R
GROUND ELEV:	6.40 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	1 OF 2

DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	CORE RECOVERY (%)	R.Q.D (%)	SPT / 0.3 m	SPT PROFILE
										20 40 60 80
0	6.40	HYDRAULIC FEED STRAIGHT ROTARY DRILLING		+ +	Topsoil, silty clay, greyish brown, low-plastic, mixed with agricultural grass roots, very moist					
1	5.40		SPT-1		LEAN CLAY(CL), soft to stiff, grayish brown to dark brown, low-plastic to non-plastic, moist to wet				10	
	4.90		UDS-01							
2	4.40		SPT-2						10	
3	3.40		SPT-3						4	
	2.90		UDS-02							
4	2.40		SPT-4						5	
5	1.40		SPT-5						4	
	0.90		UDS-03							
6	0.40		SPT-6						5	
7	-0.60		SPT-7			SILT with SAND (ML), firm, gray, non-plastic, wet, trace mica			6	
8	-1.60		SPT-8						13	
9	-2.60		SPT-9			SILTY SAND (SM), medium dense to very dense, gray to dark gray, wet, trace mica			21	
10	-3.60		SPT-10						19	
11	-4.60	SPT-11						18		
12	-5.60	SPT-12						20		
13	-6.60	SPT-13						21		
14	-7.60	SPT-14						23		
15	-8.60	SPT-15						21		
16	-9.60	SPT-16						22		
17	-10.60	SPT-17						24		
18	-11.60	SPT-18						27		
19	-12.60	SPT-19						32		
20	-13.60	SPT-20						36		
					(CONTINUED)					

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-02

PROJECT:	Construction of Production facility at Gharo Sindh	STARTED :	July 13, 2024	FINAL DEPTH:	35 m
LOCATION:	Ghara Sindh	FINISHED :	July 14, 2024	LOGGED BY:	Zulqarnain
COORDS:	E: 357854.402 N : 2735208.872	DEPTH OF GWT:	0.88 m	CHECKED BY:	M.R
GROUND ELEV:	6.40 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	2 OF 2

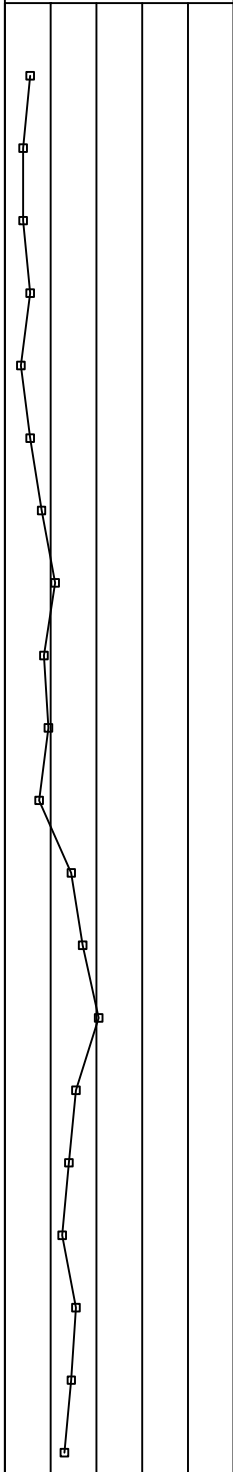
DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	CORE RECOVERY (%)	R.Q.D (%)	SPT / 0.3 m	SPT PROFILE
20	-13.60	HYDRAULIC FEED STRAIGHT ROTARY DRILLING	SPT-20		SILTY SAND (SM), medium dense to very dense, gray to dark gray, wet, trace mica				36	
21	-14.60		SPT-21						38	
22	-15.60		SPT-22						39	
23	-16.60		SPT-23						37	
24	-17.60		SPT-24						35	
25	-18.60		SPT-25						39	
26	-19.60		SPT-26						42	
27	-20.60		SPT-27						44	
28	-21.60		SPT-28						48	
29	-22.60		SPT-29						53	
30	-23.60		SPT-30						57	
31	-24.60		SPT-31						63	
32	-25.60		SPT-32						70	
33	-26.60		SPT-33						R	
34	RUN-1				SILT STONE, yellowish brown, highly weathered to highly fractured, medium strong		41	0	R	
34	RUN-2				MUDSTONE, yellowish brown, fresh to slightly weathered, very week to week moist		95	95		
35					(Bottom of the borehole at 35.0 m)					
36										
37										
38										
39										
40										

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-03

PROJECT:	Construction of Production facility at Gharo Sindh	STARTED :	July 05, 2024	FINAL DEPTH:	35 m
LOCATION:	Gharo Sindh	FINISHED :	July 07, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 358240.102 N : 2735197.6	DEPTH OF GWT:	0.78 m	CHECKED BY:	M.R
GROUND ELEV:	5.80 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	1 OF 2

DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	CORE RECOVERY (%)	R.Q.D (%)	SPT / 0.3 m	SPT PROFILE	
0	5.80	HYDRAULIC FEED STRAIGHT ROTARY DRILLING			Topsoil, silty clay, dark brown, mixed with agricultural grass roots, moist					20 40 60 80	
1	4.80		SPT-1		SILTY CLAY (CL-ML), firm to stiff, grayish brown, low-plastic to non-plastic, moist to wet, trace gravel				11		
	4.30		UDS-01								
2	3.80		SPT-2						8		
3	2.80		SPT-3						8		
4	1.80		SPT-4			SILTY SAND (SM) to Poorly-graded SAND (SP), loose to dense, grayish brown to yellowish brown, wet, trace mica, trace silica					11
5	0.80		SPT-5					7			
6	-0.20		SPT-6					11			
7	-1.20		SPT-7					16			
8	-2.20		SPT-8					22			
9	-3.20		SPT-9					17			
10	-4.20		SPT-10					19			
11	-5.20		SPT-11					15			
12	-6.20		SPT-12					29			
13	-7.20		SPT-13					34			
14	-8.20		SPT-14					41			
15	-9.20		SPT-15					31			
16	-10.20		SPT-16					28			
17	-11.20		SPT-17					25			
18	-12.20		SPT-18					31			
19	-13.20		SPT-19					29			
20	-14.20	SPT-20					26				
					(CONTINUED)						

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-03

PROJECT:	Constructon of Production facility at Gharo Sindh	STARTED :	July 05, 2024	FINAL DEPTH:	35 m
LOCATION:	Gharo Sindh	FINISHED :	July 07, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 358240.102 N : 2735197.6	DEPTH OF GWT:	0.78 m	CHECKED BY:	M.R
GROUND ELEV:	5.80 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	2 OF 2

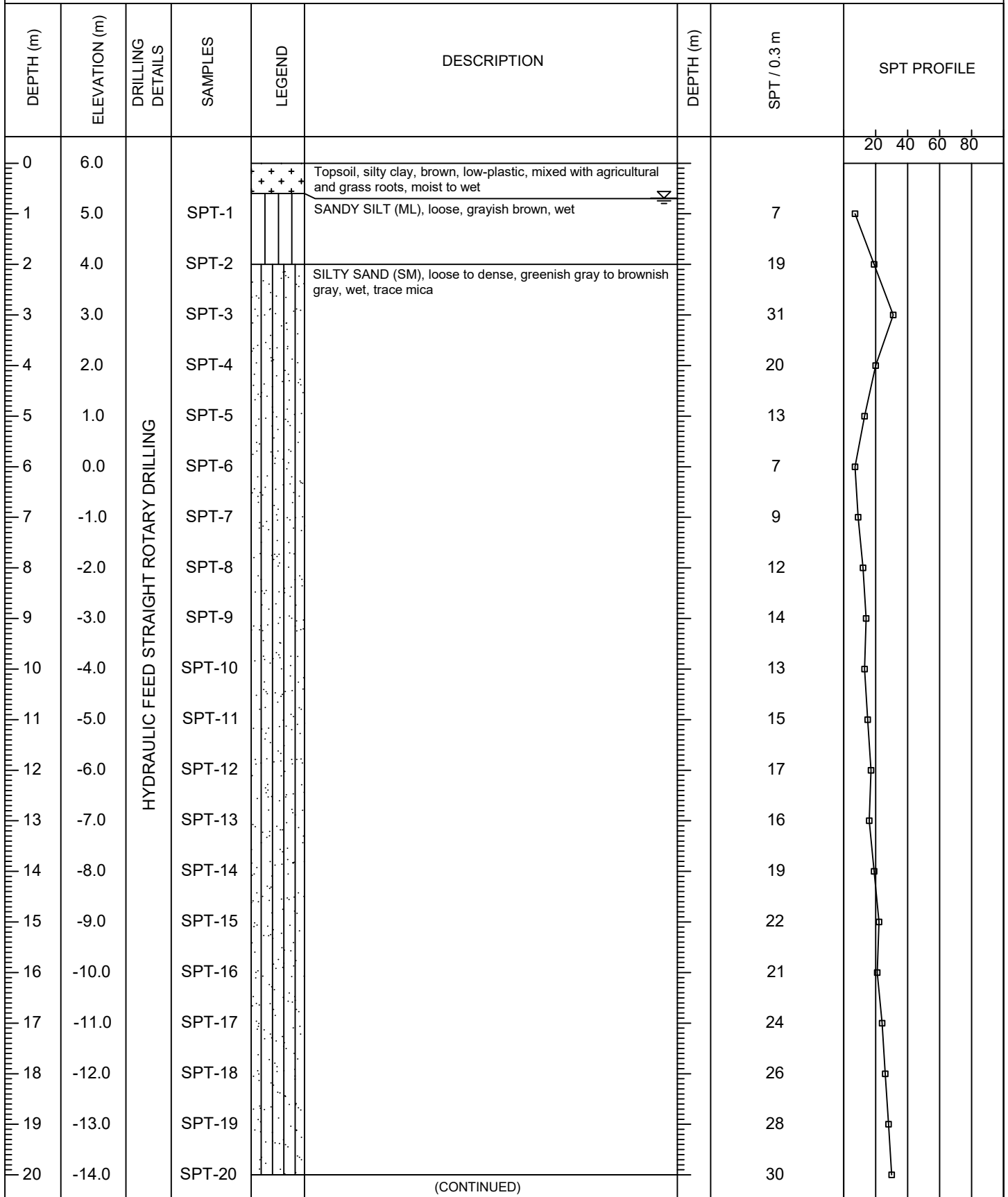
DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	CORE RECOVERY (%)	R.Q.D (%)	SPT / 0.3 m	SPT PROFILE
20	-14.20	HYDRAULIC FEED STRAIGHT ROTARY DRILLING	SPT-20		SILTY SAND (SM), loose to dense, grayish brown to yellowish brown, wet, trace mica, trace silica				26	
21	-15.20		SPT-21						36	
22	-16.20		SPT-22						33	
23	-17.20		SPT-23						34	
24	-18.20		SPT-24						32	
25	-19.20		SPT-25						28	
26	-20.20		SPT-26						38	
27	-21.20		SPT-27						43	
28	-22.20		SPT-28						41	
29	-23.20		SPT-29						40	
30	-24.20		SPT-30						43	
31	-25.20		SPT-31						47	
32	-26.20		SPT-32		GRAVELLY SILT(ML), dense, yellowish brown, wet, trace mica				38	
33	RUN-1				MARL, soft to medium hard, yellowish brown, moderately weathered to highly fractured		57	0		
34	RUN-2						36	14		
35	RUN-3				(Bottom of the borehole at 35.0 m)		37	0		
36										
37										
38										
39										
40										

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-04

PROJECT:	Constructon of Production facility at Gharo Sindh	STARTED :	July 20, 2024	FINAL DEPTH:	37 m
LOCATION:	Gharo Sindh	FINISHED :	July 22, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 357486.018 N : 2734981.198	DEPTH OF GWT:	0.69 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	1 OF 2

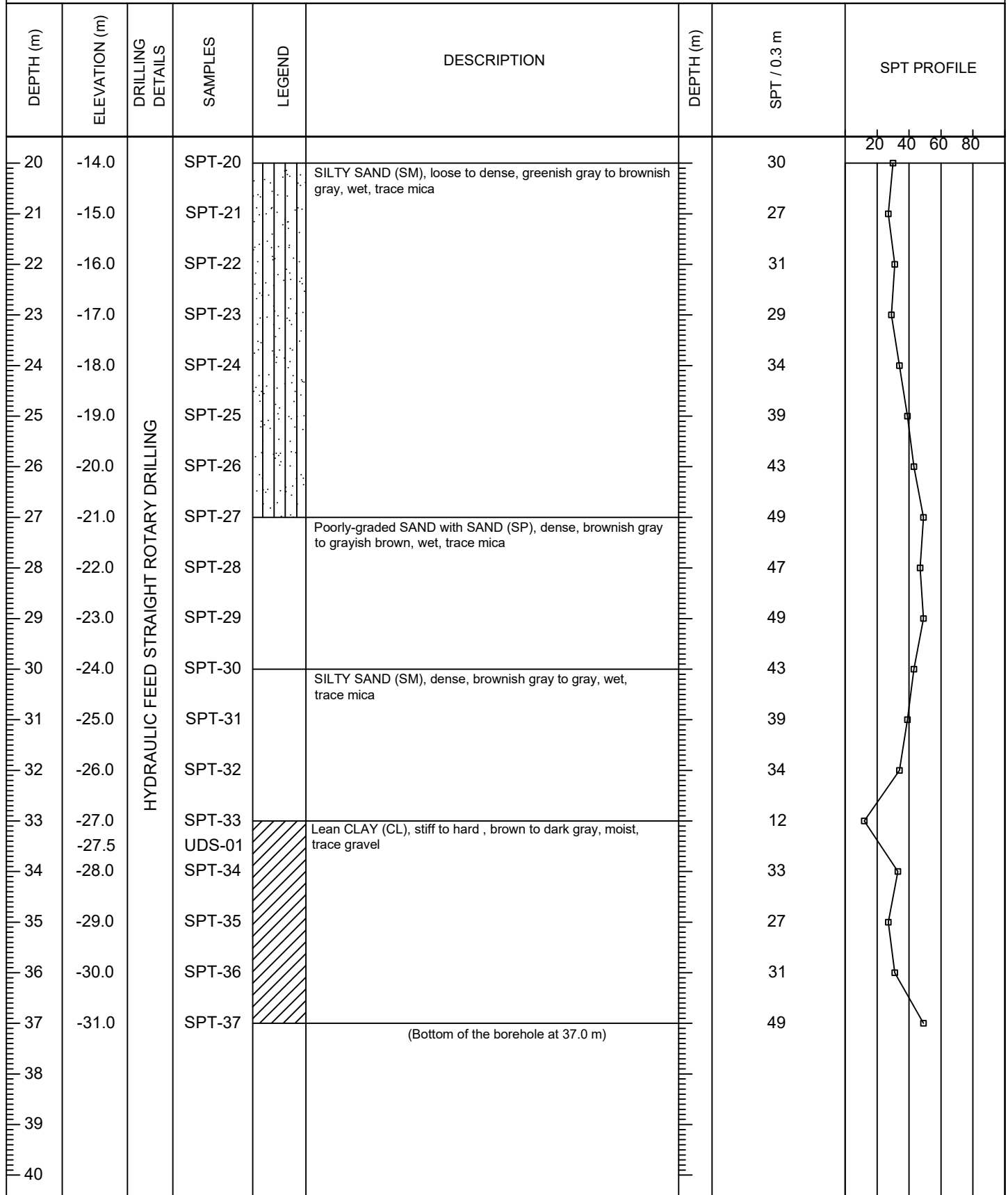


CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-04

PROJECT:	Constructon of Production facility at Gharo Sindh	STARTED :	July 20, 2024	FINAL DEPTH:	37 m
LOCATION:	Gharo Sindh	FINISHED :	July 22, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 357486.018 N : 2734981.198	DEPTH OF GWT:	0.69 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	2 OF 2



CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-05

PROJECT:	Construction of Production facility at Gharo Sindh	STARTED :	July 15, 2024	FINAL DEPTH:	35 m
LOCATION:	Gharo Sindh	FINISHED :	July 17, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 357855.76 N : 2734987.552	DEPTH OF GWT:	0.58 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	1 OF 2

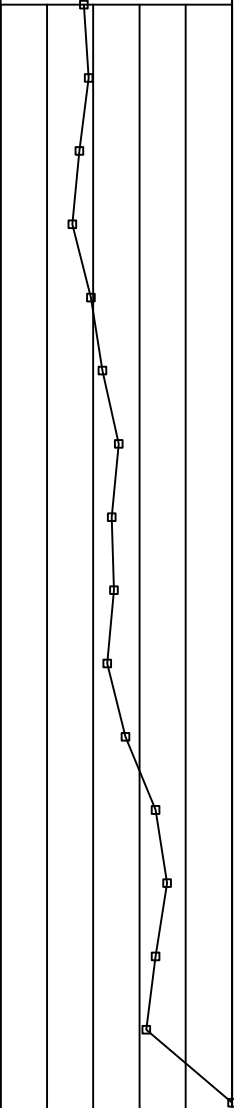
DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	SPT / 0.3 m	SPT PROFILE	
								20 40 60 80	
0	6.0	HYDRAULIC FEED STRAIGHT ROTARY DRILLING		+ +	Topsoil, LEAN CLAY (CL), dark brown, low-medium plastic, mixed with agricultural and grass roots, moist				
1	5.0		SPT-1		SANDY SILT (ML), loose to medium dense, greyish brown , moist to wet, trace mica		5		
2	4.0		SPT-2				13		
3	3.0		SPT-3				24		
4	2.0		SPT-4				27		
5	1.0		SPT-5			SILTY SAND (SM), medium dense to dense, gray, wet, trace mica		31	
6	0.0		SPT-6					35	
7	-1.0		SPT-7					32	
8	-2.0		SPT-8					29	
9	-3.0		SPT-9					33	
10	-4.0		SPT-10			SANDY SILT (ML), dense, light gray, wet, trace mica		37	
11	-5.0		SPT-11			SILTY SAND (SM) to Poorly-graded SAND with SILT (SP-SM), dense to very dense, greenish gray to gray, wet, trace mica		38	
12	-6.0		SPT-12					43	
13	-7.0		SPT-13					46	
14	-8.0		SPT-14					49	
15	-9.0		SPT-15					42	
16	-10.0		SPT-16					39	
17	-11.0		SPT-17					38	
18	-12.0		SPT-18					35	
19	-13.0		SPT-19					32	
20	-14.0		SPT-20					36	
(CONTINUED)									

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-05

PROJECT:	Constructon of Production facility at Gharo Sindh	STARTED :	July 15, 2024	FINAL DEPTH:	35 m
LOCATION:	Gharo Sindh	FINISHED :	July 17, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 357855.76 N : 2734987.552	DEPTH OF GWT:	0.58 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	2 OF 2

DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	SPT / 0.3 m	SPT PROFILE
								20 40 60 80
20	-14.0	HYDRAULIC FEED STRAIGHT ROTARY DRILLING	SPT-20		SILTY SAND (SM) to Poorly-graded SAND with SILT (SP-SM), dense to very dense, greenish gray to gray, wet, trace mica		36	
21	-15.0		SPT-21				38	
22	-16.0		SPT-22				34	
23	-17.0		SPT-23				31	
24	-18.0		SPT-24				39	
25	-19.0		SPT-25				44	
26	-20.0		SPT-26				51	
27	-21.0		SPT-27				48	
28	-22.0		SPT-28				49	
29	-23.0		SPT-29				46	
30	-24.0		SPT-30				54	
31	-25.0		SPT-31				67	
32	-26.0		SPT-32				72	
33	-27.0		SPT-33				67	
34	-28.0		SPT-34				63	
35	-29.0		SPT-35		(Bottom of the borehole at 35.0 m)		R	
36								
37								
38								
39								
40								

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-06

PROJECT:	Construction of Production facility at Gharo Sindh	STARTED :	July 08, 2024	FINAL DEPTH:	35 m
LOCATION:	Gharo Sindh	FINISHED :	July 10, 2024	LOGGED BY:	Zulqarnain
COORDS.	E : 358268.36 N : 2734989.228	DEPTH OF GWT:	0.59 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	1 OF 2

DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	CORE RECOVERY (%)	R.Q.D (%)	SPT / 0.3 m	SPT PROFILE
0	6.0	HYDRAULIC FEED STRAIGHT ROTARY DRILLING		+ + +	Topsoil, CLAYEY SILT (CL-ML), dark brown, mixed with agricultural and grass roots, moist					20 40 60 80
1	5.0		SPT-1		SILTY SAND (SM) to Poorly-graded SAND with Silt (SP-SM), loose to very dense, gray to dark gray, wet, trace mica				8	
2	4.0		SPT-2						9	
3	3.0		SPT-3						11	
4	2.0		SPT-4						9	
5	1.0		SPT-5						25	
6	0.0		SPT-6						14	
7	-1.0		SPT-7						14	
8	-2.0		SPT-8						13	
9	-3.0		SPT-9						22	
10	-4.0		SPT-10						24	
11	-5.0		SPT-11						27	
12	-6.0		SPT-12						18	
13	-7.0		SPT-13						21	
14	-8.0		SPT-14						25	
15	-9.0		SPT-15						21	
16	-10.0		SPT-16						29	
17	-11.0		SPT-17						35	
18	-12.0		SPT-18						23	
19	-13.0		SPT-19						35	
20	-14.0		SPT-20						42	
					(CONTINUED)					

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



BOREHOLE LOG: BH-06

PROJECT:	Construction of Production facility at Gharo Sindh	STARTED :	July 08, 2024	FINAL DEPTH:	35 m
LOCATION:	Gharo Sindh	FINISHED :	July 10, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 358268.36 N : 2734989.228	DEPTH OF GWT:	0.59 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	DRILLING METHOD:	STRAIGHT ROTARY	JOB NO:	J-875
				SHEET:	2 OF 2

DEPTH (m)	ELEVATION (m)	DRILLING DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	CORE RECOVERY (%)	R.Q.D (%)	SPT / 0.3 m	SPT PROFILE
20	-14.0	HYDRAULIC FEED STRAIGHT ROTARY DRILLING	SPT-20		SILTY SAND (SM) to Poorly-graded SAND with Silt (SP-SM), loose to very dense, gray to dark gray, wet, trace mica				42	
21	-15.0		SPT-21						37	
22	-16.0		SPT-22						35	
23	-17.0		SPT-23						37	
24	-18.0		SPT-24						34	
25	-19.0		SPT-25						41	
26	-20.0		SPT-26						37	
27	-21.0		SPT-27						44	
28	-22.0		SPT-28						40	
29	-23.0		SPT-29						45	
30	-24.0		SPT-30						41	
31	-25.0		SPT-31						39	
32	-26.0		SPT-32						52	
33	-27.0	RUN-1	SPT-33		LIME STONE, yellow, highly weathered to highly fractured, weak to strong, seems of fossils		24	0	R	
34	-27.0		RUN-2				31	0		
35	-29.0									
36					(Bottom of the borehole at 35.0 m)					
37										
38										
39										
40										

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



TEST PIT LOG: TP-01

PROJECT:	CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH	STARTED :	July 11, 2024	FINAL DEPTH:	1.0 m
LOCATION:	GHARO SINDH	FINISHED :	July 11, 2024	LOGGED BY:	Zulqarnain
COORDS:	E: 357461.092 N : 2735209.001	DEPTH OF GWT:	0.60m	CHECKED BY:	M.R
GROUND ELEV:	5.80 m	EXCAVATION :	MANUAL	JOB NO:	J-875
				SHEET:	1 OF 1

DEPTH (m)	ELEVATION (m)	EXCAVATION DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (kN/m³)	DRY DENSITY (kN/m³)
0.0	5.80	MANUALLY EXCAVATED TESTPIT	FDT-1		Top soil, silty clay, greyish brown, low plastic, mixed with agricultural roots, moist				
0.2					CLAYEY SILT (CL-ML), brown, non to low-plastic, moist to wet				
0.4	5.45				SILTY SAND (CL-ML), grey, wet, trace mica				
0.6									
0.8									
1.0					(Bottom of test pit at 1.0m)				
1.2									
1.4									
1.6									
1.8									
2.0									
2.2									
2.4									
2.6									
2.8									
3.0									

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



TEST PIT LOG: TP-02

PROJECT:	CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH	STARTED :	July 11, 2024	FINAL DEPTH:	3.0 m
LOCATION:	GHARO SINDH	FINISHED :	July 11, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 357849.654 N : 2735126.282	DEPTH OF GWT:	0.70m	CHECKED BY:	M.R
GROUND ELEV:	6.40m	EXCAVATION :	MANUAL	JOB NO:	J-875
				SHEET:	1 OF 1

DEPTH (m)	ELEVATION (m)	EXCAVATION DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (kN/m³)	DRY DENSITY (kN/m³)
0.0	6.40	MANUALLY EXCAVATED TESTPIT			Top soil, lean clay, dark brown, low plastic, mixed with agricultural roots				
0.2					SILTY CLAY (CL-ML), grayish brown, low to non-plastic, wet				
0.4									
0.6									
0.8									
1.0					(Bottom of test pit at 1.0m)				
1.2									
1.4									
1.6									
1.8									
2.0									
2.2									
2.4									
2.6									
2.8									
3.0									

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



TEST PIT LOG: TP-03

PROJECT:	CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH	STARTED :	July 7, 2024	FINAL DEPTH:	3.0 m
LOCATION:	GHARO SINDH	FINISHED :	July 8, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 358241.884 N : 2735229.255	DEPTH OF GWT:	1.0 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m	EXCAVATION :	MANUAL	JOB NO:	J-875
				SHEET:	1 OF 1

DEPTH (m)	ELEVATION (m)	EXCAVATION DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (kN/m³)	DRY DENSITY (kN/m³)
0.0	6.0	MANUALLY EXCAVATED TESTPIT	FDT-1		Top soil, silty clay, greyish brown, low-plastic, moist to very moist				
0.2					SILTY CLAY (CL-ML), greyish brown, non to low-plastic, moist to wet				
0.4	11.9				SILTY SAND (SM), grey, saturated, trace mica				
0.6									
0.8									
1.0									
1.2									
1.4									
1.6					(Bottom of test pit at 1.5m)				
1.8									
2.0									
2.2									
2.4									
2.6									
2.8									
3.0									

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.



TEST PIT LOG: TP-04

PROJECT:	CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH	STARTED :	July 11, 2024	FINAL DEPTH:	3.0 m
LOCATION:	GHARO SINDH	FINISHED :	July 11, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 357506.369 N : 2734954.814	DEPTH OF GWT:	0.60 m	CHECKED BY:	M.R
GROUND ELEV:	6.20 m	EXCAVATION :	MANUAL	JOB NO:	J-875
				SHEET:	1 OF 1

DEPTH (m)	ELEVATION (m)	EXCAVATION DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (kN/m³)	DRY DENSITY (kN/m³)
0.0	6.20	MANUALLY EXCAVATED TESTPIT	FDT-1		Top soil, silty clay, greyish brown, low plastic, moist to very moist mixed with grass roots				
0.2									
0.4	5.80				SANDY SILT (ML), grey brown, moist to wet, trace mica				
0.6					SILTY SAND (SM), grey, wet, trace mica				
0.8									
1.0					(Bottom of test pit at 1.0m)				
1.2									
1.4									
1.6									
1.8									
2.0									
2.2									
2.4									
2.6									
2.8									
3.0									

CLIENT:
MEGA MOTORS COMPANY (PVT) LTD.

PROJECT:	CONSTRUCTION OF PRODUCTION FACILITY AT GHARO SINDH		STARTED :	July 9, 2024	FINAL DEPTH:	3.0 m
LOCATION:	GHARO SINDH		FINISHED :	July 9, 2024	LOGGED BY:	Zulqarnain
COORDS.	E: 358224.246	N :2734974.028	DEPTH OF GWT:	0.55 m	CHECKED BY:	M.R
GROUND ELEV:	6.0 m		EXCAVATION :	MANUAL	JOB NO:	J-875
					SHEET:	1 OF 1

DEPTH (m)	ELEVATION (m)	EXCAVATION DETAILS	SAMPLES	LEGEND	DESCRIPTION	DEPTH (m)	MOISTURE CONTENT (%)	BULK DENSITY (kN/m³)	DRY DENSITY (kN/m³)
0.0	6.0	MANUALLY EXCAVATED TESTPIT	FDT-1						

CLIENT:

MEGA MOTORS COMPANY (PVT) LTD.

APPENDIX – C

(LABORATORY TEST RESULTS)



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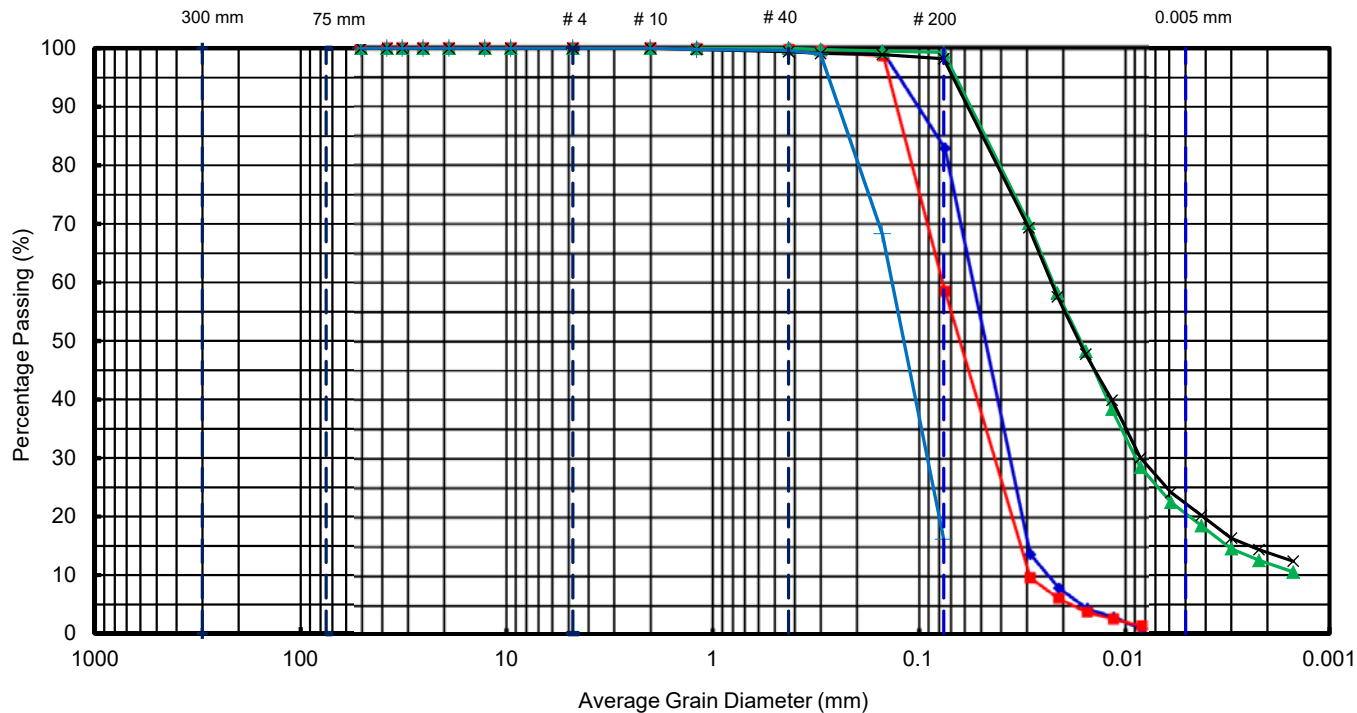
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-1

Lab Ref: J-875

Date: 26-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-2 (2.0 m)	0.00	17.10	82.90	0.00
SPT-4 (4.0 m)	0.00	41.50	58.50	0.00
SPT-6 (6.0 m)	0.00	0.70	78.85	20.46
UDS-1 (6.5 m)	0.00	1.80	76.01	22.20
SPT-9 (9.0 m)	0.00	83.90	16.10	0.00

SPT-2 (2.0 m)	SPT-4 (4.0 m)	SPT-6 (6.0 m)	UDS-1 (6.5 m)	SPT-9 (9.0 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

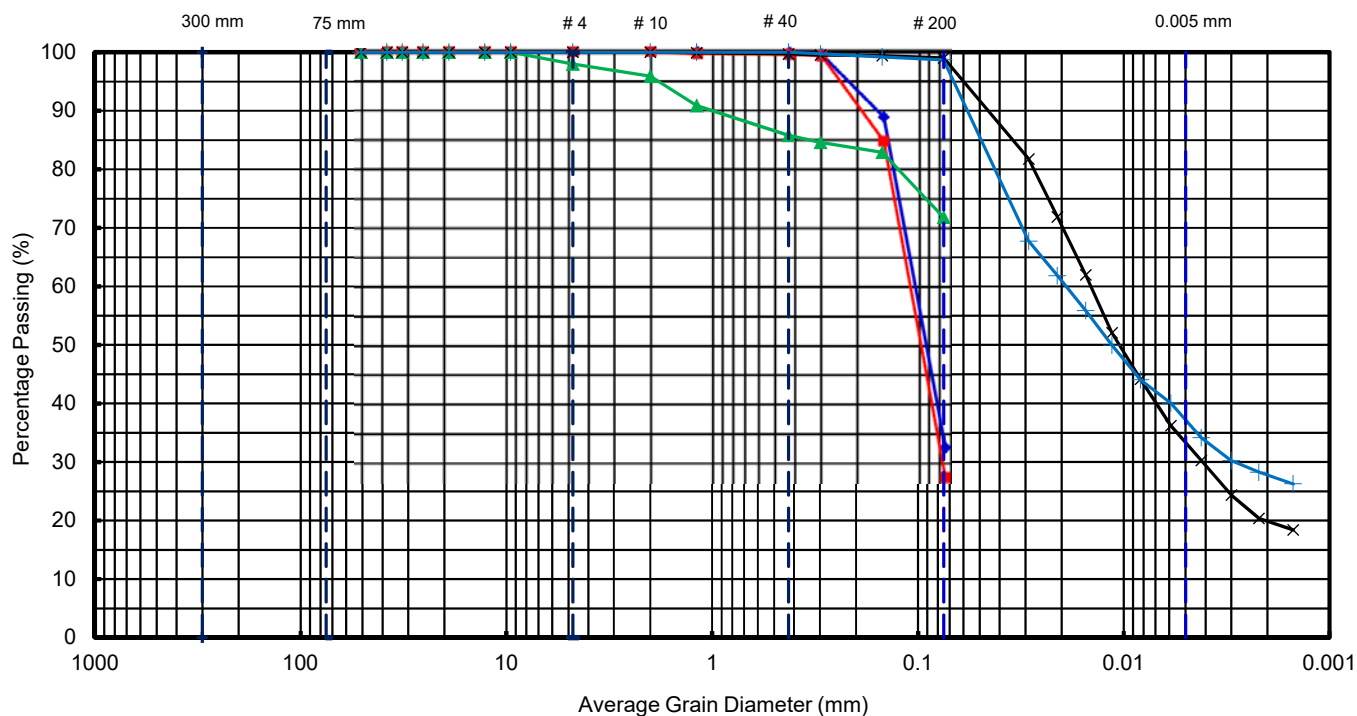
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-1

Lab Ref: J-875

Date: 26-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-16 (16.0 m)	0.00	67.30	32.70	0.00
SPT-26 (26.0 m)	0.00	72.40	27.60	0.00
SPT-31 (31.0 m)	2.00	26.20	71.80	0.00
UDS-2 (32.5 m)	0.00	1.00	65.74	33.26
UDS-3 (33.5 m)	0.00	1.30	61.59	37.11

Legend: SPT-16 (16.0 m) SPT-26 (26.0 m) SPT-31 (31.0 m) UDS-2 (32.5 m) UDS-3 (33.5 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

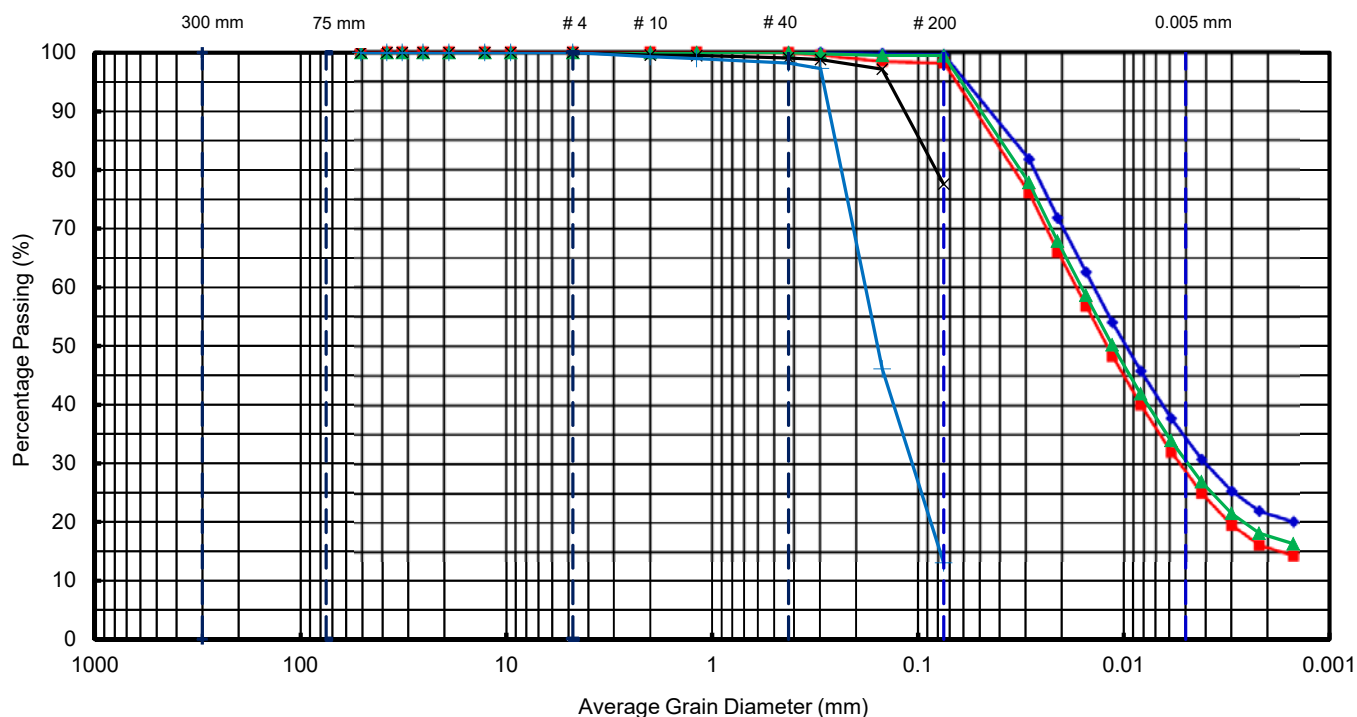
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-2

Lab Ref: J-875

Date: 20-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
UDS-1 (1.5 m)	0.00	0.50	65.20	34.30
UDS-2 (3.5 m)	0.00	1.90	69.60	28.50
SPT-5 (5.0 m)	0.00	0.50	69.10	30.40
SPT-6 (6.0 m)	0.00	22.40	77.60	0.00
SPT-10 (10.0 m)	0.00	87.00	13.00	0.00

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

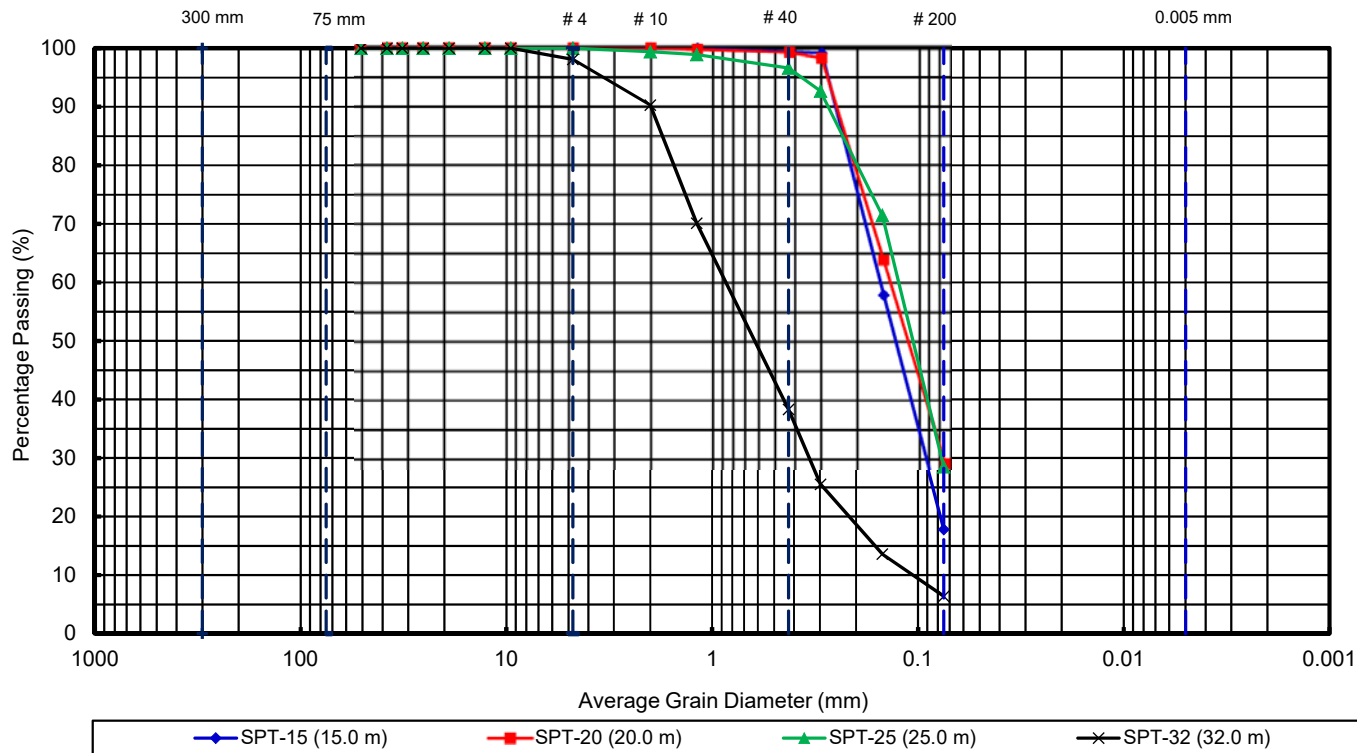
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-2

Lab Ref: J-875

Date: 20-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-15 (15.0 m)	0.00	82.20	17.80	0.00
SPT-20 (20.0 m)	0.00	70.80	29.20	0.00
SPT-25 (25.0 m)	0.00	71.50	28.50	0.00
SPT-32 (32.0 m)	1.90	91.70	6.40	0.00

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

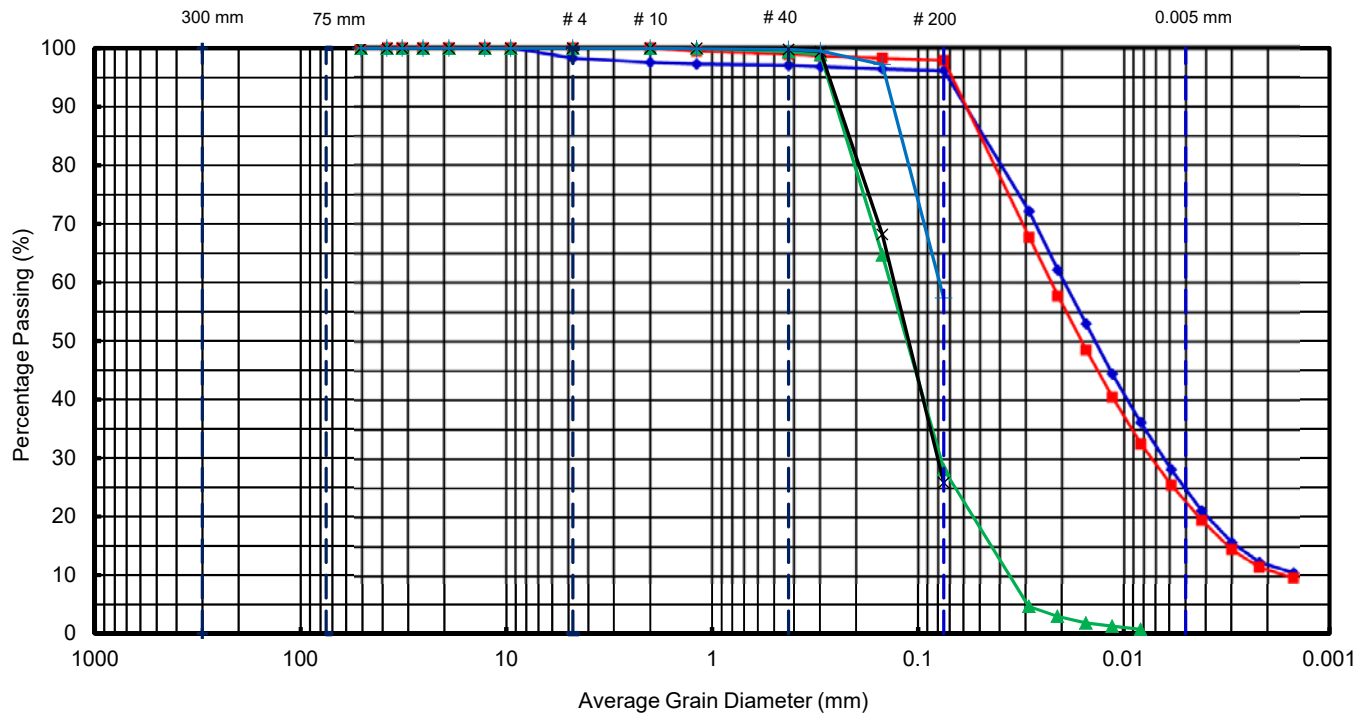
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-3

Lab Ref: J-875

Date: 20-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
UDS-1 (1.5 m)	1.80	2.10	71.40	24.70
SPT-3 (3.0 m)	0.00	2.20	75.30	22.50
SPT-6 (6.0 m)	0.00	71.90	28.10	0.00
SPT-10 (10.0 m)	0.00	74.20	25.80	0.00
SPT-12 (12.0 m)	0.00	42.70	57.30	0.00

UDS-1 (1.5 m)	SPT-3 (3.0 m)	SPT-6 (6.0 m)	SPT-10 (10.0 m)	SPT-12 (12.0 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

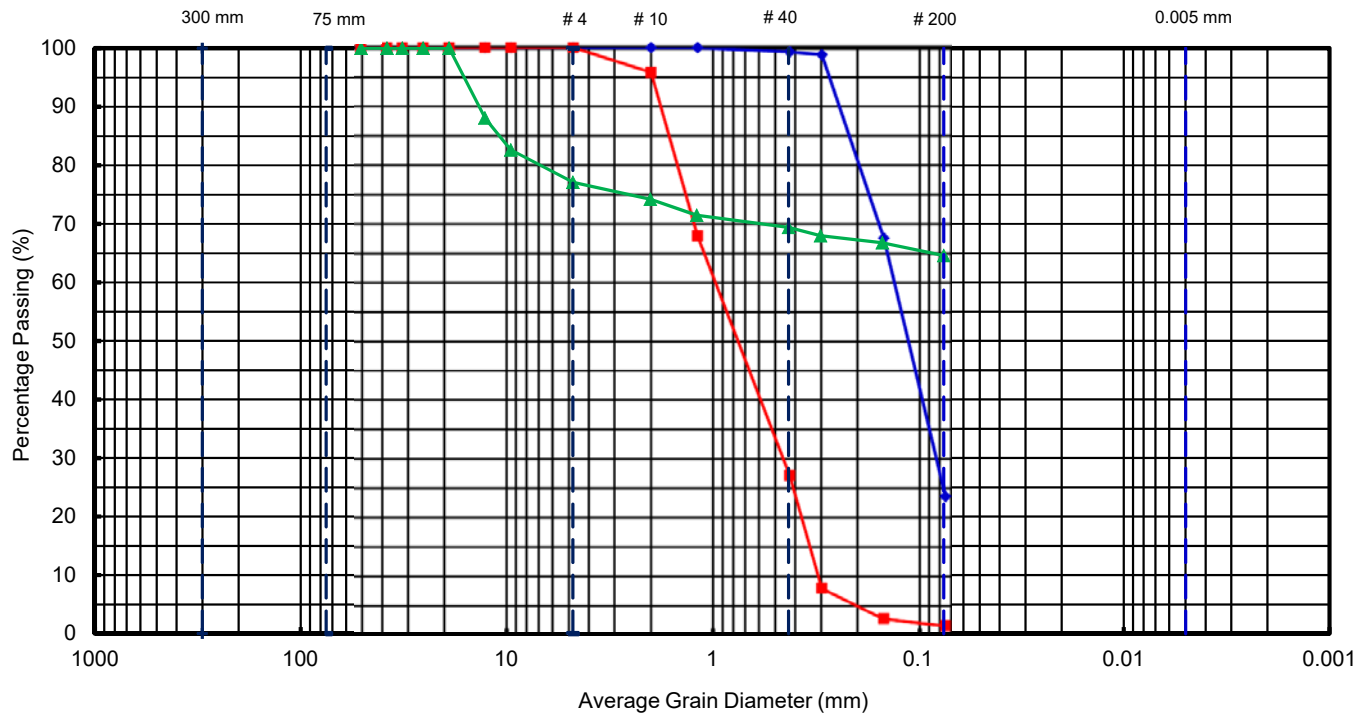
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-3

Lab Ref: J-875

Date: 20-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-18 (18.0 m)	0.00	76.40	23.60	0.00
SPT-30 (30.0 m)	0.00	98.45	1.55	0.00
SPT-32 (32.0 m)	22.90	12.50	64.60	0.00

Legend: SPT-18 (18.0 m) (Blue line with diamonds), SPT-30 (30.0 m) (Red line with squares), SPT-32 (32.0 m) (Green line with triangles)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

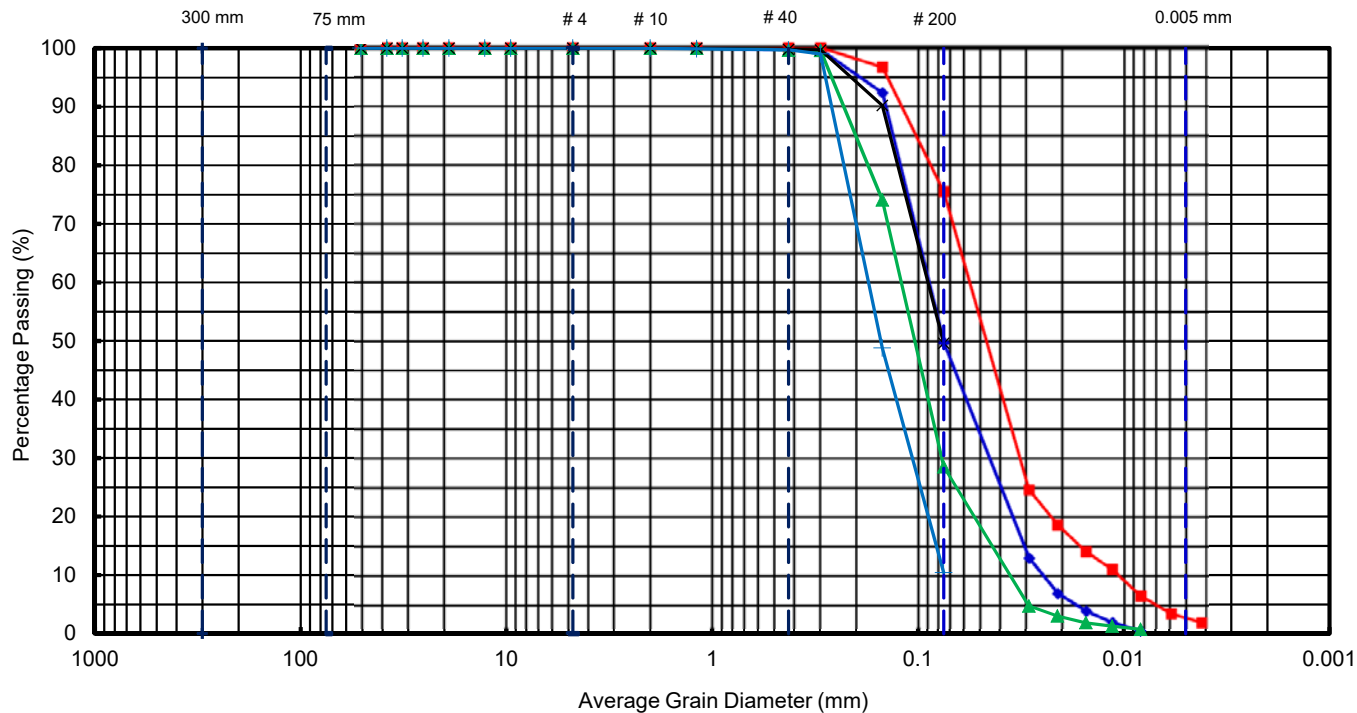
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-6

Lab Ref: J-875

Date: 21-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-1 (1.0 m)	0.00	50.30	49.70	0.00
SPT-4 (4.0 m)	0.00	24.56	72.72	2.72
SPT-7 (7.0 m)	0.00	71.50	28.50	0.00
SPT-10 (10.0 m)	0.00	50.40	49.60	0.00
SPT-14 (14.0 m)	0.00	89.60	10.40	0.00

◆ SPT-1 (1.0 m)	■ SPT-4 (4.0 m)	▲ SPT-7 (7.0 m)	✕ SPT-10 (10.0 m)	+ SPT-14 (14.0 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

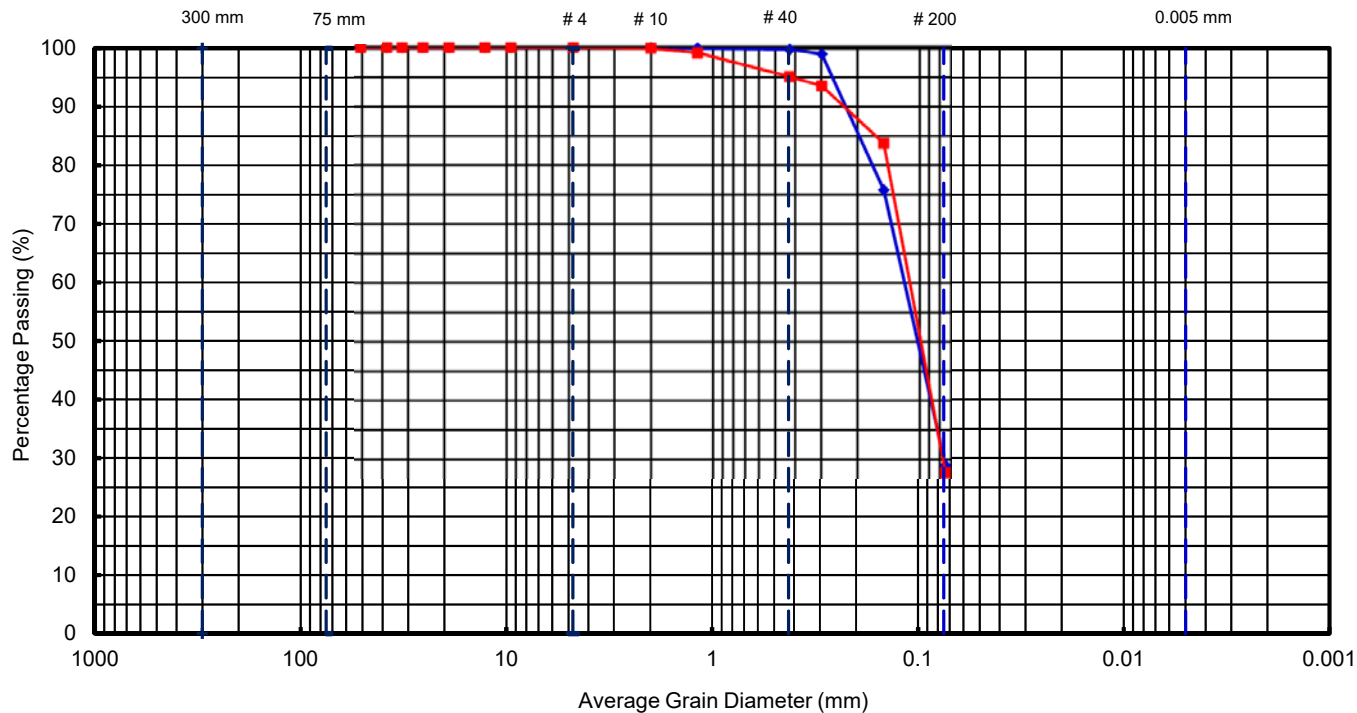
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-6

Lab Ref: J-875

Date: 21-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-25 (25.0 m)	0.00	71.00	29.00	0.00
SPT-30 (30.0 m)	0.00	72.30	27.70	0.00

SPT-25 (25.0 m)	SPT-30 (30.0 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

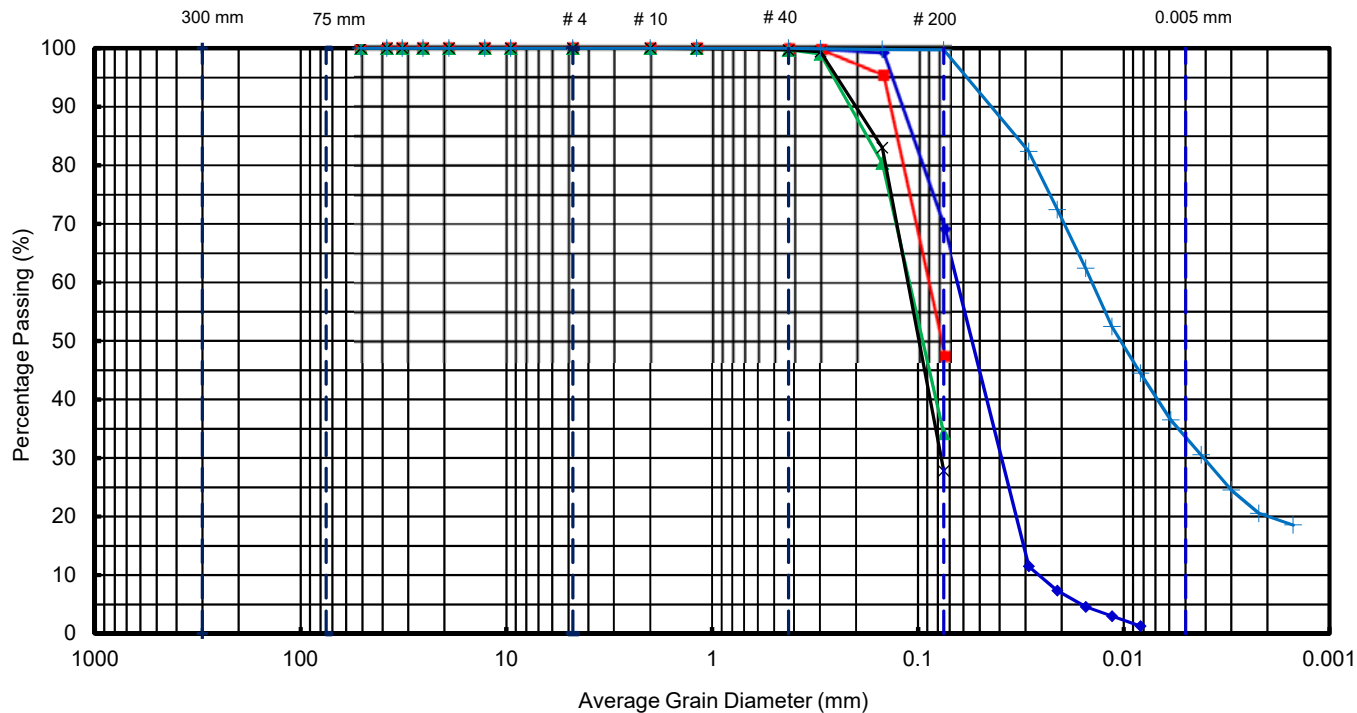
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-4

Lab Ref: J-875

Date: 26-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-2 (2.0 m)	0.00	30.80	69.20	0.00
SPT-4 (4.0 m)	0.00	52.50	47.50	0.00
SPT-8 (8.0 m)	0.00	65.80	34.20	0.00
SPT-24 (24.0 m)	0.00	72.20	27.80	0.00
UDS-1 (33.5 m)	0.00	0.30	66.20	33.50

◆ SPT-2 (2.0 m)	■ SPT-4 (4.0 m)	▲ SPT-8 (8.0 m)	✕ SPT-24 (24.0 m)	— UDS-1 (33.5 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
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Consulting Engineers

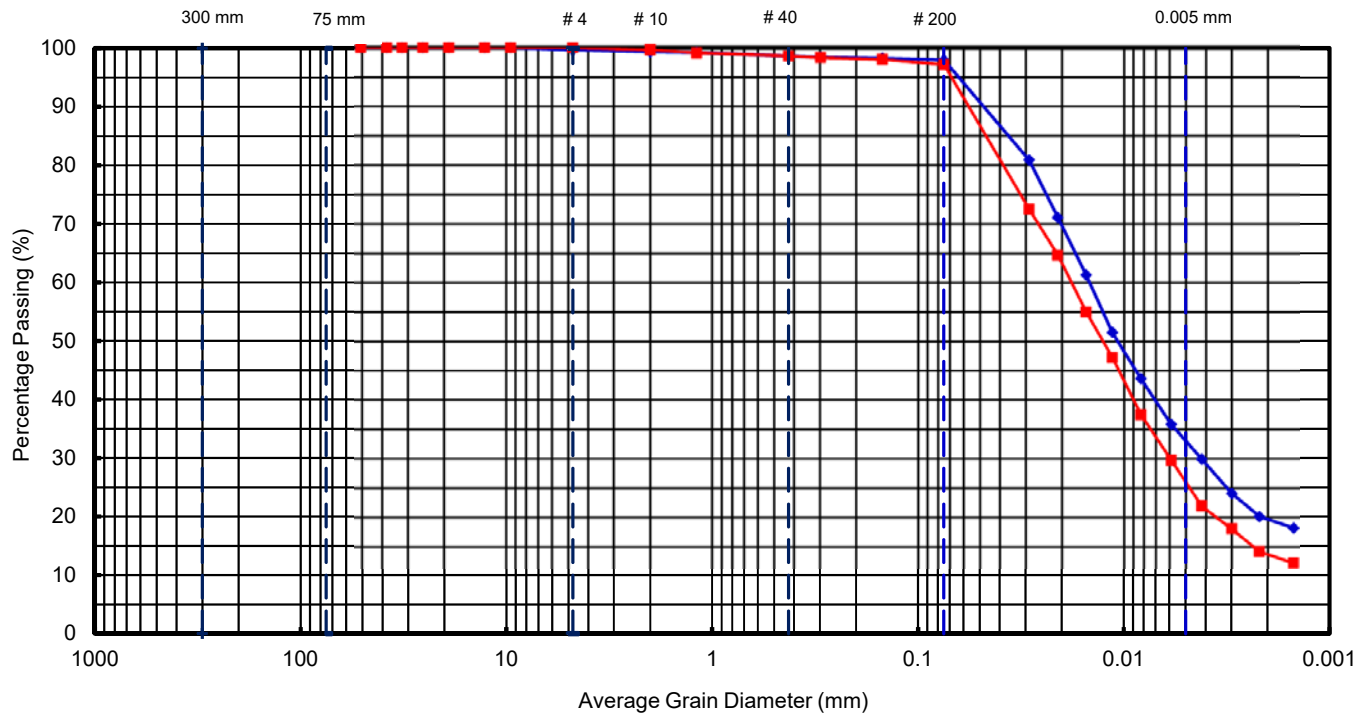
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-4

Lab Ref: J-875

Date: 26-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-34 (34.0 m)	0.40	1.70	65.01	32.90
SPT-36 (36.0 m)	0.00	2.90	71.28	25.83

— SPT-34 (34.0 m) — SPT-36 (36.0 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

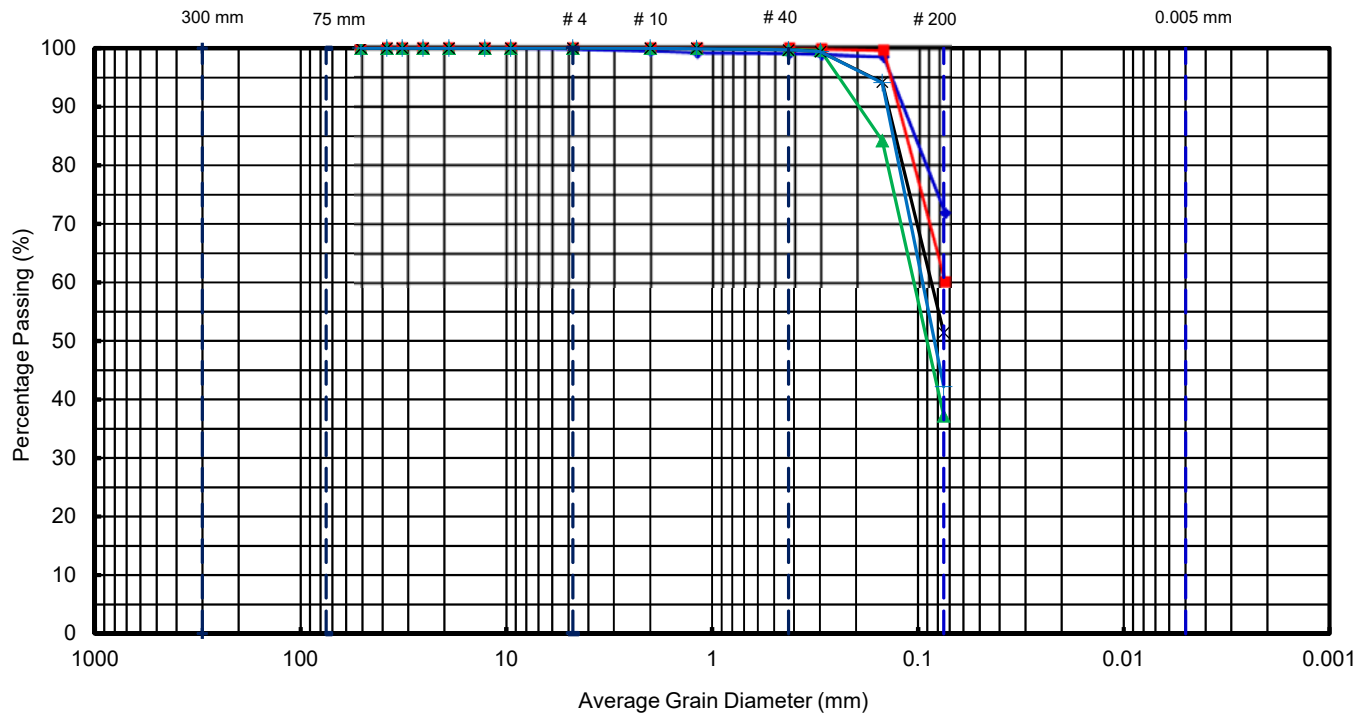
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-5

Lab Ref: J-875

Date: 26-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-2 (2.0 m)	0.20	27.90	71.90	0.00
SPT-4 (4.0 m)	0.00	39.80	60.20	0.00
SPT-6 (6.0 m)	0.00	62.80	37.20	0.00
SPT-10 (10.0 m)	0.00	48.60	51.40	0.00
SPT-20 (20.0 m)	0.00	57.80	42.20	0.00

◆ SPT-2 (2.0 m)	■ SPT-4 (4.0 m)	▲ SPT-6 (6.0 m)	✕ SPT-10 (10.0 m)	◆ SPT-20 (20.0 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Berkeley
Associates (Pvt.) Ltd.
Consulting Engineers

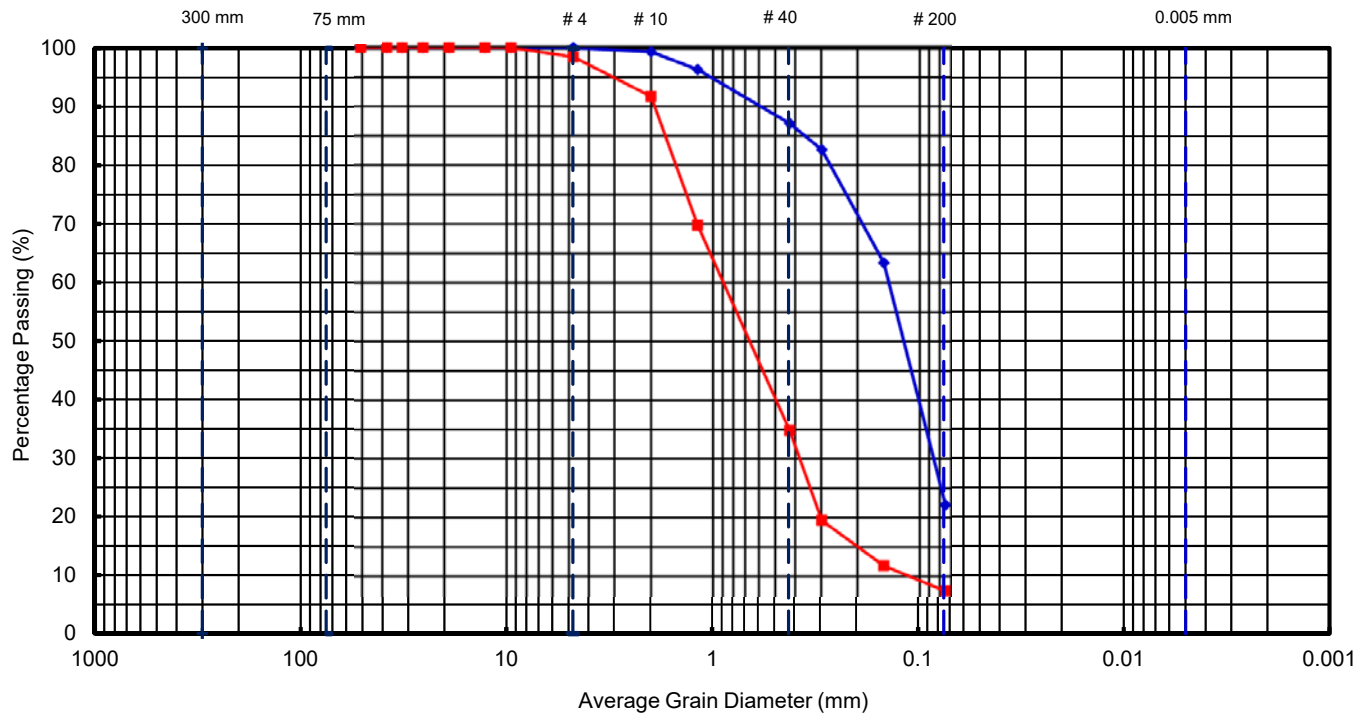
Grain Size Analysis (ASTM D422)

Project: Construction of a Production Facility, Gharo, Sindh

Borehole No. BH-5

Lab Ref: J-875

Date: 26-07-2024



Sample No.	Gravel (%)	Sand (%)	SILT (%)	CLAY (%)
SPT-30 (30.0 m)	0.00	77.80	22.20	0.00
SPT-32 (32.0 m)	1.60	90.90	7.50	0.00

—●— SPT-30 (30.0 m) —■— SPT-32 (32.0 m)

Boulders	Cobbles	Gravel	Sand			Silt	Clay
			Coarse	Medium	Fine		

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Atterberg Limits Test (ASTM D4318)

Project: Construction of a Production Facility , Gharo, Sindh

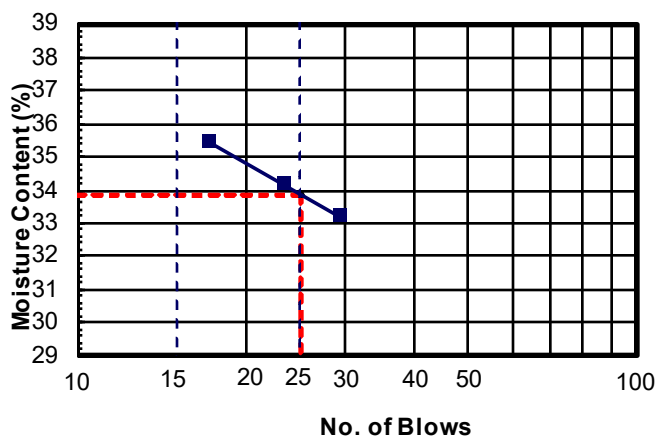
Borehole No. BH-2

Sample No.: UDS-1

Date: '21-07-2024

Depth: (meter) 1.50

Lab Ref: J-875



No. of Blows	Moisture Content (%)
17	35.47
23	34.19
29	33.25

Liquid Limit (%) 33.9

Plastic Limit (%) 21.8

Plasticity Index 12.0

Borehole No. BH-2

Sample No.: UDS-2

Depth: (meter) 3.50



No. of Blows	Moisture Content (%)
17	30.48
22	29.54
30	28.45

Liquid Limit (%) 29.1

Plastic Limit (%) 21.1

Plasticity Index 7.9

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Atterberg Limits Test (ASTM D4318)

Project: Construction of a Production Facility , Gharo, Sindh

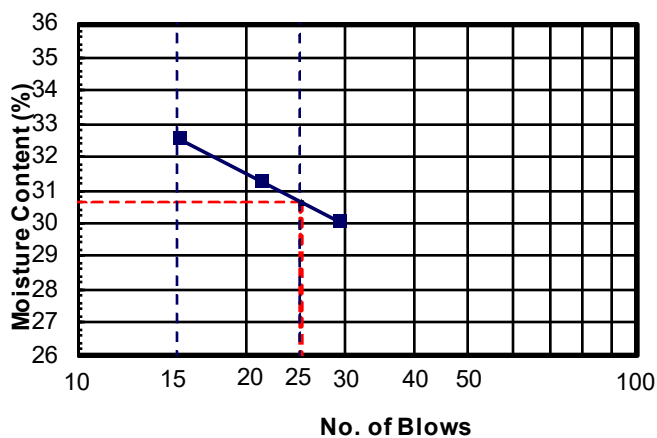
Borehole No. BH-2

Sample No.: SPT-5

Date: '21-07-2024

Depth: (meter) 5.00

Lab Ref: J-875



No. of Blows	Moisture Content (%)
15	32.57
21	31.27
29	30.08

Liquid Limit (%) 30.6

Plastic Limit (%) 21.1

Plasticity Index 9.5

Borehole No. BH-3

Sample No.: UDS-1

Depth: (meter) 1.50



No. of Blows	Moisture Content (%)
16	27.23
22	26.20
28	25.45

Liquid Limit (%) 25.8

Plastic Limit (%) 20.0

Plasticity Index 5.8

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Atterberg Limits Test (ASTM D4318)

Project: Construction of a Production Facility , Gharo, Sindh

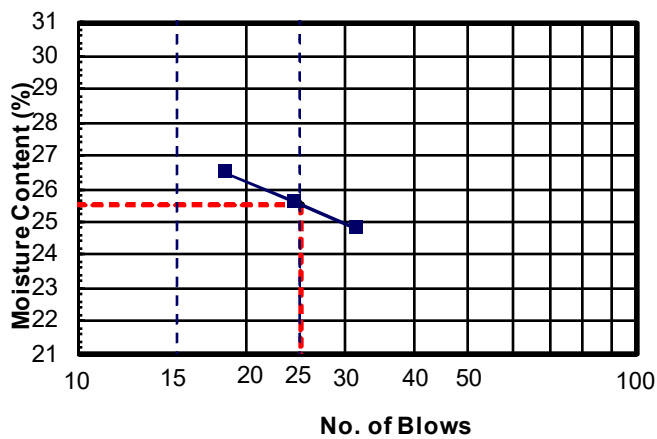
Borehole No. BH-3

Sample No.: SPT-3

Date: '21-07-2024

Depth: (meter) 3.00

Lab Ref: J-875



No. of Blows	Moisture Content (%)
18	26.53
24	25.63
31	24.84

Liquid Limit (%) 25.5

Plastic Limit (%) 20.3

Plasticity Index 5.2

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Atterberg Limits Test (ASTM D4318)

Project: Construction of a Production Facility , Gharo, Sindh

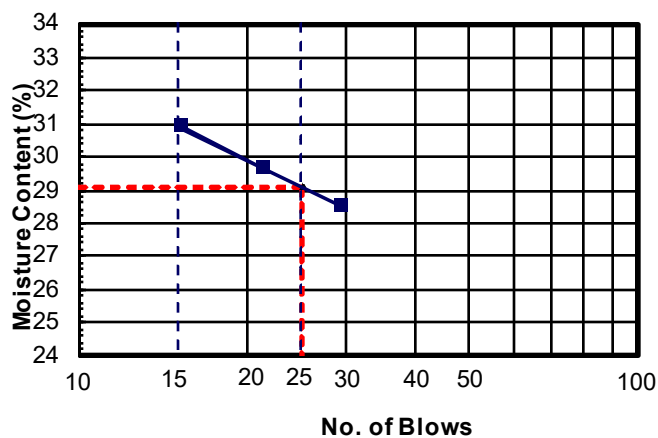
Borehole No. BH-1

Sample No.: SPT-6

Date: '26-07-2024

Depth: (meter) 6.00

Lab Ref: J-875



No. of Blows	Moisture Content (%)
15	30.93
21	29.70
29	28.56

Liquid Limit (%) 29.1

Plastic Limit (%) 20.8

Plasticity Index 8.3

Borehole No. BH-1

Sample No.: UDS-1

Depth: (meter) 6.50



No. of Blows	Moisture Content (%)
16	32.82
22	31.58
30	30.41

Liquid Limit (%) 31.1

Plastic Limit (%) 21.1

Plasticity Index 10.0

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Atterberg Limits Test (ASTM D4318)

Project: Construction of a Production Facility , Gharo, Sindh

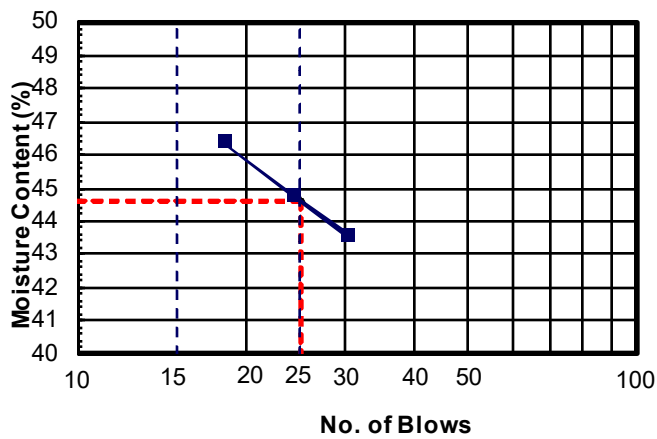
Borehole No. BH-1

Sample No.: UDS-2

Date: '26-07-2024

Depth: (meter) 32.50

Lab Ref: J-875



No. of Blows	Moisture Content (%)
18	46.41
24	44.83
30	43.63

Liquid Limit (%) 44.6

Plastic Limit (%) 24.6

Plasticity Index 20.0

Borehole No. BH-1

Sample No.: UDS-3

Depth: (meter) 33.50



No. of Blows	Moisture Content (%)
15	51.89
21	49.82
28	48.12

Liquid Limit (%) 48.8

Plastic Limit (%) 24.9

Plasticity Index 23.8

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Atterberg Limits Test (ASTM D4318)

Project: Construction of a Production Facility , Gharo,Sindh

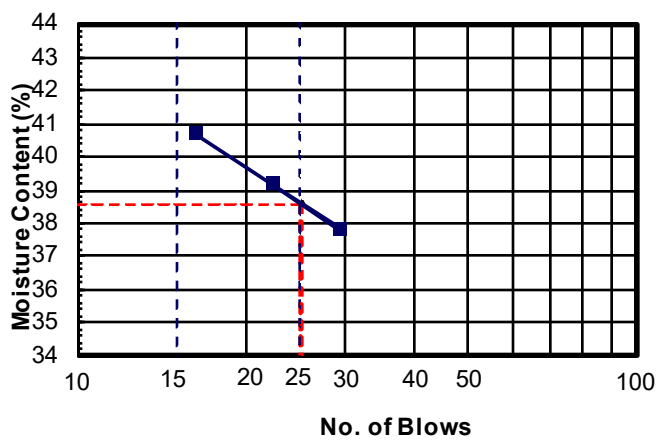
Borehole No. BH-4

Sample No.: UDS-1

Date: '26-07-2024

Depth: (meter) 33.50

Lab Ref: J-875



No. of Blows	Moisture Content (%)
16	40.70
22	39.16
29	37.87

Liquid Limit (%) 38.6

Plastic Limit (%) 22.8

Plasticity Index 15.8

Borehole No. BH-4

Sample No.: SPT-34

Depth: (meter) 34.00



No. of Blows	Moisture Content (%)
18	44.12
24	42.61
34	40.85

Liquid Limit (%) 42.4

Plastic Limit (%) 23.9

Plasticity Index 18.5

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Atterberg Limits Test (ASTM D4318)

Project: Construction of a Production Facility , Gharo, Sindh

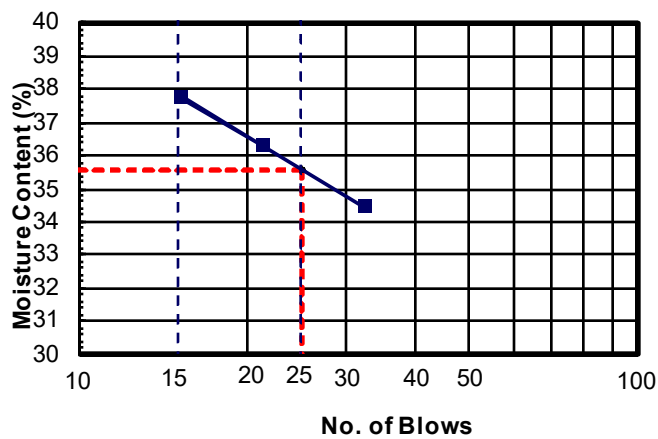
Borehole No. BH-4

Sample No.: SPT-36

Date: '26-07-2024

Depth: (meter) 36.00

Lab Ref: J-875



No. of Blows	Moisture Content (%)
15	37.81
21	36.31
32	34.50

Liquid Limit (%) 35.5

Plastic Limit (%) 21.5

Plasticity Index 14.1

Tested by:
Sikandar Hay at

Checked by:
Muhammad Ajmal

Unconfined Compression Test (ASTM D 2166)

Project: Construction of a Production Facility, Gharo, Sindh

'Date: '26-07-2024

Borehole No.: BH-1

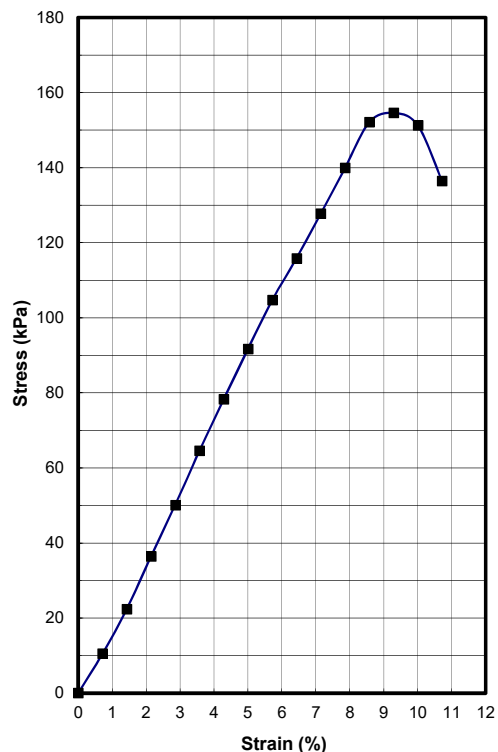
Sample No.: UDS-2

Lab Ref: J-875

Depth: (meter) 32.50

Length	14.00 cm	Area (avg.)	38.50 cm ²
Dia (avg.)	7 cm	Bulk Density	18.06 kN/m ³
Weight	992.5 g	N M C	23.17 %
Volume	539.00 cm ³	Dry Density	14.67 kN/m ³

Deformaton (mm)	Load kg	Strain (%)	Corrected Area (cm ²)	Stress (kPa)
0.00	0	0.00	38.50	0.00
1.00	4.15	0.71	38.78	10.50
2.00	8.9	1.43	39.06	22.35
3.00	14.6	2.14	39.34	36.39
4.00	20.25	2.86	39.63	50.11
5.00	26.3	3.57	39.93	64.60
6.00	32.1	4.29	40.22	78.26
7.00	37.9	5.00	40.53	91.71
8.00	43.6	5.71	40.83	104.71
9.00	48.6	6.43	41.15	115.83
10.00	54	7.14	41.46	127.72
11.00	59.6	7.86	41.78	139.88
12.00	65.3	8.57	42.11	152.07
13.00	66.9	9.29	42.44	154.58
14.00	66	10.00	42.78	151.30
15.00	60	10.71	43.12	136.46



Unconfined Compressive Strength (q_u) =

154.58 kPa

Strain =

9.3 %

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal

Unconfined Compression Test (ASTM D 2166)

Project: Construction of a Production Facility, Gharo, Sindh

'Date: '26-07-2024

Borehole No.: BH-1

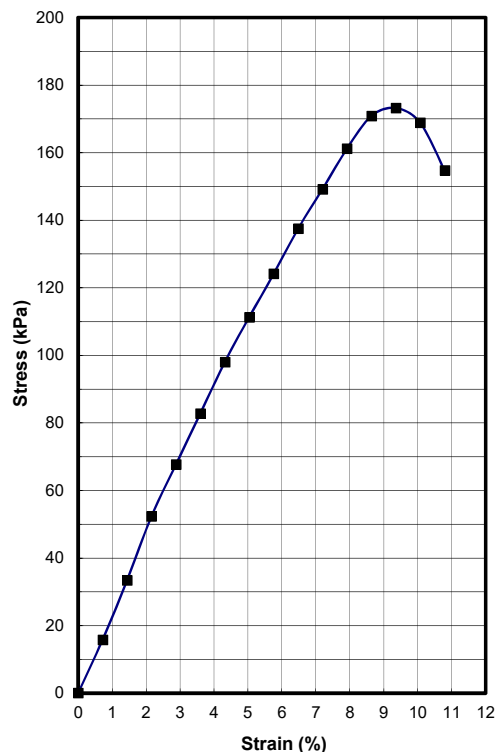
Sample No.: UDS-3

Lab Ref: J-875

Depth: (meter) 33.50

Length	13.90 cm	Area (avg.)	38.50 cm ²
Dia (avg.)	7 cm	Bulk Density	19.37 kN/m ³
Weight	1056.4 g	N M C	23.82 %
Volume	535.15 cm ³	Dry Density	15.64 kN/m ³

Deformaton (mm)	Load kg	Strain (%)	Corrected Area (cm ²)	Stress (kPa)
0.00	0	0.00	38.50	0.00
1.00	6.25	0.72	38.78	15.81
2.00	13.3	1.44	39.06	33.39
3.00	21	2.16	39.35	52.34
4.00	27.35	2.88	39.64	67.66
5.00	33.7	3.60	39.94	82.75
6.00	40.2	4.32	40.24	97.98
7.00	46	5.04	40.54	111.27
8.00	51.7	5.76	40.85	124.11
9.00	57.7	6.47	41.17	137.46
10.00	63.1	7.19	41.48	149.16
11.00	68.7	7.91	41.81	161.14
12.00	73.4	8.63	42.14	170.82
13.00	75	9.35	42.47	173.17
14.00	73.7	10.07	42.81	168.82
15.00	68.1	10.79	43.16	154.74



Unconfined Compressive Strength (q_u) =

173.17 kPa

Strain =

9.4 %

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Unconfined Compression Test (ASTM D 2166)

Project: Construction of a Production Facility, Gharo, Sindh

Date: 21-07-2024

Borehole No.: BH-2

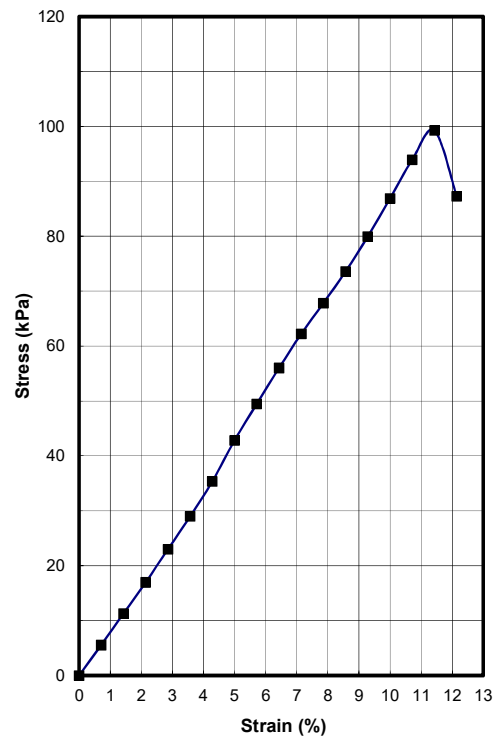
Sample No.: UDS-1

Lab Ref: J-875

Depth: (meter) 1.50

Length	14.00 cm	Area (avg.)	38.50 cm ²
Dia (avg.)	7 cm	Bulk Density	18.71 kN/m ³
Weight	1028.0 g	N M C	20.76 %
Volume	539.00 cm ³	Dry Density	15.49 kN/m ³

Deformaton (mm)	Load kg	Strain (%)	Corrected Area (cm ²)	Stress (kPa)
0.00	0	0.00	38.50	0.00
1.00	2.2	0.71	38.78	5.56
2.00	4.5	1.43	39.06	11.30
3.00	6.8	2.14	39.34	16.95
4.00	9.3	2.86	39.63	23.01
5.00	11.8	3.57	39.93	28.98
6.00	14.5	4.29	40.22	35.35
7.00	17.7	5.00	40.53	42.83
8.00	20.6	5.71	40.83	49.47
9.00	23.5	6.43	41.15	56.01
10.00	26.3	7.14	41.46	62.21
11.00	28.9	7.86	41.78	67.83
12.00	31.6	8.57	42.11	73.59
13.00	34.6	9.29	42.44	79.95
14.00	37.9	10.00	42.78	86.88
15.00	41.3	10.71	43.12	93.93
16.00	44	11.43	43.47	99.27
17.00	39	12.14	43.82	87.28



Unconfined Compressive Strength (q_u) =

99.27 kPa

Strain =

11.4 %

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal

Unconfined Compression Test (ASTM D 2166)

Project: Construction of a Production Facility, Gharo, Sindh

Date: '23-07-2024

Borehole No.: BH-2

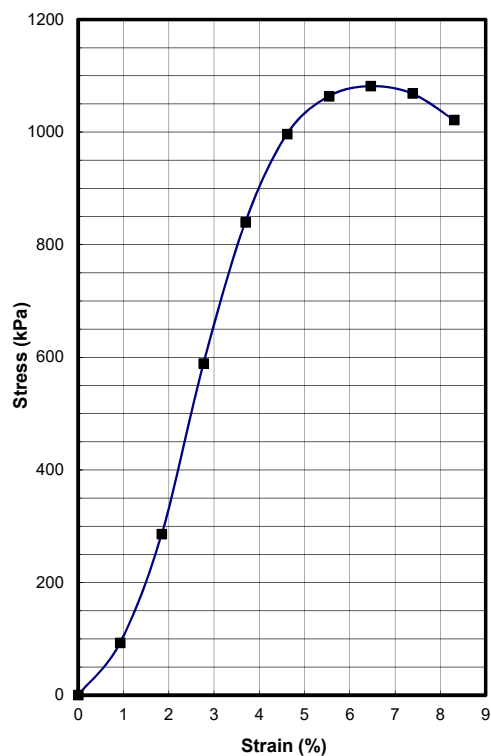
Sample No.: R-2

Lab Ref: J-875

Depth: (meter) 34.20

Length	10.84 cm	Area (avg.)	23.08 cm ²
Dia (avg.)	5.42 cm	Bulk Density	21.33 kN/m ³
Weight	543.9 g	N M C	15.42 %
Volume	250.20 cm ³	Dry Density	18.48 kN/m ³

Deformaton (mm)	Load kg	Strain (%)	Corrected Area (cm ²)	Stress (kPa)
0.00	0	0.00	23.08	0.00
1.00	22	0.92	23.30	92.61
2.00	68.6	1.85	23.52	286.08
3.00	142.6	2.77	23.74	589.10
4.00	205.2	3.69	23.97	839.66
5.00	245.9	4.61	24.20	996.56
6.00	265	5.54	24.43	1063.58
7.00	272.15	6.46	24.67	1081.61
8.00	271.5	7.38	24.92	1068.39
9.00	262.15	8.30	25.17	1021.32



Unconfined Compressive Strength (q_u) =

1081.61 kPa

Strain =

6.5 %

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Unconfined Compression Test (ASTM D 2166)

Project: Construction of a Production Facility, Gharo, Sindh

'Date: '21-07-2024

Borehole No.: BH-3

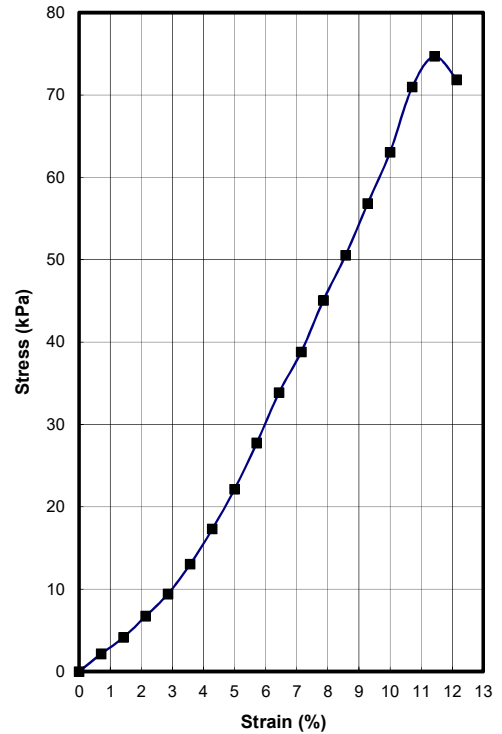
Sample No.: UDS-1

Lab Ref: J-875

Depth: (meter) 1.50

Length	14.00 cm	Area (avg.)	38.50 cm ²
Dia (avg.)	7 cm	Bulk Density	18.11 kN/m ³
Weight	995.0 g	N M C	20.43 %
Volume	539.00 cm ³	Dry Density	15.04 kN/m ³

Deformaton (mm)	Load kg	Strain (%)	Corrected Area (cm ²)	Stress (kPa)
0.00	0	0.00	38.50	0.00
1.00	0.85	0.71	38.78	2.15
2.00	1.65	1.43	39.06	4.14
3.00	2.7	2.14	39.34	6.73
4.00	3.8	2.86	39.63	9.40
5.00	5.3	3.57	39.93	13.02
6.00	7.1	4.29	40.22	17.31
7.00	9.15	5.00	40.53	22.14
8.00	11.55	5.71	40.83	27.74
9.00	14.2	6.43	41.15	33.84
10.00	16.4	7.14	41.46	38.79
11.00	19.2	7.86	41.78	45.06
12.00	21.7	8.57	42.11	50.54
13.00	24.6	9.29	42.44	56.84
14.00	27.5	10.00	42.78	63.04
15.00	31.2	10.71	43.12	70.96
16.00	33.1	11.43	43.47	74.68
17.00	32.1	12.14	43.82	71.84



Unconfined Compressive Strength (q_u) =

74.68 kPa

Strain =

11.4 %

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal

Unconfined Compression Test (ASTM D 2166)

Project: Construction of a Production Facility, Gharo, Sindh

'Date: '26-07-2024

Borehole No.: BH-4

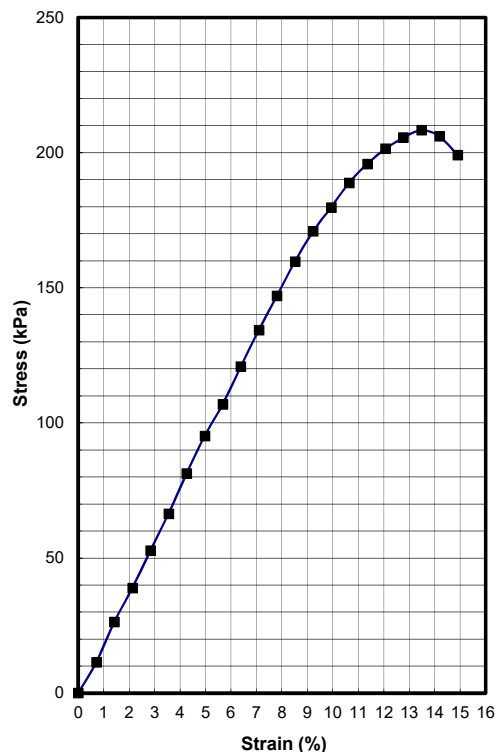
Sample No.: UDS-1

Lab Ref: J-875

Depth: (meter) 33.50

Length	14.10 cm	Area (avg.)	38.50 cm ²
Dia (avg.)	7 cm	Bulk Density	18.87 kN/m ³
Weight	1044.0 g	N M C	21.33 %
Volume	542.85 cm ³	Dry Density	15.55 kN/m ³

Deformation (mm)	Load kg	Strain (%)	Corrected Area (cm ²)	Stress (kPa)
0.00	0	0.00	38.50	0.00
1.00	4.5	0.71	38.78	11.38
2.00	10.5	1.42	39.05	26.37
3.00	15.6	2.13	39.34	38.89
4.00	21.3	2.84	39.62	52.72
5.00	27	3.55	39.92	66.33
6.00	33.3	4.26	40.21	81.21
7.00	39.3	4.96	40.51	95.13
8.00	44.45	5.67	40.82	106.80
9.00	50.65	6.38	41.13	120.78
10.00	56.74	7.09	41.44	134.28
11.00	62.6	7.80	41.76	147.01
12.00	68.5	8.51	42.08	159.63
13.00	73.9	9.22	42.41	170.88
14.00	78.3	9.93	42.74	179.64
15.00	82.95	10.64	43.08	188.81
16.00	86.7	11.35	43.43	195.78
17.00	89.91	12.06	43.78	201.40
18.00	92.5	12.77	44.13	205.53
19.00	94.5	13.48	44.50	208.27
20.00	94.25	14.18	44.86	206.02
21.00	91.85	14.89	45.24	199.11



Unconfined Compressive Strength (q_u) = 208.27 kPa

Strain = 13.5 %

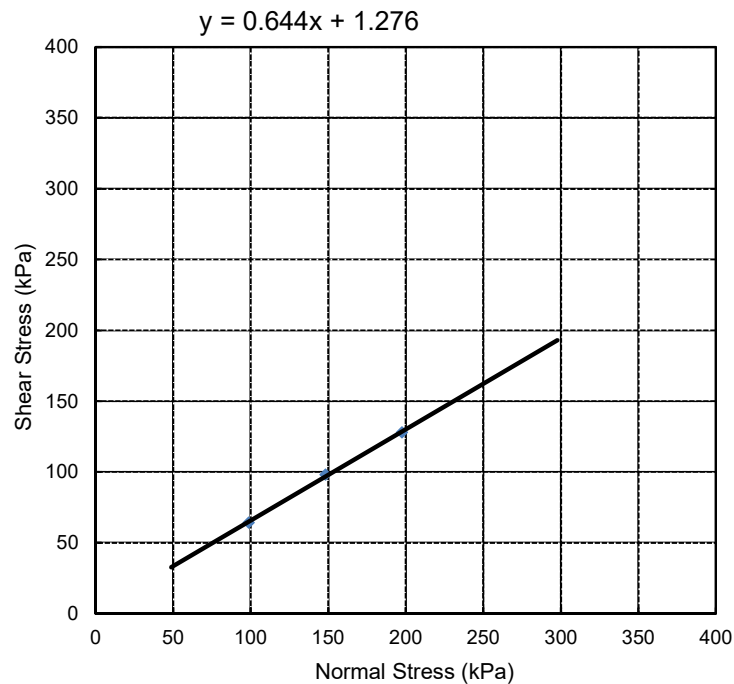
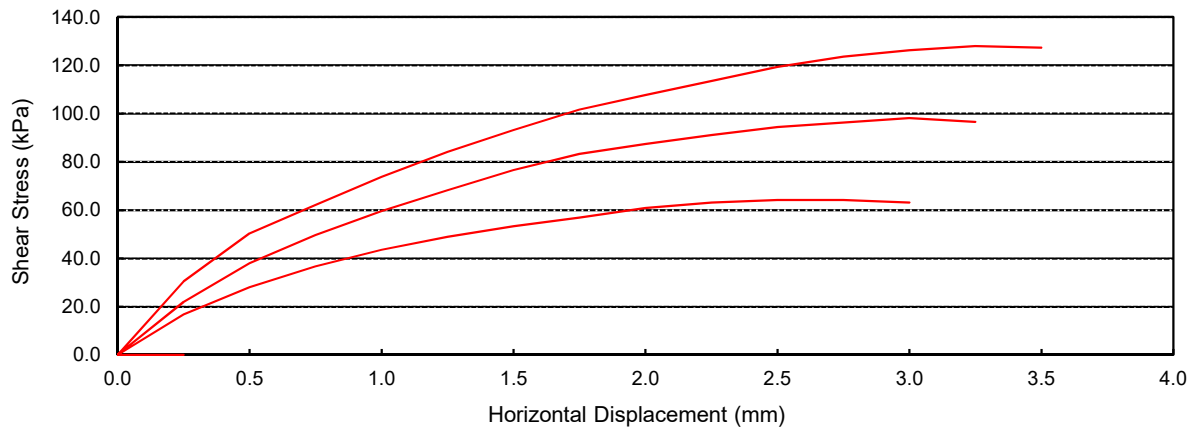
Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Direct Shear Test (ASTM D3080)

Project:	Construction of a Production Facility, Gharo, Sindh	Sample Type:	Remoulded
Borehole No.:	BH-1	Depth:	9.00 meter
Sample No.:	SPT-9	Test Condition:	Soaked
Date:	26-07-2024	Bulk Density:	18.13 kN/m ³
Lab Ref:	J-875	Moisture Content:	16.50 %



LINEAR REGRESSION

Internal Friction Angle (ϕ)	=	32.8	Degrees
Cohesion (c)	=	1.3	kPa

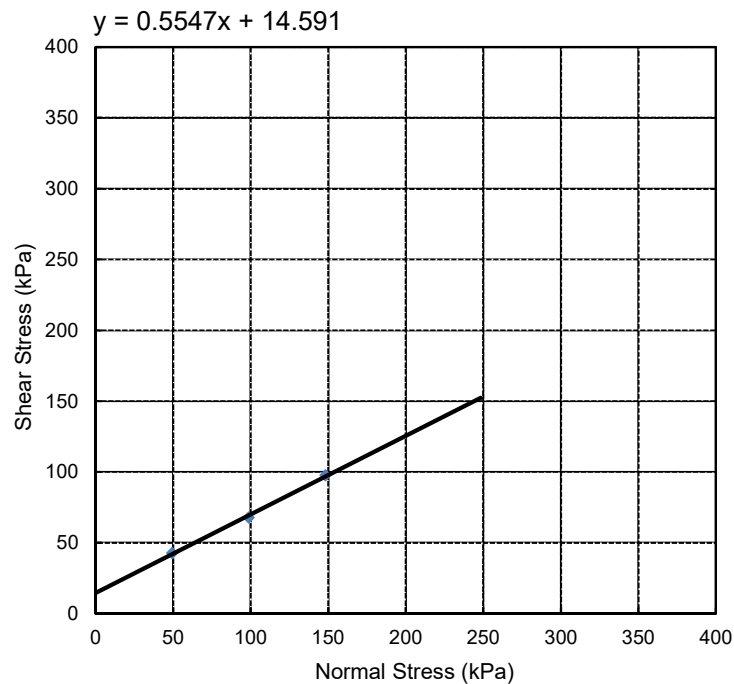
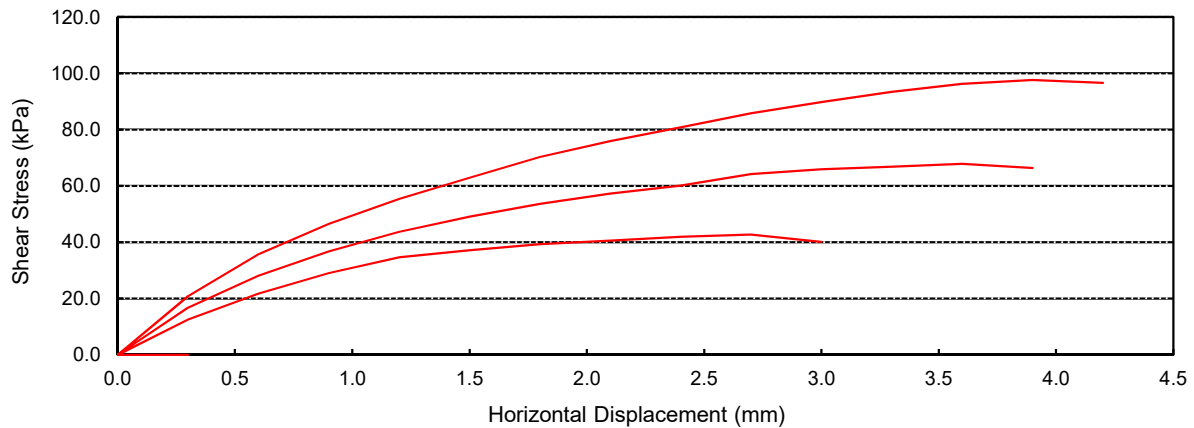
Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Direct Shear Test (ASTM D3080)

Project:	Construction of a Production Facility, Gharo, Sindh	Sample Type:	Remoulded
Borehole No.:	BH-02	Depth:	6.00 meter
Sample No.:	SPT-6	Test Condition:	Soaked
Date:	20-07-2024	Bulk Density:	18.06 kN/m ³
Lab Ref:	J-875	Moisture Content:	16.30 %



LINEAR REGRESSION

Internal Friction Angle (ϕ) = **29.0** **Degrees**
Cohesion (c) = **14.6** **kPa**

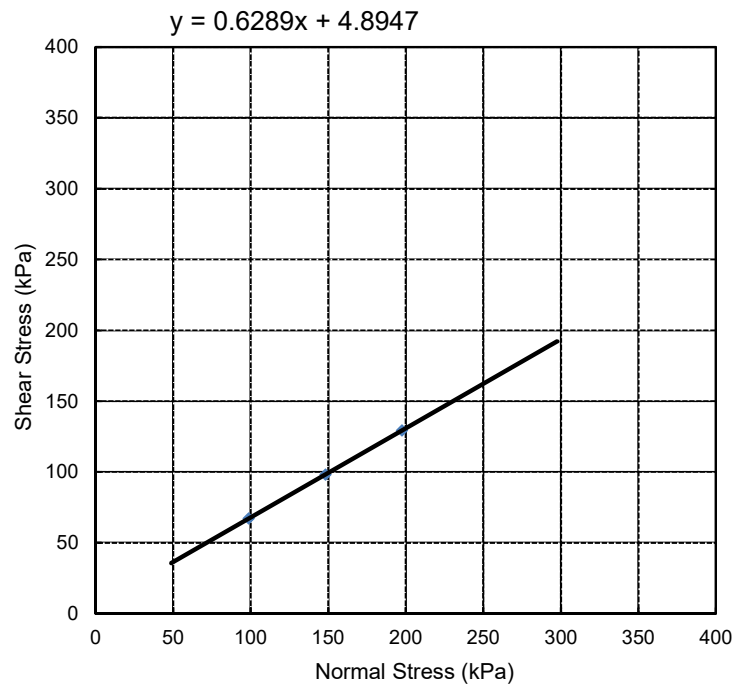
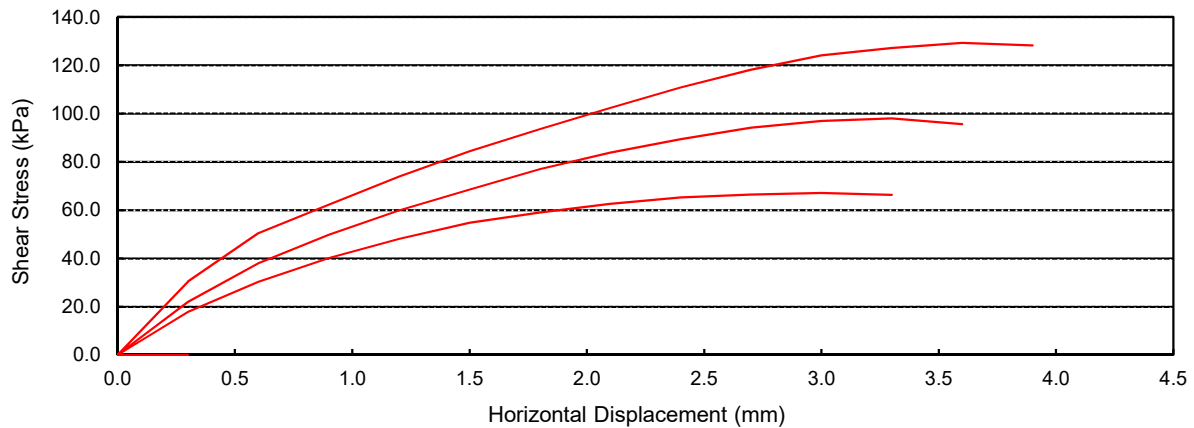
Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Direct Shear Test (ASTM D3080)

Project:	Construction of a Production Facility, Gharo, Sindh	Sample Type:	Remoulded
Borehole No.:	BH-03	Depth:	10.00 meter
Sample No.:	SPT-10	Test Condition:	Soaked
Date:	20-07-2024	Bulk Density:	18.78 kN/m ³
Lab Ref:	J-875	Moisture Content:	17.32 %



LINEAR REGRESSION

Internal Friction Angle (ϕ) = **32.2** **Degrees**
Cohesion (c) = **4.9** **kPa**

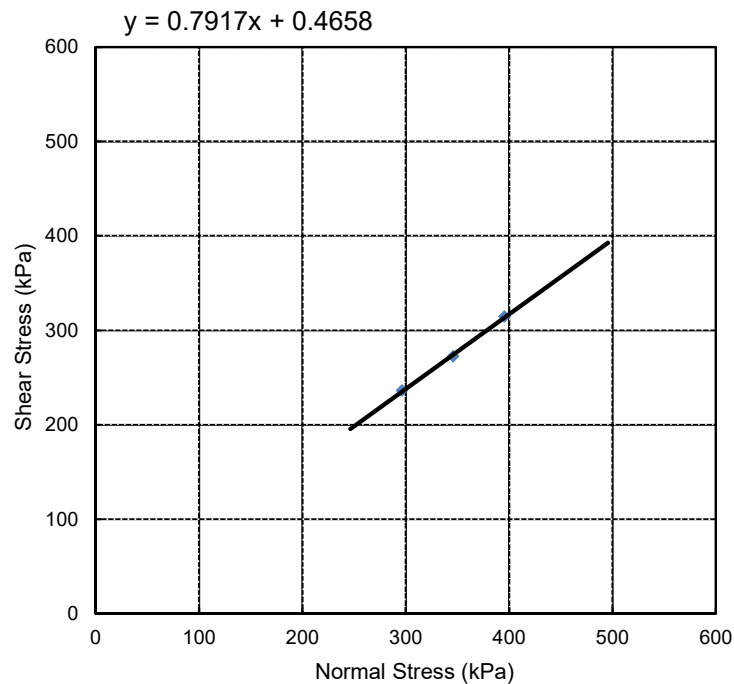
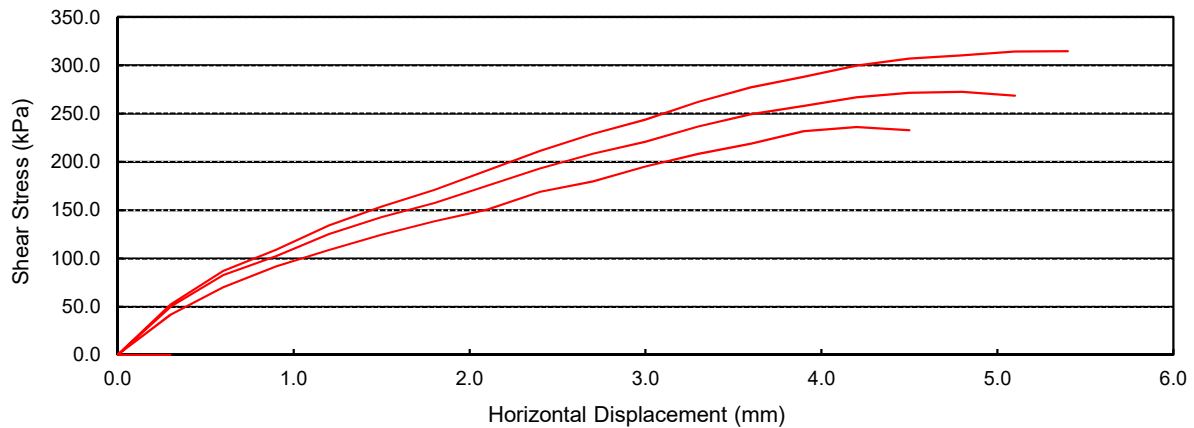
Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Direct Shear Test (ASTM D3080)

Project:	Construction of a Production Facility, Gharo, Sindh	Sample Type:	Remoulded
Borehole No.:	BH-4	Depth:	24.00 meter
Sample No.:	SPT-24	Test Condition:	Soaked
Date:	26-07-2024	Bulk Density:	18.68 kN/m ³
Lab Ref:	J-875	Moisture Content:	17.6 %



LINEAR REGRESSION

Internal Friction Angle (ϕ) = **38.4** **Degrees**
Cohesion (c) = **0.5** **kPa**

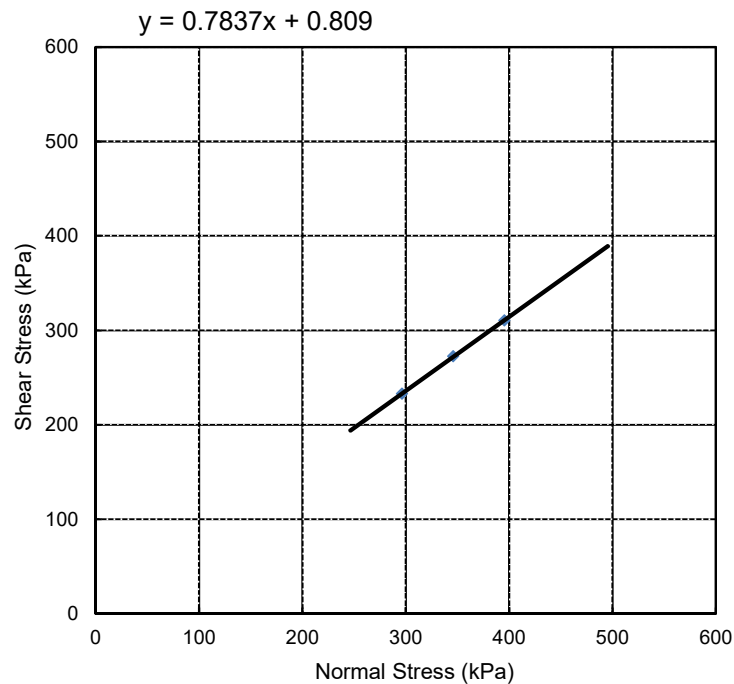
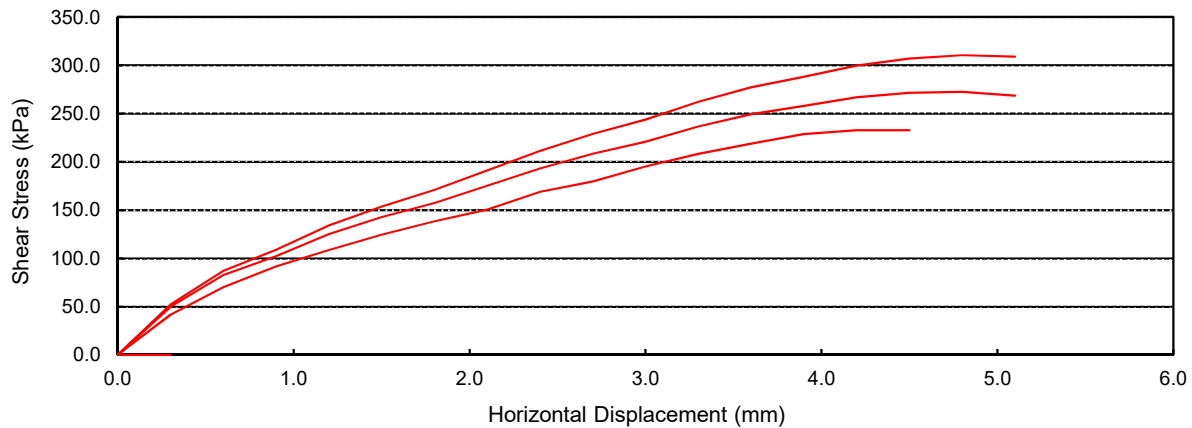
Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Direct Shear Test (ASTM D3080)

Project:	Construction of a Production Facility, Gharo, Sindh	Sample Type:	Remoulded
Borehole No.:	BH-5	Depth:	30.00 meter
Sample No.:	SPT-30	Test Condition:	Soaked
Date:	20-07-2024	Bulk Density:	18.50 kN/m ³
Lab Ref:	J-875	Moisture Content:	19.0 %



LINEAR REGRESSION

Internal Friction Angle (ϕ)	=	38.1	Degrees
Cohesion (c)	=	0.8	kPa

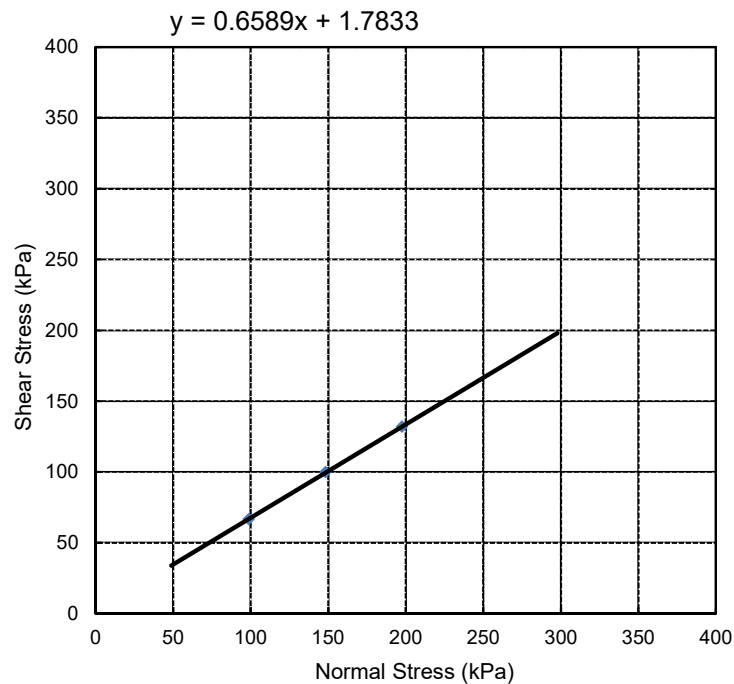
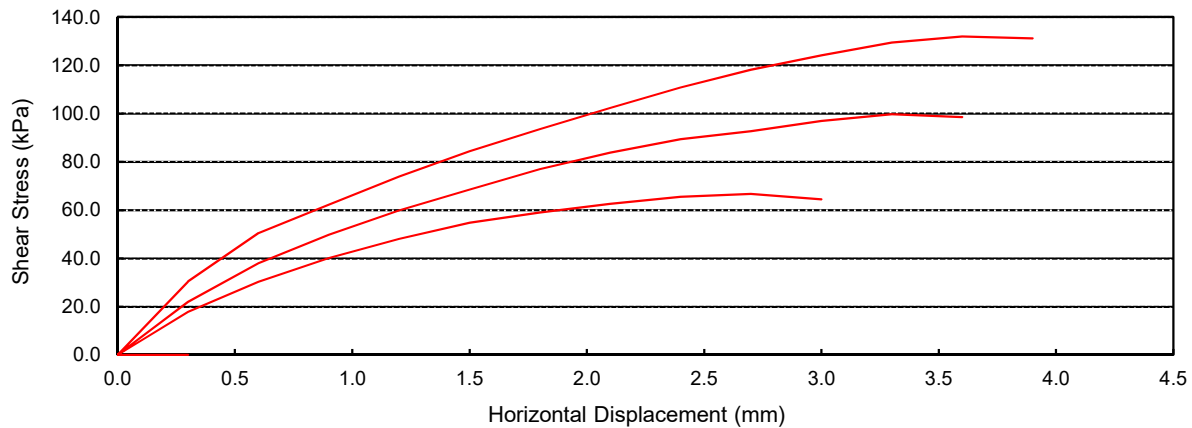
Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal



Direct Shear Test (ASTM D3080)

Project:	Construction of a Production Facility, Gharo, Sindh	Sample Type:	Remoulded
Borehole No.:	BH-06	Depth:	14.00 meter
Sample No.:	SPT-14	Test Condition:	Soaked
Date:	20-07-2024	Bulk Density:	18.45 kN/m ³
Lab Ref:	J-875	Moisture Content:	17.32 %



LINEAR REGRESSION

Internal Friction Angle (ϕ)	=	33.4	Degrees
Cohesion (c)	=	1.8	kPa

Tested by:
Sikandar Hayat

Checked by:
Muhammad Ajmal

APPENDIX-D

(PHOTOGRAPHS)



Photo-1: Performance of Standard Penetration Test at the location of BH-01.



Photo-2: Piezometer installed at the location of BH-03.

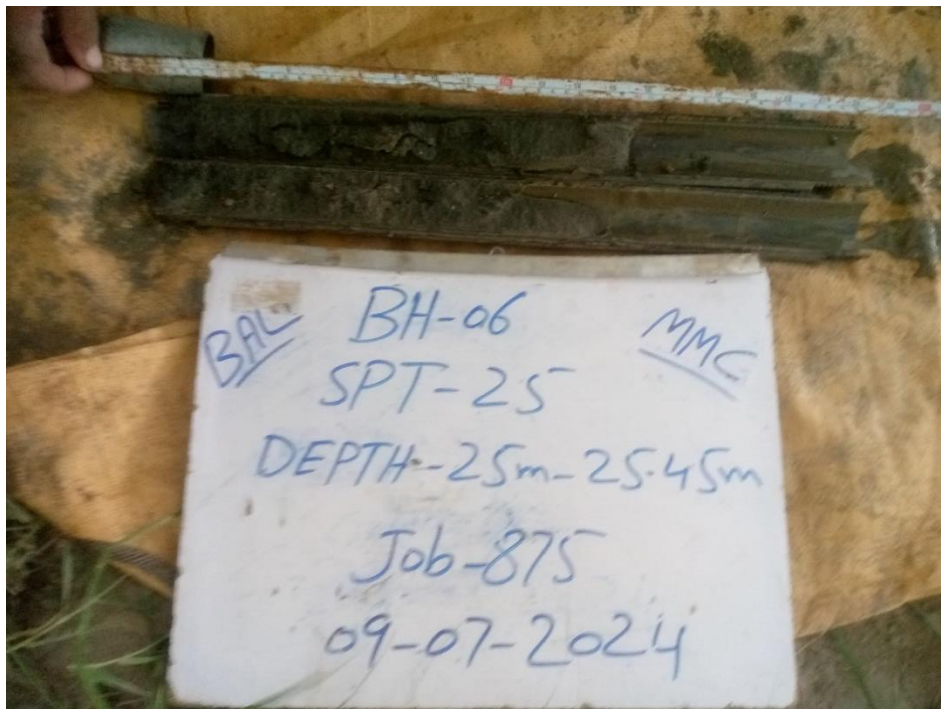


Photo-3: Collected SPT sample at the location of BH-06.



Photo-4: Performance of Field Density Test at TP-05.

**APPENDIX III -
EMERGENCY
PREPAREDNESS
& RESPONSE
PLAN**

GUIDELINE EMERGENCY PREPAREDNESS AND RESPONSE PLAN

1.1 PURPOSE

The purpose of this Emergency Response Procedure is to provide measures and guidance for the establishment and implementation of emergency preparedness plans for the project. The aim of the Emergency Response Procedure is to:

- i. Ensure all personnel and visitors to the office/job sites are given the maximum protection from unforeseen events.
- ii. Ensure all personnel are aware of the importance of this procedure to protection of life and property.

1.2 EMERGENCY PREPARATION AND RESPONSE MEASURE SCOPE

The emergency management program is applied to all Project elements and intended for use throughout the Project life cycle. The following are some emergencies that may require coordinated response.

- i. Construction Accident
- ii. Road & Traffic Accident
- iii. Hazardous material spills
- iv. Structure collapse or failure
- v. Trauma or serious illness
- vi. Sabotage
- vii. Fire
- viii. Environmental Pollution
- ix. Loss of person
- x. Community Accident

1.3 RESPONSIBILITIES

The detailed roles and responsibilities of certain key members of the Emergency Response team available to assist in emergency are provided in **Table 1** below.

Table 1: Emergency Response Team

Action Group	Responsibility
Emergency Coordinator	▪ Overall control of personnel and resources. ▪ The Emergency Coordinator will support and advise the Site Safety Supervision as necessary. ▪ Serves as public relations spokes persons, or delegates to some staff member the responsibility for working with news media regarding any disaster or emergency. Also assure proper coordination of news release with appropriate corporate staff or other designated people.
Site Safety Supervision (Emergency Commander)	▪ Overall responsibility for activating emergency plan and for terminating emergency actions. ▪ Be alternative of emergency response chairpersons. ▪ Disseminates warnings and information as required to ensure all people in the immediate area have been warned and evacuated either by alarms or by word of mouth. ▪ Supervise the actions of the Emergency Response Team to ensure all persons are safe from the danger. ▪ Notify outside authorities if assistance is required. ▪ Carries the responsibility for coordinating actions including other organizations in accordance with the needs of the situation.

Action Group	Responsibility
	▪ Ensure maximum co-operation and assistance is provided to any outside groups called to respond to an emergency. ▪ Establish and appoint all emergency organization structure and team. ▪ Assures adequate delegation of responsibilities for all key positions of assistants on the Project to assist with any foreseeable emergency. ▪ Ensure resources available to purchase needed emergency response equipment and supplies. ▪ Assures that all persons on the Emergency Response Team aware and fully understand their individual responsibilities for implementing and supporting the emergency plan. ▪ Establish the emergency drill schedule of all identified emergency scenarios, track the status and evaluate the emergency. ▪ The Emergency Commander shall ensure that senior management personnel have been reported of the emergency as soon as practical after the event.
Security Team	▪ Ensure that the exit route is regularly tested and maintained in good working order. ▪ Maintain station at the security gate or most suitable location to secure the area during any emergency such that only authorized personnel and equipment may enter, prevent access to the site of unauthorized personnel. ▪ Assist with strong/activation of services during an emergency. ▪ Ensure vehicles and obstructions are moved to give incoming emergency vehicles access to the scene, if ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct any incoming emergency service to the site of emergency.
Rescue & Medical Team	▪ Protect the injured from further danger and weather. ▪ Provide treatment to the victim(s) to the best of their ability by first aid and then transfer to hospital. ▪ Remain familiar with the rescue activities and rescue apparatus. ▪ Assist outside medical services personnel when they arrive
General Administration Team	Response to support any requested general facilities for assisting Emergency Response Team in their work.
Government Relation Team	▪ Coordinate with local government on a matter of concerned in the emergency response plan to liaise with local officers in their affair for support Emergency Response Team. ▪ Coordinate emergency plan with the government authorities, local community.
Environment Team	In case of emergency related to the environmental pollution such as the chemical spill, oil spill into the ambient, the environment team will support the technical advice to control and mitigate the pollution until return to the normal situation.
Department Heads	▪ Call up of personnel into the safe location for protective life and property. ▪ Take immediate and appropriate action while Emergency Response Team is being mobilized. ▪ Keep in touch with the Emergency Commander ▪ Control and supervise operators and contractors on the implementation of this procedure, with consultation with Safety Team as necessary. ▪ Provide and maintain emergency equipment of their responsible areas.

Action Group	Responsibility
Other Staff and Employees	▪ All other staff and employees will remain at their workstations or assembly point unless directed otherwise from Emergency Response Team. ▪ Each supervisor will ensure that all members of his work group are accounted for and keep in touch with each of their Department Head.

1.4 PROCEDURE

Emergency situation and injuries to person can occur at any time or place either on Project site or elsewhere. The most two common types of emergencies on site are fire and serious accident.

Figure 3.1 Emergency Procedures for Fire

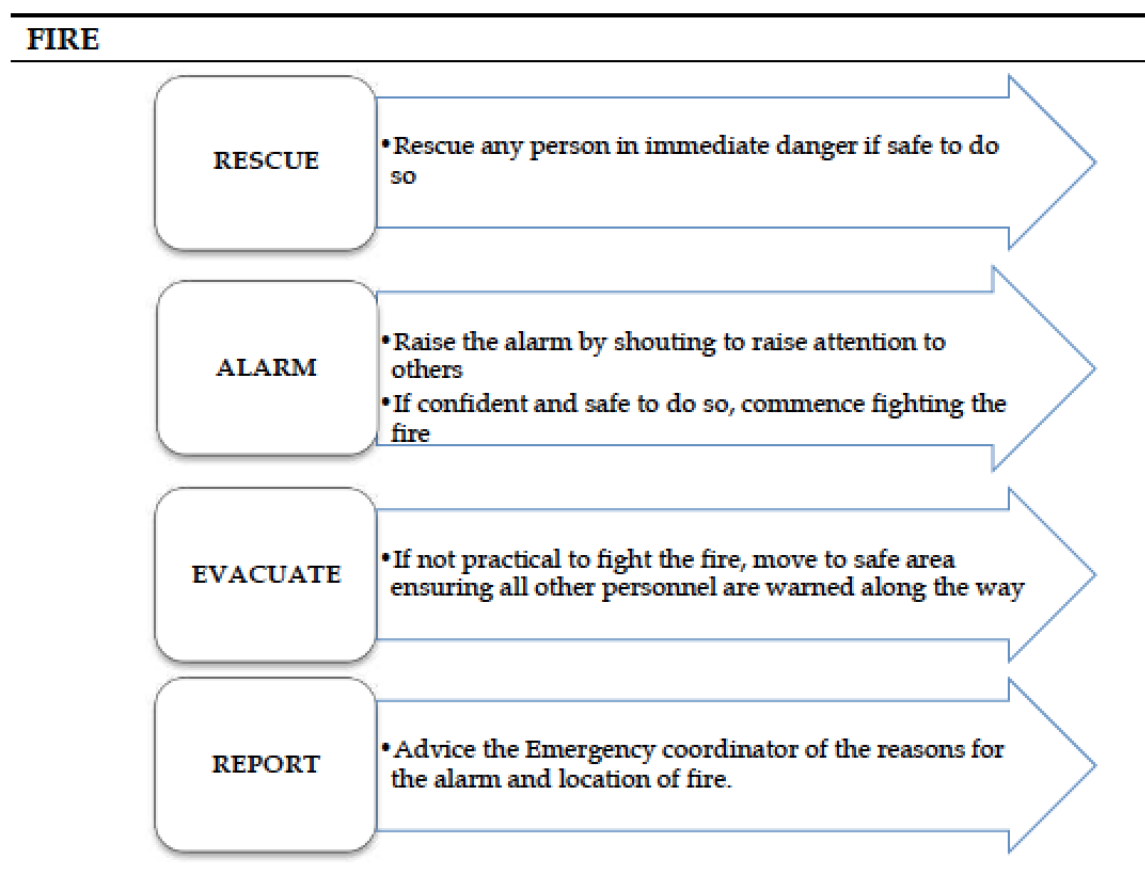
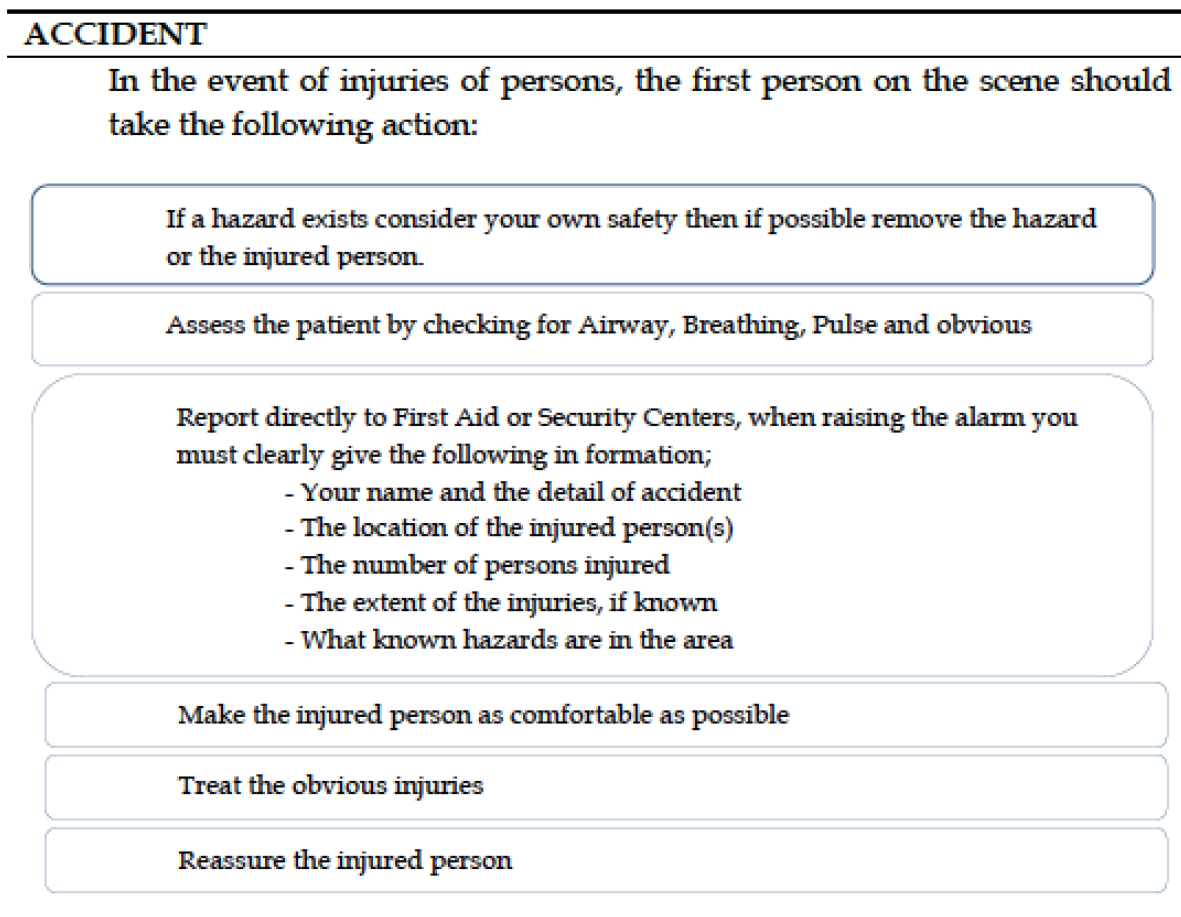


Figure 3.2 Emergency Procedures for Serious Accident



3.5 COMMUNICATION WITH AUTHORITIES / PRESS AT SITE

In the event of an accident or incident, only senior staff is permitted to give factual information to the authorities for resource of liability exposure. The press must be avoided politely, at all costs, with the terse comment that “the matter is under investigation and relevant information when available will be provided by our Head Office” Do not ever give your opinion or story.

1.5 FIRST AID PERSONS

Upon advice of medical emergency, make immediate assessment to response required and if necessary, advise security to summon ambulance or medical assistance, the qualified first aid attendant should also,

- Provide treatment to the victim(s) to the best of his/her ability.
- Ensure the safety of victims by ceasing any work activity in the area.
- Protect the injured from further danger and weather.
- Assist medical services personnel when they arrive.

1.6 GENERAL ADMINISTRATION TEAM

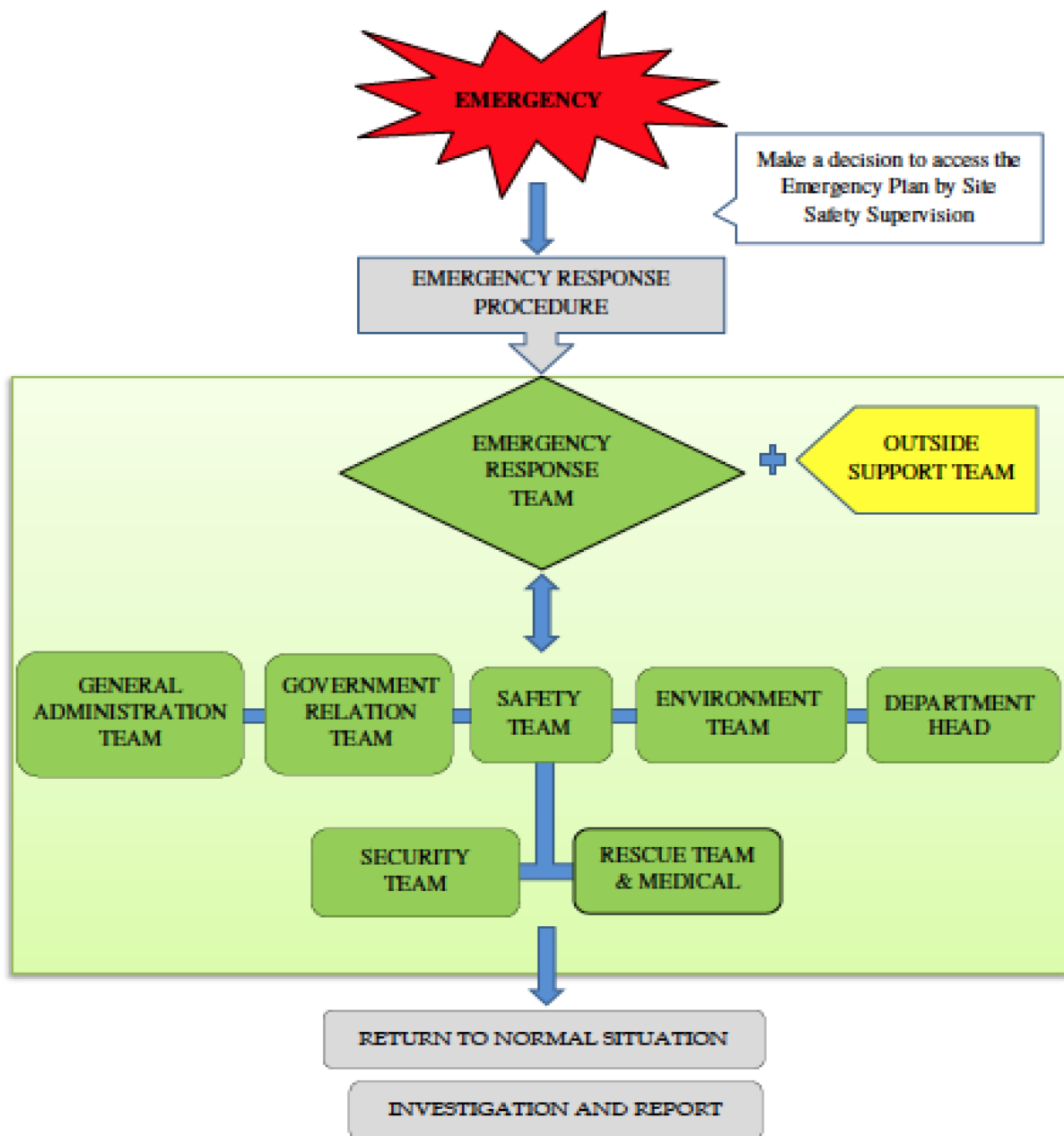
Upon advice of medical emergency, maintain contact with first aid personnel and summon ambulance if required.

1.7 SECURITY TEAM

- If ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct vehicle closest to the scene.
- Prevent access to the site of unauthorized personnel (press, etc.).

1.8 EMERGENCY COORDINATOR

- The Emergency Coordinator shall assist emergency personnel at the scene as required through allocation of company resources.
- The Emergency Coordinator shall ensure next-of-kin are properly notified as soon as possible and give whatever company support and assistance is necessary to assist them bundle the situation
- The Emergency Coordinator shall ensure that senior management personnel are advised of the emergency as soon as practical after the event.



Note: Name of contact person and call number from Owner/ Contractor to be determined.

1.9 INCIDENT AND ACCIDENT REPORT

Section A: Identification Data										
Report No:	Date of Reported:				Reporter:		Sign:			
Job Title:					Company Name:					
Section B: Violence Rate										
Accident Violence: ☐ 01-Death ☐ 02-Serious Injury ☐ 03-Lost Time Injury ☐ 04-First Aid ☐ 05- Not Injury ☐ 06-Near Miss Property Damage Cost: ☐ 1-2,000 USD ☐ 2,001-10,000 USD ☐ 10,001-50,000 ☐ > 50,001										
Section C: Environmental Impact										
Affected area		☐ Construction area		☐ Public area						
Receptor		☐ None		☐ Workers		☐ Community				
Type of pollution		☐ Physical		☐ Chemical		☐ Biological				
Toxicity		☐ Non-toxic		☐ Low - toxic		☐ High - toxic				
Return to Normal		☐ 1 day		☐ 1 day to 1 week		☐ ≥ 1 week				
Cumulative impact		☐ Non-cumulative		☐ Cumulative						
Section D: Injured/illness Employee										
1.Name:		Sex:	Date of Birth:			Age:	Regular Job Title:		Experience:	
		☐ Male ☐ Female	Month	Day	Year				In this job title Years Weeks	In this Project Years Weeks
Site:		Company:		Reference:			Phone No:		Social Security Number	
Part of Body Injured or Affected:				Nature of Injury or Illness:						
☐ Head ☐ Hands ☐ Face ☐ Nose				☐ Laceration ☐ Amputation ☐ Puncture ☐ Fracture						
☐ Eyes ☐ Legs ☐ Teeth ☐ Neck				☐ Strain & Sprain ☐ Burns ☐ Contusion ☐ Dry Heat Friction						
☐ Trunk ☐ Toes ☐ Elbow ☐ Shoulder				☐ Hernia ☐ Foreign Body ☐ Chemical ☐ Contamination						
☐ Back ☐ Ankle ☐ Wrist ☐ Foot				☐ Skin (Occupational) ☐ Rash ☐ Irritation						
☐ Arms ☐ Thumb ☐ Fingers ☐ Internal										
Remark:				Remark:						
2.Name:		Sex:	Date of Birth:			Age:	Regular Job Title:		Experience:	
		☐ Male ☐ Female	Month	Day	Year				In this job title Years Weeks	In this Project Years Weeks
Site:		Company:		Reference:			Phone No:		Social Security Number	
Part of Body Injured or Affected:				Nature of Injury or Illness:						
☐ Head ☐ Hands ☐ Face ☐ Nose				☐ Laceration ☐ Amputation ☐ Puncture ☐ Fracture						
☐ Eyes ☐ Legs ☐ Teeth ☐ Neck				☐ Strain & Sprain ☐ Burns ☐ Contusion ☐ Dry Heat Friction						
☐ Trunk ☐ Toes ☐ Elbow ☐ Shoulder				☐ Hernia ☐ Foreign Body ☐ Contamination ☐ Chemical						
☐ Back ☐ Ankle ☐ Wrist ☐ Foot				☐ Skin (Occupational) ☐ Rash ☐ Irritation						
☐ Arms ☐ Thumb ☐ Fingers ☐ Internal										
Remark:				Remark:						
Section E: Accidents/incident Details										
Date Accident/Incident Occurred:			Time Accident/Incident Occurred:				Exact Location of the Accident / Incident:			

Details of the actual Job Being done at the time:		
Details of Accident / Incident / What actually happened?		
Section F: Accident Cause (Basic cause mark X / Contributing cause, if any mark O)		
UNSAFE CONDITIONS 1 ☐ Inadequately Guarded 2 ☐ Unguarded 3 ☐ Defective Tools, Equipment, or Substance 4 ☐ Unsafe Design or Construction 5 ☐ Hazardous Arrangement 6 ☐ Unsafe Illumination 7 ☐ Unsafe Ventilation 8 ☐ Unsafe Clothing 9 ☐ Insufficient Instruction 10 ☐ Lack of system of work Why was the unsafe act committed? _____	UNSAFE ACTS 1 ☐ Operating Without Authority / Training 2 ☐ Operating at Unsafe Speed 3 ☐ Marking SHE Device Inoperative 4 ☐ Using Unsafe Equipment or Equipment Unsafely 5 ☐ Unsafe Loading, Placing, Mixing 6 ☐ Taking Unsafe Position 7 ☐ Working on Moving or Dangerous Equipment 8 ☐ Distraction, Teasing, Horse Play 9 ☐ Failure to use Personal Protective Devices 10 ☐ Lack of effective instruction or supervision Why did the unsafe condition exist? _____	
Section G: Guide to Corrective Action (Base on the cause checked above, I am taking the following corrective action)		
UNSAFE ACT ☐ Stop the Behaviour ☐ Study the job ☐ Instruct (tell-show-try-check) ☐ Follow Up ☐ Enforce	UNSAFE CONDITION ☐ Remove ☐ Guard ☐ Warn ☐ Supervisory Training	If Supervisor can't handle, then recommend to ☐ Site Engineer, or ☐ Site Manager, or ☐ Project Manager, or ☐ Safety Committee
Detail below any immediate remedial actions that have been taken:		
Detail below any corrective and preventative actions that could be taken to prevent future re-occurrence:	Responsible	Completion Date

Section H: Witness Statement			
Witness Name		Interviewer Name	
Section I: Reviewed & Recommend by			
Recommendation: 			
Reviewed By:	Position:	Signature:	Date:
Remarks : If Accident or Incident happened with lost time injury and affected to the publicity must further report to Safety Department; : First Aid Cases will not applicable to this form; : The accident report shall submit to Safety Department within 3 days : Attached the photograph or sketch the location of accident / incident;			

1.10 SUGGESTED CONTENTS OF EPRP

The Contractor should prepare the EPRP based on the guidelines provided in the above sections. The suggested structure of the EPRP is listed below:

1. Purpose
2. Applicable Scope
3. Preparation Basis
4. Emergency Response System
 - 4.1 Generals
 - 4.2 Emergency Response System
 - 4.3 Responsibilities
5. Major Safety Risks
6. Precautionary Measures
 - 6.1 Training and Exercise
 - 6.2 Hazard Source Monitor
 - 6.3 Alert Action
 - 6.4 Management Measures
7. Control Measures
 - 7.1 Response
 - 7.2 Response Procedures
 - 7.3 Emergency Response
 - 7.4 Emergency Completion and Restoration
8. Emergency Response Report and Settlement
9. Supporting Measures
 - 9.1 Communication
 - 9.2 Emergency Team
 - 9.3 Funding for Emergency
 - 9.4 Provisions and Resources
10. Records

APPENDIX IV - CHANCE FIND PROCEDURES

ARCHAEOLOGICAL ‘CHANCE FIND’ PROCEDURE

1. BACKGROUND

The purpose of this document is to address the possibility of archaeological deposits becoming exposed during ground altering activities within the project area and to provide protocols to follow in the case of a chance archaeological find to ensure that archaeological sites are documented and protected as required.

The Antiquities Act, 1975, protects archaeological sites, whether on Provincial Government owned or private land. They are non-renewable, very susceptible to disturbance and are finite in number. Archaeological sites are an important resource that is protected for their historical, cultural, scientific and educational value to the general public and local communities. Impacts to archaeological sites must be avoided or managed by development proponents. The objectives of this ‘Archaeological Chance Find Procedure’ are to promote preservation of archaeological data while minimizing disruption of construction scheduling. It is recommended that due to the moderate to high archaeological potential of some areas within the project area, all on site personnel and contractors be informed of the Archaeological Chance Find Procedure and have access to a copy while on site.

2. POTENTIAL IMPACTS TO ARCHAEOLOGICAL SITES

Developments that involve excavation, movement, or disturbance of soils have the potential to impact archaeological materials, if present. Activities such as road construction, land clearing, and excavation are all examples of activities that may adversely affect archaeological deposits.

3. RELEVANT LEGISLATION

It ensures the protection, preservation, development and maintenance of antiquities in the provinces of Pakistan. The Act defines “antiquities” as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these 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 relevant provincial governments to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the subproject proponents are obligated to ensure that no activity is undertaken in the proximity of a protected antiquity, report to the Department of Archaeology, any archaeological discovery made during the course of the project.

4. REMEDIES AND PENALTIES

The Antiquities Act, 1975 provides for heritage inspection or investigation orders, temporary protection orders, civil remedies and penalties to limit contraventions. These powers provide:

“A contravention of any provision of this Act or the rules shall, where no punishment has been specifically provided be punishable with rigorous imprisonment for a term which may extend to two years, or with fine up to rupees ten hundred thousand, or with both.”

5. ARCHAEOLOGICAL ‘CHANCE FIND’ PROCEDURE

If you believe that you may have encountered any archaeological materials, stop work in the area and follow the procedure below:

The following ‘chance-find’ principles will be implemented by the contractor throughout the construction works to account for any undiscovered items identified during construction works:

- i. Workers will be trained in the location of heritage zones within the construction area and in the identification of potential items of heritage significance.
- ii. Should any potential items be located, the site supervisor will be immediately contacted and work will be temporarily stopped in that area.

- iii. If the site supervisor determines that the item is of potential significance, an officer from the Department of Archaeology (DoA) will be invited to inspect the site and work will be stopped until DoA has responded to this invitation.
- iv. Work will not re-commence in this location until agreement has been reached
- v. between DoA and NTDC as to any required mitigation measures, which may include excavation and recovery of the item.
- vi. A precautionary approach will be adopted in the application of these procedures.

6. DETAILED PROCEDURAL STEPS

- If the Director, department of Archaeology receives any information or otherwise has the knowledge of the discovery or existence of an antiquity of which there is no owner, he shall, after satisfying himself as to the correctness of the information or knowledge, take such steps with the approval of the Government, as he may consider necessary for the custody, preservation and protection of the antiquity.
- Whoever discovers, or finds accidentally, any movable antiquity shall inform forth with the Directorate within seven days of its being discovered or found.
- If, within seven days of his being informed, the Director decides to take over the antiquity for purposes of custody, preservation and protection, the person discovering or finding it shall hand it over to the Director or a person authorized by him in writing.
- Where the Director decides to take over an antiquity, he may pay to the person by whom it is handed over to him such cash reward as may be decided in consultation with the Advisory Committee.
- If any person, who discovers or finds any movable antiquity contravenes the provisions of the Act, he shall be punishable with imprisonment for a term which may extend to five (05) years, or with fine not less than fifteen hundred thousand rupees or with both and the Court convicting such person shall direct that the antiquity in respect of which such contravention has taken place shall stand forfeited to Government.
- The Director or any officer authorized by him with police assistance may, after giving reasonable notice, enter into, inspect and examine any premises, place or area which or the sub-soil of which he may have reason to believe to be, or to contain an antiquity and may cause any site, building, object or any antiquity or the remains of any antiquity in such premises, place or area to be photographed, copied or reproduced by any process suitable for the purpose.
- The owner or occupier of the premises, place or area shall afford all reasonable opportunity and assistance to the Director.
- No photograph, copy of reproduction taken or made shall be sold or offered for sale except by or with the consent of the owner of the object of which the photograph, copy or the reproduction has been taken or made.
- Where substantial damage is caused to any property as a result of the inspection, the Director shall pay to the owner thereof reasonable compensation for the damage in consultation with the Advisory Committee.
- If the Director after conducting an inquiry, has reasonable grounds to believe that any land contains any antiquity, he may approach the Government to direct the Revenue Department to acquire such land or any part thereof and the Revenue Department shall thereupon acquire such land or part under the Land Acquisition Act, 1894 (I of 1894), as for a public purpose.

APPENDIX V - OCCUPATIONAL HEALTH & SAFETY PLAN

GUIDELINE OCCUPATIONAL HEALTH AND SAFETY PLAN

Occupational Health and Safety covers all personnel working under the project and will be in line with the World Bank EHS guidelines on health and safety.

The Occupational Health and Safety program will aim to ensure that the workplace is safe and healthy by: addressing the hazards and risks at the workplace; outlining the procedures and responsibilities for preventing, eliminating and minimizing the effects of those hazards and risks; identifying the emergency management plans for the workplace or workplaces; and, specifying how consultation, training and information are to be provided to employees at various workplaces.

Some of the risks/hazards associated with workplaces are due to working close to or at sites associated with the various project construction activities. Other risks associated with the project construction phase include risk of increase of vector borne and other different diseases.

The following sections will be implemented during the construction phase to address and ensure workers' health and safety.

1.1 SCREENING AND REGULAR UNANNOUNCED CHECKING OF WORKERS

As per the procedure for hiring workers, all contractors and labor agencies are required to make all prospective workers undergo medical tests to screen for diseases and sicknesses, prior to selection and employment of any worker. The contractor is also responsible for ensuring that no worker who has a criminal record is employed at the project site. It will be ensured that all workers undergo medical tests to screen diseases at source and at sites in consultation with the designated Health Officer.

In addition to this, the Project Management will also undertake sudden, unannounced checks on workers to look for diseases such as COVID-19, HIV, STDs, and hepatitis and take necessary steps as mandated by the Contractual agreement between the Contractor and the Worker(s).

1.2 MINIMIZING HAZARDS AND RISKS AT THE WORKPLACE

To ensure safety at all work sites, the following will be carried out:

- i. Installation of signboards and symbols in risky and hazardous areas, to inform workers to be careful.
- ii. Construction of barricades around construction sites and deep excavated pits, to cordon off and deter entry of unauthorized personnel and workers into these areas.
- iii. Providing a safe storage site/area for large equipment such as power tools and chains, to prevent misuse and loss.
- iv. Proper Housekeeping: Ensuring that materials are all stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse. Brick stacks will not be more than 7 feet in height and for concrete blocks they will not be more than 6 feet high.
- v. Removing all scrap timber, waste material and rubbish from the immediate work area as the work progresses.
- vi. Where scaffolds are required, ensuring that each scaffold or its components shall be capable of supporting its own weight and at least 4 times the maximum intended load applied or transmitted to it. The platform/scaffold plank shall be at least 15 inches wide and 1.5 inches thick. The rope should be capable of supporting at least 6 times the maximum intended load applied or transmitted to that rope. Pole scaffolds over 60 feet in height shall be designed by a registered professional engineer and shall be

constructed and loaded in accordance with that design. Where scaffolds are not provided, safety belts/safety nets shall be provided;

- vii. Ensure that all ramps or walkways are at least 6 feet wide, having slip resistance threads and not inclined at more than a slope of 1 vertical and 3 horizontal.
- viii. Stacking away all excavated earth at least 2 feet from the pit to avoid material such as loose rocks from falling back into the excavated area and injuring those working inside excavated sites.
- ix. Constructing support systems, such as bracing to adjoining structures that may be endangered by excavation works nearby.
- x. Only a trained electrician to construct, install and repair all electrical equipment to prevent risks of electrical shocks and electrocution.
- xi. Install fire extinguishers and/or other fire-fighting equipment at every work site to prepare for any accidental fire hazards.

1.3 PROVISION OF PERSONAL PROTECTIVE EQUIPMENT

Risks to the health and safety of workers can be prevented by provision of Personal Protective Equipment (PPEs) to all workers. This will be included in the construction cost for each Contractor. Depending on the nature of work and the risks involved, contractors must provide without any cost to the workers, the following protective equipment:

- i. High visibility clothing for all personnel during road works must be mandatory.
- ii. Helmet shall be provided to all workers, or visitors visiting the site, for protection of the head against impact or penetration of falling or flying objects.
- iii. Safety belt shall be provided to workers working at heights (more than 20 ft) such as roofing, painting, and plastering.
- iv. Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on feet.
- v. Ear protecting devices shall be provided to all workers and will be used during the occurrence of extensive noise.
- vi. Eye and face protection equipment shall be provided to all welders to protect against sparks.
- vii. Respiratory protection devices shall be provided to all workers during occurrence of fumes, dusts, or toxic gas/vapor.
- viii. Safety nets shall be provided when workplaces are more than 25 feet (7.5 m) above the ground or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors or safety belts is impractical.

The specific PPE requirements for each type of work are summarized below.

Table 1: PPE Requirement List

Type of Work	PPE
Elevated work	Safety helmet, safety belt (height greater than 20 ft), footwear for elevated work.
Handling work safety	Helmet, leather safety shoes, work gloves.
Welding and cutting work	Eye protectors, shield and helmet, protective gloves.
Grinding work	Dust respirator, earplugs, eye protectors.
Work involving handling of chemical substances	Dust respirator, gas mask, chemical-proof gloves. Chemical proof clothing, air-lined mask, eye protectors.
Wood working	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Blasting	Hard hat, eye and hearing protection.
Concrete and masonry work	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Excavation, heavy equipment, motor graders, and bulldozer operation	Hard hat, safety boots, gloves, hearing protection.
Quarries	Hard hat, eye protectors, hearing protection, safety footwear, leather

Type of Work	PPE
	gloves and dust respirator.

1.4 PROCEDURES TO DEAL WITH EMERGENCIES SUCH AS ACCIDENTS, SUDDEN ILLNESS AND DEATH OF WORKERS

First aid kits will be made available at all times throughout the entire construction period by the respective contractors. This is very important, because most work sites will be at some distance from the nearest hospital. In addition to the first aid kits, the following measures should be in place:

- i. Provision of dispensaries by the individual EPC contractor.
- ii. A vehicle shall be on standby from the Project Office so that emergency transportation can be arranged to take severely injured/sick workers to the nearest hospital for immediate medical attention.
- iii. A designated Health Officer/worker for the Project will be identified as a focal person to attend to all health and safety related issues. This employee's contact number will be posted at all work sites for speedy delivery of emergency services. The focal person shall be well versed with the medical system and facilities available at the hospital.
- iv. Communication arrangements, such a provision of radios or mobile communication for all work sites, for efficient handling of emergencies, will be made.

1.5 RECORD MAINTENANCE AND REMEDIAL ACTION

The Project Management will maintain a record of all accidents and injuries that occur at the work site. This work will be delegated by the contractor to the site supervisor and regularly reviewed every quarter by project management. Reports prepared by the contractor shall include information on the place, date and time of the incident, name of persons involved, cause of incident, witnesses present and their statements. Based on such reports, the management can jointly identify any unsafe conditions, acts or procedures and recommend for the contractor to undertake certain mitigative actions to change any unsafe or harmful conditions.

1.6 COMPENSATION FOR INJURIES AND DEATH

Any casualty or injury resulting from occupational activities should be compensated as per the local labor laws of Pakistan. Where compensation is sought by the injured party, proper procedures for documentation of the case will be followed, including a detailed report on the accident, written reports from witnesses, report of the examining doctor and his/her recommendation for treatment. Each individual contractor will be responsible for ensuring compensation for the respective workers.

1.7 AWARENESS PROGRAMS

The Project management will undertake awareness programs through posters, talks, and meetings with the contractors to undertake the following activities:

- i. Dissemination sessions will clarify the rights and responsibilities of the workers regarding interactions with local people (including communicable disease risks, such as HIV/AIDS, COVID-19), work site health and safety, waste management (waste separation, recycling, and composting), and the illegality of poaching.
- ii. Make workers aware of procedures to be followed in case of emergencies such as informing the focal health person who in turn will arrange the necessary emergency transportation or treatment.

1.8 NOMINATION OF A HEALTH AND SAFETY FOCAL PERSON

Within each site (especially if different sites are being implemented by different contractors), a Health and Safety Focal Person will be appointed. The Terms of Reference for the focal person will mainly be as follows:

- i. Function as the focal person/representative for all health and safety matters at the workplace;
- ii. Responsible for maintaining records of all accidents and all health and safety issues at each site, the number of accidents and its cause, actions taken and remedial measures undertaken in case of safety issues;
- iii. Be the link between the contractor and all workers and submit grievances of the workers to the contractor and instructions/directives on proper health care and safety from the contractors back to the workers;
- iv. Ensure that all workers are adequately informed on the requirement to use Personal Protective Equipment and its correct use;
- v. Also responsible for the first aid kit and making sure that the basic immediate medicines are readily available.

APPENDIX VI - TRAFFIC MANAGEMENT PLAN

GUIDELINE TRAFFIC MANAGEMENT PLAN

1. Need for Plan

During the construction period of the project, considerable vehicular movement carrying large amounts of material and machinery is expected. This will definitely interrupt the local traffic and is therefore important to manage the traffic to avoid the nuisance to local residents in terms of noise, dust, congestion and inconvenience.

2. The plan

The objective of Traffic Management Plan (TMP) is to define the requirements that should be implemented to mitigate any potential negative risks to the environment, workers or the community resulting from construction traffic.

The TMP will advise and inform site Contractors and external suppliers of equipment and materials of access and entry points along with other key information such as tipping areas and wash-out areas. It is intended to compliment and work alongside relevant EMP. The TMP will be classed as “live” and therefore be subjected to updates as required.

The Contractor, at the time of the execution of the project, will prepare a comprehensive TMP in coordination with local traffic police department, WSD, emergency services and local administrative department. WSD and CSC will review and approve the Contractor’s TMP. The Contractor’s TMP shall include following mitigation measures during its preparation:

- Undertake a road conditions assessment prior to and following the peak construction period, to assess any damage to road infrastructure that can be attributed to Project development.
- Repair damage as appropriate or enter into a voluntary agreement with the relevant roads authority to reimburse the cost of any repairs required to the public road network as a result of the Project.
- Spoil dumpsites located close to project site to minimize journey distance and limit movements to site access roads.
- Construction of worker accommodation on site to reduce light vehicle movements relating to travel to/ from the site.
- Provision of bus/minibus services for personnel living in nearby settlements.
- Movements of construction workers will be planned to avoid the busiest roads and times of day when traffic is at its greatest.
- Schedule deliveries and road movements to avoid peak periods.
- Driver training for HGV drivers and refresher course every six months for project drivers.
- Speed restrictions for project traffic travelling through communities (to be agreed with National Highway Authority).
- Run a safety campaign to improve the people’s knowledge of the traffic hazard on their roads, public information and other activities to address the issues.

- Run a pedestrian awareness programme.
- Temporary signage

The traffic management plan for the project corridor is provided below.

3. Other Recommendations

It is important to manage public access routes during construction because it can cause delay to local traffic and create a safety hazard both on and offsite. People working and living near the tower sites would be annoyed by the emissions, noise and visual intrusion of queuing vehicles. Some important factors involved in access routes and site traffic are as follows:

3.1. Public Access Routes

The use of public road for site access may be restricted in terms of:

- Vehicle size, width and type of load
- Time limits
- Parking
- Pedestrian conflicts

Contractor should have consultation with the local police or local authority to address these issues and to effectively manage them before the beginning of the construction.

3.2. Site Workers Traffic

Site personnel should not be permitted to park vehicles right on the road; this will lead to disruption in material deliveries. Designated parking areas with appropriate parking space will be needed for this purpose; any plain area near construction site can be used for this purpose.

3.3. Site Rules

- Access to and from the site must be only via the specified entrance.
- On leaving the site, vehicles must be directed to follow the directions given.
- Drivers must adhere to the site speed limits.
- All material deliveries to site must keep allocated time limits.
- No material or rubbish should be left in the loading-unloading area.
- Develop a map for alternate routes showing material delivery services.
- Assign designated personnel on site to receive deliveries and to direct the vehicles.
- Monitor vehicle movement to reduce the likelihood of queuing or causing congestion in and around the area.
- Project vehicles should have a unanimous badge or logo on windscreen displaying that they belong to the project.

4. Contractor's Obligation

The traffic management plan of the Contractor should be safe enough and widening of any access roads and construction of the detours (as applicable and practical) must be completed

prior to start of project construction activities so that heavy vehicular transportation for construction activities do not hinder the normal course of traffic lanes. Contractor must ensure that road closures are carried out by a competent person. The Contractor obligation must include the display of traffic signs according to the need to divert the traffic volume and to guide the road users in advance. The traffic sign, traffic light should be placed from any diverting route or road marking.

The Contractor should consider the environmental and social impacts of the traffic during construction. It will be sole responsibility of the Contractor to implement a plan which produces minimum nuisance to the local people and to the environment. Safety of the people should be given due importance. It will be under Contractor obligation to notify the traffic management plan and its later changes to CSC, WSD, emergency services and Traffic Police, and also publish weekly programme in the local newspaper.

APPENDIX VII - WASTE MANAGEMENT PLAN

CONSTRUCTION WASTE MANAGEMENT PLAN

Construction waste material consists mainly of concrete, masonry, limestone, sandstone, metal, and wood, depending on the construction type. In building waste, a larger percentage of paper, plastic, etc. is expected due to packaging materials and the wood retired from formwork and scaffolding. This is in addition to significant amounts of concrete, masonry and metal materials.

1.0 Origins and Causes of Construction Waste

Origins of waste	Causes of waste
Contractual	▪ Errors in contract documents ▪ Contract documents incomplete at commencement of construction
Design	▪ Design changes ▪ Design and detailing complexity ▪ Design and construction detail errors ▪ Unclear/unsuitable specification ▪ Poor coordination and communication (late information, last minute client requirements, slow drawing revision and distribution)
Procurement	▪ Ordering errors (i.e., ordering items not in compliance with specification) ▪ Over allowances (i.e., difficulties to order small quantities) ▪ Supplier errors
Transportation	▪ Damage during transportation ▪ Difficulties for delivery vehicles accessing construction sites ▪ Insufficient protection during unloading ▪ Inefficient methods of unloading
On-site Management and Planning	▪ Lack of on-site waste management plans ▪ Improper planning for required quantities ▪ Delays in passing information on types and sizes of materials and components to be used ▪ Lack of on-site material control ▪ Lack of supervision
Material storage	▪ Inappropriate site storage space leading to damage or deterioration ▪ Improper storing methods ▪ Materials stored far away from point of application
Material handling	▪ Materials supplied in loose form ▪ On-site transportation methods from storage to the point of application ▪ Inadequate material handling
Site operation	▪ Accidents due to negligence ▪ Unused materials and products ▪ Equipment malfunction ▪ Poor craftsmanship

Origins of waste	Causes of waste
	▪ Use of wrong materials resulting in their disposal ▪ Time pressure ▪ Poor work ethics
Residual	▪ Waste from application processes (i.e., over preparation of mortar) ▪ Off-cuts from cutting materials to length ▪ Waste from cutting uneconomical shapes ▪ Packaging
Other	▪ Weather ▪ Vandalism ▪ Theft

2.0 Construction Waste Management Plan

1) Waste Management Goals

To establish that this project shall generate at least 50% less waste into landfills and the processes shall be employed to ensure that this goal is met. These shall include prevention of damage to materials to be incorporated into the work due to mishandling, improper storage, contamination, inadequate protection or other factors as well as minimizing poor quantity estimation, as well as through building design.

2) Responsibility

- The Project Director shall be responsible for the implementation of the administrative portions of this program, including the notification of subcontractor management, the training of the site supervisor and the onsite posting of this plan.
- The site supervisor will be responsible for the implementation of the onsite portions of this program including the training of subcontractor personnel.

3) Waste Prevention Planning

- In addition to other requirements specified herein it is a requirement for the work of this project that the contractor comply with the applicable city waste disposal requirements.
- Of the inevitable waste that is generated, the waste materials designated in this specification shall be salvaged for reuse and or recycling where practical and possible.
- Project Construction Documents: The General Contractor will contractually require all subcontractors to comply with these recycling guidelines. A copy of this "Construction Waste Management Plan" will accompany all subcontractor agreements and require subcontractor participation.
- The "Construction Waste Management Plan" shall be implemented and executed as follows and as on the chart:
 - Salvageable materials will be diverted from disposal where feasible.
 - There will be a designated area on the construction site reserved for materials that can be recycled.
 - Areas shall be marked to designate what recycle materials are to be stored there.
 - Hazardous waste will be managed by a licensed hazardous waste vendor.

4) Communication & Education Plan

- This Construction Waste Management Plan will be posted onsite.

- Each subcontractor will be made aware of the intent of this project with respect to reduction of waste and recycling.
- Onsite recycling containers and/or areas will be plainly marked.
- The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan.
- All recycling containers/areas will be clearly marked.
- Lists of acceptable/unacceptable materials will be posted at the site.
- All subcontractors will be informed in writing of the importance of non-contamination with other materials or trash.

5) Motivation Plan

The General Contractor will conduct a pre-award meeting for subcontractors. Subcontractors under consideration will be required to attend the meeting to review project goals and requirements with the project team. Attendance will be a prerequisite for award of subcontracts. This document will be an attachment to every subcontract. Copies of the attachment will be posted prominently at the job site.

6) Expected Project Waste, Disposal, and Handling

The following chart identifies waste materials expected on this project, their expected disposal methods and handling procedures. New items may be added as needed.

Material	Quantity	Disposal Method	Handling Procedure
Land clearing debris		Keep separate for reuse and or wood sale. Separate topsoil and rock for future landscaping use.	Keep separated in designated areas onsite.
Clean dimensional wood and palette wood		Keep separate for reuse by on-site construction or by site employees for either heating stoves or reuse in home projects. May be offered to public.	Keep separated in designated areas onsite.
Plywood, OSB, particle board		Reuse onsite when possible, landfill or recycle off site.	Keep separated in designated areas onsite. Place in "Trash" container.
Painted or treated wood		Reuse, off site recycle, landfill.	Keep separated in designated areas onsite. Place in "Trash" container.
Concrete		Recycle when possible.	
Concrete Masonry Units		Keep separate for re-use by on-site construction or by site employees.	Keep separated in designated areas onsite.

Material	Quantity	Disposal Method	Handling Procedure
Metals		Recycle off site when possible. Separate copper wire when possible.	Keep separated in designated areas onsite. Place in "Metals" container.
Paint		Reuse onsite.	Keep separated in designated areas onsite
Insulation		Reuse, landfill.	
Flooring		Reuse, landfill.	
Carpet and pad		Reuse or recycle with carpet manufacturer	
Glass		Glass Bottles: recycle locally.	Keep separated in designated areas onsite.
Plastics		Plastic Bottles: recycle locally; be aware of plastics that are acceptable to recycle facility.	Keep separated in designated areas onsite.
Beverage		Recycle locally	Keep separated in designated areas onsite.
Cardboard		Recycle locally	Keep separated in designated areas onsite.
Paper and newsprint		Recycle locally	Keep separated in designated areas onsite.

7) Waste Disposal Company

To be determined

a) Contact:

8) Recycle Hauler

To be determined

b) Contact:

c) Some or all recycle may be hauled by the builder.

9) Possible Recycle Locations and Acceptable Materials

- i) Coordinate with companies which are registered with local Municipality that accept materials for recycle; and
- ii) Using the above as a resource, a list will be kept indicating local opportunities for recycle of expected materials. New locations should be added as needed.