ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
HAZARDOUS WASTE INCINERATOR
DEH MAI GARHI, MANGHOPIR SUB-DIVISION, KARACHI-WEST

Final Report
March 2020
M/s. CITY WASTE INCINERATOR

Environmental Impact Assessment (EIA)

HAZARDOUS WASTE INCINERATOR
Deh Mai Garhi, Manghopir Sub-Division,
Karachi-West

FINAL REPORT
March 2020
Environment, Health & Safety Services

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M/s. CITY WASTE INCINERATOR

Environmental Impact Assessment (EIA)

HAZARDOUS WASTE INCINERATOR

Deh Mai Garhi, Manghopir
Sub-Division, Karachi-West

Prepared for:
M/s. City Waste Incinerator

Prepared by:
EHS Services

Date:
March 2020

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   (x): No impact will occur

   Short Term (-ve)
   Long Term (+ve)

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## Hazardous Waste Incinerator

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Executive Summary

The purpose of this Environmental Impact Assessment report submission to the Sindh Environmental Protection Agency (SEPA) is to grant the proponent an opportunity to install an incineration plant at an industrial site which is ideal located for siting the hazardous waste incineration facility. The proposed incinerator is expected to handle **500 kgs/hr** during its peak operation. The requirement of an EIA study for proposed incineration facility is justified in view of the nature of project category under Schedule II of EIA/IEE Regulations 2014, Category H. Waste Disposal and treatment, 1. Handling, storage or disposal of hazardous or toxic wastes or radioactive waste (including landfill sites, incineration of hospital toxic waste).

The proposed site is located at survey no. 318, UC-8, Deh Mai Garhi, Manghopir sub-division, Karachi West. The area is well connected to road that will enable its operators to safely transport wastes by road from the industrial areas for incineration. The macroenvironment is part of Karachi West District, an administrative district of Karachi Division. Bounded on the north and north west by Lasbella district of Balochistan Province, on the north east by Karachi (East) district. On the east by Karachi Central, Karachi (West) and Karachi (South) district and on the South by Arabian Sea. District West incorporates areas of Mauripur, Harbour, Baldia, SITE, Mominabad, Korangi and Manghopir sub-divisions. Baldia Town is bordered by SITE Town and Orangi to the east and by Keamari Town to the north and west, with most of the western boundary formed by part of the RCD Highway.

The site location has following advantages:

- Site is located in the macroenvironment of industrial activity centre.
- Easy availability of infrastructure such as water and power.
- Availability of raw material (hazardous waste) from nearby areas
- Well connected by road network.
- Well-developed plotting of industrial premises.

The incinerator would be a dual chamber-static type incinerator. The waste would be incinerated in the static primary chamber at about 850 deg C. Solid waste would be charged into the primary chamber manually from one end and the ash would remove manually from the other end of the primary chamber. Hot air will be blown from a hot air generated to a chamber with screw arrangement.

The waste feeding will be done manually to the primary chamber. Feeding material will be prepared as per the recipe and will be charged in periodic intervals as per the heat value. Feed recipe will be prepared in bags of 20-25 kgs.
each and will be fed directly to primary chamber using labors. The labors who are feeding the waste will wear all required safety PPEs.

Primary chamber is the main part of the incineration plant. Chamber shall be made up of mild steel shell, lined with an insulating material as the base layer shall be followed by refractory material in order to withstand the high temperature. Primary Chamber shall maintain temperature around 800°C to 850°C. Secondary chamber shall maintain temperature around 1000°C to 1100°C. The refractory in the primary chamber will be capable of withstanding a maximum of around 1200°C and the refractory in secondary chamber will be capable of withstanding around 1400°C.

The Mitigation Management Matrix will be used as a management & monitoring tool for implementation of the mitigation measures required by the EIA. Mitigation management matrix is provided in the table EX-1.

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<th>Aspect</th>
<th>Mitigation Measures</th>
<th>Monitoring</th>
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| 1.   | Collection and transportation of hazardous waste | ▪ All the provisions corresponding to transportation of Hazardous Wastes under Hazardous Substances Rules 2014, will be duly complied with, in all respects. For collection and Transportation, about 10 nos. of vehicles will be provided. Type of vehicles used will be of required capacity (crane mounted containerized collection and loading vehicles /covered trucks / trucks having pneumatic loading / unloading arrangements).  
▪ Experienced drivers will be employed for this purpose & adequate training will be given to every driver. As a practice, a trained driver and helper will accompany the transportation vehicle to ensure compliance of HSE management system. Drivers and helpers will be trained in emergency procedures to handle emergency situations & contain pollution and first aid in case of injuries.  
▪ Washing of tanker/ container and disposal of effluent: each container/vehicle will be thoroughly washed prior to being sent to the industry for collection of wastes & post collection & unloading at site. The effluent water will be treated in the proposed effluent treatment plant.  
▪ Vehicles will be painted preferably in blue color with white strip of 15 to 30 cm width running centrally all over the body. This is to facilitate easy identification.  
▪ Vehicle will be fitted with mechanical handling equipment as may be required for safe handling and transportation of the waste. | Monitoring Compliance through IMC |
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#### 1. On-Site\n
- The words "HAZARDOUS WASTE" will be displayed on all sides of the vehicle in Urdu & English.
- Name of the facility operator will be displayed.
- Emergency phone numbers will be displayed properly.
- Carrying of passengers is strictly prohibited and those associated with the waste haulers will be permitted only in the cabin.
- Transporter will carry inventory of the wastes during transportation as stipulated under the procedures.
- The trucks will be dedicated for transportation of hazardous wastes and they will not be used for any other purpose.
- Each vehicle will carry first-aid kit, spill control equipment and fire extinguisher.
- HW transport vehicle will run only at a controlled & safe speed to avoid any eventuality during the transportation of HW.
- The driver of the transport vehicle will have valid driving license for heavy vehicles and shall have experience in transporting the chemicals. Driver(s) will be properly trained for handling the emergency situations and safety aspects involved in the transportation of hazardous waste.
- Design of the trucks will be such that there is no spillage during transportation.

#### 2. Off-Site\n
**Transportation of Hazardous Wastes**

- It will be ensured that Hazardous Wastes (incinerator ash) are packaged in a manner suitable for safe handling, storage and transport. Labelling on packaging is readily visible and material used for packaging will withstand physical conditions and climatic factors.
- Information regarding characteristics of wastes particularly in terms of being Corrosive, Reactive, Ignitable or Toxic will be provided on the label.
- Hazardous Wastes transportation will be in accordance with the provisions of Hazardous Substances Rules 2014.
- All other records in respect of the handling, transportation & disposal of hazardous waste will be maintained properly and kept available to SEPA as & when required.

#### 3. Storage Area/Shed

- The storage area will be designed for average 30-day storage for solid as well as liquid wastes.
- Flammable, Ignitable, Reactive and Non-Compatible waste will be stored separately in the designated areas.
- Storage area will be provided with flame proof fittings, automatic smoke & heat detection system, adequate firefighting systems etc.
- Loading and unloading of Hazardous Wastes in storage sheds will only be done under the supervision of the well trained and experienced staff.

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<td>Monitoring Compliance through IMC</td>
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### 4. Storage of Drums/Containers
- Minimum of 1-meter clear space will be left between two adjacent rows of drums in pairs for inspection.
- At least two routes to escape in the event of any fire in the area.
- Doors and approaches of the storage area will be of suitable sizes for entry of forklift and firefighting equipment.
- The storage area with concrete floor or steel sheet to prevent percolation of spills, leaks etc. and the floor will be structurally sound and chemically compatible with waste.
- The floor level will at least be 150 mm above the ground level.
- Provision of peripheral drainage system connected with the sump so as to collect any accidental spills on roads or within the storage yards as well as accidental flow due to firefighting.
- The stacking of drums should be restricted up to three, high on pallets (wooden frames).
- For Waste having flash point less than 65.5°C, the drums will not be stacked more than one height.
- No drums will be opened in the storage sheds for sampling etc. and such activity will be done in designated places outside the storage areas.
- Drums containing wastes will be labeled properly indicating mainly type, quantity, characteristics, source and date of storing etc.

### 5. Spillage/leakage Control
- The storage areas will be inspected daily for detecting any signs of leaks or deterioration if any.
- Leaking or deteriorated containers will be removed and ensured that such contents are transferred to a sound container.
- In case of spills/ leaks/ dry adsorbents/cotton will be used for cleaning instead of water.
- Proper slope with collection pits will be provided in the storage area so as to collect the spills/leakages.
- Adequate number of spill kits with compatible sorbent material in adequate quantity will be provided.

### 6. Record Keeping and Maintenance
- Proper records regarding the industry-wise type of waste received, characteristics as well as the location of the wastes that have been stored in the facility will be maintained.

### 7. Air & Noise Pollution
- Vehicular emissions due to movement of construction machinery and vehicles. Water sprinkling will be done from time to time to reduce dust generation due to vehicular movements.
### Necessary acoustic enclosures, wherever feasible will be provided for all these facilities to limit the noise levels within prescribed limits.
- All materials in liquid shall be charged into incinerator with pumps or under gravity through closed pipes.
- All process emissions will be passed through properly designed scrubber and finally released into atmosphere through adequate stack height.
- All pumps handling hazardous chemicals shall be provided with mechanical seals to prevent fugitive emission.
- Any spillage from drums etc. will be absorbed with saw dust/soda ash and mopped clean. The contaminated absorbent will be safely disposed of along with hazardous waste.
- Storage tank will be provided with level gauge, dyke wall, automated loading and unloading for the chemicals to avoid human contact. All storage tanks will be designed and placed according to international standards.
- Measuring Instruments with sound alarm and having strategically placed sensing elements will be provided for alerting the personnel in case of any escape of gases.
- All equipments in the proposed project will be designed/operated to have a noise level not exceeding prescribed standard in line with the requirements of OSHA.
- Acoustic enclosures for considerable noise generating point sources such as DG Set will be provided for noise attenuation.
- Workers will be provided with suitable personal protective equipment (PPE) such as earmuffs and earplugs.
- Rotation of workers in the high noise area will be done.
- Green belt will be developed to reduce noise.
- Equipment will be maintained in good working order to reduce noise.
- All equipment will be operated within specified design parameters.

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<th>8. Water Pollution</th>
<th>The effluent wastewater will be treated in the ETP &amp; re-circulated for scrubbing &amp; reused for vehicle/floor washing, greenbelt development etc. Domestic wastewater will also be treated at site.</th>
<th>Monitoring Compliance through IMC</th>
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| 9. Land Pollution | Impervious flooring will be provided at areas wherever handling/storage of waste will be done. Effluent generated due to container/vehicle/floor washing will be collected & treated in effluent treatment plant. No effluent will be discharged outside plant premises. | Monitoring Compliance through IMC |
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The proposed project design has integrated mitigation measures with a view to ensuring compliance with all the applicable laws and procedures. From the foregoing, it is concluded that the proposed hazardous waste incinerator project is at appropriate location in as far as land use and interactions with human social and economic setting is concerned. There are no extensive habitations in the neighborhood, no significant sensitive environmental features are found within the vicinity and the area is not fully zoned giving an opportunity to isolate the location for this purpose in future. However, there are certain social concerns that touch on general environmental pollution, groundwater contamination, health of the workers, attraction of human settlements in future and soil contamination. For this reason, appropriate preventive measures have been included in the project design, planning, construction and operation stages. Compliance monitoring will be carried out to ensure compliance with the requirements of the EIA and to document and report all non-compliances.

During the project construction & operation phases, the proponent and contractor will avoid inadequate/inappropriate use of natural resources, conserve nature sensitively and guarantee a respectful and fair treatment of all people working on the project, general public at the vicinity and inhabitants of the project. In relation to the proposed project, mitigation measures that will be incorporated during construction phase, the development’s input to the society and cognition that the project proponent is economically and environmentally sound, this development will be considered beneficial and important. The proposed development is a timely venture to tackle City’s Hazardous Waste Management problems through a dedicated facility.

This study recommends that the proposed project be allowed to go ahead provided the outlined mitigation measures are adhered to. Major concerns should nevertheless be focused towards minimizing the occurrence of impacts that would degrade the general environment. This will be achieved through close follow-up and implementation of the recommended Environmental Management and Monitoring plans (EMPs).
1. Introduction

Name of the Project: Hazardous Waste Incinerator
Name of the Proponent: M/s. City Waste Incinerator
Location of the Project: Deh Mai Garhi, Manghopir Sub-Division, Karachi West
Total area of the plot: 4,840 Sq. Yards

Presented in this report are the findings of the Environmental Impact Assessment (EIA) study submitted to the Sindh Environmental Protection Agency (SEPA) for its approval to install a hazardous waste incinerator at survey # 318, UC-8, Deh Mai Garhi, Manghopir sub-division, Baldia Town, Karachi West.

Project location and site view is shown in figure 1.1 & 1.2 respectively.

Figure 1.1: Location of Project Site
1.1 Project Overview

Industrialization & Industrial growth in Karachi with the implementation of Hazardous Substances Rules (2014) as well as Hospital waste management rules (2014), has necessitated the need to develop a hazardous waste incineration facility that can deal with the increased demand of industrial hazardous waste & toxic waste disposal and at the same time meet the ever demanding regulatory framework. The proponent is a private Pakistani entity who intends to develop the site to install an incinerator to facilitate waste management within Karachi.

The availability of a commercial hazardous waste treatment facility is not only a critical environmental issue, but also an essential economic factor for an Industrial Hub like Karachi that aspires to grow its industrial base. Most international companies expect a hazardous waste management program to be in place that is both economical and meets international standards. Besides, without the means to treat and dispose hazardous wastes, it is not possible to enforce the current environmental legislation. Upon realization of the growing hazardous wastes challenges, the proponent is seeking to install a facility to be able to provide a hazardous waste handling capacity to cater for the need of such waste disposal by ever increasing industrial establishments in the City.
The purpose of this Environmental Impact Assessment report submission to the Sindh Environmental Protection Agency (SEPA) is to grant the proponent an opportunity to install an incineration plant at an industrial site which is ideal located for siting the hazardous waste incineration facility. The proposed site is located at survey no. 318, UC-8, Deh Mai Garhi, Manghopir sub-division, Karachi West. The area is well connected to road that will enable its operators to safely transport wastes by road from the industrial areas for incineration. The proposed incinerator is expected to handle 500 kgs/hr during its peak operation.

Incineration is a high temperature, thermal destruction oxidation process in which hazardous wastes are converted in the presence of oxygen in air into gases and incombustible solid residue. The gases are vented into the atmosphere after passing through adequate air pollution control system to meet emission guidelines while the solid residue (incineration ash) is sent to authorized landfill for disposal. Any waste can be classified as hazardous, if the waste substance is solid, semi-solid or non-aqueous liquid which because of its quantity, concentration or characteristics in terms of physical, chemical, infectious quality i) can cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitate reversible illness, or ii) pose a substantial present or potential hazard to human health or environment when it is improperly treated, stored, transported, disposed of or otherwise managed. Thus, a waste is hazardous if it exhibits whether alone or when in contact with other wastes or substances, any of the characteristics identified below:

- corrosivity
- reactivity
- ignitability
- toxicity
- explosive
- acute toxicity
- infectious property

1.2 Need for Environmental Impact Assessment (EIA)

The EIA study is a mandatory requirement under the provisions of Sindh Environmental Protection Act 2014 and the rules made thereunder. Sindh Environmental Protection Act, 2014 under section 17 (1) mandatorily requires proponent of project to file an IEE or EIA, as the case may be, and obtain approval from the SEPA before commencing construction or operation of the project. Section 17 (1) of the 2014 Act is reproduced herein under for ready reference:
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Environmental Impact Assessment (EIA)  
Hazardous Waste Incinerator

“17. (1) No proponent of a project shall commence construction or operation unless he has filed with the agency an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA), and has obtained from the Agency.”

Sindh Environmental Protection Agency (Review of IEE/EIA) Regulations, 2014 (“2014 Regulations”) made in exercise of powers conferred under section 37 of the Act 2014 categorizes projects in three categories provided in Schedule I, II and III of the 2014 Regulations. Projects have been classified on the basis of expected degree of adverse environmental impact. Project types listed in Schedule II of the regulations are designated as potentially seriously damaging to the environment and require EIA, and those listed in Schedule I as having potentially less adverse effects and require an IEE.

The requirement of an EIA study for proposed incineration facility is justified in view of the nature of project category under Schedule II of EIA/IEE Regulations 2014, Category H. Waste Disposal and treatment, 1. Handling, storage or disposal of hazardous or toxic wastes or radioactive waste (including landfill sites, incineration of hospital toxic waste). It is therefore necessary to prepare a detailed account of environmental impact of the proposed activities so that appropriate interventions could be taken. This assessment focuses on various parameters covering all environmental & social issues. The plan seeks to define the project in a holistic manner and suggest possible mitigation measures for development. It has been learnt that through early planning before the start of the project as well as through all phases of the project's development, if environmental concerns are considered simultaneously with other technical and economic criteria, it may be possible to develop the housing projects with the safeguard of environmental and socioeconomic resources of microenvironment & macroenvironment of the area.

The assessment was conducted with the following objectives:

- To identify possible environmental impacts, both positive and negative
- To assess the significance of the impacts
- To assess the relative importance of the impacts of relative plan designs, and sites
- To propose preventive mitigation and compensative measures for the significant negative impacts of the project on the environment.
- Generate baseline data for monitoring and evaluating how well the mitigation measures are being implemented during the project cycle.
- To present information on impact of alternatives
- To present the results of the EIA that can guide informed decision making and safe operation of the incineration plant
1.3 Methodology adopted for Environmental Assessment

EHS Services team was formally inducted in January 2020 to perform the Environmental Impact Assessment (EIA) of proposed incineration plant project. This study has adopted the following methodology for assessment of impact of different activities:

- Environment screening, in which the project was identified as among those requiring environmental impact assessment under schedule II
- Environmental scoping that provided the key environmental issues
- Desk Stop studies and interviews
- Physical inspection of the site and surrounding areas
- Reporting

1.3.1 Environmental Screening

This step was applied to determine whether an environmental impact assessment was required and what level of assessment was necessary. This was done in reference to requirements of the SEPA (Review of IEE/EIA) Regulations 2014. Issues considered included the physical location, sensitive issues and nature of anticipated impacts.

1.3.2 Environmental Scoping

The Scoping process helped narrow down onto the most critical issues requiring attention during the assessment. Environmental issues were categorized into physical, natural/ecological and social, economic and cultural aspects.

1.3.3 Desktop Study

This included documentary review on the nature of the proposed activities, project documents, designs policy and legislative framework as well as the environmental setting of the area among others. It also included discussions with managers and design engineers.

1.3.4 Site Assessment

Field visits were meant for physical inspections of the site characteristics and the environmental status of the surrounding areas to determine the anticipated impacts. It also included further interviews with neighbors.
1.3.5 Reporting

Finally, the report has been compiled according to the guidelines for preparation and review of environmental assessment reports. The report includes description of the project, description of microenvironment and macroenvironment, public consultation and screening of potential environmental impact of activities during the pre-construction, construction and operation phases.

The report has been presented in the following sections:
Section 1 - Introduction to Project and EIA Processes
Section 2 - Description of Project
Section 3 - Overview of National and Provincial Legislation & Guidelines relevant to the project and to this EIA
Section 4 - Description of Environment of Project Area
Section 5 - Public Consultation & Participation
Section 6 - Screening of Potential Environmental Impacts & Mitigation Measures
Section 7 - Environmental Management and Monitoring Plan (EMP)
Section 8 - Conclusion and Recommendations
2. Description of Project

The proposed site is located at survey no. 318, UC-8, Deh Mai Garhi, Manghopir sub-division, Karachi West. The site location has following advantages:

▪ Site is located in the macroenvironment of industrial activity centre.
▪ Easy availability of infrastructure such as water and power.
▪ Availability of raw material (hazardous waste) from nearby areas
▪ Well connected by road network.
▪ Well-developed plotting of industrial premises.

2.1 Screening of Alternatives

2.1.1 Review of Alternate Technologies

Three main types of incinerators are used: controlled air, excess air, and rotary kiln. The description of each type is presented below:

1. Controlled-Air Incinerators

Controlled-air incineration is the most widely used hazardous & medical waste incinerator technology. This technology is also known as starved-air incineration, two-stage incineration, or modular combustion. Figure 2.1 presents a typical schematic diagram of a controlled air unit.

Combustion of waste in controlled air incinerators occurs in two stages. In the first stage, waste is fed into the primary, or lower, combustion chamber, which is operated with less than the stoichiometric amount of air required for combustion. Combustion air enters the primary chamber from beneath the incinerator hearth (below the burning bed of waste). This air is called primary or under fire air. In the primary (starved-air) chamber, the low air-to-fuel ratio dries and facilitates volatilization of the waste, and most of the residual carbon in the ash burns. At these conditions, combustion gas temperatures are relatively low (760 to 980°C [1,400 to 1,800°F]).

In the second stage, excess air is added to the volatile gases formed in the primary chamber to complete combustion. Secondary chamber temperatures are higher than primary chamber temperatures-typically 980 to 1,095°C (1,800 to 2,000°F). Depending on the heating value and moisture content of the waste, additional heat may be needed. This can be provided by auxiliary burners located at the entrance to the secondary (upper) chamber to maintain desired temperatures.

Waste feed capacities for controlled air incinerators range from about 0.6 to 50 kg/min (75 to 6,500 lb/hr) (at an assumed fuel heating value of 19,700 kJ/kg)
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Waste feed and ash removal can be manual or automatic, depending on the unit size and options purchased. Throughput capacities for lower heating value wastes may be higher, since feed capacities are limited by primary chamber heat release rates. Heat release rates for controlled air incinerators typically range from about 430,000 to 710,000 kJ/hr-m³ (15,000 to 25,000 Btu/hr-ft³). Because of the low air addition rates in the primary chamber, and corresponding low flue gas velocities (and turbulence), the amount of solids entrained in the gases leaving the primary chamber is low. Therefore, the majority of controlled air incinerators do not have add-on gas cleaning devices.

Figure 2.1: Controlled Air Incinerator
2. Excess Air Incinerators

Excess air incinerators are typically small modular units. They are also referred to as batch incinerators, multiple chamber incinerators, or "retort" incinerators. Excess air incinerators are typically a compact cube with a series of internal chambers and baffles. Although they can be operated continuously, they are usually operated in a batch mode.

Figure 2.2 presents a schematic for an excess air unit.

![Excess Air Incinerator Schematic](image-url)
Typically, waste is manually fed into the combustion chamber. The charging door is then closed, and an afterburner is ignited to bring the secondary chamber to a target temperature (typically 870 to 980°C [1600 to 1800°F]). When the target temperature is reached, the primary chamber burner ignites. The waste is dried, ignited, and combusted by heat provided by the primary chamber burner, as well as by radiant heat from the chamber walls. Moisture and volatile components in the waste are vaporized, and pass (along with combustion gases) out of the primary chamber and through a flame port which connects the primary chamber to the secondary or mixing chamber. Secondary air is added through the flame port and is mixed with the volatile components in the secondary chamber. Burners are also installed in the secondary chamber to maintain adequate temperatures for combustion of volatile gases. Gases exiting the secondary chamber are directed to the incinerator stack or to an air pollution control device. When the waste is consumed, the primary burner shuts off. Typically, the afterburner shuts off after a set time. Once the chamber cools, ash is manually removed from the primary chamber floor and a new charge of waste can be added.

Incinerators designed to burn general hospital waste operate at excess air levels of up to 300 percent. If only pathological wastes are combusted, excess air levels near 100 percent are more common. The lower excess air helps maintain higher chamber temperature when burning high-moisture waste. Waste feed capacities for excess air incinerators are usually 3.8 kg/min (500 lb/hr) or less.

3. **Rotary Kiln Incinerators**

Rotary kiln incinerators, like the other types, are designed with a primary chamber, where waste is heated and volatilized, and a secondary chamber, where combustion of the volatile fraction is completed. The primary chamber consists of a slightly inclined, rotating kiln in which waste materials migrate from the feed end to the ash discharge end. The waste throughput rate is controlled by adjusting the rate of kiln rotation and the angle of inclination. Combustion air enters the primary chamber through a port. An auxiliary burner is generally used to start combustion and maintain desired combustion temperatures. Both the primary and secondary chambers are usually lined with acid-resistant refractory brick, as shown in the schematic drawing, Figure 2.3.

Volatiles and combustion gases pass from the primary chamber to the secondary chamber. The secondary chamber operates at excess air. Combustion of the volatiles is completed in the secondary chamber. Due to the turbulent motion of the waste in the primary chamber, solids burnout rates and particulate entrainment in the flue gas are higher for rotary kiln incinerators than for other incinerator designs. As a result, rotary kiln incinerators generally have add-on gas cleaning devices.
Figure 2.3: Rotary Kiln Incinerator

2.1.2 Review of Alternate Emission Control Systems

The most frequently used air pollution control devices are wet scrubbers and fabric filters (FFs). Fabric filters provide mainly PM control. Other PM control technologies include venturi scrubbers and electrostatic precipitators (ESPs). In addition to wet scrubbing, dry sorbent injection (DSI) and spray dryer (SD) absorbers have also been used for acid gas control.

Wet scrubbers use gas-liquid absorption to transfer pollutants from a gas to a liquid stream. Scrubber design and the type of liquid solution used largely determine contaminant removal efficiencies. With plain water, removal efficiencies for acid gases could be as high as 70 percent for HCl and 30 percent for SO2. Addition of an alkaline reagent to the scrubber liquor for acid neutralization has been shown to result in removal efficiencies of 93% to 96%.

Wet scrubbers are generally classified according to the energy required to overcome the pressure drop through the system. Low-energy scrubbers (spray towers) are primarily used for acid gas control only and are usually circular in cross section. The liquid is sprayed down the tower through the rising gas. Acid gases are absorbed/neutralized by the scrubbing liquid. Low-energy scrubbers mainly remove particles larger than 5-10 micrometers (μm) in diameter.

Medium-energy scrubbers can be used for particulate matter and/or acid gas control. Medium energy devices rely mostly on impingement to facilitate
removal of PM. This can be accomplished through a variety of configurations, such as packed columns, baffle plates, and liquid impingement scrubbers.

Venturi scrubbers are high-energy systems that are used primarily for PM control. A typical venturi scrubber consists of a converging and a diverging section connected by a throat section. A liquid (usually water) is introduced into the gas stream upstream of the throat. The flue gas impinges on the liquid stream in the converging section. As the gas passes through the throat, the shearing action atomizes the liquid into fine droplets. The gas then decelerates through the diverging section, resulting in further contact between particles and liquid droplets. The droplets are then removed from the gas stream by a cyclone, demister, or swirl vanes.

A fabric filtration system (baghouse) consists of a number of filtering elements (bags) along with a bag cleaning system contained in a main shell structure with dust hoppers. Particulate-laden gas passes through the bags so that the particles are retained on the upstream side of the fabric, thus cleaning the gas. A FF is typically divided into several compartments or sections. In a FF, both the collection efficiency and the pressure drop across the bag surface increase as the dust layer on the bag builds up. Since the system cannot continue to operate with an increasing pressure drop, the bags are cleaned periodically. The cleaning processes include reverse flow with bag collapse, pulse jet cleaning, and mechanical shaking. When reverse flow and mechanical shaking are used, the particulate matter is collected on the inside of the bag; particulate matter is collected on the outside of the bag in pulse jet systems. Generally, reverse flow FFs operate with lower gas flow per unit area of bag surface (air-to-cloth ratio) than pulse jet systems and, thus, are larger and more costly for a given gas flowrate or application. Fabric filters can achieve very high (>99.9 percent) PM removal efficiencies. These systems are also very effective in controlling fine particulate matter, which results in good control of metals & organics entrained on fine particulate.

Particulate collection in an ESP occurs in 3 steps: (1) suspended particles are given an electrical charge; (2) the charged particles migrate to a collecting electrode of opposite polarity; and (3) the collected PM is dislodged from the collecting electrodes and collected in hoppers for disposal.

Charging of the particles is usually caused by ions produced in a high voltage corona. The electric fields and the corona necessary for particle charging are provided by converting alternating current to direct current using high voltage transformers and rectifiers. Removal of the collected particulate matter is accomplished mechanically by rapping or vibrating the collecting electrode plates. ESPs have been used in many applications due to their high reliability and efficiency in controlling total PM emissions. Except for very large and carefully
designed ESPs, however, they are less efficient than FFs at control of fine particulates and metals.

Dry sorbent injection (DSI) is another method for controlling acid gases. In the DSI process, a dry alkaline material is injected into the flue gas into a dry venturi within the ducting or into the duct ahead of a particulate control device. The alkaline material reacts with and neutralizes acids in the flue gas. Fabric filters are employed downstream of DSI to: (1) control the PM generated by the incinerator, (2) capture the DSI reaction products and unreacted sorbent, and (3) increase sorbent/acid gas contact time, thus enhancing acid gas removal efficiency and sorbent utilization. Fabric filters are commonly used with DSI because they provide high sorbent/acid gas contact. Fabric filters are less sensitive to PM loading changes or combustion upsets than other PM control devices since they operate with nearly constant efficiency. A potential disadvantage of ESPs used in conjunction with DSI is that the sorbent increases the electrical resistivity of the PM being collected. This phenomenon makes the PM more difficult to charge and, therefore, to collect. High resistivity can be compensated for by flue gas conditioning or by increasing the plate area and size of the ESP.

The major factors affecting DSI performance are flue gas temperature, acid gas dew point (temperature at which the acid gases condense), and sorbent-to-acid gas ratio. DSI performance improves as the difference between flue gas and acid dew point temperatures decreases and the sorbent to-acid gas ratio increases. Acid gas removal efficiency with DSI also depends on sorbent type and the extent of sorbent mixing with the flue gas. Sorbents that have been successfully applied include hydrated lime (Ca\(\text{OH}\)\(_2\)), sodium hydroxide (NaOH), and sodium bicarbonate (NaHCO\(_3\)). For hydrated lime, DSI can achieve 80 to 95 % of HCl removal and 40 to 70 % removal of SO\(_2\) under proper operating conditions.

The primary advantage of DSI compared to wet scrubbers is the relative simplicity of the sorbent preparation, handling, and injection systems as well as the easier handling and disposal of dry solid process wastes. The primary disadvantages are its lower sorbent utilization rate and correspondingly higher sorbent and waste disposal rates.

In the spray drying process, lime slurry is injected into the SD through either a rotary atomizer or dual-fluid nozzles. The water in the slurry evaporates to cool the flue gas, and the lime reacts with acid gases to form calcium salts that can be removed by a PM control device. The SD is designed to provide sufficient contact and residence time to produce a dry product before leaving the SD adsorber vessel. The residence time in the adsorber vessel is typically 10 to 15 seconds. The particulates leaving the SD (fly ash, calcium salts, and unreacted hydrated lime) are collected by an FF or ESP.
2.2 Incineration Process

The proposed incinerator would be designed for a capacity of **500 kg/hr** capacity unit which can incinerate waste up to **5000Kg in 10 hours operation** & capable of incinerating solid / semi solid / liquid hazardous wastes. The incinerator shall charge hazardous wastes - primarily solids but would also be flexible enough to incinerate liquid, highly viscous and semi solid form. The incinerator is designed to accept hazardous waste with a broad range of characteristics.

The proposed incinerator will have the following components: i) Incineration unit, ii) LDO burner system, iii) Liquid waste injection system, iii) Venturi scrubber, iv) Packed bed scrubber, v) ID fan, vi) HEPA Filter, vii) Chimney, and viii) On-line emission monitoring system.

Design of incinerator system is shown in figure 2.1.

![Figure 2.1: Design of Incinerator System](image)

2.3 Components of Incinerator

2.3.1 Incinerator Unit

The incinerator would be a dual chamber-static type incinerator. The waste would be incinerated in the static primary chamber at about 850 deg C. Solid waste would be charged into the primary chamber manually from one end and the ash would remove manually from the other end of the primary chamber. Hot air will be blown from a hot air generated to a chamber with screw arrangement.
The waste feeding will be done manually to the primary chamber. Feeding material will be prepared as per the recipe and will be charged in periodic intervals as per the heat value. Feed recipe will be prepared in bags of 20-25 kgs each and will be fed directly to primary chamber using labors. The labors who are feeding the waste will wear all required safety PPEs.

Primary chamber is the main part of the incineration plant. Chamber shall be made up of mild steel shell, lined with an insulating material as the base layer shall be followed by refractory material in order to withstand the high temperature. Primary Chamber shall maintain temperature around 800°C to 850°C. Secondary chamber shall maintain temperature around 1000°C to 1100°C. The refractory in the primary chamber will be capable of withstanding a maximum of around 1200°C and the refractory in secondary chamber will be capable of withstanding around 1400°C.

2.3.2 Burner System

The temperature of the combustion chamber would be initially raised and maintained at around 850°C by firing auxiliary fuels like LDO. The Burner system is stepless oil fired system designed with the consideration that pre-heating shall be for 8 hours. The required certification of burners will be submitted along with delivery. Since the initial energy requirement for preheating will be more, the capacity of burners has been considered accordingly. The burner is operated only during preheating and whenever temperature goes below 750 – 800°C. The air required for fuel (like LDO) combustion in primary as well as secondary auxiliary burners are provided by an inbuilt blower. The blower shall be capable of delivering 20% excess air as per maximum fuel consumption of burner.

2.3.3 Venturi Scrubber

The waste flue gases leaving the secondary chamber would be cleaned in a venturi scrubber in order to suddenly bring down the temperature as well as to remove the particulates present in the flue gas. The scrubbing media would be primarily water in the venturi scrubber and is slightly alkaline with about 9 pH. The slightly alkaline media along with the typical design with tangential action helps effective removal of alkaline flue gases by the efficient gas to liquor contact. The scrubbed liquid would be collected in a scrubber tank which is separated by internal partitions. The sludge along with scales accumulates in scrubber tank and is removed periodically.

2.3.4 Packed Bed Scrubber

The gases devoid of particulates are subsequently scrubbed in a packed bed scrubber with fresh water to remove the residual gases like a polishing system.
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The packed bed scrubber shall be filled with PP pall rings which give additional contact area for scrubbing. Alkaline conditions are not maintained in the packed bed to avoid scaling formation and the frequent choking of the packed bed. An underground storage tank for packed bed water circulation shall be provided. Fresh water shall be used for scrubbing in packed bed scrubber. The scrubber liquor is neutralized in the storage tank and reused for scrubbing.

2.3.5  ID Fan

The total system will be kept under negative draft by the ID fan. The impeller of ID fans will be rubber lined and its capacity shall be designed in such a way as to accommodate the flue gases generated.

2.3.6  Hepa Filter

The gases from the ID fan would be allowed to pass through a fine particulate filter in order to remove the very fine particulates before they are let out into the atmosphere though the chimney.

2.3.7  Chimney

The outlet of the HEPA filter is attached to a chimney and the cleaned gases are let out into the atmosphere through this chimney. The chimney shall be 20 feet high for dispersion of flue gases.

2.3.8  Controls and monitoring

Operation within the key parameters of the combustion process is assured by systems of monitors and computer controls. These systems make automatic adjustments to key functions as necessary. The incinerator has waste feed cut-offs (WFCOs) to assure protective operations. WFCOs automatically stop the feeding of waste into the incinerator if any of the key parameters even momentarily falls outside the narrow range of operating requirements.

In order to monitor key parameters “Online Flue gas analyzer” will be installed, the result of the same shall be directly displayed on the computer screens and the same shall be within the prescribed limits laid down by SEPA.

2.3.9  Residue Management

The primary chamber discharges an inorganic ash. The ash, and any residue is analyzed to assure that it does not contain any hazardous organic constituents above concentration levels specified in regulations as safe for land disposal. These concentration levels are almost always less than one part per million for
any organic hazardous constituent. This inorganic residue is further treated by mixing it with chemical stabilizers to chemically bind the constituents. The chemically stabilized inorganic residue is analyzed to assure that the metals cannot leach out of the residue above the low levels specified in rules. Finally, the stabilized and certified inorganic waste residue is placed in a hazardous waste landfill having two liners, with a leachate collection system between the two liners. Groundwater monitoring is also provided, outside the landfill, to supplement the protection provided by the double-liner, leachate collection and leak detection systems of the landfill itself.

2.4 Utilities

2.4.1 Water requirement

The total daily water requirement of the proposed project will be met through provision from the existing water supply network.

![Figure 2.2: water supply line within the Plot](image)

2.4.2 Wastewater management

Wastewater generated from the various waste treatment processes will be treated in ETP proposed in project premises. Treated water will be re-circulated for scrubbing, washing purpose & reused for greenbelt. Domestic wastewater generated will be disposed of to soak pit via septic tank.
2.4.3 Power requirement

The total power demand is 58 KW. The power supply shall be drawn from the grid. A 100 KVA PMT has been installed at the site.

![Figure 2.3: H.T. O/H (Left) and 100 KVA PMT (Right)](image)

2.4.4 Fuel requirement

The fuel requirement for the proposed common facility for incinerator plant would be ~ 46Lit/hr.

2.4.5 Manpower

The manpower for the project is 15 persons including skilled and semi-skilled persons. Drivers for transportation purpose are proposed to be outsourced.

2.5 Incineration facility operations

2.5.1 Collection and transportation of hazardous waste

All the provisions corresponding to transportation of Hazardous Wastes under Hazardous Substances Rules 2014, will be duly complied with, in all respects. For collection and Transportation, about 10 nos. of vehicles will be provided. Type of vehicles used will be of required capacity (crane mounted containerized...
collection and loading vehicles /covered trucks / trucks having pneumatic loading / unloading arrangements).

Experienced drivers will be employed for this purpose & adequate training will be given to every driver. As a practice, a trained driver and helper will accompany the transportation vehicle to ensure compliance of HSE management system. Drivers and helpers will be trained in emergency procedures to handle emergency situations & contain pollution and first aid in case of injuries.

Washing of tanker/ container and disposal of effluent: each container/vehicle will be thoroughly washed prior to being sent to the industry for collection of wastes & post collection & unloading at site. The effluent water will be treated in the proposed effluent treatment plant.

2.5.2 Off-Site Transportation of Hazardous Wastes

The off-site transportation requirements involve:

- **Container**: to be of appropriate leak-proof material with mechanical stability.
- **Labelling**: to identify the waste, describe the possible hazard, and the remedial measures/first aid required in case of accidental spills.
- **Transportation vehicle**: to identify the waste displaying the possible hazard, the remedial measures/first aid required in case of accidental spills, telephone number of the contact person/controlling agency in case of emergency etc. through labelling.
- **Collector/transporter selection**: to have technical competence and relevant skills and other requirements.
- **License**: to carry application and ‘No Objection Certificate’ documents issued by concerned authorities.
- **Emergency procedures**: to have knowledge about actions to be taken in case of spills or accidents.

The following guidelines will be followed prior to handing over of the waste to the transporter:

- It will be ensured that Hazardous Wastes (incinerator ash) are packaged in a manner suitable for safe handling, storage and transport. Labelling on packaging is readily visible and material used for packaging will withstand physical conditions and climatic factors.
- Information regarding characteristics of wastes particularly in terms of being Corrosive, Reactive, Ignitable or Toxic will be provided on the label.
- Hazardous Wastes transportation will be in accordance with the provisions of Hazardous Substances Rules 2014.
All other records in respect of the handling, transportation & disposal of hazardous waste will be maintained properly and kept available to SEPA as & when required.

2.5.2.1 Responsibilities of the HW Transporter

Transporter of hazardous wastes will be responsible for:

- Obtaining training against hazardous substances rules 2014 for handling & transport of hazardous waste.
- The transport vehicles will be designed suitably to handle and transport the hazardous wastes of various characteristics.
- The transporter will follow all the Rules pertaining to transportation of hazardous waste as stipulated under the Hazardous Substances Rules 2014.
- Transporting the waste will be carried out in closed environment at all times.
- Delivering the wastes at designated points only.
- Informing HSE department immediately in case of spillage, leakage or other accidents during transportation.
- The transporter company will train the driver with regard to the emergency response measures to be taken during the transportation of waste.
- Cleanup in case of contamination.
- Cleaning of vehicles will be carried out at designated places and the wastewater will be treated in ETP.

2.5.2.2 Transportation Requirement

The following are the requirements pertaining to the transportation of hazardous wastes:

- Vehicles will be painted preferably in blue color with white strip of 15 to 30 cm width running centrally all over the body. This is to facilitate easy identification.
- Vehicle will be fitted with mechanical handling equipment as may be required for safe handling and transportation of the waste.
- The words "HAZARDOUS WASTE" will be displayed on all sides of the vehicle in Urdu & English.
- Name of the facility operator will be displayed.
- Emergency phone numbers will be displayed properly.
- Carrying of passengers is strictly prohibited and those associated with the waste haulers will be permitted only in the cabin.
- Transporter will carry inventory of the wastes during transportation as stipulated under the procedures.
- The trucks will be dedicated for transportation of hazardous wastes and they will not be used for any other purpose.
- Each vehicle will carry first-aid kit, spill control equipment and fire extinguisher.
HW transport vehicle will run only at a controlled & safe speed to avoid any eventuality during the transportation of HW.

The driver of the transport vehicle will have valid driving license for heavy vehicles and shall have experience in transporting the chemicals. Driver(s) will be properly trained for handling the emergency situations and safety aspects involved in the transportation of hazardous waste.

Design of the trucks will be such that there is no spillage during transportation.

### 2.5.2.3 Storage Area/Shed

Temporary Storage Facility will be provided primarily to store the wastes upon receipt at the facility until its pathway of waste disposal is determined. Each batch of received waste will be kept separately following compatibility and labeling of the wastes. Hazardous wastes Rules 2014 will be followed in letter & spirit.

Following practices will be adopted in design of storage area:

- The storage area will be designed for average 30-day storage for solid as well as liquid wastes.
- Flammable, Ignitable, Reactive and Non-Compatible waste will be stored separately in the designated areas.
- Storage area will be provided with flame proof fittings, automatic smoke & heat detection system, adequate firefighting systems etc.
- Loading and unloading of Hazardous Wastes in storage sheds will only be done under the supervision of the well trained and experienced staff.
- Minimum of 1-meter clear space will be left between two adjacent rows of drums in pair for inspection.
- At least two routes to escape in the event of any fire in the area.
- Doors and approaches of the storage area will be of suitable sizes for entry of forklift and firefighting equipment.
- The storage area with concrete floor or steel sheet to prevent percolation of spills, leaks etc. and the floor will be structurally sound and chemically compatible with waste.
- The floor level will at least be 150 mm above the ground level.
- Containment measures such as proper slopes as well as collection pit to collect wash water and the leakages/spills, & treatment in ETP etc.
- Provision of peripheral drainage system connected with the sump so as to collect any accidental spills on roads or within the storage yards as well as accidental flow due to firefighting.

### 2.5.2.4 Storage of Drums/Containers

Following practices will be adopted for storage of drums/containers:
The stacking of drums should be restricted up to three, high on pallets (wooden frames).

For Waste having flash point less than 65.5°C, the drums will not be stacked more than one height.

No drums will be opened in the storage sheds for sampling etc. and such activity will be done in designated places outside the storage areas.

Drums containing wastes will be labeled properly indicating mainly type, quantity, characteristics, source and date of storing etc.

### 2.5.2.5 Spillage/leakage Control Measures

- The storage areas will be inspected daily for detecting any signs of leaks or deterioration if any.
- Leaking or deteriorated containers will be removed and ensured that such contents are transferred to a sound container.
- In case of spills/leaks/ dry adsorbents/cotton will be used for cleaning instead of water.
- Proper slope with collection pits will be provided in the storage area so as to collect the spills/leakages.
- Adequate number of spill kits with compatible sorbent material in adequate quantity will be provided.

### 2.5.2.6 Record Keeping and Maintenance

Proper records regarding the industry-wise type of waste received, characteristics as well as the location of the wastes that have been stored in the facility will be maintained.

### 2.6 Effluent Treatment Plant

The effluent treatment plant will be installed to ensure that effluent water generated during the process of scrubbing, washing container, vehicles, floors etc., is treated and reused after treatment. Proper utilization of water will be ensured by recirculation of treated wastewater for scrubbing, vehicle & floor washing, washing of discarded containers & greenbelt development. The ETP will be designed for 10,000 gallons capacity. The main components of the effluent treatment plant & final disposal are as follows:

- Water Collection Tank
- Primary treatment
- Chemical Treatment
- Primary clarifier/Sedimentation tank
- Secondary treatment
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- Trickling filter
- Secondary clarifier
- Tertiary treatment
- Pressure sand filter
- Activated carbon filter
- Sludge drying beds
- Sludge filter press
- ETP Sludge treatment in Incinerator
- Ash disposal to authorized landfill site.

2.7 Sources of Pollution

The various types of pollution envisaged from the proposed project are: i) Air pollution; ii) Water pollution; iii) Land Pollution iv) Noise pollution v) Hazardous waste generation, and vi) Solid waste generation.

The project will be provided with necessary pollution control facilities to keep the gaseous emission, liquid effluent and noise emission within the permissible limits prescribed by SEPA under SEQS. Details of emissions from the proposed incineration facility are given in the following sections.

The details of impacts and mitigation measures are discussed in Chapter 6 of EIA.

2.7.1 Air Pollution

Various sources of air pollution identified during construction and operation phase for the proposed project are as follows:

Construction Phase: Vehicular emissions due to movement of construction machinery and vehicles. Water sprinkling will be done from time to time to reduce dust generation due to vehicular movements.

Operation Phase:

Point Source

- **Incinerator facility:** Emissions of Primary Pollutants from stack. In case of improper quenching, reduced efficiency of incinerator etc. emission of dioxins/furans are also envisaged.
- **DG Sets:** Emissions of PM, SO2, NOx & CO from stack. These emissions are not continuous as DG sets will be used only as emergency power back-up. Also, low sulphur diesel to be used for DG Set operations will considerably reduce generation of sulphur dioxide.
The facility will be equipped with proper air pollution control system for reducing the pollutants and also a stack of adequate height will be provided for proper dispersion of the air pollutants as per SEQS.

Line Source

- Particulate Matter emissions from movement of vehicles carrying waste material on paved roads & vehicular emissions like SPM, CO & HCs from exhaust of the vehicles are envisaged as line source emissions. Only vehicles having valid fitness certification will be allowed. Trucks will be covered with tarpaulin/plastic sheet to reduce the spillage of hazardous material.

Fugitive Emissions & Control

- Fugitive emissions from storage & handling area for hazardous materials is envisaged due to proposed project.
- Suitable control measures will be taken to control the fugitive emission during loading/unloading, storage and handling of waste.
- Odour control & mitigation measures are detailed in chapter 6 of this report.

Dioxin & Furans Generation & its Control

- Dioxin and furans are generated due to incomplete combustion of Polychlorinated Biphenyls & Polyvinyl Chloride in Incinerator.
- The incineration facility will be equipped with an adequate Air pollution control system to control release of these pollutants in the environment. Regular monitoring of Dioxin and Furans will be carried out during operation phase.

2.7.2 Water Pollution

The wastewater generation from the common waste treatment facility is envisaged from floor washing, vehicle washing, scrubber operations, laboratory and domestic use. The effluent wastewater will be treated in the ETP & re-circulated for scrubbing & reused for vehicle/floor washing, greenbelt development etc. Domestic wastewater will also be treated at site.

2.7.3 Impact on Land environment

The proposed project will have negligible impact on the land use of the project site as the present land use of plot area is for industrial use only. Proposed greenbelt development & plantation will improve the aesthetics of the area.

Soil pollution due to proposed project will be due to:
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- Construction & commissioning of the project may result in compaction of soil & topsoil loss.
- Fuel leakages on soil during vehicular activities may result in soil contamination.
- Leakages due to storage and handling of fuel &/or hazardous waste may result in soil contamination.

Impervious flooring will be provided at areas wherever handling/storage of waste will be done. Effluent generated due to container/vehicle/floor washing will be collected & treated in effluent treatment plant. No effluent will be discharged outside plant premises.

2.7.4 Noise Pollution

The major noise generation source will be incinerator operations, pumps attached to the ETP & D.G sets. Necessary acoustic enclosures, wherever feasible will be provided for all these facilities to limit the noise levels within prescribed limits.

2.7.5 Solid and Hazardous Waste Identification, Quantification, Storage & Disposal

The proposed proposal has a manpower requirement of 15 persons. Municipal waste generated at the site will be collected and handled in line with the provisions of the SEP Act 2014.

Hazardous wastes generated at site will be handled & stored as per Hazardous Substances Rules 2014 and will be disposed as per prescribed procedures.
3. Statutory Requirements

Presented in this section are the Policy, Legal and Administrative Framework applicable to Project in the context of sustainable development. All legal provisions relevant to environmental protection applicable to the planning, construction and operation were identified under the scope of the EIA. The proponent has to be well aware of these requirements and comply with the provisions as applicable and necessary.

3.1 Administrative Framework

Before the 18th amendment in the Constitution of Pakistan, the environmental issues were governed under the federal regime through Pakistan Environmental Protection Act, 1997. As a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government. The Ministry of Environment at the federal level was abolished. Its functions related to national environmental management were transferred to the provinces. To manage the international obligations in the context of environment, a new ministry - the Ministry of Climate Change – was created at the federal level. As of now, all four provinces have enacted their own environmental protection laws.

For Sindh province, the Sindh Environmental Protection Act, 2014 (SINDH ACT NO.VIII OF 2014) was passed by the Provincial Assembly of Sindh on 24th February, 2014 and assented to by the Governor of Sindh on 19th March, 2014 and published in official gazette on Thursday March 20, 2014. (Hereinafter the Sindh Environmental Protection Act, 2014 is referred to as the “2014 Act”).

Under the 2014 Act, the Environmental Protection Council (the “EPC”) has been formed consisting of Chief Minister as Chairman with Minister in charge of Environment Protection Department, Addl. Chief Secretary, Planning & Development Department, Government of Sindh and Secretaries of Environment, Finance, Public Health Engineering, Irrigation, Health, Agriculture, Local Government, Industries, Livestock & Fisheries Forest & Wildlife, Energy, Education Departments Government of Sindh and Divisional Commissioners of Sindh. Non-official members are also included (i.e. representatives of Chamber of Commerce & Industry and from medical or legal professions etc.) along with DG, EPA & two Members of Provincial Assembly also form part of EPC.

The EPC within the framework of the 2014 Act acts as a policy making body. The functions and powers of EPC include coordination & supervision of provisions of Act, approving provincial environmental & sustainable development policies & SEQS, provide guidance for protection & conservation, consider annual Sindh Environmental Report, deal with interprovincial and federal provincial issues,
provide guidance for bio safety & assist Federal Government in implementation of various provisions of UN Convention on laws on Seas (UNCLOS).

Sindh Environmental Protection Agency (the “SEPA”) establishes under the provisions of the 2014 Act is headed by Director General with the aim to exercise the powers and perform the functions assigned to it under the provisions of the 2014 Act and the rules and regulations made there under. The SEPA acts as the executive body of the provisions of the 2014 Act. It has technical and legal staff and may form advisory committees. SEPA requires preparing environmental policies, taking measures for implementation of environmental policies, preparing Sindh Environment Report and preparing or revising Sindh Environmental Quality Standards. It also establishes systems and procedures for surveys, surveillance, monitoring, measurement, examination, investigation research, inspection and audit to prevent and control pollution and to estimate the costs of cleaning up pollution and rehabilitating the environment and sustainable development. SEPA would also take measures for protection of environment such as to promote research; issues licenses for dealing with hazardous substances, certify laboratories, identify need for or initiate legislation, specify safeguards etc. SEPA would also encourage public awareness and education regarding environmental issues. SEPA has powers to enter or inspect under a warrant issued by Environmental Protection Tribunal or a Court search at any time, any land or building etc. where there are reasonable grounds to believe that an offence has been or is being or likely to be committed. SEPA may also take samples, arrange for testing or confiscate any article in discharge of their duties.

The 2014 Act also provides for establishing Sindh Sustainable Fund derived from various sources such as voluntary contributions or fees generated etc. This fund is utilized for protection, conservation or improvement of environment.

Under the 2014 Act and rules and regulations made there under a complete framework for pre and post approval is given, which a proponent of project requires to comply with.

3.2 Statutory Framework

As stated supra after 18th Amendment in Constitution of Pakistan, 1973 subject of environmental protection is devolved to the provinces and all provinces have enacted their own provincial environmental protection acts, rules and regulations. Now all matters related to environmental protection are governed under respective provincial environmental protection laws. However, it would apposite to give here a brief history of the development of statutory environmental framework in the Country. Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed
between the federal and provincial governments through two ‘lists’ attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the ‘Concurrent List’ contained subjects regarding which both the federal and provincial governments could enact laws. The subject of ‘environmental pollution and ecology’ was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject. However, as a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government. The Ministry of Environment at the federal level was abolished. Its functions related to national environmental management were transferred to the provinces. To manage the international obligations in the context of environment, a new ministry - the Ministry of Climate Change – was created at the federal level. The PEPA 1997 is no longer applicable to the provinces. The provinces have enacted their own environmental protection laws. These provincial laws are largely based on PEPA 1997 and, hence, provide the same level of environmental protection as the parent law. Between 1993 and 2010, the Pak-EPA promulgated several rules, regulations, standards, and guidelines to implement the provisions of the PEPA 1997. The province of Sindh has made its own rules and regulations. However, sectorial guidelines made under PEPA 1997 are still useful document to benefit from.

Sindh EPA has taken lead in finalizing and notifying the Sindh Provincial rules, regulations and standards.


- 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.
For purpose of this report, the 2014 Act, Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014 (“2014 Regulations”) and other relevant rules and regulations made under the 2014 Act are applicable.

3.3 Constitutional Provision

The Constitution of Pakistan is supreme law of the Country. It is one of the few constitutions in the world, which covers environmental protection and considers it one of the fundamental rights of citizens of Pakistan. Article 9 & 14 of the Constitution bestows fundamental right to life and dignity to every citizen. The Supreme Court of Pakistan in landmark judgment in the case of Shehla Zia and others versus WAPDA (1994) referred to both these Articles and laid down the foundation of modern environmental law in Pakistan. The august Court held that the word “life” in the constitution has not been used in a limited manner. A wide meaning should be given to enable a man not only to sustain life but to enjoy it.

Under the Constitution, Article 14 provides that the dignity of man and subject to law the privacy of home shall be inviolable. The fundamental right to preserve and protect the dignity of man under Article 14 is unparalleled and could be found only in few Constitutions of the world. The Constitution guarantees dignity of man and also right to “life” under Article 9 and if both are read together, question will arise whether a person can be said to have dignity of man if his right to life is below bare necessity like without proper food, clothing, shelter, education, health care, clean atmosphere and unpolluted environment.

3.4 Sindh Environmental Protection Act, 2014

The 2014 Act as stated above is the basic legislative tool empowering the provincial government to frame regulations for the protection of the environment. The Act envisages protection, improvement, conservation & rehabilitation of environment of Sindh with the help of legal action against polluters and green awakening of communities. It equally lays emphasis for the preservation of the natural resources of Sindh and to adopt ways and means for restoring the balance in its eco-system by avoiding all types of environmental hazards. The act is applicable to a broad range of issues and extends to air, water, industrial liquid effluent, marine, and noise pollution, as well as to the handling of hazardous wastes.

The following articles of the SEPA 2014 have a direct bearing on the proposed Project:

- Article 11(1): ‘Subject to the provisions of this Act and the rules and regulations therein, no person shall discharge or emit or allow the discharge or emission of any effluent, waste, pollutant, noise or any other matter that
may cause or likely cause pollution or adverse environmental effects, as defined in Section 2 of this Act, in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards...’

- Article 11(2): ‘All persons, in industrial or commercial or other operations, shall ensure compliance with the Environmental Quality Standards for ambient air, drinking water, noise or any other Standards established under section 6(1)(g)(i); shall maintain monitoring records for such compliances; shall make available these records to the authorized person for inspection; and shall report or communicate the record to the Agency as required under any directions issued, notified or required under any rules and regulations.’

- Article 14 (1): ‘Subject to the provisions of this Act and the rules and regulations, no person shall cause any act, deed or any activity, including;
  o (b) disposal of solid and hazardous wastes at unauthorized places as prescribed;
  o (c) dumping of wastes or hazardous substances into coastal waters and inland water bodies; and
  o (d) release of emissions or discharges from industrial or commercial operations as prescribed.

- Article 15 (1): ‘Subject to the provisions of this Act, no person shall operate or manufacture a motor vehicle or class of vehicles from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the Sindh Environmental Quality Standards or, where applicable, the standards established under sub-clause (i) of clause (g) of sub-section (1) of section 6’.

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

- Article 17(2): The agency shall;
  o a) review the initial environmental examination and accord its approval, subject to such terms and conditions as it may prescribe, or require submission of an environmental impact assessment by the proponent; or
  o (b) review the environmental impact assessment and accord its approval subject to such terms and conditions as it may deem fit to impose or require
that the environmental impact assessment be re-submitted after such modifications as may be stipulated or decline approval of the environmental impact assessment as being contrary to environmental objectives.

- Article 17(3): ‘Every review of an environment impact assessment shall be carried out with public participation and, subject to the provisions of this Act, after full disclosure of the particulars of the project’.

- Article 17(4): ‘The Agency shall 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’.

- Article 20(1): ‘The Agency shall from time to time require the person in charge of a project to furnish, within such period as may be specified, an environmental audit or environmental review report or environmental management plan containing a comprehensive appraisal of the environmental aspects of the project’.

- Article 20(2): The report of a project prepared under sub-section (1) shall include:
  
  - (a) analysis of the predicted qualitative and quantitative impact of the project as compared to the actual impact;
  
  - (b) evaluation of the efficacy of the preventive, mitigation and compensatory measures taken with respect to the project; and
  
  - (c) recommendations for further minimizing or mitigating the adverse environmental impact of the project.

- Article 20(3): ‘Based on its review of the environmental audit report, the Agency may, after giving the person in charge of the project an opportunity of being heard, direct that specified mitigation and compensatory measures be adopted within a specified time period and may also, where necessary, modify the approval granted by it under section 17’.
3.5 Sindh EPA (Review of IEE and EIA) Regulations 2014

Sindh Environmental Protection Agency (Review of IEE / EIA) Regulations, 2014 (“2014 Regulations”) made in exercise of powers conferred under section 37 of the Act 2014 provide the necessary guidelines on the preparation, submission, & review of Initial Environmental Examinations (IEEs) and Environmental Impact Assessments (EIAs). The regulations categorize projects in three categories provided in Schedule I, II and III of the 2014 Regulations.

The project falls in Schedule II (List of Projects requiring EIA) of the 2014 Regulations.

The submission and approval procedure for the EIA is summarized below:

- The EIA report shall be submitted, together with a review fee and form included as Schedule-V of the Sindh IEE/EIA Regulations 2014.

- The SEPA shall conduct a preliminary scrutiny and reply within 15 working days of the submittal of the report a) confirming completeness, or b) asking for additional information, if needed, or c) returning the report requiring additional studies, if necessary.

- The SEPA is required to make every effort to complete the EIA review process within four months of the issue of confirmation of completeness.

- SEPA shall call for a Public Hearing for the project to invite all the concerned persons to raise concerns on the project.

- Following the Public Hearing, SEPA shall constitute a Committee of Experts to assist the agency in review of the EIA.

- The approval granted at the end of the review process is valid for three years for start of construction.

- Once project construction has been completed, the proponent is required to submit a request to the SEPA for confirmation of compliance. An environmental management plan for the operation phase is to accompany the request.

- The SEPA is required to communicate its decision within four months of receipt of the request. The project can commence operation only after it has received approval from the SEPA.
3.6 Guidelines for Public Consultation

Public consultation is mandated under Sindh’s environmental law. Regulation 11 of the 2014 Regulations provides the general requirements whereas the sectoral guidelines indicating specific assessment requirements are provided in the Guidelines for Public Consultation 1997 (the ‘Guidelines’). These are summarized below:

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

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

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

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

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

▪ **Other Important Considerations:** ‘The development of a public involvement program would typically involve consideration of the following issues; objectives of the proposal and the study; identification of stakeholders; identification of appropriate techniques to consult with the stakeholders; identification of approaches to ensure feedback to involved stakeholders;
M/s. CITY WASTE INCINERATOR

and mechanisms to ensure stakeholders’ consideration are taken into account’.

As above, the Guidelines for Public Consultation introduce effective ways to inform the contents of the project to the general public during the planning stage and that eventually consensus building toward the implementation of project is reached.

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

3.7 Hazardous Substances Rules 2014

These rules may be called the Hazardous Substances Rules, 2014.

Substances prescribed as hazardous substances. As provided in subclause (b) of clause (xxv) of section 2, substances listed in Schedule-I are hereby prescribed as hazardous substances.

Packing and labeling.

(1) A container of a hazardous substance shall be of such size, material and design as to ensure that –

(a) it can be stored, transported and used without leakage and safely;

(b) the hazardous substance therein does not deteriorate in a manner as to render it more likely to cause, directly or in combination with other substances, an adverse environmental effect.

(2) The following information shall be printed conspicuously, legibly and indelibly on every container of a hazardous substance:

(a) name of the hazardous substance;

(b) name, address and license number of the licensee;

(c) net contents (volume or weight);

(d) date of manufacture and date of expiry, if any;

(e) a warning statement comprising –
(i) the word “DANGER!” in red on a contrasting background;

(ii) a picture of a skull and cross-bones;

(iii) pertinent instructions for use, storage and handling and safety precautions relating thereto.

(f) instructions regarding return or disposal of the empty container:

Provided that if the hazardous substance has an inner container as well as an outer container, the information shall be printed on both containers:

Provided further that if it is impracticable to print the aforesaid information on the container itself due to its size, material or design, the same shall be printed on a label or tag which shall be conspicuously affixed or attached to the container in such manner as to render it difficult to remove. The empty chemical containers or drums may not be used for other purposes:

(g) basic instructions mentioning immediate steps to be taken in case of any accident or emergency, preferably in local language.

Conditions for premises.

(i) The premises in which a hazardous substance is generated, collected, consigned, treated, disposed of, stored or handled shall

(a) comply with the conditions specified in Schedule-IV;

(b) be fitted with a notice on the outer door or gate bearing the following information:

(i) the words “DANGER! HAZARDOUS SUBSTANCE!” in red, on a contrasting background; and

(ii) a prominent picture of a skull and cross-bones.

(2) In case of import of hazardous substances, proponent shall provide approval from Climate Change Division (International Convention Wing) Government of Pakistan.

3.8 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.

Table 3.1 shows Sindh environmental quality standard for ambient air.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Time-weighted average</th>
<th>Concentration in Ambient Air</th>
<th>Method of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur Dioxide (SO(_2))</td>
<td>Annual Average*</td>
<td>80μg/m(^3)</td>
<td>Ultraviolet Fluorescence Method</td>
</tr>
<tr>
<td></td>
<td>24 hours**</td>
<td>120μg/m(^3)</td>
<td></td>
</tr>
<tr>
<td>Oxides of Nitrogen as (NO)</td>
<td>Annual Average*</td>
<td>40μg/m(^3)</td>
<td>Gas Phase Chemiluminescence</td>
</tr>
<tr>
<td></td>
<td>24 hours**</td>
<td>40μg/m(^3)</td>
<td></td>
</tr>
<tr>
<td>Oxides of Nitrogen as (NO(_2))</td>
<td>Annual Average*</td>
<td>40μg/m(^3)</td>
<td>Gas Phase Chemiluminescence</td>
</tr>
<tr>
<td></td>
<td>24 hours**</td>
<td>80μg/m(^3)</td>
<td></td>
</tr>
<tr>
<td>O(_3)</td>
<td>1 hour</td>
<td>130μg/m(^3)</td>
<td>Non dispersive UV absorption method</td>
</tr>
<tr>
<td>Suspended Particulate Matter (SPM)</td>
<td>Annual Average*</td>
<td>360μg/m(^3)</td>
<td>High volume Sampling, (Average flow rate not less than 1.1m(^3)/minute)</td>
</tr>
<tr>
<td></td>
<td>24 hours**</td>
<td>500μg/m(^3)</td>
<td></td>
</tr>
<tr>
<td>Respirable Particulate Matter (PM10)</td>
<td>Annual Average*</td>
<td>120μg/m(^3)</td>
<td>B Ray absorption method</td>
</tr>
<tr>
<td></td>
<td>24 hours**</td>
<td>150μg/m(^3)</td>
<td></td>
</tr>
<tr>
<td>Respirable Particulate Matter (PM2.5)</td>
<td>Annual Average*</td>
<td>40μg/m(^3)</td>
<td>B Ray absorption method</td>
</tr>
<tr>
<td></td>
<td>24 hours**</td>
<td>75μg/m(^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 hour</td>
<td>15μg/m(^3)</td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>Annual Average*</td>
<td>1μg/m(^3)</td>
<td>ASS Method after sampling using EPM 2000 or equivalent Filter paper</td>
</tr>
<tr>
<td></td>
<td>24 hours**</td>
<td>1.5μg/m(^3)</td>
<td></td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>8 hours**</td>
<td>5mg/m(^3)</td>
<td>Non Dispersive Infra Red (NDIR) method</td>
</tr>
<tr>
<td></td>
<td>1 hour</td>
<td>10mg/m(^3)</td>
<td></td>
</tr>
</tbody>
</table>

*Annual arithmetic means 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.

Table 3.2 shows the standards for motor vehicle noise.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standards (maximum permissible limit)</th>
<th>Measuring method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>85dB(A)</td>
<td>Sound-meter at 7.5 meter from the source</td>
</tr>
</tbody>
</table>
Table 3.3 shows the Sindh Environmental Quality Standard for noise.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Category of Area / Zone</th>
<th>Limit it in dB(A) Leq*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Day Time</td>
</tr>
<tr>
<td>1</td>
<td>Residential area (A)</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>Commercial area (B)</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>Industrial area (C)</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>Silence Zone (D)</td>
<td>50</td>
</tr>
</tbody>
</table>

Note: 1 Day time hours: 6.00 a.m to 10.00 p.m
2 Night time hours: 10.00 p.m to 6.00 p.m
3 Silence zone; Zone which are declared as such by competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.
4 Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.

*dB(A)Leq Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

The SEQS for effluents are shown in Table 3.4.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Into Inland Waters</th>
<th>Into Sewage Treatment</th>
<th>Into Sea</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temperature or Temp. increase</td>
<td>&lt;3</td>
<td>&lt;3</td>
<td>&lt;3</td>
<td>°C</td>
</tr>
<tr>
<td>2</td>
<td>pH value (H+)</td>
<td>6-9</td>
<td>6-9</td>
<td>6-9</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Biological Oxygen Demand (BOD), at 20 °C</td>
<td>80</td>
<td>250</td>
<td>80</td>
<td>mg/l</td>
</tr>
<tr>
<td>4</td>
<td>Chemical Oxygen Demand (COD)</td>
<td>150</td>
<td>400</td>
<td>400</td>
<td>mg/l</td>
</tr>
<tr>
<td>5</td>
<td>Total Suspended Solids (TSS)</td>
<td>200</td>
<td>400</td>
<td>200</td>
<td>mg/l</td>
</tr>
<tr>
<td>6</td>
<td>Total Dissolved Solids (TDS)</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>mg/l</td>
</tr>
<tr>
<td>7</td>
<td>Oil and Grease</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>mg/l</td>
</tr>
<tr>
<td>8</td>
<td>Phenolic Compounds (as Phenol)</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
<td>mg/l</td>
</tr>
<tr>
<td>9</td>
<td>Chloride (as Cl)</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>SC</td>
</tr>
<tr>
<td>10</td>
<td>Fluoride (as F)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>mg/l</td>
</tr>
<tr>
<td>11</td>
<td>Cyanide (as CN)total</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>mg/l</td>
</tr>
<tr>
<td>12</td>
<td>An-ionic detergents (as MBAS)</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>mg/l</td>
</tr>
<tr>
<td>13</td>
<td>Sulphate(SO₄²⁻)</td>
<td>600</td>
<td>1000</td>
<td>1000</td>
<td>SC</td>
</tr>
<tr>
<td>14</td>
<td>Sulphide (S⁻)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>mg/l</td>
</tr>
<tr>
<td>15</td>
<td>Ammonia (NH₃)</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>mg/l</td>
</tr>
<tr>
<td>16</td>
<td>Pesticides</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td>mg/l</td>
</tr>
<tr>
<td>17</td>
<td>Cadmium</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>mg/l</td>
</tr>
<tr>
<td>18</td>
<td>Chromium (trivalent and hexavalent)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>mg/l</td>
</tr>
</tbody>
</table>
### Table 2.5: Sindh Environmental Quality Standards for Drinking Waters (mg/l)

<table>
<thead>
<tr>
<th>S.#</th>
<th>Properties / Parameters</th>
<th>Standard Values for Pakistan</th>
<th>S.#</th>
<th>Properties / Parameters</th>
<th>Standard Values for Pakistan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Bacterial</strong></td>
<td></td>
<td></td>
<td><strong>Chemical</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>All water intended for drinking (E.Coli or Thermo tolerant Coliform bacteria)</td>
<td>Must not be detectable in any 100 ml sample</td>
<td>3</td>
<td>Aluminum (Al) mg/l</td>
<td>≤ 0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Antimony (Sb) mg/l</td>
<td>≤ 0.005</td>
</tr>
<tr>
<td>2</td>
<td>Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)</td>
<td>Must not be detectable in any 100 ml sample</td>
<td>5</td>
<td>Arsenic (As) mg/l</td>
<td>≤ 0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>Barium (Ba) mg/l</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>Boron (B) mg/l</td>
<td>0.3</td>
</tr>
<tr>
<td>3</td>
<td>Treated water in the distribution system (E.coli or thermo tolerant coliform and total coliform bacteria)</td>
<td>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.</td>
<td>8</td>
<td>Cadmium (Cd) mg/l</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>Chloride (Cl⁻) mg/l</td>
<td>&lt; 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>Chromium (Cr) mg/l</td>
<td>≤ 0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>Copper (Cu) mg/l</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>Phenolic compounds mg/l</td>
<td>&lt;0.0002</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Toxic Inorganics (mg/liter)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td>Cyanide (CN⁻) mg/l</td>
<td>≤ 0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>Fluoride (F) mg/l</td>
<td>≤ 1.5</td>
</tr>
</tbody>
</table>

The SEQs for drinking water are shown in Table 3.5.

3.9 Sindh Prohibition of Child Employment Act, 2017

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

3.10 Land Acquisition Act, 1894

The Land Acquisition Act, 1894 (LAA) governs land acquisition against compensation for public interest projects. It is termed as draconian law because it gives complete powers to the government to acquire the land and there is no provision for landowner to refuse transferring the land. Only remedy to a landowner is to challenge quantum of compensation, that too, through a civil court where decades pass in deciding the matter. The Act gives power to the Government to acquire the land under emergency clause under which requirement of prior public notice is exempted.
3.11 Pakistan Panel Code, 1860 (PPC)

Chapter XIV of the PPC deals with the offences affecting the public health, safety, convenience, decency and morals. Person may be guilty of public nuisance if his act or omission causes common injury, danger or annoyance to the public or results in spread of infection of disease dangerous to life. The chapter also deals with environmental pollution.

3.12 Sindh Solid Waste Management Board Act, 2014

A board established under the Act for management of collection and disposal of all solid waste, to arrange for effective delivery of sanitation services, and to deal with other relevant matters. Under the Act, the board shall have the right over the solid waste related issues, assets, funds and liabilities of the Councils and shall possess sole rights on all kinds of solid waste within the limits of all Councils.

The Supreme Court of Pakistan in recent judgment passed on 16.03.2017 in C.P. No.38 of 2016 (Shahab Usto vs GoS & Ors) has shown serious reservation with regard to the continuation of the Board. The Court has observed in Para No.49 that if this Board is allowed to exist, it would be a permanent liability of the Sindh Government. In the circumstances, the Act has not been reviewed in detail.

3.13 Disaster Management Act, 2010

This Act was enacted to provide for the establishment of a National Disaster Management System for Pakistan. Sindh Disaster Management Authority enforces the Act. The Act defines ‘disaster’ as a catastrophe or a calamity in an affected area, arising from natural or man-made causes or by accident which results in a substantial loss of life or human suffering or damage to, and destruction of, property. Disaster management includes preparedness and response. The Act provides establishment of disaster management authorities at national, provincial and district levels. The authorities require preparing and implementing disaster management plan for their area.

3.14 The Sindh Occupational Safety and Health Act, 2017

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

Public Health Engineering & Rural Development Department, Government of Sindh, with the approval of Chief Minister Sindh issued the drinking water policy on 3rd May 2017. The main principles of Sindh Drinking Water Policy, adopted from the National Drinking Water policy 2009, and aligned with the Sustainable Development Goals, are as follows:

- Access to safely managed drinking water is a fundamental right of every citizen and that it is the responsibility of the Government to ensure its provision to all citizens,
- Water allocation for drinking purpose shall be given priority over other uses,
- In order to ensure equitable access, special attention shall be given to removing the existing disparities in coverage of safe drinking water and for addressing the needs of the poor and the vulnerable on priority basis.
- Recognizing that inadequate and unsafe water supply and sanitation are a major cause of diarrhea and nutritional deficiency in children, which as a consequence contribute towards child mortality. Safely managed drinking water supply and sanitation shall be integrated in health, nutrition and school health programs.
- Access shall be increased to high quality nutrition-sensitive services, including access to water, sanitation facilities, and hygiene.
- Key hygiene actions (safe drinking water, hand washing with soap, safe disposal of excreta, food hygiene) shall be integrated as essential components in all nutrition programs.
- Realizing the fact that access and availability of safe drinking water affects all aspects of life of a citizen, a multi sectoral approach, involving different departments of the government, shall be adopted to address the issues related to safe drinking water.
- Being cognizant of the fact that women are the main providers of domestic water supply and maintainers of hygienic household environment, their participations in planning, implementation, monitoring and operation & maintenance of water supply systems shall be ensured, and WASH shall be integrated in maternal and neonatal health programs.
- Responsibilities and resources shall be delegated to local authorities to enable them to discharge their assigned functions with regard to provision of safe water supply.
- A supportive policy framework shall be developed that encourages alternate options through private provision, public private partnerships, the role of NGOs and community organizations
- The execution of component-sharing model for government programs and projects shall be promoted to ensure financial sustainability and community and private sector involvement in development and O&M.
- Low cost technologies in water and sanitation, that are easy and cost-effective to maintain shall be developed and used.

### 3.16 Sindh Sanitation Policy, 2016

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

### 3.17 Sub Soil Water (Extraction and Consumption) Regulations, 2018

Besides many one big achievement of the Supreme Court appointed water commission was ensuring making of regulations on sub soil water. The Regulations are made in exercise of the powers conferred under section 16 of the KW&SB Act 1996. The Regulation introduces license regime for sub soil water extraction and consumption by industrial consumers. It empowers the Board established under KW&SB Act 1996 to ask for carrying out hydrological study and tests to qualify for applying for the license. The Regulations prohibit transportation of extracted water through water tankers and discourages water extraction in excess. The Board retains power of inspection of the water abstraction facility and cancellation of license in case of violation of the terms and conditions of the license.
4. Description of Environment

This section describes the current environmental and socioeconomic conditions of the microenvironment and macroenvironment of the Project area.

The macroenvironment is part of Karachi West District, an administrative district of Karachi Division. Bounded on the north and north west by Lasbella district of Balochistan Province, on the north east by Karachi (East) district. On the east by Karachi Central, Karachi (West) and Karachi (South) district and on the South by Arabian Sea. District West incorporates areas of Mauripur, Harbour, Baldia, SITE, Mominabad, Korangi and Manghopir sub-divisions (Figure 4.1). Baldia Town is bordered by SITE Town and Orangi to the east and by Keamari Town to the north and west, with most of the western boundary formed by part of the RCD Highway.

![Figure 4.1: Karachi District West & Its Sub-Divisions](image)

The microenvironment comprises proposed project site located at survey No. 318 Deh Mai Garhi UC-8 Manghopir, Baldia Town, Karachi West. The project site has direct connectivity with M-10 Karachi Northern Bypass & Link Roads within
200 m radius that makes this site ideally suitable for siting a waste management facility (Figure 4.2 & 4.3).

Figure 4.2: Deh Mai Garhi – microenvironment of Project site in Baldia Town

Figure 4.3: immediate neighborhood of the project
The microenvironment comprises the project site; M-10 Karachi Northern bypass on the immediate north; an informal oil tankers yard on the immediate west; Ali Asif Kanta (Weighbridge) on the immediate east while rest of the area is mostly uninhabited with isolated structures and vacant industrial plots.

4.1 Physical Resource

Detailed description of the physical resources existing in the area is stated in the following sections. Major areas covered under physical resources are; topography, geology, soil conditions, climate, surface and ground water resources, and seismology. Most of the information is collected from the authentic secondary resources besides primary data collection for critical aspects. Respective departments were contacted by the project team members and information was collected with the help of checklist. Other studies and reports were referred and reviewed for the verification of information.

4.1.1 Climatic Condition

The climate of the macroenvironment is characterized as hot and dry during summer, and mild during winter with heavy, sporadic, rainfall during the monsoon. The southwest monsoon prevails from April to October. The monsoon is characterized by a reversal in wind direction during the remaining months; and heavy rainfall over most of the Indian Subcontinent. The hottest months are between mid-March to June. The winters are mild with temperature dropping to 10°C in January. Karachi receives approximately 217.3 mm of rain annually. Almost 80% of the rain is concentrated in the monsoon season. The general characteristics of the seasons based on this data is described as follows:

- **Summer (mid-March to mid-June):** Characterized by high temperatures, moderate rainfalls with moderate atmospheric humidity and high speed-winds that blow from southwest towards northeast.
- **Summer Monsoon (mid-June to mid-September):** Characterized by high temperatures, high rainfalls with high atmospheric humidity and high speed-winds that blow from southwest towards northeast.
- **Post-Monsoon summer (mid-September to mid-November):** Characterized by moderate temperatures, low rainfalls and low speed-winds that normally blows from southwest towards northeast with direction of wind changing in the end of post-monsoon summer from southwest to northeast.
- **Winter (mid-November to mid-March):** Characterized by low temperatures, dry conditions with low atmospheric humidity and significant reduction in wind speeds that blows from northeast to southwest with the direction of wind changing in the end of winter from northeast to northwest.
4.1.2 Geology & Geomorphology

Geologically, Baldia town rests on the limestone member of Gaj Formation which belongs to Miocene age (Figure 4.5). This limestone is interlayered by thin shale units which is served as ductile material during westward collision of Indian plate after Eocene time.

Figure 4.5: Geological map of study area
This resulted in the formation of several asymmetrical folds followed by multiple normal faults in Karachi and its suburbs. Baldia town is located between western limb of Manghopir anticline and Lalji syncline (Figure 4.6). The periphery of Lalji syncline is serving as catchment area for Baldia town basin where many streams are formed between dip and escarp slopes of limestone ridges. Groundwater table occurs at a depth of > 100 feet due to steep inclination of the rocks forming the confined aquifer system. The general groundwater flow direction is northwest to southeast.

Seismotectonics of the Area: Karachi and its environs fall in the synclinorium, described earlier as being part of Indus deltaic region. Recession of the delta and its retreat towards the southeast dried up its numerous channels, estuaries and creeks that characterize the synclines and are part of the active faults. Tectonic instability of this region can be attributed to this large number of reverse and tear faults and the recently described wrench faults.¹

Seismic activity in and around the region shows that the Karachi Arc has been active since long in prompting the eastward movement of the delta. It is possible that the movement is related to the rebound that takes place after mass shift. The entire Karachi Arc and surrounding areas are seismically active with

hypocenters ranging in depth from 0-500 kilometers. From the depth of hypocenters, it is inferred that active deformation has taken place at multi-levels ranging from shallow to deep in the basement. Quite a few of the recent epicenters are found within or in close proximity to parts of Karachi that have faced recurrent earthquake activity.

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 Pakistani coastline also lie in Zone 3. The remaining parts of the country lie in Zone 2. According to this classification, the Project site would be placed in Zone 2B.

![Figure 4.7: Seismic Zones between Karachi](image)

### 4.1.3 Ambient Air & Noise Quality

Primary source of air pollution on and along the major corridors of Karachi is transport sector, so the primary pollutants in ambient air quality in the City in general and project area in particular are directly linked with fuel consumption. Studies undertaken between 1987 and 1994 had raised concern on the deteriorating air quality and noise levels. Studies over the past decade, had quantified the problem and identified the tremendous growth in volume of traffic as the main factor responsible for increasing congestion all over Karachi roads and aggravating the problem. A 1990 survey³ monitored CO at 9-10 ppm

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³ Map data source(s): PMD, GSP, Pakistan Engineering Council – Prepared by Al hasan Systems Private Limited
³ Ghauri et.al. 1994
along the busy urban streets; maximum NO2 concentrations were 0.3-0.5 ppm during the daytime; with an ozone maximum around noon of 40 ppb and 50 ppb, below WHO’s interim quality guideline. A 2005 study\(^4\) that shows hourly readings over 24 hours for O\(_3\), SO\(_2\), CO and NO\(_2\) measured at five locations in Karachi. O\(_3\) concentrations were well within the WHO guideline of 100 µg/m\(^3\) 8-hr average; NO\(_2\) and SO\(_2\) also were well within the WHO guideline of 200 µg/m\(^3\) (1-hr average) and 20 µg/m\(^3\) (24-hr), respectively.

Finally, another report\(^5\) quotes the World Bank’s data with the following maximum values: PM\(_{2.5}\) 201 µg/m\(^3\); SO\(_2\) 173 µg/m\(^3\); NO\(_2\) 122 µg/m\(^3\); O\(_3\) 86 µg/m\(^3\); CO\(_2\) mg/m\(^3\). For reference, WHO’s interim target for PM\(_{2.5}\) is 35 µg/m\(^3\), whereas its guideline is 10 µg/m\(^3\). WHO guideline for O\(_3\): 100 µg/m\(^3\) 8-hour mean. Both NO\(_2\) and SO\(_2\) are within WHO’s guideline for short term average concentration. (200 and 400 µg/m\(^3\) respectively). Data by this same author show excessive levels of PM at major intersections, including some along the Karachi BRT corridor, as well as SO\(_2\), NO\(_x\), O\(_3\) and CO, all exceeding WHO limits, based on data taken by SUPARCO in 2004.

Karachi’s air quality is nearly 5x above the safe level defined by WHO, and twice the value for daily exposure. That is also 3x the safe levels recommended by the Sindh Environmental Quality Standards for Ambient Air by the Sindh Environmental Protection Agency (SEPA).

**EHS Services** hired **SUPARCO** to conduct 24-hr ambient air monitoring at the project site. SUPARCO stationed its mobile lab at the project site on 15\(^{th}\) Feb 2020 for 24 hours to collect sample & analyze the same for concentration of primary pollutants (Figure 4.8). The results are presented below:

<table>
<thead>
<tr>
<th>S. #</th>
<th>Parameters</th>
<th>Unit</th>
<th>SEQS</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Nitrogen Oxide (NO)</td>
<td>µg/m(^3)</td>
<td>40</td>
<td>2.3 11.6 6.5</td>
</tr>
<tr>
<td>2.</td>
<td>Nitrogen Dioxide (NO2)</td>
<td>µg/m(^3)</td>
<td>80</td>
<td>21.3 31.7 26.4</td>
</tr>
<tr>
<td>3.</td>
<td>Carbon Monoxide (CO)</td>
<td>mg/m(^3)</td>
<td>5</td>
<td>3.4 4.7 4.0</td>
</tr>
<tr>
<td>4.</td>
<td>Sulphur Dioxide (SO2)</td>
<td>µg/m(^3)</td>
<td>120</td>
<td>7.0 9.6 8.2</td>
</tr>
<tr>
<td>5.</td>
<td>Ozone (O3)</td>
<td>µg/m(^3)</td>
<td>130</td>
<td>2.6 31.6 18.9</td>
</tr>
<tr>
<td>6.</td>
<td>Particulate Matter (PM2.5)</td>
<td>µg/m(^3)</td>
<td>75</td>
<td>71.2</td>
</tr>
<tr>
<td>7.</td>
<td>Particulate Matter (PM10)</td>
<td>µg/m(^3)</td>
<td>150</td>
<td>122.3</td>
</tr>
<tr>
<td>8.</td>
<td>Suspended Particulate Matter (SPM)</td>
<td>µg/m(^3)</td>
<td>500</td>
<td>402.9</td>
</tr>
<tr>
<td>9.</td>
<td>Lead</td>
<td>µg/m(^3)</td>
<td>1.5</td>
<td>0.085</td>
</tr>
</tbody>
</table>

\(^4\) Hashmi et.al.  
\(^5\) Kalwar 2014
Comparison of Air Quality data of the project site with that noted for rest of Karachi suggests that the level at the former site is lower than that observed for the other areas of Karachi. This can be attributed to the strong influence of the wind and is effective in the desired dispersion of pollutants. The dispersion so achieved places the site in the unpolluted airshed category and makes the project site suitable for siting the proposed waste management facility. However, it may also be noted that the levels of particulates exceed the safe limits prescribed by the world health organization (WHO).

The general observation during the reconnaissance survey suggests that it is a calm location with an average noise level ranging between 45.8 dB(A) and 54.5 dB(A). The average noise level at the site is raised either by the peak noise emission from traffic or by the hissing and rustling of the prevailing wind. Quite often the rustling of wind was found to raise the noise level to over 70 dB(A). Noise level recorded for the different positions shows that the ambient noise level recorded at some distance away from the M-10 National Highway or Link Road was reduced from over 80 dB(A) to <60 dB(A) at distances varying from 75 to 100 m. At the boundary line the level was invariably 54 to 55 dB(A) when there was no traffic on road and the wind was also not blowing. The noise level was also found to rise if birds would chirp or dogs would bark.
4.1.4 Water Resources, Water Quality and Drainage

4.1.4.1 Greater Karachi Bulk Water Supply System

To supply the city of Karachi with 280 MGD of water supply, the Greater Karachi Bulk Water Supply Scheme was designed in 1953. The scheme was modeled and divided into four equal phases on the basis of population projection till the year 2000. Each scheme, with the design rate of 70 MGD, comprised of open canals, covered conduits, a tunnel, siphons, pumping stations and mains to supply water from the Keenjhar Lake. The details are discussed below and shown in Figure 4.12.

1st Phase
- Proposed raw-water pumping at Dhabeji to bring 70 MGD of water from Keenjhar Lake and water treatment plant of 70 MGD at COD Hills, Karachi.
- Development of complete water conveyance system comprising of a 280 MGD lined canal, a conduit of equal capacity up to Pipri and of 140 MGD capacity up to Karachi.
- Work on 10 MG reservoir at COD Hills along with the distribution network.
- It started in 1954 and completed in 1961 at a total cost of PKR 185 million.

2nd Phase
- It included construction of a 70 MGD pump house at Dhabeji, laying of 84" dia pre-stressed pipe siphons, a 25 MGD pump house at Pipri and two water treatment plants of 25 and 45 MGD along with 10 MG reservoirs at Pipri and COD Hills respectively.
- Work for this phase was awarded in 1969 and completed in early 1971 at a total cost of PKR 200 million.

3rd Phase
- It included the construction of a 70 MGD pumping station at Dhabeji, two pumping stations along with water treatment plants of 25 MGD capacity each at North East Karachi and Pipri, 84"dia pipe siphons, three balancing reservoirs and the distribution mains.
- A reservation for supply of 22 MGD of un-filtered water to Karachi Steel has also been made under this phase.
- Work for this phase started in 1975 and completed in 1978 with the total cost of PKR 750 million.

4th Phase
- Due to financial constraints, 4th Phase works were divided into two parts.
- Under this phase improvement of lined canal, modifications of the present Dhabeji Pumping Stations, laying of 84" dia pipe syphons, construction of a 25 MGD pump house and clarification units at Pipri were commissioned.
- Also, improvement of the secondary distribution network and installation of domestic meters in K.D.A. Scheme No.1 & 5 were taken up with the
assistance of World Bank and all the works were completed in June, 1987 at a total cost of PKR 360 million.

- After this phase, the city’s water supply increased by 50 MGD.

**Hub Water Supply System**
- The Hub dam was constructed by WAPDA on Hub River to from 1963-1981
- At Stage-I, 90 MGD pump house, two steel pressure mains one 20 MG reservoir, trunk mains and primary treatment of lake water by screening and chlorination were completed in August 1982 at a total cost of PKR 260 million.
- Stage-II included the improvement of secondary distribution network and construction of a 90 MGD water treatment plant.

**5th Phase (Greater Karachi Bulk Water Supply Scheme)**
- Karachi’s water supply system has expanded considerably in this phase. As discussed in initial four phases, Karachi was getting 280 MGD of water.
- Then 100 MGD water were added to the system through K-II supply project which were completed in 1998 with the assistance of World Bank.
- Through a bulk water supply project, the city got another 40 MGD of water in 2000.
- K-III 100 MGD Water Supply Project, further added into the existing supply which were completed in 2006 with the assistance of GoP.
- Now, the K-IV water project has been planned to fill the gap between the city's demand and supply of water.
- Approved on July 10, 2014 with the proposed design capacity of supplying an additional 650 MGD of water to Karachi. K-VI will be completed in three phases at a cost of PKR 25.6 billion rupees.

**Figure 4.9: Water Supply System of Karachi (Glimpse from Past to Present)**
4.1.4.2 Proposed Bulk Water Supply Scheme

K-IV is a municipal infrastructure project being jointly developed by the Provincial and Federal Governments in Karachi, Pakistan, to augment the city's daily water supply. This project is divided into three phases and each phase will increase water supply capacity. Details of K-IV are shown in Figure 4.10.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Capacity</th>
<th>Proposed Completion Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-IV Phase-1</td>
<td>260 MGD</td>
<td>Year 2018</td>
</tr>
<tr>
<td>K-IV Phase-2</td>
<td>260 MGD</td>
<td>Year 2022</td>
</tr>
<tr>
<td>K-IV Phase-3</td>
<td>130 MGD</td>
<td>Year 2025</td>
</tr>
</tbody>
</table>

Figure 4.10: K-IV Bulk Water Supply Schemes Karachi

4.1.4.3 Present Water Supply and Sewerage System

The water supply and sewerage system in the macroenvironment is managed by Karachi Water Supply & Sewerage Board (KW&SB). Present water supply system of Karachi City has a supply capacity of 560 mgd. Actually, as of the end of year 2006, the KW&SB supply bulk water of about 630 mgd beyond the capacity as shown in following Table. Out of 630 mgd, water of 209 mgd is supplied without filtration, which is equivalent to one third of actual supply amount of 630 mgd.
Water is collected and treated by the conventional water treatment plants and distributed by a system which is at least 40-45 years old with some new distribution facilities in the city. The outdated system along with improper operation and maintenance causes the issue of revenue loss. In addition, there is no metering for retail customers and only 25 percent of commercial and industrial customers have a metered supply. The water supply is irregular due to power failure at KW&SB pumping stations which further increases the problems in water distribution system. Moreover, almost 40 per cent of the population lives in slums with limited water supply & poor sanitary infrastructure.

Figure 4.11 presents the detailed water distribution in Karachi.

![Current Water Supply Position of Karachi]

**Figure 4.11: Current Water Distribution System in Karachi from Hub Reservoir and Keenjhar Lake**

<table>
<thead>
<tr>
<th>Supplied from</th>
<th>Rated Capacity</th>
<th>Actual Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gharo Filtration Plant</td>
<td>20 mgd</td>
<td>30 mgd</td>
</tr>
<tr>
<td>Pipri Filtration Plant</td>
<td>with Filtration 100 mgd</td>
<td>102 mgd</td>
</tr>
<tr>
<td></td>
<td>without Filtration -</td>
<td>32 mgd</td>
</tr>
<tr>
<td>Dumlootree Conduit (without Filtration)</td>
<td>from Wells 20 mgd</td>
<td>0 mgd</td>
</tr>
<tr>
<td></td>
<td>from GK/K-III Systems -</td>
<td>17 mgd</td>
</tr>
<tr>
<td>NEK Old Filtration Plant</td>
<td>25 mgd</td>
<td>5 mgd</td>
</tr>
<tr>
<td>NEK New Filtration Plant</td>
<td>100 mgd</td>
<td>100 mgd</td>
</tr>
</tbody>
</table>
4.1.4.4 Water Supply Network

Karachi water and sewerage board (KWSB) is the organization responsible for water transmission and distribution across the city. Indus river system authority (IRSA) provides water to Sindh, therefore, this river indirectly becomes part of water supply system for the city. River Indus feeds water to the Lake Keenjhar. From Keenjhar, water through conduits goes to Haleji, Gharo, Port Qasim, Steel Mills and then to Dhaheji pumping station. From Dhaheji Pumping station, water is pumped to different pumping stations to supply water among all six districts of the city by using electrical pumping motors. Water from Hub Dam is supplied to Hub Pump House through Hub Canal and then supplied to NEK, Old Reservoir and different areas of the city. Karachi’s water supply infrastructure comprises of 25 bulk water reservoirs, 150 pumping stations, 8 water-filtration plants, 75 kilometers of canals, over 11,000 kilometers of pipeline, 20 sewage-pumping stations, 3 sewage treatment plants, and over 250,000 manholes. Almost 1.13 million domestic connections and 9,317 bulk customers in Karachi are provided water supply and sewerage services (Figure 4.12). In informal settlements and industries, most of the water demand is met through non-piped systems, including private water tankers. Almost 24 hydrants have been licensed to the private parties by KWSB. Out of these 24 hydrants, only 10 are operational while the rest were closed as per a recent Supreme Court Order. unregulated hydrants are rampant spread across the city. KWSB introduced amendments to discourage the illegal use of hydrants. Since 2009, it has dismantled over 948 illegal hydrants in an effort to confront the illegal use of water. Now six regulated and meter hydrants supply water to the city. Despite that, the issue of unregulated hydrants needs attention. There are two distribution channels for Karachi, mainly Northern and Southern Channels.

In an order passed on April 17, 2019, the Sindh High Court directed the managing director of the Karachi and Water Sewerage Board (KWSB) to supply water to the residents of union councils in Baldia Town as per the board’s rules. The direction came during a hearing of a petition of Baldia Town residents against the failure of the KWSB to supply water to them. The petitioners’ counsel submitted that the residents had not been supplied with water for the last three years despite clear directions of the court. He requested the court to direct the KWSB to provide water connections to the residents. The KWSB’s counsel stated that the petitioners were residents of unauthorized areas and all authorized
colonies were being supplied with water from the Hub Dam. The court directed the KWSB counsel to ensure the supply of water to the petitioners strictly under the KWSB rules and regulations. Earlier, the Supreme Court mandated judicial commission on water and sanitation on July 03, 2018 directed the KW&SB to lay pipelines in Baldia Town area to provide drinking water to the area people.

Figure 4.12: Karachi Water Resources and Bulk Water Supply System

4.1.4.5 Water demand and supply with past trends and future trends

Karachi mainly relies on River Indus for water supply due to the decreased level of water from Hub dam. Karachi receives approximately 580 MGD of water from River Indus, but requirement of the city is around 820-1200 MGD according to World Health Organization (WHO) standards. That means Karachi gets almost 50 per cent of its present requirement. Recent studies suggest that population will grow by 30 per cent from 2017 to 2030. This will translate in an increased water demand which will in turn put pressure on the already scarce water resources. Figure 4.13 shows water supply and demand gap till the year 2017.
The shortage of water in Karachi city due to rapid increase in population and industrial activities, has forced people to meet their water requirements from alternative supplies such as privately-owned groundwater sources which extract, process and sell groundwater at a very high commercial cost. However, the quality of groundwater is very poor in Karachi mainly due to the excessive pumping of groundwater by farmers, seepage of domestic wastewater in groundwater, huge amounts of chemical constituents in industrial wastewater and sea water encroachment, rendering it medically unfit for human consumption if consumed without prior treatment. A study conducted by PCRWR in 2015-2016 to assess the water quality of cities of Pakistan revealed that out of 28 samples collected from surface and groundwater of Karachi, 24 were found contaminated with E.coli. This constitutes almost 86 per cent of the total water sources of Karachi rendering it unfit for consumption. The most probable source of bacterial contamination is the sewerage discharge, which is usually flowing in pipelines parallel to that of drinking and household water and poor maintenance and breakages in pipelines lead to the mixing of water supply with the sewerage water. Also, no significant improvement in the water quality was observed from the year 2002-2015. Another study analyzed the surface and groundwater samples of Karachi and found that almost 88 percent of the samples/sources had Lead values higher than the WHO recommended guidelines. According to a world bank study conducted in 18 towns of Karachi, blood lead levels greater than WHO guideline were found in 89 per cent of the samples. Increased lead levels have been related to learning disabilities in children resulting in socioeconomic problems for future generations.

A study was carried out by the Department of Geology, University of Karachi, Pakistan\textsuperscript{6} to assess the groundwater quality for drinking purpose in Baldia Town, Karachi. For this purpose, groundwater samples (n=18) were randomly collected from various depths (> 100 feet) through boring wells after monsoon season. Data revealed that except two (BT-5, 8) which were turbid and smoky, rest of

\begin{table}
\centering
\begin{tabular}{|c|c|c|c|}
\hline
Year & Population (Million) & Demand (MGD) & Supply (MGD) & Gap (MGD) \\
\hline
1998 & 11.33 & 567 & 410 & 157 \\
2017 & 14.9 & 820 & 650 & 170 \\
\hline
\end{tabular}
\caption{Water Supply and Demand Gap till the Year 2017}
\end{table}

\textsuperscript{6} Fate of Urban Groundwater in Shallow Confined Aquifers: Case Study of Baldia Town, Karachi, Pakistan, Sustainable Development Research; Vol. 1, No. 1; 2019
the samples were colorless, non-turbid and sweet in taste. Groundwater temperature fluctuates between 19-26 °C. The pH varies between slightly acidic to slightly basic (range: 6.8-7.3) where two third of total samples have pH < 7. All the samples have very high TDS content (range: 1240-16910 mg/L; mean: 6832 mg/L) which exceeded the national drinking water quality standard (1000 mg/L) set by PCRWR. Hardness values varied in the extreme range (1000-9500 mg/L; mean: 2366 mg/L). Relative abundance of major cations follows the order of Mg > Ca > Na > K while anions varied in the order of HCO3 > SO4 > NO3 > Cl. Dissolved Fe+3 (mean: 0.01 mg/L) varies within WHO permissible limit (0.3 mg/L) while Mn showed concentration < 0.01 mg/L. Concentration of trace elements declined in the order of Ni > Zn > Cr > Co.

This study revealed that groundwater of Baldia Town is not suitable for drinking purpose due to its very high hardness (mean hardness: 2366 mg/L) and salt content (Mean TDS: 6832 mg/L), which may cause different diseases and disabilities upon long term use. It is strongly influenced by semi-arid climate and water rock interaction which is manifested by geochemical signatures. High salt content is due to the excessive amount of major salts of Mg, Ca, Na and K while the high hardness is attributed to elevated concentration of bicarbonate and sulphate ions. The hardness of water is temporary (bicarbonate) which can be removed by boiling. Trace element geochemistry revealed that limestone dissolution (Ca, Zn) and ion exchange from shales (Ni, Co, Cr) are main natural processes to alter the chemistry of groundwater in study area. Despite the occurrence of industrial hub, anthropogenic contamination is not obvious which is due to the confined nature of shallow (depth < 200 ft) aquifers in study area.

4.1.4.7 Existing Sewerage Facilities and Drainage System

The existing sewerage catchment area which covers 18 towns in Karachi city is divided into three districts, namely: respective catchment area of T.P-1, T.P-2 and T.P-3. KW&SB formulated the Master Plan of the water supply and sewerage system in cooperation with JICA in 2008. However, most of the projects for rehabilitation and augmentation proposed in the Master Plan study, etc. have not been carried out due to financial constraint of KW&SB. Due its negligence to maintain and operationalize the treatment plants, not only municipal effluent but industrial effluent also is directly going into sea destroying marine life.

In January 2018, the Supreme Court appointed Honorable Justice Amir Hani Muslim, a retired Supreme Court judge, the new head of the water commission with a mandate to ‘implement’ the recommendations of the previous commission that the apex court had formed in December 2016 in response to a constitutional petition. Treatment of sewage, a much-neglected issue, saw a revival under the commission. Thus, Sewage Treatment Plant-III (77MGD) was restored in June 2018. STP-I (100MGD) could not be completed in 2019 despite time-bound undertaking submitted to Judicial Commission (water). STP-IV
(180MGD) is supposed to be operational by December 2020. Five industrial effluent treatment plants are scheduled to be built in the SITE, Trans-Lyari, F.B, Landhi and Superhighway areas.

Figure 4.14: Existing Sewerage System of Karachi

4.1.4.8 Collection and Disposal Mechanism

The condition of sewerage system in Baldia Town is poor which is deteriorating day by day. Sewerage pipelines are broken sporadically in macroenvironment. When the drains are choked, the sewerage water comes up and spills out in the study area. As a result, roads are severely damaged (cracked or pitted) or completely eroded away. Due to poor maintenance of the internal roads, most of the paved parts are washed out and unpaved surfaces are triggering infiltration of water in large amount. It becomes more pronounced during rainy season.

Sewage is gathered through pipes and uncovered channels and drained in water bodies through rivers and nullahs. Karachi's untreated wastewater, including domestic sewage and industrial wastewater is discharged into the Lyari and Malir rivers, and finally disposed to the nearest coastal belt. Out of the 475 MGD of wastewater generated, around 420 MGD of wastewater remains untreated and a part of it is drained into the sea through the 232 km network of Main nullah
and 1000 km network of town drains. These nullahs mainly discharge into the two main rivers namely; Malir River and Lyari River.

Currently, there is a huge gap between wastewater generation and treatment. The wastewater generated in Karachi city is beyond the capacity of the existing treatment plants. Approximately 417-425 MGD of wastewater is drained into sea water without any treatment.

4.1.4.9  Greater Karachi Sewerage Plan (S-III)

To improve the sewerage system of Karachi and reduce the pollution load on natural water bodies, KWSB is working on Greater Karachi Sewerage Plan (S-III). This project, through a well-integrated system of collection, treatment and sewage of wastewater from municipal and industrial sources, aims to improve the environmental conditions of Karachi. In this project, sewage will be transmitted to the River Lyari and Malir via a RCC before finally being disposed of in the sea. Following initiatives will be taken under this project

- Malir Trunk Sewer: 05 Contract Packages with overall length of 22.74 km
- Lyari Trunk Sewer: 08 Contract Packages with overall length of 33.32 km
- Upgradation and Capacity Enhancement of Sewage Treatment Plant from 51 to 100 MGD at Haroonabad SITE
- Upgradation and Capacity Enhancement of Sewage Treatment Plant from 54 to 180 MGD at Muaripur
- Construction of New Sewage Treatment Plant at Korangi of 180 MGD

According to the planning commission of Pakistan 862 Million Rupees have been allocated to the project for the fiscal year of 2018-2019. The rehabilitation of the TPIII for 77 MGD has been done while five different packages of sewage transmission in the length of 20.151 km have substantially been completed.

4.1.5  Solid Waste Management System in Karachi

Even though Karachi is the seventh largest city in the world with a population of over 20 million, it does not have a proper hazardous & non-hazardous waste disposal system. The present state of lifting of solid waste in Karachi is also deplorable; the City has been turned into a heap of garbage. Due to unplanned growth of commercial-cum-residential buildings, the environmental situation in Karachi has become alarming.

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7 KTIP
Karachi generates ~12,000 to 14,000 tons of solid waste\(^8\), which includes domestic, industrial and hospital waste. ~9000 tons of solid is produced in the areas under DMCs, and remaining 3000 in the Cantonments, etc. Despite its needs & huge load, Karachi does not have Garbage Transfer Stations in all districts. The present situation in all commercial & industrial area is that the garbage is mostly found littered around the corners of the streets or dumped on make-shift sites even burnt openly during the day times and mostly during late hours causing huge health & safety risks for over 20 million population.

The Sindh government enacted Solid Waste Management, Act, 2014 and created a board called the Solid Waste Management Board (SSWMB) to establish “Integrated Solid Waste Management System” in all cities of the Province. The SSWMB is responsible for collection and disposal of solid waste and other wastes including municipal, industrial and medical waste in the entire Province of Sindh. The SSWMB is maintaining two dumping sites namely Surjani Town and Gond Pass, where ~40% of garbage is dumped. Due to lack of implementation of (management & monitoring) system, the remaining garbage mainly ends up in water bodies or otherwise burnt. No work on engineered landfill site has been initiated so far even though waste management issues are aggravated and causing huge damages to the environmental & social outlook of the City.

In a span of about 5-years, the Sindh Solid Waste Management Board (SSWMB) could not expand its operations to all the 29 districts of the province; even in the Karachi City, where the SSWMB is functional, its performance does not seem to be praiseworthy because it has control over only 35 per cent of the city. District Municipal Corporations (DMCs) comprise 35 per cent of Karachi, while the District Council, which deals with 15 per cent of the city, controls the rural areas.

At present, DMCs have got following resources available to manage waste:

- The staff at DMC Malir is 336. Amount incurred on their salaries is Rs.13,800,000/- Average monthly expenditure on repair and maintenance including Diesel is Rs.7,000,000/-. Garbage generated per day is 750 tons; of which 450 tons is lifted and dumped at Sharafi Goth, whereas Garbage backlog is 9000 tons per month. 27 different types of vehicles are being used for collecting solid waste.

- The staff at DMC Karachi Central is 3157. Amount incurred on their salaries is Rs.64,562,333/-. Average monthly expenditure on Diesel is Rs.14,272,244/-. Garbage generated per month is 59800 tons; but only 55536 tons is lifted and dumped on a site outside of the city. Garbage backlog is 4264 tons per month. 118 different types of vehicles are being used for collecting solid waste.

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\(^8\) some estimates put the range at 14,000 to 18,000 tonnes
The staff at DMC Korangi is 1544. Amount incurred on their salaries is Rs.36,656,764/-; Average monthly expenditure on operation & maintenance including Diesel is Rs.29,381,546/-; Garbage generated per day is 1200 tons; 800 tons is lifted and dumped on site namely Jam Chakro. Garbage backlog is 400 tons per day. 59 different types of vehicles are being used for collecting solid waste.

The staff at DMC Karachi East is 1531. Amount incurred on their salaries is Rs.42,696,863/-; Average monthly expenditure on operation & maintenance including Diesel is Rs.33,270,460/-; Garbage generated per day is 1200 tons, which is lifted and dumped on a site outside of the city. 116 different types of vehicles are being used for collecting solid waste.

The staff at DMC Karachi South is 2083 against total strength of 3372. Amount incurred on their salaries is Rs.45,842,134/-; Average monthly expenditure on operation & maintenance including Diesel is Rs.32,400,000/-. Garbage generated per day is 1150 tons; 1100 tons is lifted and dumped on a site outside of city, Garbage backlog is 50 tons per day. 124 different types of vehicles are being used for collecting solid waste.

The staff at DMC Karachi West is 1741. Amount incurred on their salaries is Rs.336,684,691/-; Average monthly expenditure on operation & maintenance including Diesel is Rs.1,266,144,157/-. Garbage generated per day is 1730 tons; 1210 tons is lifted and dumped on a site outside of the city, Garbage backlog is 520 tons per day. 88 different types of vehicles are being used for collecting solid waste.

In South DMC, SSWMB has jurisdiction over one road, while the adjacent road is under the control of military cantonment and another is covered by the Pakistan Railways. But unfortunately, there is a total lack of coordination among the departments. Afghan children collect garbage from houses and dump it at the nearest Kachra Kundi (dumping site). Before dumping the garbage, the children forage in it for precious items like glass, steel, plastic and paper.

The authorities are also responsible for cleaning storm water drains and excavate huge amounts of debris due to disposal of solid waste simply into the drains. SSWMB estimates that there has been a backlog of 1.6 million tonnes of garbage in the city that has accumulated over the years but due to limitation of technical & financial resources, the SSWMB was unable to lift all the garbage that was produced in the city.

The situation of industrial (hazardous & non-hazardous) waste management in Karachi is also unsatisfactory. For e.g. SITE Karachi consists of 2,600 Industrial units but the mechanism for disposal of waste is not in place. There are more than 65 different types of industries in the city including tanneries, foundries, metal processors, manufacturers of plastic, rubber, glass, ceramics, tiles, cement, textiles, pharmaceuticals, soaps and detergents, fish processing units, producers of fertilizers, pesticides, chemicals, and the makers of edible oils and
M/s. CITY WASTE INCINERATOR

Environmental Impact Assessment (EIA)

Hazardous Waste Incinerator

cars. Several Sepa-certified private companies also offer solid waste disposal services to industries. The Sindh Solid Waste Management Board Act, 2014 does not absolve individual industries and industry associations of the primary responsibility to manage and remove their industrial waste, but it bars them from engaging private companies for the purpose.

In the absence of a unified citywide mechanism for the removal of industrial waste, what Karachi has is a mishmash. Hundreds of thousands of rag pickers, usually boys in their early teens, unregistered contractors and small companies rummage through the trash to find anything reusable and saleable, all these together, by default, constitute the city’s industrial waste disposal mechanism. The problem with this informal arrangement is that waste collectors are often unaware of the hazards they might be exposed to. They are also only concerned about what can be reused and sold. The rest is often thrown at open garbage dumps along roads.

According to the KMC’s Municipal department, over 5,000 medical facilities are working in the City limits; this includes 20 secondary and tertiary care hospitals, but only 2% do have their own medical waste disposal system but none of them fully comply with WHO requirements. For e.g. Jinnah Post Graduate Medical Center (JPMC) has its own incinerator to burn medical waste but lacks implementation of WHO guidelines. Civil Hospital & Abbasi Shaheed hospital do not have any incineration site or proper system in place to segregate the infections and non-infectious waste.

It is fact that 85% of the total waste generated from health-care units comprises of non-hazardous waste. The 15% remains as hazardous material that may be infectious, toxic or radioactive because it includes injections, swabs, bandages, disposable medical devices, human tissue, organs or fluids, body parts, contaminated animal carcasses, syringes, needles, disposable scalpels, blades, expired, unused and contaminated drugs and vaccines among several other items. According to the World Health Organization, the average medical waste per patient on a daily basis is ~2 KG. KMC collects waste from 400 registered medical facilities @ Rs 50 per Kg which is incinerated at dumped at incineration facilities near at Mewa Shah Graveyard.
Figure 4.15: Treated and untreated wastewater discharged into a storm drain in Korangi (Source: Herald)
Figure 4.16: Tons of hazardous medical waste, syringes, blood vials washed up on the seashore on morning of September 02, 2019 (Source: Gulf News)

4.2 Description of Ecological Environment

4.2.1 Flora

The ecosystem of the macroenvironment was under forest cover of acacia and other xerophytes in the early 1920s. The tree cover was subsequently cleared for urban development & agriculture. The physical landscape was found fairly covered with grass and brushwood during the consultants’ visits of the site. The present landscape has evolved under sub-tropical and arid conditions besides extended drought. The effects of aridity that are visible in the erosional work of the Sukhan nala and Malir River have been aggravated by extensive excavation of sand and gravel from the riverbeds to the extent of getting their rock bottom exposed. The entire area is barren land with scanty vegetation.

The impoverished ecosystem resulting from the non-availability of surface as well as groundwater has irreversibly reduced the biodiversity of the indigenous as well as introduced vegetation. There are even otherwise no habitats of the plants, large and small animals, birds or reptiles within 10 km of the site.

The ecosystem of the macroenvironment includes flat, sandy, plain dominated by low shrubs and no trees. Natural vegetation is restricted to depression areas
where moisture is available for greater part of the year and longer period of time. The native vegetation is of the desert scrub type comprising a wide variety of bushes and shrubs.

**Trees:** Prosopis juliflora is the most significant widespread species distributed in all types of habitats. Among the Acacia species, Acacia nilotica is the most common species, which is distributed in low alluvial depressions, plains and foothills associated with relatively low austere moisture regime.

Trees found in the macroenvironment during the surveys include *Acacia nilotica* (babul), *Acacia senegal* (khor), *Salvadora oleoides* (khabar) and *Prosopis senegal* (kandi), *Acacia arabica* (kikar), *Tamarix gallica* (lai), *tamarix aphylla*, willow or bahan (*populus euphratica*), Neem (*azadrachta indica*) Aerva javanica, *Maerva arenaria*, *Abutilou sp*, *Amaranthus viridis*, *Cordia gharaf*, *Rhazya stricta*, karil (*capparis aphyila*), acacia or siris (*acacia lebbek*), pipal (*ficus religiosa*) & tamarind (*tamarindus indica*). Because of extensive deforestation and prolonged drought, only few of the above species are to be found in the macroenvironment and none in the microenvironment of the Project site.

**Bush:** Predominant bush species found in macroenvironment is Devi. In majority of cases, comparatively older plants have been cut to meet the fuel wood requirements in the area. Chali, Damral and Darathi (local names) are the bush species that are found in the area. No special medicinal value is associated with these bush species by the locals.

**Grass:** Wild grass is the only predominant grass species in the macroenvironment of project area. The dry topsoil due to drought conditions did not offer much chance for greenery to survive in the area.

**Crops:** Agricultural activities were minimal in the macroenvironment until recently when the vegetable growers of the area started extracting groundwater from depth exceeding 100 m. Major vegetable crops grown here include Indian corn, Pumpkin, ladyfinger, Jawar, Gowar Moong (local name), Zucchini (local name: Tori), Bitter Gourd (Local name: Karela). Cereal crops e.g. Wheat is also grown but vegetables being ready cash crop are preferred here.

4.2.2 **Fauna**

The ecosystem in the macroenvironment had diversified fauna in the not too distant past when it had extensive forest cover over it.

**Livestock:** Donkey, Dog, Cat, Goat sheep but not many horses or camels are the major livestock found in the area. Local inhabitants in the macroenvironment
maintain stocks of cows, goats and sheep that were found grazing in the area. Large wild mammals are virtually absent in the areas adjacent to Project site.

**Wildlife:** No wildlife of significance is seen in the macroenvironment. Wild Hare, Fox, and Jackal that were quite common in the area, are still to be seen but their number and frequency of visits has substantially reduced now. The most common wildlife found in the area nowadays around is the Snake. However, no rare or endangered species have been reported in the area.

**Birds:** The most common birds found in the macroenvironment are sparrows, crows, robins and doves. Characteristic bird species that have adapted to the environment and are still to be found in the area include the Indian grey partridge (*francolinus pondicertanis*), chest-nut-bellied sand grouse (*pterocles exustus*), rock dove (*Columbia livia*), Indian little button quail (*turnix sylvatica*) and Eurasian roller (*coracias garrulous*). Kites and vultures, the high-flying birds that used to abound in the Malir Valley were not spotted during the reconnaissance survey and were reported to have substantially reduced in number by the locals. Migratory birds such as ducks, geese, and waterfowl no longer visit this area.

**Wildlife Reserves**

There is no Wildlife Reserve in close proximity of project site & its macroenvironment. However, at a distance of approximately 35 kilometers northeast of the site, the Balochistan Wildlife Department has established a Wildlife Sanctuary around Hub Dam. Adjacent to and about 15 km in the farther northeast is the Khirthar National Park managed by the Sindh Wildlife Department.

Hub Dam has emerged as an important staging and wintering area for waterfowl in Pakistan. The waterfowls include grebes, pelicans, ducks, coots, waders, gulls, terns and cranes. More than 75 species of avifauna have so far been recorded at Hub Dam and its surroundings.

Cranes are usually observed during spring and autumn migration. Over 400 common cranes (*Grus grus*) were observed at the dam in March 1984 and 150 in October 1991. However, regular monitoring of the crane population during its migration passage has not been carried out by any agency. The birds are not equally distributed over the reservoir. The main concentration of birds is observed in areas adjacent to the spillway, and in the northeast and northwest extremity of the reservoir. The drought lasting over 8 years, dried up the Dam and that had reduced the bird population till recent times.
4.3 Socioeconomic Environment

Karachi is the biggest city district of Pakistan and plays a dominant role in the economy, politics and culture of Pakistan. The city is blessed with a strong industrial base, diverse ethnic populace, efficient financial institutions, cheap labor and powerful business/financial corporations. This city, compared to all other cities of Pakistan, generates maximum revenue for the Government. It has comparative advantage of being the only operational seaport of the country, which makes it the focus of all trade and business in Pakistan.

4.3.1 Administrative Division

In 2001, five districts of Karachi were merged to form the city district of Karachi. Under the devolution plan, the Local Government System was introduced in which Karachi was composed of 18 towns and 178 union councils.

Later, the City District Government of Karachi was dissolved into six (06) constituent districts, namely: Karachi East, Karachi West, Karachi Central, Karachi South, Korangi and Malir. These districts form the Karachi Division now. There are also six military cantonments, which are administered by the Pakistan Army. District Municipal Corporations, headed by Deputy Commissioners, work under Commissioner Karachi for administration. Malir Cantonment is the largest Cantonment in Pakistan, created back in 1942. Next to the Defence Housing Authority (Karachi), it has the largest number of Defence officers' housing schemes in Pakistan. An outline of existing condition of land holdings in Karachi is illustrated as follows.

![Figure 4.17: Land Holdings by Agency in Karachi (Source: KMP 2020)](image-url)
4.3.2 Land Use

The project site is in District West, Karachi. District West has emerged as the largest of Karachi’s six districts in terms of population, number of registered voters and constituencies. This District incorporates areas of Mauripur, Harbour, Baldia, SITE, Mominabad, Korangi and Manghopir sub-divisions.

Baldia Town is located in district West on the outskirts of Karachi. The area saw a large influx of Pashtun migrants first in 1965. Since then there have been several waves of migration in the area; the most significant being the recent influx of IDPs as a result of a military-led operations in the region9.

4.3.3 Demography

As per provisional census results of 2017 total population of Pakistan is 207,774,520 with an average annual growth rate of 2.40 from 1998 to 2017. In 1998, the total population of all districts that form the current Karachi district was 9,856,318 while according to the 2017 census population of Karachi city reached to 16,051,521 with an average annual growth rate of 2.60. In terms of overall %age population change District Malir observe highest, 105.79%, increase in population while lowest population increase is in the district south as 21.22%. District wise population is presented below:

![District Wise Population of Karachi](image)

9 C-37429-PAK-1
4.3.4 Households and Average Household Size in Karachi

According to the provisional results of 2017 census the Karachi division has total 2,770,074 number of Households with and average household size of 5.79 and sex ratio of 110.90. District wise details are presented below:
### Economic and Livelihood Conditions

Karachi is the largest city in Pakistan and represents almost 10% of the population of Pakistan. Its economy is about one-quarter that of the national Gross Domestic Product (GDP). Karachi produces about 30% of the manufactured goods, handles 95% of foreign trade and contributes more than 65% of the national revenue. The primary sector of Pakistani economy (agriculture) probably does not represent more than 1% of Karachi’s Gross Regional Domestic Product (GRDP). The secondary sector (manufacturing, construction, electricity, gas) constitute one quarter of the metropolitan’s economy. The tertiary sector (services) represents the remaining three-quarters of GRDP.

Karachi has seen a large increase in its labour force and labour force participation rate continues to increase. While higher than other areas of the country, it remains quite low at 30.4%. This can partly be explained by low female participation rate. Employment rate is quite high in this city. In terms of family characteristics, 85% are nuclear families while the remaining 15% live in joint families. 80% of the houses are owner occupied in the city.

District west is also one of the largest contributors to inland revenue, since it houses the city’s largest industrial site, as well as the Karachi Port, Oil Terminal,
Deepwater Container Terminal and Fish Harbour. Valeeka Textile Mill, the largest factory in the district, was inaugurated by Quaid-e-Azam Muhammad Ali Jinnah.

Baldia is one of the most impoverished areas and most residents in the area tend to live here because housing rental costs are lower than other more central parts of Karachi.

### 4.3.6 Health Facilities

The total number of public and private sector health facilities in Karachi is 989. As per Health Profile of Sindh 2016, there is one doctor for every 3,029 patients, one nurse for every 7,282 patients and one bed for every 1,291 patients in Karachi. Details of these health facilities and doctors are presented below:

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<tr>
<th>Health Facilities</th>
<th>No.</th>
<th>Beds</th>
</tr>
</thead>
<tbody>
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<td>Local Bodies Hospitals</td>
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<td>Dispensaries (Govt./Local Bodies/ Private/Missionaries)</td>
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<td>MCHC (Govt./Local Bodies/ Private/Missionaries)</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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Source: Health Profile of Sindh 2016 (BOS-Sindh)

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<tbody>
<tr>
<td>Per Nurse:</td>
<td>7,282</td>
</tr>
<tr>
<td>Per Bed:</td>
<td>1,291</td>
</tr>
</tbody>
</table>

Note: *It includes Physicians, Surgeons, Gynecologist, Pediatricians and Doctors/GMO

Source: Health Profile of Sindh 2016 (BOS-Sindh)

| Physicians     | 285 |
| Surgeons       | 271 |
| Gynecologist   | 217 |
| Pediatricians  | 222 |
| Doctors/GMO    | 5,320 |
| Dentists       | 276 |
Few healthcare facilities near the project area include: Halai Ghanchi Hospital, M.S. Murshid Hospital & SHED Medical Centre.

Health costs related to air pollution in Karachi are estimated in the range of PRs 30-40 billion every year. The presence of high concentrations of pollutants in the air of Karachi causes multiple types of respiratory diseases among its residents. Twenty-three percent of the patients admitted to the Civil Hospital were diagnosed with respiratory tract infections (IUCN 2007). Open burning of industrial solid waste and the discharge of untreated liquid waste are serious hazards in Karachi. Recent fatalities occurred due to direct exposure of people to the burning of industrial toxic solid waste. A World Bank study looking at 18 towns of Karachi city revealed blood lead concentration exceeding the WHO guideline in 89 percent of the sampled sources (World Bank 2010).  

Figure 4.19: Health Facilities Map-Karachi
4.3.7 Education

According to the recent study of RSU-Sindh Management Information System the Karachi division has total 2,915 schools including primary, middle, secondary and higher secondary schools. District Malir and District Central has highest number of schools i.e., 613 schools in each district while District East has lowest, 267 number of Schools. District wise School data and enrolment status for 2015-2016 is presented below.

<table>
<thead>
<tr>
<th>Type of School</th>
<th>Central</th>
<th>East</th>
<th>South</th>
<th>West</th>
<th>Malir</th>
<th>Korangi</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>372</td>
<td>169</td>
<td>331</td>
<td>280</td>
<td>488</td>
<td>377</td>
<td>2,017</td>
</tr>
<tr>
<td>Middle</td>
<td>100</td>
<td>30</td>
<td>75</td>
<td>42</td>
<td>75</td>
<td>57</td>
<td>379</td>
</tr>
<tr>
<td>Secondary</td>
<td>132</td>
<td>62</td>
<td>88</td>
<td>47</td>
<td>43</td>
<td>112</td>
<td>484</td>
</tr>
<tr>
<td>Higher Secondary</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>613</td>
<td>267</td>
<td>499</td>
<td>372</td>
<td>613</td>
<td>551</td>
<td>2,915</td>
</tr>
</tbody>
</table>

Source: RSU-Sindh Management Information System (SEMIS)

4.3.8 Solid Waste Management

Solid waste management of the area falls under the jurisdiction of DMC West. Garbage generated per day is 1730 tons; 1210 tons is lifted and dumped on a site outside of the city, Garbage backlog is 520 tons per day. 88 different types of vehicles are being used for collecting solid waste.
4.3.9 Traffic

Karachi district covers an area of 3,706.83 km² and is served by a well-established network of major roads. The total road length in Karachi city is approximately 10,000 km. Local roads accounted for 93%, while the highways and arterial roads for less than 5%.

The built environment of the project area includes the Karachi Northern Bypass (M-10). The Karachi Northern Bypass starts from the ICI bridge zero point of Mauripur road passing through SITE Ltd area and turns towards the RCD highway and moves northeast direction from Km 18+00 on RCD highway and terminates at Karachi – Hyderabad Motorway. The M-10/Karachi Northern Bypass is a 2-lane road of Karachi (one lane on each side). That connects the M-9 motorway to the Karachi Port, and provides an easy access to the transporters and to the commuters who can go directly to the Karachi port without entering the main arteries of city.

Figure 4.21: View of M-10 from the Project site
4.3.10 Fire Services Condition in Karachi City

If we look at the statistical figure of Karachi fire station, we find that there are only 18 fire stations in Karachi out of which only 10 Fire stations have the capacity to control massive fires, and rest of the 8 fire stations need a backup in case of a huge fire. The Firemen and their equipment are not even capable to survive in critical conditions due to lack of manpower and proper machinery. The fire tending vehicle is also not properly managed; only 2 vehicles are available in each station for fighting. Karachi is under the outbreak of un-planned slum areas. 55% of area of Karachi is under this menace because of which the fire brigade doesn’t have ideal path accessibility towards the emergency spot in majority of the cases. Traffic is quite congested in these areas which make it difficult to provide immediate aid and response in an emergency circumstance.
5. Stakeholder Consultation

Stakeholder consultation is a means of involving all primary and secondary stakeholders in the project's decision-making process in order to address their concerns, improve project design, and give the project legitimacy.

Stakeholder consultation, if conducted in a participatory and objective manner, is a means of enhancing project sustainability. It is best to initiate the stakeholder consultation process at an early stage in a project cycle. This ensures that feedback from communities and other stakeholders directly or indirectly affected by the project can be used to adjust and improve the project's design, planning, and implementation, and help structure the project to be both environmentally and socially sound.

Sindh Environmental Protection 2014 mandates stakeholder consultation as an EIA tool to take onboard all primary & secondary stakeholders in the decision-making process. The objective is to address the concerns of the stakeholders as well as ecology. Stakeholder consultation, if conducted in a participatory and objective manner has been found to enhance the sustainability of the Project.

This EIA has conducted the stakeholder consultation meetings at the earliest stage of initiation of environmental assessment process. The stakeholder consultation has ensured feedback from communities and other stakeholders directly or indirectly affected by the project.

5.1 Objectives of Stakeholders Consultation

Objectives of the public consultation process adopted for this Project are as follows:

- To inform primary as well as secondary stakeholders about the Project and project activities.
- To obtain feedback from primary and secondary stakeholders on the Project and project activities.
- To set-out the boundaries of the assessment by collecting information on relevant potential environmental & social issues of the Project & project activities, and to propose mitigation measures.

5.2 Identification of Stakeholders

Stakeholders are people, groups, or institutions that may be affected by, can significantly influence, or are important to the achievement of the stated purpose of a proposed intervention. The main stakeholders for the proposed Project include the following:
M/s. CITY WASTE INCINERATOR

- Sindh Environmental Protection Agency (SEPA)
- Utility agencies
- Academia
- NGOs
- Residents and business owners of the project area

Figure 5.1: Consultation with Professional Engineers & Experts
A variety of consultation tools were used to engage stakeholders and gather their feedback. A systematic approach was adopted, whereby stakeholders were initially contacted through official letters, followed-up through phone calls and emails and where possible, and meetings were held to solicit stakeholder concerns and recommendations. Consultation with the residents, businesses and public service institutions in the immediate vicinity of the project area was given priority to ensure they are informed regarding the project details and they have ample opportunity to share their concerns & comments.

5.3 Consultation Feedback

The comments, concerns and suggestions received from stakeholders during the consultation meetings have been collated in this section. Following are the observations of the stakeholders at the meetings arranged for consultations on the nature of the project & procedures followed for densification:

- **Incineration process releases furans and dioxin emission which are injurious to health of receptors. Measures to control emission should be taken to greater extent by adopting one of the modern technologies adequately equipped with pollution control devices for compliance of SEQS.**

- **SEPA should review SEQS and set emission limits for incineration devices on the lines of Punjab EPA. Average daily intakes due to emissions must be calculated, and from this cancer risks and number of additional cancers that would result must be derived.**

- **Emission of heavy metals should be monitored.**

- **In long term, Incineration plant can produce energy for which provision should be kept in the technology being adopted.**

- **The bottom ash produced should be recycled or landfilled and should be put to good use in engineering projects after treatment, if required.**

- **Fine particles <2.5 micron must be handled through filters and scrubbers.**

- **Plant should be located away from sensitive receptors (e.g. school and health care facilities). The proposed location seems ideal for the siting of city waste incinerator in view of its being away from local communities who always have opposed the presence of incinerating plant in the locality.**
ECC&CDD should bound the industries to utilize incineration facilities for disposal of hazardous waste. This will encourage investors and will enable them to recover their investment costs through long periods of contract.

ECC&CDD should also issue guidance for the industries to recycle, reuse and waste reduction & final disposal of hazardous waste through incineration.

Transportation of hazardous waste to incineration plant should be done through SEPA licensed waste contractors having all required certifications.

Drivers should be trained & given awareness about handling of hazardous waste and on how to deal with emergencies during accidental spillages.

All unskilled jobs should be offered to residents of the area to improve socioeconomic situation of the macroenvironment of project area.

Hospital waste must be brought to the incineration plant with specialized arrangements to avoid risk of exposure to waste handlers.

Residents were most concerned about the potential adverse health impact of dioxins, fine particles and carcinogens present in emissions.

Construction waste must be disposed of in proper manner by the proponents & fire escape route and emergency exits must be provided as per international codes and standards.

Proponent should establish a green belt along the periphery of the project site to offset the impact of carbon emissions.

The potential health effects of the development outlined in consultation with stakeholders, both positive and negative, were tabulated.

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Quantifiable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>An anxiety about environmental pollution has a negative effect on physical, mental and emotional health¹¹ ¹²</td>
</tr>
</tbody>
</table>

### Employment

Employment is associated with lower death rates, less heart disease and better mental health\(^{13}\)  

<table>
<thead>
<tr>
<th>Noise</th>
<th>Background noise may cause stress and sleep disturbance(^{14})</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

### Occupational risks

Exposure to air pollution, toxic substances and noise at work carries health risks  

<table>
<thead>
<tr>
<th>Road accidents</th>
<th>Road traffic results in deaths and injuries(^{15})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partly</td>
<td></td>
</tr>
</tbody>
</table>

### Stack emissions

Air pollution, especially fine particles, increases death rates and hospital admission rates for heart and lung conditions\(^{16}^{17}\)  

<table>
<thead>
<tr>
<th>Dioxins can damage the immune and reproductive systems(^{18})</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dioxins and metals can cause cancer and other effects(^{19})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>

### Use of landfill reduced

Living near a landfill may increase the risk of congenital abnormalities and low birth weight\(^{20}\)  

<table>
<thead>
<tr>
<th>Burning landfill gas in flares or engines causes air pollution and releases dioxins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>

---

M/s. CITY WASTE INCINERATOR

Environmental Impact Assessment (EIA)

Hazardous Waste Incinerator

Figure 5.2: Consultation with project area representatives
Figure 5.2: Consultation with project area representatives
6. Screening of Potential Environmental Impacts and Mitigation Measures

This section presents the screening process that identifies the environmental aspects and makes assessment of impact of different activities on the physical, biological and social environment. The screening process has through review of literature, screening of potential environmental and social aspects raised by the stakeholders, primary as well as secondary baseline data, and expert judgment, made assessment of the potential impacts of said activities on the physical, biological, and socioeconomic environment of the Project. Mitigation measures have been proposed to reduce, minimize or compensate for the identified potential negative impacts and their adoption has been recommended.

![Figure 6.1: Impact Assessment Approach](image)

6.1 Siting of Project

The proposed site for City waste incinerator project has been selected in view of availability of necessary infrastructure and utilities for setting-up the treatment and safe disposal of Hazardous Waste generated from various industries.

The macroenvironment of District West has the largest industrial area. These industries generate considerable amount of incinerable Hazardous Wastes & generates significant amount of waste which can be recycled / reconditioned.

In view of the above, the selected location for the proposed project has been deemed appropriate.

The Site location has the following advantages:
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Environmental Impact Assessment (EIA)
Hazardous Waste Incinerator

- Site is located in the environs of an Industrial Area.
- Easy availability of infrastructure such as water and power.
- Well connected by Road infrastructure.
- Industries can avail the benefit of proposed common waste treatment facility for disposal of their incinerable hazardous waste & recyclable material.

6.2 Assessment of Impacts at the Construction & Operation stages

The impacts of construction phase are temporary in nature and subside once the construction activities get over. Major pollutants generated from construction, erection & commissioning activities are particulate matter (PM10 and PM2.5), NOx, SO2 & CO. Generation of dust from construction activities will be main cause of increase in PM10 and PM2.5. However, no major construction activity will be required at site for the proposed project. The impacts of construction phase on various environmental attributes are tabulated below:

<table>
<thead>
<tr>
<th>Table 6.1: Construction Phase: Impact &amp; Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S. #</strong></td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>M/s. CITY WASTE INCINERATOR</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>Environmental Impact Assessment (EIA)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Ecology</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The impact on the surrounding ecology due to the project will mainly occur from the deposition of dust generated due to construction activities onto the nearby vegetation.</td>
<td></td>
</tr>
<tr>
<td>No national park, wildlife sanctuary, biosphere reserve exists within the close proximity of the project site.</td>
<td></td>
</tr>
<tr>
<td>Agriculture fields dominate the terrestrial ecology in the area.</td>
<td></td>
</tr>
<tr>
<td>Adequate measures will be taken to suppress dust generated due to construction activities.</td>
<td></td>
</tr>
<tr>
<td>The incremental emission of air pollutants during construction phase is not likely to induce any significant changes in the terrestrial ecology.</td>
<td></td>
</tr>
<tr>
<td>No cutting of trees will be done.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Socioeconomic Environment</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The project will have positive impact on the socioeconomics of the area.</td>
<td></td>
</tr>
<tr>
<td>Local labour particularly unskilled labour will be employed based on eligibility, during construction as well as post-construction phase.</td>
<td></td>
</tr>
<tr>
<td>The locals would get opportunities for employment in the project. This includes drivers and labors involved in the handling of waste.</td>
<td></td>
</tr>
<tr>
<td>The socio-economic conditions of the area are expected to improve.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Occupational &amp; Community Health</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries in construction activities.</td>
<td></td>
</tr>
<tr>
<td>Respiratory issues due to dust</td>
<td></td>
</tr>
<tr>
<td>High blood pressure etc. due to continuous working near noise generating machinery</td>
<td></td>
</tr>
<tr>
<td>PPEs such as dust masks &amp; earmuffs will be provided to workmen to reduce occupational health hazards.</td>
<td></td>
</tr>
<tr>
<td>Implementation of administrative controls into work processes, such as job rotations and rest or stretch breaks will be done.</td>
<td></td>
</tr>
<tr>
<td>Sprinkling of water for dust suppression to minimize dust from vehicle movements &amp; construction activities.</td>
<td></td>
</tr>
</tbody>
</table>
6.2.1 Impact on Land use, Topography & Drainage

This proposed project is located at survey#318, UC-8, Deh Mai Garhi, Manghopir sub-division, Baldia Town, Karachi District West. The study area is characterized by a relatively flat terrain. No additional impacts to land use will occur due to the construction or operation of proposed incinerator project. Proposed greenbelt development & plantation will improve the aesthetics of the area. No surface drainage is modified/ diverted as such no disturbance is caused to the natural drainage system. Hence, the impact on the topography and drainage of the study area is negligible.

Figure 6.1 shows the terrain of the area.
6.2.2 Impact on Soil

Potential impacts on soil quality due to proposed project activities are given below:

- Topsoil during site preparation: soil erosion.
- Construction & commissioning of the project: compaction of soil & topsoil loss.
- Fuel leakages on soil during vehicular activities: compaction of soil & soil contamination.
- Leakages due to storage and handling of fuel, solid hazardous waste- soil contamination.
The contractor shall be mandated to follow the SOPs with regard to handling, storage, transfer, use and final disposal of contaminants, if any by the proponent. Standard practices for handling of waste & no discharge of wastewater outside the plant premises will ensure no contamination of the soil and hence the impacts due to the facility on the soil quality are negligible. The impact will be confined to the core zone only.

**Mitigation Measure**

The following measures will be adopted during the construction stage to reduce the chances of soil contamination:

- Fuel oils, lubricants, and chemicals will be stored in covered dyked areas, underlain with impervious lining.
- Washing and maintenance of vehicles and equipment will only be carried out at designated areas.
- Regular inspections will be carried out to detect leakages in construction vehicles and equipment.
- Appropriate implements such as shovels, plastic bags and absorbent materials will be made available near fuel and oil storage areas for removal of oil and contaminated soil.
- Contaminated soil will be removed and properly disposed after treatment such as by incineration.
- Hazardous Substances Rules 2014 will be adhered to for storage, transfer, subsequent handling and final disposal of any chemicals/substances during the operation stage.

**6.2.3 Impact on Air Quality**

Air Pollutants emitted from the incinerator operations include: (1) particulate matter (PM), (2) metals, (3) acid gases, (4) oxides of nitrogen (NOx), (5) carbon monoxide (CO), (6) organics, and (7) various other materials present in wastes.

Particulate matter is emitted as a result of incomplete combustion of organics (i.e., soot) and by the entrainment of noncombustible ash due to the turbulent movement of combustion gases. Particulate matter may exit as a solid or an aerosol, and may contain heavy metals, acids, and/or trace organics.

Uncontrolled particulate emission rates vary widely, depending on the type of incinerator, composition of the waste, and the operating practices employed.
Entrainment of PM in the incinerator exhaust is primarily a function of the gas velocity within the combustion chamber containing the solid waste. Controlled air incinerators have the lowest turbulence and, consequently, the lowest PM emissions; rotary kiln incinerators have highly turbulent combustion, and thus have the highest PM emissions.

The type and amount of trace metals in the flue gas are directly related to the metals contained in the waste. Metal emissions are affected by the level of PM control and the flue gas temperature. Most metals (except mercury) exhibit fine-particle enrichment and are removed by maximizing small particle collection. Mercury, due to its high vapor pressure, does not show significant particle enrichment, and removal is not a function of small particle collection in gas streams at temperatures greater than 150°C (300°F).

Acid gas concentrations of hydrogen chloride (HCl) and sulfur dioxide (SO2) in MWI flue gases are directly related to the chlorine and sulfur content of the waste. Most of the chlorine, which is chemically bound within the waste in the form of polyvinyl chloride (PVC) and other chlorinated compounds, will be converted to HCl. Sulfur is also chemically bound within the materials making up medical waste and is oxidized during combustion to form SO2.

Oxides of nitrogen (NOx) represent a mixture of mainly nitric oxide (NO) and nitrogen dioxide (NO2). They are formed during combustion by: (1) oxidation of nitrogen chemically bound in the waste, and (2) reaction between molecular nitrogen and oxygen in the combustion air. The formation of NOx is dependent on the quantity of fuel-bound nitrogen compounds, flame temperature, and air/fuel ratio.

Carbon monoxide is a product of incomplete combustion. Its presence can be related to insufficient oxygen, combustion (residence) time, temperature, and turbulence (fuel/air mixing) in the combustion zone.

Failure to achieve complete combustion of organic materials evolved from the waste can result in emissions of a variety of organic compounds. The products of incomplete combustion (PICs) range from low molecular weight hydrocarbon (e.g., methane or ethane) to high molecular weight compounds (e.g., polychlorinated dibenzo-p-dioxins and dibenzofurans [CDD/CDF]). In general, combustion conditions required for control of CO (i.e., adequate oxygen, temperature, residence time, and turbulence) will also minimize emissions of most organics. Dioxin/furan formation will be minimized by ensuring that incineration only takes place at temperatures above 800°C.

The technology of treatment of hazardous waste to be adopted in proposed project is thermal destruction based on Incinerator technology involving
combustion & oxidation of waste at suitable high temperatures in primary &
secondary combustion chambers followed by Quenching for control of dioxins
followed by Air Pollution Control Equipments like Cyclone separator, Venturi
Scrubber, Packed Bed Scrubber, HEPA filter leading to ID fan and Stack. Thus, a
complete treatment system for burning of wastes including series of air
pollution control equipments for control of emissions to atmosphere to have a
complete process control. The entire system will be automated and controlled
by online measurements and monitoring system.

Ambient air concentrations are estimated using dispersion modeling, in
particular, screening-level models to estimate worst-case concentrations. This
purpose of this modeling is to estimate maximum exposures that might occur to
workers or others very close to the incinerator, and to assess the effect of stack
height on these exposures. To support the application for the project, an
assessment including an air dispersion modelling study and surrounding baseline
levels on the ambient air quality was performed. Predictions were made for
maximum ground level concentrations of the pollutants of concern. The
AERSCREEN model was used to produce the estimates of "worst-case" 1-hour,
"worst-case" 3-hour, 8-hour, 24-hour, and annual concentrations at breathing
height, directly downwind. Concentrations are a function of the source
parameters and meteorological parameters.

** STACKDATA **

<table>
<thead>
<tr>
<th></th>
<th>METRIC</th>
<th>ENGLISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emission Rate CO:</td>
<td>0.0744 g/s</td>
<td>0.590 lb/hr</td>
</tr>
<tr>
<td>Emission Rate NOx:</td>
<td>0.3666 g/s</td>
<td>2.910 lb/hr</td>
</tr>
<tr>
<td>Emission Rate SO2:</td>
<td>0.1491 g/s</td>
<td>1.183 lb/hr</td>
</tr>
<tr>
<td>Emission Rate HF:</td>
<td>0.669E-02 g/s</td>
<td>0.531E-01 lb/hr</td>
</tr>
<tr>
<td>Emission Rate HCL:</td>
<td>0.0744 g/s</td>
<td>0.591 lb/hr</td>
</tr>
<tr>
<td>Emission Rate TSP:</td>
<td>0.883E-04 g/s</td>
<td>0.701E-03 lb/hr</td>
</tr>
<tr>
<td>Stack Height:</td>
<td>6.00 meters</td>
<td>19.69 feet</td>
</tr>
<tr>
<td>Stack Diameter:</td>
<td>0.460 meters</td>
<td>18.11 inches</td>
</tr>
<tr>
<td>Stack Temperature:</td>
<td>1073.2 K</td>
<td>1472.0 Deg F</td>
</tr>
<tr>
<td>Exit Velocity:</td>
<td>18.000 m/s</td>
<td>59.06 ft/s</td>
</tr>
<tr>
<td>Stack Flow Rate:</td>
<td>6338 ACFM</td>
<td></td>
</tr>
<tr>
<td>Model Mode:</td>
<td>RURAL</td>
<td></td>
</tr>
<tr>
<td>Dist to Ambient Air:</td>
<td>1.0 meters</td>
<td>3.0 Feet</td>
</tr>
</tbody>
</table>

** TERRAIN DATA **

Input coordinates are UTM
Source Longitude: 66.94447 deg 292539. Easting
Source Latitude: 24.99471 deg 2765935. Northing
UTM Zone: 42 Reference Datum: 4 (NAD 83)
Source elevation will be determined by AERMAP

Probe distance: 5000. meters 16404. feet
** METEOROLOGY DATA **

Min/Max Temperature: 295.8 / 305.0 K  72.7 / 89.4 Deg F
Minimum Wind Speed: 3.1 m/s
Anemometer Height: 10.000 meters

Albedo: 0.21
Bowen Ratio: 1.62
Roughness Length: 1.000 (meters)

Results of Dispersion Analysis: The maximum impact on the air-shed (MGLC) from the operation of proposed incineration process will be at 22 meters directed towards 150 degrees for all pollutants meaning that the emissions are contained well-within the boundary of the project site. The annual concentrations of the modelled pollutant levels will be CO $\rightarrow 1.262 \ \mu g/m^3$ $(0.001262 \text{ mg/m}^3)$, NOx $\rightarrow 6.221 \ \mu g/m^3$, SO2 $\rightarrow 2.530 \ \mu g/m^3$, HF $\rightarrow 0.1135 \ \mu g/m^3$, HCL $\rightarrow 1.263 \ \mu g/m^3$ and TSP $\rightarrow 0.1499E-02 \ \mu g/m^3$.

The detailed analysis is shown in the following tables and graphs.
M/s. CITY WASTE INCINERATOR

Environment Impact Assessment (EIA)

Hazardous Waste Incinerator

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**AERSCREEN MAXIMUM IMPACT SUMMARY (SCENARIO 1 - CO emissions)**

<table>
<thead>
<tr>
<th>Calculation Procedure</th>
<th>Maximum Conc (ug/m³)</th>
<th>Scaled 3-Hour Conc (ug/m³)</th>
<th>Scaled 8-Hour Conc (ug/m³)</th>
<th>Scaled 24-Hour Conc (ug/m³)</th>
<th>Scaled Annual Conc (ug/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEVATED TERRAIN</td>
<td>12.62</td>
<td>12.62</td>
<td>11.36</td>
<td>7.575</td>
<td>1.262</td>
</tr>
<tr>
<td>DISTANCE FROM SOURCE</td>
<td>22.00 meters directed toward 150 degrees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECEPTOR HEIGHT</td>
<td>0.94 meters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
</tbody>
</table>

Max Impact Distance: 46.0 m - Conc: 10.68 μg/m³ - Flow Sector: 15 deg - Receptor Height: 0.99 m

Max Conc: 12.625 μg/m³ - Distance: 22.0 m - Flow Sector: 150 deg - Elevation: 0.94 m
AERSCREEN MAXIMUM IMPACT SUMMARY (SCENARIO 2 – NOx emissions)

<table>
<thead>
<tr>
<th>CALCULATION PROCEDURE</th>
<th>MAXIMUM 1-HOUR CONC (ug/m³)</th>
<th>SCALED 3-HOUR CONC (ug/m³)</th>
<th>SCALED 8-HOUR CONC (ug/m³)</th>
<th>SCALED 24-HOUR CONC (ug/m³)</th>
<th>SCALED ANNUAL CONC (ug/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEVATED TERRAIN</td>
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<td>62.21</td>
<td>55.99</td>
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</tr>
<tr>
<td>RECEPTOR HEIGHT</td>
<td>0.94 meters</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>IMPACT AT THE AMBIENT BOUNDARY</td>
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</tr>
</tbody>
</table>
**M/s. CITY WASTE INCINERATOR**

**Environmental Impact Assessment (EIA)**

**Hazardous Waste Incinerator**

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**AERSCREEN MAXIMUM IMPACT SUMMARY (SCENARIO 3 – SO₂ emissions)**

<table>
<thead>
<tr>
<th>CALCULATION PROCEDURE</th>
<th>MAXIMUM 1-HOUR CONC (μg/m³)</th>
<th>SCALED 3-HOUR CONC (μg/m³)</th>
<th>SCALED 8-HOUR CONC (μg/m³)</th>
<th>SCALED 24-HOUR CONC (μg/m³)</th>
<th>SCALED ANNUAL CONC (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEVATED TERRAIN</td>
<td>25.30</td>
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<tr>
<td>RECEPTOR HEIGHT</td>
<td>0.94 meters</td>
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<td></td>
</tr>
<tr>
<td>IMPACT AT THE AMBIENT BOUNDARY</td>
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</tbody>
</table>
AERSCREEN MAXIMUM IMPACT SUMMARY (SCENARIO 4 - HF emissions)

<table>
<thead>
<tr>
<th>Calculation Procedure</th>
<th>Maximum 1-Hour Conc (ug/m³)</th>
<th>Scaled 3-Hour Conc (ug/m³)</th>
<th>Scaled 8-Hour Conc (ug/m³)</th>
<th>Scaled 24-Hour Conc (ug/m³)</th>
<th>Scaled Annual Conc (ug/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEVATED TERRAIN</td>
<td>1.135</td>
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<tr>
<td>RECEPTOR HEIGHT</td>
<td>0.94 meters</td>
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<tr>
<td>IMPACT AT THE AMBIENT BOUNDARY</td>
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</tr>
</tbody>
</table>
M/s. CITY WASTE INCINERATOR

Environmental Impact Assessment (EIA)

Hazardous Waste Incinerator

Flow Sector Analysis - Max 1-Hour Concentration [μg/m²]

Max Conc: 12.53 μg/m² - Distance: 25.0 m - Flow Sector: 150 deg - Receptor Height: 1.07 m

Flow Sector Analysis - Impact Distance [m]

Max Impact Distance: 40.0 m - Conc: 10.66 μg/m² - Flow Sector: 10 deg - Receptor Height: -0.99 m

Max 1-Hour Concentration vs Downwind Distance

Max Conc: 12.631 μg/m² - Distance: 22.0 m - Flow Sector: 150 deg - Elevation: 0.94 m
M/s. CITY WASTE INCINERATOR

Environmental Impact Assessment (EIA)

Hazardous Waste Incinerator

<table>
<thead>
<tr>
<th>CALCULATION PROCEDURE</th>
<th>MAXIMUM 1-HOUR CONC (µg/m³)</th>
<th>SCALED 3-HOUR CONC (µg/m³)</th>
<th>SCALED 8-HOUR CONC (µg/m³)</th>
<th>SCALED 24-HOUR CONC (µg/m³)</th>
<th>SCALED ANNUAL CONC (µg/m³)</th>
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</thead>
<tbody>
<tr>
<td>ELEVATED TERRAIN</td>
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<td>12.63</td>
<td>11.37</td>
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<tr>
<td>RECEPTOR HEIGHT</td>
<td>0.94 meters</td>
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</tr>
<tr>
<td>IMPACT AT THE AMBIENT BOUNDARY</td>
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<td>0.000</td>
<td>0.000</td>
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<td>0.000</td>
</tr>
</tbody>
</table>

Flow Sector Analysis - Max 1-Hour Concentration [µg/m³]

Max Conc: 0.015 µg/m³ - Distance: 25.0 m - Flow Sector: 150 deg - Receptor Height: 1.67 m

Flow Sector Analysis - Impact Distance [m]

Max Impact Distance: 40.0 m - Conc: 0.013 µg/m³ - Flow Sector: 10 deg - Receptor Height: 0.99 m
**Hazardous Waste Incinerator**

### AERSCREEN MAXIMUM IMPACT SUMMARY (SCENARIO 6 - TSP emissions)

<table>
<thead>
<tr>
<th>CALCULATION PROCEDURE</th>
<th>MAXIMUM 1-HOUR CONC (ug/m³)</th>
<th>SCALED 3-HOUR CONC (ug/m³)</th>
<th>SCALED 8-HOUR CONC (ug/m³)</th>
<th>SCALED 24-HOUR CONC (ug/m³)</th>
<th>SCALED ANNUAL CONC (ug/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEVATED TERRAIN</td>
<td>0.1499E+01</td>
<td>0.1499E+01</td>
<td>0.1349E+01</td>
<td>0.8993E+02</td>
<td>0.1499E+02</td>
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<tr>
<td>DISTANCE FROM SOURCE</td>
<td>22.00 meters directed toward 150 degrees</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>RECEPTOR HEIGHT</td>
<td>0.94 meters</td>
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<td></td>
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</tr>
<tr>
<td>IMPACT AT THE AMBIENT BOUNDARY</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The following activities may cause impact on air quality during the operational phase:

<table>
<thead>
<tr>
<th>S. #</th>
<th>Activity</th>
<th>Impact</th>
<th>Mitigation Measures</th>
</tr>
</thead>
</table>
| 1.   | Transportation of waste to the facility from industry                    | Generation of dust and emission of HC & CO.                           | → Water sprinkling for dust suppression  
     |                                                                           |                                                                        | → Properly covered vehicles for transportation  
     |                                                                           |                                                                        | → Regular & preventive maintenance of vehicles. |
| 2.   | Temporary waste material storage, stabilization & handling, dismantling & segregation | Particulate matter emissions & odour generation                       | → Storage will be done as per Hazardous Substances Rules 2014  
     |                                                                           |                                                                        | → Standard operating will be developed & implemented  
     |                                                                           |                                                                        | → Development of green belt for dust & odour suppression |
| 3.   | Incinerator operations                                                    | Generation of CO, NOx, SO2, HF, HCl, TSP, dioxin & furan              | → Adequate Air Pollution Control System will be installed like Bag Filter, Scrubbers, Mist eliminator, rapid |
### 6.2.3.1 Air Pollution Control Devices

Air pollution control system cleans the incinerator products of combustion. The functional requirements of flue gas cleaning system are:

- **Control the acid gas emissions**
- **Control of particulate emissions**

The incineration facility will be designed to ensure the wastes are destroyed in a safe, controllable and efficient manner:

- The combustion and flue gas cleaning system always operates under safe negative pressure. This prevents the escape of combustible products to atmosphere prior to being processed through the entire Incineration process.
- Both chambers are maintained at excess air condition at sufficient temperature and residence time to ensure the complete oxidation of wastes.
- The highly efficient air cleaning system traps the particulate matters and neutralizes the acidic gases prior to their release into the atmosphere.
- System has got the inbuilt safety interlocks. If any operational parameter goes outside the pre-determined boundary limits, it will cause an automatic shutdown of portion / all of the Incineration System depending upon the particular upset parameter.

The air pollution control system includes:

- **Rapid quencher:** Rapid quenching system to prevent reformation of dioxins by rapidly lowering the flue gas temperatures, particularly from 500 °C to less than 200 °C & to cool down hot gases coming from incinerator.
- **Bag House:** Flue gases will be passed through bag filters for removal of particulates.
- **Wet alkaline scrubber** *(Venturi and Packed Bed)*: Dry lime and activated carbon are injected for neutralization of acidic gases (HCl, HF, and SO2) and removal of organic constituents. Adsorption by activated carbon to remove any dioxin & furans, mercury (if present in waste feed) in the flue gases.

- **Mist eliminator**: Often there is a need to eliminate the mist in the stack emissions, therefore, de-mister will be provided.

- **ID Fan**: to maintain the entire system in negative draft for proper removal of flue gases.

- **HEPA Filter**: The gases from the ID fan would be allowed to pass through a fine particulate filter in order to remove the very fine particulates before they are let out into the atmosphere though the chimney.

- **Stack**: Incinerator & DG Set will be provided with adequate stack height meeting for proper dispersion of cleaned gases in atmosphere.

- **Controls and monitoring**: Operation within the key parameters of the combustion process is assured by systems of monitors and computer controls. These systems make automatic adjustments to key functions as necessary. For example, if temperatures begin to drop below desired range; supplemental waste fuels are automatically injected. Conversely, if temperatures rise above the desired range, waste feeds rate is reduced.

**6.2.3.2 Dioxins & Furan control**

- To prevent reformation of dioxins, rapid lowering of the flue gas temperatures, particularly from 500°C to less than 200°C by adopting rapid quench will be done.

- To reduce the precursors essential for formation of Dioxins & Furans, complete combustion to the extent possible, will be ensured in secondary chamber by maintaining minimum temperature of about 1050 ± 50°C and a residence time of at least 2 seconds.

**6.2.3.3 Odour control**

- Suction hood to be provided in hazardous waste storage area.

- Flue gas shall be passed through wet scrubbing system involving removal of odour by absorption.
Providing mask to the employees at the site to avoid health issues due to obnoxious odor.

Development of vegetation growth to cover of the open areas of the site reduces odour. Good plantation cover forms a surface capable of absorbing and forming sinks for odourous gases. Leaves, with their large combined areas in a tree crown, sorbs pollutants on their surface, thus effectively reduce odourous compound concentrations.

Adequate green belt will be developed, and good housekeeping practices will be followed.

6.2.3.4 Fugitive emissions/effluents & management

Fugitive emissions shall be controlled by taking following steps:

- All materials in liquid shall be charged into incinerator with pumps or under gravity through closed pipes.
- All process emissions will be passed through properly designed scrubber and finally released into atmosphere through adequate stack height.
- All pumps handling hazardous chemicals shall be provided with mechanical seals to prevent fugitive emission.
- Any spillage from drums etc. will be absorbed with saw dust/soda ash and mopped clean. The contaminated absorbent will be safely disposed of along with hazardous waste.
- Storage tank will be provided with level gauge, dyke wall, automated loading and unloading for the chemicals to avoid human contact. All storage tanks will be designed and placed according to international standards.
- Measuring Instruments with sound alarm and having strategically placed sensing elements will be provided for alerting the personnel in case of any escape of gases.

6.2.3.5 Safeguards Taken in Design Stage

- All the waste handling vehicles shall be provided with spark arresters at the exhaust.
- Provision of standby arrangement for all critical equipments and pumps.
M/s. CITY WASTE INCINERATOR

- Provision of standby ID fan
- Equipment will be designed, inspected stage wise, tested and certified by an independent third party in accordance with relevant codes and standards.
- A fire hydrant system is proposed to be laid that shall cover the entire plant area.

6.2.4 Impact of off-Site Traffic on Existing Infrastructure

M/s. City Waste Incinerator has its own arrangements of vehicles for transportation of the waste. Adequate road transport facility is already available in the area which is sufficient to cater the needs of excess vehicular movement.

6.2.5 Impact on Water Resources and Quality

The daily freshwater requirement for the proposed project will be met through KWSB water supply connection already available at the site. No changes in water bodies or the land surface affecting drainage or run-off are envisaged. No disturbance is envisaged for water courses.

6.2.5.1 Wastewater Generation, Treatment and Disposal

The wastewater will be generated from:

→ Vehicle/Floor washing,
→ Scrubber,
→ Discarded container recycling; and
→ Laboratory

Effluent generation from the hazardous waste treatment & incinerator operations will be treated in effluent treatment plant. Treated water will be recycled into scrubbing process and reused for floor/vehicle washing, greenbelt & domestic (flushing) purpose. Zero discharge condition of wastewater will be maintained.

6.2.5.2 Impact on Surface Water & Ground Quality

Water contamination may occur due to:
- Discharge of untreated wastewater outside the project premises.
- Depletion of water sources due to use of surface water.
- Run-off contamination in case of any leakage from hazardous waste storage area.
However, no wastewater will be discharged outside the project premises hence impact on surface water quality will be negligible. The proposed project will properly utilize rainwater by implementing appropriate rainwater-harvesting mechanism.

**Mitigation Measures**

- Domestic wastewater will be discharged through septic tank into soak pit.
- All the hazardous waste will be stored as per guidelines in storage area with impervious flooring to control any leachate and prevent ground/surface water contamination. Drains connected to ETP will be provided around storage area, vehicle washing area.
- Periodical monitoring of Ground & surface water quality will be done.

**6.2.6 Impact on Noise Levels**

The major source of noise generating source during the operation phase of the proposed hazardous waste treatment & incinerator project are incinerator, diesel generator set, shredder, pumps and compressors, ID Fan, waste segregation & dismantling, vehicles etc.

**Mitigation Measures**

SEQS for noise level specifies the limiting value of an overall noise level for a specified area. However, OSHA standard calls for regulations of noise level around the noise emitting equipment.

- All equipments in the proposed project will be designed/operated to have a noise level not exceeding prescribed standard in line with the requirements of OSHA.
- Acoustic enclosures for considerable noise generating point sources such as DG Set will be provided for noise attenuation.
- Workers will be provided with suitable personal protective equipment (PPE) such as earmuffs and earplugs.
- Rotation of workers in the high noise area will be done.
- Green belt will be developed to reduce noise.
- Equipment will be maintained in good working order to reduce noise.
- All equipment will be operated within specified design parameters.

**6.2.7 Impacts on Socio-Economic Environment**

Small to medium scale incinerator projects are economical and environment friendly solutions for tackling the problem of Hazardous Waste.
While assessing the socio-economic and health impact of the people of surrounding villages of the project site it has been noticed that the proposed project will generate some job opportunities in the area during the construction & operation phase and also will solve the hazardous waste management problems in the macroenvironment of District West in particular.

The operation phase of the project will have positive impact in the surrounding areas. However, some side effects cannot be ignored which may arise for any developmental projects. The positive and negative impacts are highlighted in the following sections.

Positive Impact

1. Employment Opportunities for Job Seekers: The proposed project will require unskilled, semiskilled, and skilled people during its operation and construction phases which in turn would generate some direct and indirect employment which is a positive aspect of the project.

2. Improvement of the living standard area due to CSR activities: Nearby villages will get developed through Corporate Social Responsibility (CSR) activities of the company. Project proponent may provide health aid to local villages based on need and request from the respondents during the consultation process. This project will bring social change in the society with improved socio-economic life of the local people.

6.2.8 Support services

The site will not be complete until support facilities are put into place. These will include.

(i) Offices,
(ii) Sanitation facilities (toilets, bathrooms, hydrants, wastewater drains,
(iii) Health and safety provisions (fire extinguishers, hydrants, signage, exits, first Aid points etc.,
(iv) Security arrangements.

There are risks of fire outbreaks from proposed activities posing potential danger to not only the site, but also the neighboring land users. Heat is also a serious impact to the employees operating the incinerator. The general ambient heat around the entire premises is also likely to be relatively high extending the risk to more workers.
Mitigation measure

- All workers should be provided with protective gear. These include working safety boots, overalls, helmets, goggles, earmuffs, respirators/masks and gloves.

- Construction crew at the site will be sensitized on social issues such as drugs, alcohol, diseases.

- A first aid kit should be provided within the site. This should be fully equipped at all times and should be managed by qualified person.

- The contractor should have workmen’s compensation cover.

6.2.9 Disturbance to Ecology

The project site does not form special habitat so there is no threat of habitat loss also. No trees will be uprooted. Greenbelt development will provide habitat to the existing species in later stage. Greenbelt will be developed with suitable native species only which have good air quality tolerance index. This greenbelt will serve as a habitat for many local faunal species in later stage.

Facts considered during selection of plant species for greenbelt development are:

- Type of pollutant (mainly air) likely to disperse from project activities.
- Adaptability of plant species to the local environment
- Biological–filter Efficiency: Absorption of gases, Dust capturing
7. Environmental Management Plan (EMP)

7.1 Introduction

Environmental Management Plan aims at formulation, implementation and monitoring of environmental protection measures during & after commissioning of project. The plan indicates the details as to how various measures have been or are proposed to be taken including cost components as may be required.

Following elements are the major components of Environment Management Plan:

- **Commitment and policy:** The project strive to provide and implement the environment management plan that incorporates all issues related to air, land and water.

- **Planning:** This head includes identification of environmental impacts, legal requirements and setting of environmental objectives.

- **Implementation:** This comprises of resources available to the developers, accountability of contractors, training of operational staff associated with environmental control facilities and documentation of measures to be taken.

- **Measurement and evaluation:** This include monitoring, corrective actions and record keeping.

This EIA has examined both negative and positive impacts of each stage of the proposed incineration plant. The mitigation measures proposed are based on a good understanding of the sensitivity and behavior of environmental receptors, case studies, legislative controls, guidelines, & expert advice.

7.2 Structure of the EMP

The EMP consists of the following section.

- Legislation and guidelines.
- Organizational structure and roles and responsibilities.
- Mitigation management’s matrix
- Environmental monitoring programme
- Change management plan
- Training Programme
7.3 Legislation and Guidelines

The EIA has discussed in detail all the legislation and guidelines which has relevance to the project. M/s. City Waste Incinerator shall ensure that the construction and operation of project is conducted in conformance to relevant legislations and guidelines and guidance is sought as and when required. City Waste Incinerator shall also ensure that the key project management staff is aware of these legislations and guidelines. Sindh Environmental Quality Standards (SEQS) are provided in Chapter 2.

7.4 Organizational Structure and Roles and Responsibilities

7.4.1 Organizational Structure

The proposed project includes the following main organization:

- City Waste Incinerator as the project proponent and owners of the EMP.
- Contractor(s) required during the operational phase as the executors of the EMP.

These organizations will have the following roles and responsibilities during the project activities.

7.4.2 Roles and Responsibilities

**Project Proponent:** As project proponents, City Waste Incinerator will be responsible for ensuring the implementation of the EMP. HSE Manager will be responsible for the overall environmental performances during the proposed project. He/she will be responsible for ensuring the implementation of the EMP by City Waste Incinerator and all project contractors. HSE Advisor will be appointed and be made responsible for implementation of the EMP and liaison with project contractor and stakeholders at site regarding environmental issues during the construction & installation phase. Further an IMC\(^{21}\) will be taken onboard for monitoring EMP’s compliance and provide technical support.

**Project Contractors:** For the proposed project, M/s. City Waste Incinerator will appoint contractor(s) for different field and onsite operations. The contractor will be mandated to implement provisions of EMP and ensure compliance with environmental and other codes of conduct required by City Waste Incinerator. Overall responsibility of the contractor’s environmental performances will rest

\(^{21}\) Independent Monitoring Consultant
with the HSE Advisor within the contractor’s organization reporting to their management. The contractor’s staff will have functional responsibilities to ensure implementation of or adherence to the EMP.

- **Co-ordination with Stakeholders:** M/s. City Waste Incinerator will ensure that co-ordination with the regulators and other stakeholders on environmental & social matters is maintained throughout the project.

- **Monitoring:** M/s. City Waste Incinerator and the contractors will ensure that monitoring of the project activities is carried out throughout the project. IMC will monitor all project activities during the construction and operation phase to keep a record of all non-conformances observed and report these along with actions to proponent for further action.

- **Emergency Procedures:** M/s. City Waste Incinerator and the contractors will prepare contingency plans to deal with any emergency situation that may arise during the construction & operation and communicate these to the regulatory agencies if required by these agencies.

- **Approvals:** M/s. City Waste Incinerator will be responsible for obtaining all relevant approvals such as approvals from relevant agencies.

- **Trainings:** The project proponent and contractors will be responsible for providing training to their staff members according to the training programme.

### 7.5 Communication and Documentation

City Waste Incinerator and the contractor will ensure that the communication and documentation requirements specified in the EMP are fulfilled during the construction and operation phase.

**Change Management:** The EIA for the proposed operation recognizes that changes in the operation or the EMP may be required during the project activities and therefore provides a Change Management Plan to manage such changes. Overall responsibility for the preparation of change management statements will be with Proponent’s site representative.

**Restoration:** City Waste Incinerator along with the construction contractor will be responsible for the final restoration of work areas.
7.6 Maintenance of the EMP

EMP needs to be revised on timely basis to keep up to date as per the requirements comes up regularly. Therefore, outlining the responsibilities and activities associated with the maintenance of the EMP is essential. EMP revision procedures must include requirements for notification of the appropriate government and municipal agencies so that their role is also played in the overall management process.

7.7 Mitigation Management Matrix

The Mitigation Management Matrix will be used as a management & monitoring tool for implementation of the mitigation measures required by the EIA. Mitigation management matrix for construction and operation is provided in the table 7.1.

<table>
<thead>
<tr>
<th>S. #</th>
<th>Aspect</th>
<th>Mitigation Measures</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Collection and transportation of hazardous waste</td>
<td>▪ All the provisions corresponding to transportation of Hazardous Wastes under Hazardous Substances Rules 2014, will be duly complied with, in all respects. For collection and Transportation, about 10 nos. of vehicles will be provided. Type of vehicles used will be of required capacity (crane mounted containerized collection and loading vehicles /covered trucks / trucks having pneumatic loading / unloading arrangements). ▪ Experienced drivers will be employed for this purpose &amp; adequate training will be given to every driver. As a practice, a trained driver and helper will accompany the transportation vehicle to ensure compliance of HSE management system. Drivers and helpers will be trained in emergency procedures to handle emergency situations &amp; contain pollution and first aid in case of injuries. ▪ Washing of tanker/ container and disposal of effluent: each container/vehicle will be thoroughly washed prior to being sent to the industry for collection of wastes &amp; post collection &amp; unloading at site. The effluent water will be treated in the proposed effluent treatment plant. ▪ Vehicles will be painted preferably in blue color with white strip of 15 to 30 cm width running centrally all over the body. This is to facilitate easy identification.</td>
<td>Monitoring Compliance through IMC</td>
</tr>
<tr>
<td><strong>M/s. CITY WASTE INCINERATOR</strong></td>
<td><strong>Environmental Impact Assessment (EIA)</strong></td>
<td></td>
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<td>---------------------------------</td>
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</tr>
<tr>
<td><strong>Hazardous Waste Incinerator</strong></td>
<td><strong>Monitoring Compliance through IMC</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Vehicle Requirements
- Vehicle will be fitted with mechanical handling equipment as may be required for safe handling and transportation of the waste.
- The words "HAZARDOUS WASTE" will be displayed on all sides of the vehicle in Urdu & English.
- Name of the facility operator will be displayed.
- Emergency phone numbers will be displayed properly.
- Carrying of passengers is strictly prohibited and those associated with the waste haulers will be permitted only in the cabin.
- Transporter will carry inventory of the wastes during transportation as stipulated under the procedures.
- The trucks will be dedicated for transportation of hazardous wastes and they will not be used for any other purpose.
- Each vehicle will carry first-aid kit, spill control equipment and fire extinguisher.
- HW transport vehicle will run only at a controlled & safe speed to avoid any eventuality during the transportation of HW.
- The driver of the transport vehicle will have valid driving license for heavy vehicles and shall have experience in transporting the chemicals. Driver(s) will be properly trained for handling the emergency situations and safety aspects involved in the transportation of hazardous waste.
- Design of the trucks will be such that there is no spillage during transportation.

### Off-Site Transportation of Hazardous Wastes
- It will be ensured that Hazardous Wastes (incinerator ash) are packaged in a manner suitable for safe handling, storage and transport. Labelling on packaging is readily visible and material used for packaging will withstand physical conditions and climatic factors.
- Information regarding characteristics of wastes particularly in terms of being Corrosive, Reactive, Ignitable or Toxic will be provided on the label.
- Hazardous Wastes transportation will be in accordance with the provisions of Hazardous Substances Rules 2014.
- All other records in respect of the handling, transportation & disposal of hazardous waste will be maintained properly and kept available to SEPA as & when required.
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<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.</strong></td>
<td><strong>Storage Area/Shed</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ The storage area will be designed for average 30-day storage for solid as well as liquid wastes.</td>
<td>Monitoring Compliance through IMC</td>
</tr>
<tr>
<td></td>
<td>▪ Flammable, Ignitable, Reactive and Non-Compatible waste will be stored separately in the designated areas.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Storage area will be provided with flame proof fittings, automatic smoke &amp; heat detection system, adequate firefighting systems etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Loading and unloading of Hazardous Wastes in storage sheds will only be done under the supervision of the well trained and experienced staff.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Minimum of 1-meter clear space will be left between two adjacent rows of drums in pair for inspection.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ At least two routes to escape in the event of any fire in the area.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Doors and approaches of the storage area will be of suitable sizes for entry of forklift and firefighting equipment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ The storage area with concrete floor or steel sheet to prevent percolation of spills, leaks etc. and the floor will be structurally sound and chemically compatible with waste.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ The floor level will at least be 150 mm above the ground level.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Containment measures such as proper slopes as well as collection pit to collect wash water and the leakages/spills, &amp; treatment in ETP etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Provision of peripheral drainage system connected with the sump so as to collect any accidental spills on roads or within the storage yards as well as accidental flow due to firefighting.</td>
<td></td>
</tr>
<tr>
<td><strong>4.</strong></td>
<td><strong>Storage of Drums/Containers</strong></td>
<td>Monitoring Compliance through IMC</td>
</tr>
<tr>
<td></td>
<td>▪ The stacking of drums should be restricted up to three, high on pallets (wooden frames).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ For Waste having flash point less than 65.5°C, the drums will not be stacked more than one height.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ No drums will be opened in the storage sheds for sampling etc. and such activity will be done in designated places outside the storage areas.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Drums containing wastes will be labeled properly indicating mainly type, quantity, characteristics, source and date of storing etc.</td>
<td></td>
</tr>
<tr>
<td><strong>5.</strong></td>
<td><strong>Spillage/leakage Control</strong></td>
<td>Monitoring Compliance through IMC</td>
</tr>
<tr>
<td></td>
<td>▪ The storage areas will be inspected daily for detecting any signs of leaks or deterioration if any.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Leaking or deteriorated containers will be removed and ensured that such contents are transferred to a sound container.</td>
<td></td>
</tr>
</tbody>
</table>
### Record Keeping and Maintenance

- Proper records regarding the industry-wise type of waste received, characteristics as well as the location of the wastes that have been stored in the facility will be maintained.

### Air & Noise Pollution

- Vehicular emissions due to movement of construction machinery and vehicles. Water sprinkling will be done from time to time to reduce dust generation due to vehicular movements.
- Necessary acoustic enclosures, wherever feasible will be provided for all these facilities to limit the noise levels within prescribed limits.
- All materials in liquid shall be charged into incinerator with pumps or under gravity through closed pipes.
- All process emissions will be passed through properly designed scrubber and finally released into atmosphere through adequate stack height.
- All pumps handling hazardous chemicals shall be provided with mechanical seals to prevent fugitive emission.
- Any spillage from drums etc. will be absorbed with saw dust/soda ash and mopped clean. The contaminated absorbent will be safely disposed of along with hazardous waste.
- Storage tank will be provided with level gauge, dyke wall, automated loading and unloading for the chemicals to avoid human contact. All storage tanks will be designed and placed according to international standards.
- Measuring Instruments with sound alarm and having strategically placed sensing elements will be provided for alerting the personnel in case of any escape of gases.
- All equipments in the proposed project will be designed/operated to have a noise level not exceeding prescribed standard in line with the requirements of OSHA.
- Acoustic enclosures for considerable noise generating point sources such as DG Set will be provided for noise attenuation.

**Monitoring Compliance through IMC**
8. Water Pollution
- The effluent wastewater will be treated in the ETP & re-circulated for scrubbing & reused for vehicle/floor washing, greenbelt development etc. Domestic wastewater will also be treated at site.

Monitoring Compliance through IMC

9. Land Pollution
- Impervious flooring will be provided at areas wherever handling/storage of waste will be done. Effluent generated due to container/vehicle/floor washing will be collected & treated in effluent treatment plant. No effluent will be discharged outside plant premises.

Monitoring Compliance through IMC

7.8 Environmental Monitoring Programme

The objective of the environmental monitoring during the construction & operation phase will be as follows:

- To check compliance of the contractors with the EMP by monitoring activities of the project on a daily basis. This will be called compliance monitoring.
- To monitor impacts of the operation in which there has been a level of uncertainty in prediction such as impacts of air pollution & noise etc. and to recommend mitigation measures if the impacts are assessed to be in excess of or different from those assessed in the EIA. The aim will be attained through effects monitoring.
- To achieve these objectives, the following monitoring programme will be implemented.

7.8.1 Compliance Monitoring

Compliance monitoring will be carried out to ensure compliance with the requirements of the EIA and to document and report all non-compliances. The mitigation management matrix provided in the EMP will be used as a management and monitoring tool. The proponent will make regular checks on the contractor's works; keep records of all non-compliances observed during the
execution of the project activities; & the details of all remedial actions taken to mitigate the project impacts.

### 7.8.2 Effects Monitoring

The effects monitoring requirements have been detailed in Table 7.2. An independent monitoring consultant (IMC) will be responsible to carry out the required effects monitoring during the construction and operation phase.

<table>
<thead>
<tr>
<th>Table 7.2: Environmental Monitoring Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aspect</strong></td>
</tr>
</tbody>
</table>
| **Air Quality** | During Construction Phase:  
All parameters defined in SEQS for AAQ  
During Operation Phase:  
- Temperature  
- Carbon Monoxide  
- Excess oxygen  
- Pressure  
- Total Particulate Matter  
- HCl  
- HF  
- SO₂  
- NOx  
- TOC  
- Loss on Ignition (LOI)  
- Mercury  
- Heavy Metals  
- Dioxins and furans | Activity areas  
Stack | Monthly |
| **Drinking Water Quality** | Parameters defined under Drinking Water Quality Standards | Drinking water sources | Monthly |
| **Wastewater Quality** | BOD, COD, DO, TSS, TDS, pH, NOₓ, SO₄, Oil & Grease  
- Daily quantities of treated effluent disposed  
- Quantity and point of usage of treated wastewater  
- Treated wastewater quality | Discharge Points | Monthly |
| **Noise Levels** | Decibels [dB(A)Scale] | Activity areas | Monthly |
| **Soil Contamination** | pH, EC, Colour, TDS, TOC, TSS, PAH, heavy metals (such as Pb, Cd, Cu, Zn, Cr, Hg, Ni), CN, F, As and Mn. | Contaminated sites | Monthly |
| **Solid Waste Handling** | Daily quantity of waste received | Waste handling areas | Monthly |
| **Accidents** | Date and time of the accident  
Sequence of events leading to accident  
Chemical datasheet assessing effect of accident on health and environment  
Emergency measure taken  
Step to prevent recurrence of such events | Throughout the site and associated activities areas | Monthly |
7.9 Emergency Response Plan

Emergency may be defined as a sudden event causing or has the potential to cause serious human injury and/or environmental degradation of large magnitude. The best “cure” for an emergency is, of course, “prevention”. Any emergency starts as a small incident that may become a major accident if not controlled in time. At the initial stages, the fire organization chart shall need to be put into action. If the incident goes beyond control, the Main Incident Controller will need to actuate the on-site plan at the appropriate stage as considered necessary. During idle shift/ holidays, the security personnel will combat the incident as per the fire organization chart below and at the same time inform various emergency controllers for guidance and control the situation. An emergency organization chart is prepared by appointing key personnel and defining their specific duties that will be handy in emergency.

Emergency organization is set up specifying duties and responsibilities of all to make best use of all resources to avoid confusion while tackling the emergency. Figure below provided detailed information on emergency organization chart.

![Emergency Organization Chart](image)

Figure 7.1: Emergency Organization Chart

**Dangerous Situations:** These are defined as the following:

- Any fire or explosion in the facility
- Any smoke outside/inside installation
- Strong persisting smell of H2S within the facility
Emergency Response for Incinerator Plant

**Basic Actions:**

- Immediate action is the most important factor in the emergency control because the first few seconds count.
- Take immediate steps to stop fire and raise alarm simultaneously.
- Stop all operations and ensure closure of all isolation valves.
- As fires develop and spread quickly, so all out efforts should be made to contain the spread of fire.
- Plant personnel without any specific duties should assemble at the nominated place.
- All vehicles except those that are required for emergency use should be moved away from the operating area in an orderly manner at prenominated route.
- Electrical system except the lighting and firefighting system should be isolated.
- If the feed to the fire cannot be cut off, the fire must be controlled and not extinguished.
- Start water spray systems in the areas involved in or exposed to secondary fire risks.

**Actions in the Event of Fire**

- Extinguishing fires: A small fire at a point of leakage should be extinguished by enveloping with a water spray or a suitable smothering agent such as CO2 or DCP.
- Firefighting personnel working in or close to un-ignited vapour clouds or close to fire, must be protected continuously by water sprays. Fire fighters
should advance towards the fire downwind if possible- BE CAREFUL TO AVOID H2S EXPOSURE.

- In case the only valve that can be used to stop the leakage is surrounded by fire, it may be possible to close it manually. The person attempting the closure should be continuously protected by water sprays, fire entry suit, water jet blanket and SCBAs etc. The person must be equipped with a safety belt and a manned lifeline. In case of rapid increase in decibel level, evacuate the area, as there would have been over pressurization.

Post Emergency Follow Up

- All cases of fire occurrence, no matter how small, must be reported promptly to the Coordinator for follow up.
- Under no circumstances should fire extinguishing equipment once used be returned to its fixed location before it is recharged/ certified fit by the Fire chief/ Safety Manager.
- Used fire extinguishers must be laid horizontally to indicate that they have been expended.

<table>
<thead>
<tr>
<th>Important and Emergency Telephone Numbers</th>
<th>Karachi (0213)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edhi Ambulance</td>
<td>115</td>
</tr>
<tr>
<td>Civil Hospital</td>
<td>992 15960</td>
</tr>
<tr>
<td>Edhi Welfare Centre</td>
<td>241 3232</td>
</tr>
<tr>
<td>Police Emergency</td>
<td>15</td>
</tr>
<tr>
<td>Rescue Service</td>
<td>1122</td>
</tr>
</tbody>
</table>

7.10 Change Management Plan

The EIA for the proposed project recognizes that changes in the operation or the EMP may be required during the construction and operation and therefore provides a Change Management Plan to manage such changes. The management of changes is discussed under two separate headings, Additions to the EMP and Changes to the Operation and the EMP.

Changes to the EMP

The EIA and the EMP have been developed based on the best possible information available at the time of the EIA study. However, it is possible that during the conduct of the proposed operation additional mitigation measures
based on the findings of environmental monitoring during the operation may have to be included in the EMP. In such cases following actions will be taken:

- A meeting will be held between City Waste Incinerator and the concerned project contractors. During the meeting, the proposed addition to the EMP will be discussed and agreed upon by all parties.
- Based on the discussion during the meeting, a change report will be produced collectively, which will include the additional EMP clause and the reasons for the addition.
- The report will be signed by all parties and will be filled at the site office: A copy of the report will be sent to City Waste Incinerator and contractor head offices.
- All relevant project personnel will be informed of the addition.

**Changes to the Operation**

The change management system recognizes three orders of changes:

**First Order:** A first order change is one that leads to a significant departure from the project described or the impacts assessed in the EIA and consequently require a reassessment of the environmental impacts associated with the change. Example of first order change includes change in location of proposed project. Action required in this case will be that the environmental impacts of the proposed change will be reassessed by City Waste Incinerator and sent to the SEPA for approval.

**Second Order:** A second order change is one that does not result in the change in project description or impacts that are significantly different from those detailed in the EIA. Example of second order changes includes extension in the site area. Action required for such changes will be that City Waste Incinerator will reassess the impact of the activity on the environment & specify additional mitigation measures if required and report the changes to SEPA.

**Third Order:** A third order change is one that does not result in impacts above those already assessed in the EIA, rather these may be made site to minimize the impact of an activity such as:

- Increase in project workforce;
- Change in layout plan.

The only action required for such changes will be to record the change in the Change Record Register.
7.11 Training Programme

Environmental training will form part of the environmental management system. The training will be directed towards all personnel for general environmental awareness.

Objectives: The key objective of training programme is to ensure that the requirements of the EMP are clearly understood and followed throughout the project. The trainings to the staff will help in communicating environmental related restrictions specified in the EIA and EMP.

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

Training Programme: The environmental awareness, EIA and EMP training will be carried out during the project activities.

Training log: A training log will be maintained by the contractors. The training log will include:

- Topic
- Date, time and location
- Trainer
- Participants

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

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

Training Material: The contractors will develop & prepare training material regarding environmental awareness, sensitivity of the area, EIA, EMP and restrictions to be followed during the project. Separate training material will be prepared for each targeted staff.
8. Conclusion

The proposed project design has integrated mitigation measures with a view to ensuring compliance with all the applicable laws and procedures. From the foregoing, it is concluded that the proposed hazardous waste incinerator project is at appropriate location in as far as land use and interactions with human social and economic setting is concerned. There are no extensive habitations in the neighborhood, no significant sensitive environmental features are found within the vicinity and the area is not fully zoned giving an opportunity to isolate the location for this purpose in future. However, there are certain social concerns that touch on general environmental pollution, groundwater contamination, health of the workers, attraction of human settlements in future and soil contamination. For this reason, appropriate preventive measures have been included in the project design, planning, construction and operation stages.

During the project construction & operation phases, the proponent and contractor will avoid inadequate/inappropriate use of natural resources, conserve nature sensitively and guarantee a respectful and fair treatment of all people working on the project, general public at the vicinity and inhabitants of the project. In relation to the proposed project, mitigation measures that will be incorporated during construction phase, the development's input to the society and cognition that the project proponent is economically and environmentally sound, this development will be considered beneficial and important. The proposed development is a timely venture to tackle City’s Hazardous Waste Management problems through a dedicated facility.

This study recommends that the proposed project be allowed to go ahead provided the outlined mitigation measures are adhered to. Major concerns should nevertheless be focused towards minimizing the occurrence of impacts that would degrade the general environment. This will be achieved through close follow-up and implementation of the recommended Environmental Management and Monitoring plans (EMPs).
Annexures
PART-I

GOVERNMENT OF SINDH
SINDH ENVIRONMENT PROTECTION AGENCY

NOTIFICATION

NO.FPA/TECH/739/2014:- In exercise of the powers conferred under clause (g) of sub-section (1) of section 6 of the Sindh Environmental Protection Act, 2014, the Sindh Environmental Protection Agency, with the approval of the Sindh Environmental Protection Council, is pleased to establish the following standards:


   (2) These Standards shall come into force at once.

2. In these Standards, unless there is anything repugnant in the subject or context —

   (a) "Government" means the Government of Sindh;

   (b) "Standards" means the Sindh Environmental Quality Standards.

Liv-158 Ext-I-8 (23) Price Rs. 70.00
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Into Inland Waters (°C)</th>
<th>Into Sewage Treatment (°C)</th>
<th>Into Sea (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temperature 40°C or Temperature Increase *</td>
<td>≤3</td>
<td>≤3</td>
<td>≤3</td>
</tr>
<tr>
<td>2</td>
<td>pH value (H+⁴)</td>
<td>6-9</td>
<td>6-9</td>
<td>6-9</td>
</tr>
<tr>
<td>3</td>
<td>Biochemical Oxygen Demand (BOD₅) at 20°C (¹)</td>
<td>80</td>
<td>250</td>
<td>80**</td>
</tr>
<tr>
<td>4</td>
<td>Chemical Oxygen Demand (COD) (¹)</td>
<td>150</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>5</td>
<td>Total Suspended Solids (TSS)</td>
<td>200</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>6</td>
<td>Total Dissolved Solids (TDS)</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
</tr>
<tr>
<td>7</td>
<td>Oil and Grease</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Phenolic compounds (as phenol)</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>9</td>
<td>Chloride (as Cl⁻⁻)</td>
<td>1000</td>
<td>1000</td>
<td>SC***</td>
</tr>
<tr>
<td>10</td>
<td>Fluoride (as F⁻⁻)</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Cyanide (as CN⁻⁻) total</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>12</td>
<td>An-ionic detergents (as MBAS) (²)</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>13</td>
<td>Sulphate (SO₄²⁻)</td>
<td>600</td>
<td>1000</td>
<td>SC***</td>
</tr>
<tr>
<td>14</td>
<td>Sulphide (S²⁻⁻)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>15</td>
<td>Ammonia (NH₃)</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>16</td>
<td>Pesticides (³)</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>17</td>
<td>Cadmium (⁴)</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>18</td>
<td>Chromium (trivalent and hexavalent (⁴))</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>19</td>
<td>Cooper (⁴)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>20</td>
<td>Lead (⁴)</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>21</td>
<td>Mercury (⁴)</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>22</td>
<td>Selenium (⁴)</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>23</td>
<td>Nickel (⁴)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>24</td>
<td>Silver (⁴)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>25</td>
<td>Total toxic metals</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>26</td>
<td>Zinc</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>27</td>
<td>Arsenic (⁴)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>28</td>
<td>Barium (⁴)</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>29</td>
<td>Iron</td>
<td>8.0</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>30</td>
<td>Manganese</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>31</td>
<td>Boron (⁴)</td>
<td>6.0</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>32</td>
<td>Chlorine</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Explanations:

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Sindh Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.

2. Methylene Blue Active Substances: assuming surfactant as biodegradable.

3. Pesticides include herbicides, fungicides, and insecticides.

4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

5. Applicable only when and where sewage treatment is operational and BOD$_5$=80mg/l is achieved by the sewage treatment system.

6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

* The effluent should not result in temperature increase of more than $3^\circ C$ at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.

** The value for industry is 200 mg/l

*** Discharge concentration at or below sea concentration (SC).

Note: 1. Dilution of liquid effluents to bring them to the STANDARDS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.

2. The concentration of pollutants in water being used will be subtracted from the effluent for calculating the STANDARDS limits”.

“SINDH ENVIRONMENTAL QUALITY STANDARDS FOR INDUSTRIAL GASEOUS EMISSION (mg/Nm$^3$, UNLESS OTHERWISE DEFINED).”

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Source of Emission</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Smoke</td>
<td>Smoke opacity not to exceed</td>
<td>40% or 2 Ringleman Scale or equivalent smoke number</td>
</tr>
<tr>
<td>2</td>
<td>Particulate matter</td>
<td>(a) Boilers and Furnaces</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(i) Oil fired</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(ii) Coal fired</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(iii) Cement Kilns</td>
<td>300</td>
</tr>
</tbody>
</table>
(b) Grinding, crushing,
    Clinker coolers and Related processes,
    Metallurgical Processes,
    converter, blast
    furnaces and
    cupolas.

<table>
<thead>
<tr>
<th></th>
<th>Hydrogen Chloride</th>
<th>Any</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Chlorine</td>
<td>Any</td>
<td>150</td>
</tr>
<tr>
<td>5.</td>
<td>Hydrogen Fluoride</td>
<td>Any</td>
<td>150</td>
</tr>
<tr>
<td>6.</td>
<td>Hydrogen Sulphide</td>
<td>Any</td>
<td>10</td>
</tr>
</tbody>
</table>
| 7. | Sulphur Oxides   | Sulfuric acid/
                   | Sulphonic
                   | acid plants
| 8. | Carbon Monoxide  | Any | 800 |
| 9. | Lead             | Any | 50  |
| 10.| Mercury          | Any | 10  |
| 11.| Cadmium          | Any | 20  |
| 12.| Arsenic          | Any | 20  |
| 13.| Copper           | Any | 50  |
| 14.| Antimony         | Any | 20  |
| 15.| Zinc             | Any | 200 |
| 16.| Oxides of Nitrogen| Nitric acid
    Manufacturing
    unit. | 3000 |

<table>
<thead>
<tr>
<th></th>
<th>Other plants except power plants operating on oil or coal:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gas fired</td>
</tr>
<tr>
<td></td>
<td>Oil fired</td>
</tr>
<tr>
<td></td>
<td>Coal fired</td>
</tr>
</tbody>
</table>

---

**Explanations:**

1. Based on the assumption that the size of the particulate is 10 micron or more.
2. Based on 1 percent Sulphur content in fuel oil. Higher content of Sulphur will ease standards to be pro-rated.
3. In respect of emissions of Sulphur dioxide and Nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to Standards specified above, comply with the following standards:-
A. Sulphur Dioxide

Sulphur Dioxide Background levels Micro-gram per cubic meter (µg/m³) Standards.

<table>
<thead>
<tr>
<th>Background Air Quality (SO2 Basis)</th>
<th>Annual Average</th>
<th>Max. 24-hours Interval</th>
<th>Criterion I Max. SO2 Emission (Tons per Day Per Plant)</th>
<th>Criterion II Max. ground level increment to ambient (One year Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpolluted</td>
<td>&lt;50</td>
<td>&lt;200</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>Moderately Polluted*</td>
<td>50</td>
<td>200</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>Low</td>
<td>100</td>
<td>400</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>High</td>
<td>&gt;100</td>
<td>&gt;400</td>
<td>100</td>
<td>10</td>
</tr>
</tbody>
</table>

* For intermediate values between 50 and 100 µg/m³ linear interpolations should be used.
** No projects with Sulphur dioxide emissions will be recommended.

B. Nitrogen Oxide

Ambient air concentrations of Nitrogen oxides, expressed as NOx should not be exceed the following:

- Annual Arithmetic Mean: 100µg/m³ (0.05 ppm)

Emission level for stationary source discharge before missing with the atmosphere should be maintained as follows:

- For fuel fired steam generators as Nanogram (10^0-gram) per joule of heat input:
  - Liquid fossil fuel: 130
  - Solid fossil fuel: 300
  - Lignite fossil fuel: 260

Note:- Dilution of gaseous emissions to bring them to the STANDARDS limiting value is not permissible through excess air mixing blowing before emitting into the environment.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameter</th>
<th>Standards (maximum permissible limit)</th>
<th>Measuring Method</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Smoke</td>
<td>40% or on the Ringleman Scale during engine acceleration mode</td>
<td>To be compared with Ringleman Chart at a distance of 6 meters or more.</td>
<td>Immediate effect</td>
</tr>
<tr>
<td>2</td>
<td>Carbon Monoxide</td>
<td>6 %</td>
<td>Under idling conditions: Non-dispersive infrared detection through gas analyzer.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Noise</td>
<td>85 db (A)</td>
<td>Sound-meter at 7.5 meter from the source.</td>
<td></td>
</tr>
</tbody>
</table>
For new Vehicles

EMISSION STANDARDS FOR DIESEL VEHICLES

(a) For passenger Cars and Light Commercial Vehicles (g/Km)

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>Category/Class</th>
<th>Tiers</th>
<th>CO</th>
<th>HC+</th>
<th>PM</th>
<th>Measuring Method</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Passenger</td>
<td>M 1: with</td>
<td>Pak-II</td>
<td>1.0</td>
<td>0.7</td>
<td>0.08</td>
<td>NEDC</td>
<td>All imported and local</td>
</tr>
<tr>
<td>Cars.</td>
<td>reference mass</td>
<td>IDI</td>
<td></td>
<td></td>
<td></td>
<td>(ECE 15+</td>
<td>manufactured</td>
</tr>
<tr>
<td></td>
<td>(RW).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EUDCL.)</td>
<td>Diesel vehicles with effect from</td>
</tr>
<tr>
<td></td>
<td>up to 2500 kg.</td>
<td>Pak-II</td>
<td>1.0</td>
<td>0.9</td>
<td>0.10</td>
<td></td>
<td>01-07-2012</td>
</tr>
<tr>
<td></td>
<td>Cars with RW</td>
<td>IDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>over 2500 kg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>to meet NI.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Category</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>standards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>NI-I (RW&lt;1250</td>
<td>Pak-II</td>
<td>1.0</td>
<td>0.70</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>Kg)</td>
<td>IDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pak-II</td>
<td>1.0</td>
<td>0.90</td>
<td>0.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pak-II</td>
<td>1.25</td>
<td>1.0</td>
<td>0.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pak-II</td>
<td>1.25</td>
<td>1.3</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pak-II</td>
<td>1.50</td>
<td>1.2</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pak-HF</td>
<td>1.50</td>
<td>1.6</td>
<td>0.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Parameter Standards (maximum permissible limit) Measuring method**

### For Heavy Duty Diesel Engines and Large Goods Vehicles (g/Kwh)

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>Category/ Class</th>
<th>Tiers</th>
<th>CO</th>
<th>HC</th>
<th>NOx</th>
<th>PM</th>
<th>Measuring Method</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Duty and Diesel Engines</td>
<td>Pak-II</td>
<td>4.0</td>
<td>1.1</td>
<td>7.0</td>
<td>0.15</td>
<td></td>
<td>ECE-R.49</td>
<td>All Imported and local manufactured diesel vehicles with the effect 1-7-2012</td>
</tr>
<tr>
<td>Large goods Vehicles</td>
<td>N2(2000) and up</td>
<td>4.0</td>
<td>7.0</td>
<td>1.10</td>
<td>0.15</td>
<td></td>
<td>EDC</td>
<td></td>
</tr>
</tbody>
</table>

**Parameter Standards (maximum permissible limit) Measuring method**

<table>
<thead>
<tr>
<th>Noise the Source</th>
<th>85 db (A)</th>
<th>Sound-meter at 7.5 meters from the Source</th>
</tr>
</thead>
</table>

**Emission Standards for Petrol Vehicles (g/km)**

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>Category/ Class</th>
<th>Tier</th>
<th>Co</th>
<th>HC+</th>
<th>NOx</th>
<th>Measuring Method</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Cars.</td>
<td>M 1: with reference mass (RW): upto 2500 kg. Cars with RW over 2500 kg. to meet N1 Category standards</td>
<td>Pak-II</td>
<td>2.20</td>
<td>0.5</td>
<td></td>
<td>NEDC (ECE 15+) (EUDC)</td>
<td>All imported and new models * locally manufactured petrol vehicles with effect from 1st July, 2009**</td>
</tr>
<tr>
<td>Light Commercial Vehicles</td>
<td>Pak-II</td>
<td>2.20</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
<td>------</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI-I (RW&lt;1250 kg)</td>
<td>Pak-II</td>
<td>4.0</td>
<td>0.65</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI-NI-II (1250kg&gt; kg RW &lt; 1700 Kg)</td>
<td>Pak-II</td>
<td>5.0</td>
<td>0.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI-III(RW&gt; 1700 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Rickshaws &amp; Motor Cycles</td>
<td>Pak-II</td>
<td>5.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 strokes &lt; 150 cc</td>
<td></td>
<td></td>
<td>ECER 40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 strokes &gt; 150cc</td>
<td>Pak-II</td>
<td>5.5</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Parameter Standards (maximum permissible limit) Measuring method**

| Noise source | 85 db (A) | Sound-meter at 7.5 meters from the
|--------------|-----------|----------------------------------|

Explanations:
- **DI**: Direct Injection.
- **IDI**: Indirect Injection.
- **EUDCL**: Extra Urban Driving Cycle.
- **NEDC**: New European Driving Cycle.
- **ECE**: Urban Driving Cycle.
- **M**: Vehicles designed and constructed for the carriage of passenger and comprising no more than eight seats in addition to the driver's seat.
- **N**: Motor vehicles with at least four wheels designed and constructed for the carriage of goods.
- ****: New model means both model and engine type change.
- ****: The existing models of petrol driven vehicles locally manufactured will immediately switch over to Pak-II emission standards but no late than 30th June, 2012.
## Sindh Environmental Quality Standards for Ambient Air

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Time-weight average</th>
<th>Concentration in Ambient Air</th>
<th>Method of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur</td>
<td>Annual Average*</td>
<td>80 µg/m³</td>
<td>Ultraviolet Fluorescence method</td>
</tr>
<tr>
<td>Dioxide(SO₂)</td>
<td>24 hours**</td>
<td>120 µg/m³</td>
<td>Gas Phase</td>
</tr>
<tr>
<td>Oxides of Nitrogen as (NO)</td>
<td>24 hours**</td>
<td>40 µg/m³</td>
<td>Chemiluminescence</td>
</tr>
<tr>
<td>Oxides of Nitrogen as (NO₂)</td>
<td>24 hours**</td>
<td>80 µg/m³</td>
<td>Gas Phase</td>
</tr>
<tr>
<td>O³</td>
<td>1 hour</td>
<td>130 µg/m³</td>
<td>Chemiluminescence</td>
</tr>
<tr>
<td>Suspended</td>
<td>Annual Average*</td>
<td>360 µg/m³</td>
<td>Non-dispersive UV absorption method</td>
</tr>
<tr>
<td>Particulate Matters(SPM)</td>
<td>24 hours**</td>
<td>500 µg/m³</td>
<td>High Volume</td>
</tr>
<tr>
<td>Respirable</td>
<td>Annual Average*</td>
<td>120 µg/m³</td>
<td>Sampling (Average flow rate not less than 1.1 m³/minute)</td>
</tr>
<tr>
<td>Particulate Matter PM10</td>
<td>24 hours**</td>
<td>150 µg/m³</td>
<td>B-Ray absorption method</td>
</tr>
<tr>
<td>Respirable</td>
<td>Annual Average*</td>
<td>40 µg/m³***</td>
<td>B-Ray absorption method</td>
</tr>
<tr>
<td>Particulate Matter PM2.5</td>
<td>24 hours**</td>
<td>75 µg/m³</td>
<td>ASS Method after sampling using EPM 2000 or equivalent filter paper</td>
</tr>
<tr>
<td>Lead Pb</td>
<td>Annual Average*</td>
<td>1 µg/m³</td>
<td>Non-dispersive Infra Red (NDIR) method</td>
</tr>
<tr>
<td>24 hours**</td>
<td>1.5 µg/m³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon</td>
<td>8 hours**</td>
<td>5 mg/m³</td>
<td></td>
</tr>
<tr>
<td>Monoxide(CO)</td>
<td>1 hour**</td>
<td>10 mg/m³</td>
<td></td>
</tr>
</tbody>
</table>
*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly and at uniform interval.

** 24 hourly/8 hourly values should be met 98% in a year, 2% of the time. It may exceed but not on two consecutive days.

***Annual Average limit of 40µg/m³ or background annual average concentration plus allowable allowance of 9µg/m³, whichever is lower.

### Sindh Standards for Drinking Water Quality

<table>
<thead>
<tr>
<th>Properties / Parameters</th>
<th>Standard Values for Sindh</th>
<th>WHO Standards</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacterial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All water intended for drinking (e.Coli or Thermo tolerant Coliform bacteria)</td>
<td>Must not be detectable in any 100 ml sample</td>
<td>Must not be detectable in any 100 ml sample</td>
<td>Most Asian countries also follow WHO standards</td>
</tr>
<tr>
<td>Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)</td>
<td>Must not be detectable in any 100 ml sample</td>
<td>Must not be detectable in any 100 ml sample</td>
<td>Most Asian countries also follow WHO standards</td>
</tr>
<tr>
<td>Treated water in the distribution system (E.coli or thermo tolerant coliform and total coliform and total coliform bacteria)</td>
<td>Must not be detectable in any 100 ml sample</td>
<td>Must not be detectable in any 100 ml sample</td>
<td>Most Asian countries also follow WHO standards</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>≤ 15 TCU</td>
<td>≤ 15 TCU</td>
<td>Non objectionable/Acceptable</td>
</tr>
<tr>
<td>Taste</td>
<td>Non objectionable/Acceptable</td>
<td>Non objectionable/Acceptable</td>
<td>Non</td>
</tr>
<tr>
<td>Odour</td>
<td>Non</td>
<td>Non</td>
<td>Non</td>
</tr>
<tr>
<td>Properties / Performance</td>
<td>Standard Values for Pakistan</td>
<td>Who Standards</td>
<td>Remarks</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------</td>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>Antimony (Sb)</td>
<td>≤ 0.005 (P)</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>≤ 0.05 (P)</td>
<td>0.01</td>
<td>Standard for Pakistan similar to most Asian developing countries</td>
</tr>
<tr>
<td>Barium (Ba)</td>
<td>0.7</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Boron (B)</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.01</td>
<td>0.003</td>
<td>Standard for Pakistan similar to most Asian developing countries</td>
</tr>
<tr>
<td>Chloride (Cl)</td>
<td>≤ 250</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>≤ 0.05</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Toxic Inorganic</strong></td>
<td>mg/Liter</td>
<td>mg/Litre</td>
<td></td>
</tr>
<tr>
<td>Cyanide (CN)</td>
<td>≤ 0.05</td>
<td>0.07</td>
<td>Standard for Pakistan similar to Asian developing countries</td>
</tr>
<tr>
<td>Fluoride (F)*</td>
<td>≤ 1.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>≤ 0.05</td>
<td>0.01</td>
<td>Standard for Pakistan similar to most Asian developing countries</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>≤ 0.5</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>≤ 0.001</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>≤ 0.02</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Properties / Performance</td>
<td>Standard Values for Pakistan</td>
<td>Who Standards</td>
<td>Remarks</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------</td>
<td>---------------</td>
<td>---------</td>
</tr>
<tr>
<td>Nitrate (NO₃)</td>
<td>≤ 0.50</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Nitrite (NO₂⁻)</td>
<td>≤ 0.3 (P)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Selenium (SE)</td>
<td>0.01 (P)</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Residual chlorine</td>
<td>0.2-0.5 at consumer end 0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.5 at source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>5.0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Standard for Pakistan similar to most Asian developing countries</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties / Performance</th>
<th>Standard Values for Pakistan</th>
<th>Who Standards</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic</td>
<td></td>
<td>PSQCA No. 4639-2004, Page No. 4</td>
<td></td>
</tr>
<tr>
<td>Pesticides mg/L</td>
<td></td>
<td>Table No. 3 Serial No. 20-58 may be consulted ***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Annex II</td>
<td></td>
</tr>
<tr>
<td>Phenolic compounds (as Phenols) mg/L</td>
<td>≤ 0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polynuclear aromatic hydrocarbons (as PAH g/L)</td>
<td>0.01 (By GC/MS method)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties / Performance</th>
<th>Standard Values for Pakistan</th>
<th>Who Standards</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alpha Emitters bq/L or pCi</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Beta emitters</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

*** PSQCA: Pakistan Standards Quality Control Authority

**Proviso:**

The existing drinking water treatment infrastructure is not adequate to comply with WHO guidelines. The Arsenic concentrations in some parts of Sindh have been found high then Revised WHO guidelines. It will take some time to control arsenic through treatment process. Lead concentration in the proposed standards is higher than WHO Guidelines. As the piping system for supply of drinking water in urban centers are generally old and will take significant resources and time to get them replaced. In the recent past, Lead was completely phased out from petroleum
products to cut down Lead entering into environment. These steps will enable to achieve WHO guidelines for Arsenic, Lead, Cadmium and Zinc. However, for bottled water, WHO limits for Arsenic, Lead, Cadmium and Zinc will be applicable and PSQCA Standards for all the remaining parameters.

### Sindh Environmental Quality Standards for Noise

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Category of Area / Zone</th>
<th>Effective from 1st Jan, 2015</th>
<th>Effective from 1st January, 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Day Time</td>
<td>Night Time</td>
</tr>
<tr>
<td>1.</td>
<td>Residential Area (A)</td>
<td>65</td>
<td>50</td>
</tr>
<tr>
<td>2.</td>
<td>Commercial Area (B)</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>3.</td>
<td>Industrial Area (C)</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>4.</td>
<td>Silence Zone (D)</td>
<td>55</td>
<td>45</td>
</tr>
</tbody>
</table>

Note: 1. Day time hours: 6:00 a.m to 10:00 p.m
2. Night time hours: 10:00 p.m to 6:00 a.m
3. Silence zone: Zones which are declared as such by the 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 categories by the competent authority.

* dB(A) Leq: Time weighted average of the level of sound in decibels on scale relatable to human hearing.

### 3. Repeal and Savings.

(1) The provisions of the Statutory Notification dated 10th August, 2000 and 18th October, 2010, issued by the Ministry of Environment, Government of Pakistan, to the extent of the Province of Sindh are hereby repealed.

(2) All actions taken, proceedings initiated shall be deemed to have been taken and initiated validly under the the provisions of these Rules.

DIRECTOR GENERAL
SINDH ENVIRONMENTAL PROTECTION AGENCY

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