

# Initial Environmental Examination

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Project Number: 51036-002  
August 2021

## Pakistan: Khyber Pakhtunkhwa Cities Improvement Project

### Kohat Solid Waste Management Facility Development

Prepared by Project Management Unit, Local Government, Elections and Rural Development Department, Government of Khyber Pakhtunkhwa for the Asian Development Bank.

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# GOVERNMENT OF KHYBER PAKHTUNKHWA

## PROJECT MANAGEMENT UNIT

### KHYBER PAKHTUNKHWA CITIES IMPROVEMENT PROJECT LOCAL GOVERNMENT, ELECTIONS & RURAL DEVELOPMENT DEPARTMENT, PESHAWAR



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Dated: 24 August 2021

To:

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**Manila, Philippines.**

Subject: **51036-002-PAK: KHYBER PAKHTUNKHWA CITIES IMPROVEMENT PROJECT**  
**- ENDORSEMENT OF ENVIRONMENT AND SOCIAL SAFEGUARDS DOCUMENTS**

Dear Mr. Kiyoshi,

This is to confirm our endorsement of the following documents and their disclosure:

- Environmental Impact Assessment: Abbottabad Solid Waste Management Facility Development
- Environmental Impact Assessment: Mardan Solid Waste Management Facility Development
- Environmental Impact Assessment: Mingora Solid Waste Management Facility Development
- Environmental Impact Assessment: Peshawar Solid Waste Management Facility Development
- Initial Environmental Examination: Extension of JICA Water Treatment Plant and Gravity Water Supply Scheme (Abbottabad)
- Initial Environmental Examination: Construction and Improvement of Sewage Treatment System at Kohat Development Authority Township, Kohat
- Initial Environmental Examination: Construction of Roria Sewage Treatment Plant and Revamping of Sewerage System in Mardan
- Initial Environmental Examination: Kohat Solid Waste Management Facility
- Initial Environmental Examination: Improvement of Water Supply System Kohat
- Initial Environmental Examination: Salhad Park Abbottabad
- Initial Environmental Examination: Water Supply Scheme, Mingora
- Initial Environmental Examination: Improvement of Water Supply System Peshawar
- Social Due Diligence Report
- Land Acquisition and Resettlement Framework
- Land Acquisition and Resettlement Plan: Landfill Site in Abbottabad
- Land Acquisition and Resettlement Plan: Landfill Site in Kohat
- Land Acquisition and Resettlement Plan: Access Route to Landfill Site in Mingora
- Land Acquisition and Resettlement Plan: Greater Water Supply Scheme Mingora
- Land Acquisition and Resettlement Plan and Environmental Safeguard Documents: Pedestrianization of Abbottabad Old City
- Corrective Action Plan: Chuna Water Supply, Abbottabad
- Corrective Action Plan: Integrated Solid Waste Management System & Landfill Site Mingora
- Corrective Action Plan: Integrated Solid Waste Management System & Landfill Site Peshawar
- Environmental Management Plan
- Resettlement Plan
- Due Diligence Report for Use of ADB Funds for Land Acquisition and Resettlement

We are committed to their full implementation in compliance with the requirements of ADB SPS (2009) Policy, please

**(VASIF SHINWARI)**

PROJECT DIRECTOR  
PMU, KPCIP, LGE&RDD, Peshawar

Copy to:

- PS to Secretary LGE&RDD – for information

## CURRENCY EQUIVALENTS

As of 13 August 2021  
Pak Rs 1.00 = \$ 0.0065

Currency Unit – Pak Rupees (Pak Rs.)  
US\$1.00 = Pak Rs. 152

## CONVERSIONS

1 meter = 3.28 feet  
1 hectare = 2.47 acre  
1 kanal = 0.125 acre

## ACRONYMS

ADB	Asian Development Bank
ADC	Alternate Daily Cover
AD	Anaerobic Digestion
AIP	Access to Information Policy
AMSL	Above Mean Sea Level
BC	Before Construction
BOQ	Bill of Quantities
CORDEX	Coordinated Regional Downscaling Experiment
COVID19	Corona Virus Infectious Disease - 2019
CSC	Construction Supervision Consultant
DC	During Construction
DO	During Operation
DTRO	Disc Tube Reverse Osmosis
EA	Executing Agency
EDCM	Engineering Design Construction Management
EGL	Existing Ground Level
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
GER	Gross Enrollment Rate
GFI	Ground Fault Interrupter
GoP	Government of Pakistan
GRM	Grievance Redress Mechanism
HDPE	High Density Polyethylene
IA	Implementing Agency
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IWMS	Integrated Waste Management System
KDA	Kohat Development Authority
KP	Khyber Pakhtunkhwa
KPCIP	Khyber Pakhtunkhwa Cities Improvement Project
KP-EPA	Khyber Pakhtunkhwa Environmental Protection Agency
KPI	Key Performance Indicator
LAA	Land Acquisition Act (of 1984)

LARP	Land Acquisition and Resettlement Plan
Leq	Equivalent sound pressure level
LGERDD	Local Government, Elections and Rural Development Department
LHW	Lady Health Worker
LULC	Land use/Land cover
MBT	Mechanical & Biological treatment
MGD	Million Gallons per Day
MRF	Material Recovery Facility
MSF	Material Sorting Facility
MSWLF	Municipal Solid Waste Landfill
NCS	National Conservation Strategy
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NER	Net Enrollment Rate
OHS	Occupational Health and Safety
O&M	Operation & Maintenance
PAP	Project Affected Persons
PC	Public consultation
PCC	Plain Cement Concrete
PCOs	Public Call Offices
PDD	Planning & Development Department
PEPAct	Pakistan Environment Protection Act 1997
PEPC	Pakistan Environmental Protection Council
PGA	Peak Ground Acceleration
PMU	Project Management Unit
PPE	Personal Protective Equipment
RCC	Reinforced Cement Concrete
RDF	Refuse Derived Fuel
REA	Rapid Environmental Assessment
RFP	Request for Proposal
RO	Reverse Osmosis
RP	Resettlement Plan
SOPs	Standard Operating Procedures
SS	Suspended Solids
SPS	Safeguard Policy Statement
SSEMP	Site Specific Environmental Management Plan
SWMF	Solid Waste Management Facility
TPD	Tonnes per day
TMA	Tehsil Municipal Administration
TMP	Traffic Management Plan
UC	Union Council
USEPA	United States Environmental Protection Agency
WHO	World Health Organization
WSSC	Water and Sanitation Services Company
WSSCK	Water and Sanitation Services Kohat

## NOTE

In this report, “\$” refers to US dollars

## DEFINITION OF TERMS

**“Carbon Monoxide”** (also CO): A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

**“Carbon Dioxide”** (also CO<sub>2</sub>): A colorless, odorless, incombustible gas, CO<sub>2</sub>, formed during respiration, combustion, and organic decomposition and used in food refrigeration, carbonated beverages, inert atmospheres, fire extinguishers, and aerosols. Also called carbonic acid gas.

**“Ground Water”:** The supply of fresh water found beneath the Earth's surface, usually in aquifers, which supply wells and springs. Because ground water is a major source of drinking water, there is growing concern over contamination from leaching agricultural or industrial pollutants or leaking underground storage tanks.

**“Laws”:** means state and local laws and all regulations, rules, orders, decrees, decisions, instructions, requirements, policies and guidance which are issued or made by any Relevant Authority and which are legally binding, as any of them may be amended from time to time.

**“Leachate”** Contaminated water that seeps out of landfills. Often contains high amounts of organic matter and toxic chemicals.

**“Liner system”** The technical term for the layers of materials (such as clay and geosynthetics) that protect landfills from erosion, and keep trash and leachate from escaping from landfills.

**“Methane”** (also CH<sub>4</sub>): A colorless, nonpoisonous, flammable gas created by anaerobic decomposition of organic compounds. A major component of natural gas used in the home.

**“Municipal Solid Waste”** (MSW) is a waste type that includes predominantly household waste (domestic waste) with sometimes the addition of commercial wastes collected by a municipality within a given area. The term residual waste relates to waste left from household sources containing materials that have not been separated out or sent for reprocessing.

**“Operator”** means the SLF operator employed or contracted by the EA to operate, maintain and manage the facility.

**“Particulates”** (also PM<sub>10</sub>): 1. Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions. 2. Very small solids suspended in water; they can vary in size, shape, density and electrical charge and can be gathered together by coagulation and flocculation.

**“Personal Protective Equipment”** (also PPE): Clothing and equipment worn by pesticide mixers, loaders and applicators and re-entry workers, hazmat emergency responders, which is worn to reduce their exposure to potentially hazardous chemicals and other pollutants.

**“Peak Ground Acceleration”** (PGA) is a measure of earthquake acceleration on the ground and an important input parameter for earthquake engineering.

**“Recyclables”** Any materials that will be used or reused, or prepared for use or reuse, as an ingredient in an industrial process to make a product, or as an effective substitute for a commercial product. This includes, but is not limited to, paper, glass, plastic and metal.

**“Recycling”** means the process by which recovered materials are transformed into new products or feedstock for new products.

**“Residual Waste”** means all municipal solid wastes that are not processed and/or recycled.

**“Risk Assessment”:** Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants.

**“Solid Waste Management”** means any activity involving the handling, treatment and disposal of Solid Waste. Also means any supervised handling of waste materials from their source through recovery processes to final disposal.

**“Solid Waste Management System”** The entire process of storage, collection, transportation, processing, and disposal of solid wastes by any entity engaging in such process as a business, or by any state agency, city, authority, county or any combination thereof.

**“Sulfur Dioxide”** (also SO<sub>2</sub>): A pungent, colorless, gas formed primarily by the combustion of fossil fuels; becomes a pollutant when present in large amounts.

**“Waste”** means any movable articles or material for which their owner wishes to relinquish responsibility by Disposal or which must be removed from their holding place as waste to safeguard the common welfare and to protect the environment.

### **CONTENT DETAILS**

<b>S/No.</b>	<b>Version</b>	<b>Date</b>	<b>Summary of Revisions made</b>
1	1	10-05-2021	First Draft of IEE report
2	2	13-08-21	Second Draft of IEE report

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# EXECUTIVE SUMMARY

## Project Overview

1. The Khyber Pakhtunkhwa Cities Improvement Projects (KPCIP) will improve the quality of life of the residents of five KP cities, including Abbottabad, Kohat, Mardan, Mingora, and Peshawar, directly benefitting about 6 million of urban population. KPCIP will help selected cities improve their access to quality urban services through three interlinked outputs: (i) Climate resilient and gender friendly urban infrastructure improve, (ii) Institutional capacities of urban service providers and governments strengthened, and (iii) Increased women's participation in urban governance and access to economic opportunities.
2. KPCIP will support the Government of Pakistan's development priorities, established in (i) the National Water Policy (2018), (ii) the Local Government Act (2019), and (iii) Pakistan Vision 2025. The project is also aligned with ADB's operational priorities of (i) addressing remaining poverty and reducing inequalities; (ii) accelerating progress in gender equality; (iii) tracking climate change, building climate and disaster readiness; (iv) making cities more liveable; and (v) strengthening governance and institutional capacity, outlined in ADB's Strategy 2030, and is included in ADB's country operations business plan for Pakistan, 2021–2023.
3. The project readiness financing (approved in March 2019) has financed the preparation and engineering design of the KPCIP. The Department of Local Government, Elections and Rural Development Department (LGE&RDD), the Government of Khyber Pakhtunkhwa, will be the executing agency for the project and the city governments of the five target cities, including the respective Water and Sanitation Services Companies, will be the implementing agencies.
4. This report has been prepared based on detailed engineering designs, due diligence assessments, and studies conducted by the government and project readiness financing consultants. The Government of Pakistan, Asian Development Bank (ADB), and Asia Infrastructure Investment Bank (AIIB) are expected to approve KPCIP in Q3 2021.
5. The Project has the following four major components:
  - Improvement of water supply systems in five cities.
  - Development of sewage treatment plants (STPs) in two cities.
  - Provision of Integrated Solid Waste management (ISWM) system in four cities.
  - Development of Urban/Green Spaces in five cities.
6. The proposed Integrated Waste Management System (IWMS) has the following two main components:
  - **Component 1:** Improvement of existing waste collection & transport system in Kohat City
  - **Component 2:** Solid Waste Management Faciltiy Development & Operation
7. The IWMS within Kohat city is crucial for successful operation of the SWMF as it provides strategic approach to sustainable management of solid waste covering all

sources and all aspects, including generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency. The operational protocols and modalities of the IWMS have been established to improve environmentally sound practices with respect to waste management and attempting to close existing bottlenecks in the system.

8. The Component 1 is an existing activity that is proposed to be further enhanced and improved in turns of its operational efficacy through implementation of the IWMS. On the other hand, the proposed Component 2 is the environmentally sensitive intervention and thus this IEE report focuses on this component.
9. The proposed Component 2 consists of the development of a well engineered and designed solid waste management facility (SWMF) which will ensure the solid waste generated from Kohat city is managed in accordance with international good practices on solid waste management.
10. The proposed SWMF is situated on Mohammadzai Fort Road, a few kilometers outside of the Hangu Bypass Road and about 7 km away from the city centre.
11. The total area of the landfill is approximately 20 acres. The site is a barren land situated along a dry river bed located outside of the flood plain with small herbs/shrubs planted along its boundaries and some in the middle of the proposed site. The route of proposed landfill of Kohat connects to Hungu bypass through Nisar Khan Chowk.

A map of the project area is provided as **Figure ES-1**.

### **Project Need**

12. Estimating waste generation figures is difficult, based only on one waste characterization, however, with the available information it is estimated that, approximately 150 t/d waste is generated in the city and the waste generation is projected from 2020 to 2030. Any system would be designed keeping in view the next 10 years requirements when the waste generation would be around 180-220 t/d.
13. Considering the climatic conditions of Kohat City, where humidity is high and temperatures provides a conducive environment for the microbes to rapidly degrade, the organic fraction of the waste which produce smell and attract animals, thus contributing to spread of filth and disease. Furthermore, there is common practice of burning waste which poses an even greater risk to safety of neighboring households.
14. Throwing of waste into the running water body, such as stream or a canal, is a common practice and almost all water bodies flowing through the city have been turned into dumping sites. Water and Sanitation Services Kohat (WSSCK) aims to counter these practices and has deployed containers and litter bins on main roads and streets. Sanitary workers, after sweeping the streets, collect waste in wheelbarrows to their designated waste storage points in the area, usually containers.
15. Proposed installation of primary and secondary Municipal Solid Waste (MSW) collection systems and the development of an international standard MSW management facility have been designed to address SWM issues of Kohat city.

### **Study Methodology**

16. Both secondary and primary data on ambient noise levels and air quality, water resources, flora, fauna and information from the detailed design conducted for this and

other projects of similar nature were collected, reviewed, and analyzed. Extensive field visits to the project area were undertaken and key receptors and stakeholders within the project area were identified and consulted.

17. Detailed ambient air quality and noise monitoring at different key receptor points in the project area were conducted. Apart from exceedances in PM<sub>10</sub> at four locations, all other pollutants are within the applicable 'most stringent' standards/guidelines. The ambient noise levels were also assessed to be generally within the applicable standards/guidelines during the daytime as well as during the nighttime. Furthermore, the ground water quality was also assessed to be within the applicable NEQS limits.
18. The significance of impacts from the proposed project were then assessed and for those impacts requiring mitigation, suitable measures were proposed to reduce impacts to within acceptable limits as per local and international applicable regulations. A detailed environmental management and monitoring plan was developed to ensure compliance to the proposed measures during the project development.

### **Public Consultation Process**

19. A total of five comprehensive focus group discussions with stakeholders were organized with a total of over 40 different stakeholders. The first round of public consultations was conducted in the month of May, 2020, while the second round of public consultation was completed in the month of June, 2020. Information on positive and negative impacts associated with constructional and operational stage and proper mitigation of adverse impacts were shared at these consultations.

### **Analysis of Alternatives**

20. If 'no project' option is used, it will result in loss of all positive impacts caused that project would pose on Kohat city; such as eradicating open dumping of solid waste, improving civic services in terms of integrated waste management, removing existing bottlenecks in the system and improving the aesthetic aspects of the city. If the project is not implemented, urban environmental quality will be further degraded. It also limits the urban development of the area in a sustainable manner.
21. On the other hand, if the project is implemented, it will result in improved SWM system services and improved urban environment quality. Furthermore, project implementation will also create job opportunities during construction, thereby improving the socioeconomic condition of the local people and help in improving their quality of life. Thus, the 'no project' option is not a viable option.
22. The three different sites considered were as follows:
  - **Mohammadzai Fort Rd:** located North West of the city, 7 km from the city center.
  - **Kohat Bypass/N-55 Link Rd:** area located East of the city, 8km from the city center.
  - **Kamardhand:** area located South West of the city, 8-9 km from the city center.
23. The proposed site was selected since it fulfilled the detailed site selection criteria that was developed, and Section-4 is already imposed on the proposed land. The social

acceptability of the project is enhanced by educating the nearby population on the merits of a sanitary landfill and the robustness of the resettlement plan.

24. Different types of landfills were also considered such as Sanitary landfill, Bioreactor landfill and Secured landfill. Based on the comparison conducted, the project design consultant suggested to construct a sanitary landfill for Kohat as it is relatively low in cost and requires less technical and operational maintenance as compared to other options.
25. Different landfill construction alternatives were also considered such as Lining, Leachate collection and treatment and Gas collection and treatment with flaring proposed for landfill gas management. The selection among these alternatives has taken into account not just the monetary cost incurred to apply the plan but also the environmental impact associated with it. In case using the gas for energy is feasible, even the more expensive management plan can produce financial paybacks.
26. For Kohat, flaring has been proposed for landfill gas management. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed.
27. Other types of alternatives that were considered were technological alternatives for Anaerobic Digestion System, technological alternatives for Material Recovery Facility, Waste Disposal Alternatives along with a comparison of possible treatment options as well as an Economic Aspect Analysis of the different types of landfilling technologies.

## Baseline Conditions

28. **Physical Environment:** Topography of proposed SWMF consists of plains. The site has silty soils strata with no rock formation, and mainly comprises of unconsolidated surficial deposits of silts, sands and gravel. Project area is falling in Zone 2B with moderate seismicity risk. Ground water is found at depth of about 36 feet and lab analysis shows that water quality is within NEQS. Ambient noise levels being within the most stringent guidelines during the daytime as well as during the nighttime. Air shed seems to be of good quality with the ambient air quality within the acceptable NEQS standards with PM<sub>10</sub> being the only pollutant that is exceeding the guidelines at every monitored location. Major Land use of the project area is barren land.
29. **Biological Environment:** Project is falling outside environmental sensitive areas (Wildlife Park, Wildlife sanctuary, Game Reserve or Protected/Reserved Forests) and critical habitats. The present flora of the irrigated areas is exotic. *Acacia modesta*, *Acacia nilotica*, *Ziziphus nummularia*, *Salvadora oleoides*, *Saccharum grifithii*, *Desmostachya bipinnata*, *Dodonaea viscosa*, *Calotropis procera*, *Withania coagulans* and *Rhazia stricta* with small patches of *Capparis decidua* and *Maytenus royleanus* were observed during the study. No endangered species are available present in the project area. Red Fox, Asiatic jackal, Indian Crested Porcupine, Wild Boar, five striped Palm Squirrel, Little Indian Field Mouse and Small Indian Mongoose are important mammals of the area with IUCN least concern status. The commonly found avifauna of the project area are Black Drongo, Black Kite, Crow (*Corvus splendens*), House sparrow, White breasted Kingfisher, Red-vented Bulbul and Little Brown Dove etc.
30. **Social Environment:** The project area falls in the jurisdiction of Union Council (UC) Muhammad Zai, Kohat in Khyber Pakhtunkhwa Province, under the latest revision of Pakistan's administrative structure, promulgated in 2001. The district divided into two tehsils Kohat and Lachi with headquarters at Kohat. The city's annual growth rate is

estimated at 3.03 % per year, and the population of Kohat district is 993,874 according to the 2017 census.

31. The names of the major settlements falling in the project area are Muhammad Zai, Oblan Camp and Laal Maila. Most of the people are farmers in the nearby villages. They are engaged in agriculture either directly or indirectly. The literacy rate for population 10 years and above (2010-2011) was 59% in 2013.

## Potential Major Impacts

32. The screening matrices for the pre-construction, construction and operation phases of the SWMF are provided below as **Tables ES.1, ES.2 and ES.3**.
33. **Pre-construction/design phase:** The key potential impacts that have been assessed and for which necessary mitigation measures have also been proposed as follows:
- Improper designing of landfill site leading to various impacts.
  - Improper selection of landfill site due to non-compliance with IFC guidelines
34. **Construction phase:** The key potential impacts that have been assessed and for which necessary mitigation measures have also been proposed, as required, are as follows:
- Improper Construction of landfill not in accordance with finalized design
  - Community health and safety issues
  - Occupational health and safety issues
  - Improper handling and/or disposal of hazardous and non-hazardous waste
35. **Operation phase:** The key potential impacts that have been assessed and for which necessary mitigation measures have also been proposed as follows:
- Generation of Leachate
  - Possible Contamination of Soil and Groundwater
  - Generation of Landfill Gas
  - Generation of Objectionable Odor and impact on air quality
  - Attraction of Vermin and disease vector generation
  - Occupational Health and Safety
  - Waste Collection and Hauling Impacts
  - Wind blown litter
  - Closure and Post Closure impacts

## Mitigation Measures

36. Mitigation measures associated with pre-construction, design, operation, closure and post closure phases are detailed in the IEE report. Necessary design considerations have been included for leachate collection and treatment, landfill gas management, odor and vector controls. Mitigations associated with construction phase are detailed in the IEE report to avoid soil and ground/surface water contamination, OHS issues, social conflicts, vegetation loss and communicable diseases.
37. Mitigations for operation phase are provided to ensure that leachate and landfill gas is managed properly, there would be limited waste hauling impacts, traffic issues, wind blown litter, vector spread and air quality issues. Daily cover will be applied to avoid odour and litter issues. Buffer zone through necessary plantation will be developed to improve aesthetic appeal of the area. Project will result in improved waste management services, improved public health and improved aesthetic appeal of the area.

### **Climate Change Exposure of Landfill Site**

38. This includes identification of climate change hazards in the context of potential climate scenarios. For example, precipitation changes can degrade covers of landfill. Moreover, a number of anthropogenic stressors, socio-economic and land-use changes near and around the landfill site in the future may complicate and exacerbate the above-mentioned climate change events and increase exposure of the site. Temperature changes can impact the composting process and also can impact the decomposition process responsible for leachate production. For example, land-development can affect natural protective barriers.

### **Climate Change Sensitivity of Landfill Site**

39. Likelihood of climate change related hazards are included in sensitivity assessment that could negatively affect the functioning of the landfill site including direct impacts (accessibility, physical damage, water damage) and indirect impacts (accidental fire, explosion or ecosystem damage). These direct and indirect impacts can affect the landfill site in terms of damage to liner or cover materials, washout of contaminated contents, leachate collection and removal, landfill gas management etc.

### **Cumulative Impacts**

40. No other infrastructure works are planned to be conducted in the landfill project area while these project works shall be conducted. Thus, no cumulative impacts are expected.

### **Indirect and Induced Impacts**

41. Potential impacts arising from each phase of the proposed Kohat SWM facility have been identified and assessed based on field data, secondary data, expert opinion and examining previous similar projects in Pakistan. These include effects on physical, biological and socio-economic environment. Impacts on the environment from air emissions, traffic and community noise have also been assessed and have found to be acceptable and within the carrying capacities of the environmental media.
42. Thus, negative indirect and induced impacts from the proposed landfill works are not expected.

### **Institutional Arrangements**

43. During the construction phase, the overall responsibility for the implementation and monitoring of the EMP rests with the Project Director (PD), Project Management Unit (PMU), KP Local Government Election and Rural Development Department (LGERDD). The PD through assistance from the Supervision Consultant's Environmental staff and the Environment team of PMU will supervise the implementation of the proposed mitigation measures and monitor the implementation progress in the field. Monthly environmental monitoring data/reports will be incorporated in the project implementation progress reports to be shared with ADB and such monthly reports will be consolidated into bi-annual monitoring reports and submitted to ADB for review and clearance. Upon clearance, all such reports will be uploaded on the PMU and ADB websites.

### **Conclusion & Recommendations**

44. An action plan with clear roles and responsibilities of stakeholders has been provided in the report. The PMU, Contractors and the Construction Supervision Consultant (CSC) are the major stakeholders responsible for the action plan. The action plan must be implemented prior to commencement of construction work. In order to execute successful operation of SWMF facility, institutional review and capacity building (IRCB) component is included in the project design to enhance services delivery of WSSCK.
45. Mitigation measures will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures in the EMP are implemented and to determine whether the environment is protected as intended. This will include observations on and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported.
46. The majority of the environmental impacts are associated with the operation phase of the project since these will be long term, such as generation of objectionable odor and impact on air quality, attraction of vermin and disease vector generation, Leachate generation, Possible contamination of soil and groundwater, Generation of Landfill Gas etc., to name a few. These shall be mitigated through necessary measures.
47. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures. Based on the findings of this IEE study, the classification of the Project as Category 'B' is confirmed. It is concluded that the proposed project should proceed, with appropriate mitigation measures and monitoring programs identified in the IEE study.

**Table ES-1: Screening of possible Impacts during Design/Pre-Construction phase**

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short Term, Long Term)
1	Improper designing of landfill site leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.)	Likely	Moderate	Medium	Long Term
2	Improper selection of landfill site due to non-compliance with IFC guidelines for Landfills	Likely	Moderate	Medium	Long Term
3	Lack of integration of IEE/EMP requirements into Construction bid documents	Likely	Moderate	Medium	Short Term
4	Material Hauling impacts	Likely	Moderate	Medium	Short Term
5	Contractor's environmental safeguards capacity	Likely	Moderate	Medium	Short Term
6	Improper location of worker camps leading to improper disposal of solid waste and sewage and privacy issues for residents in project area.	Likely	Moderate	Medium	Short Term
7	Land acquisition and resettlement impacts	Likely	Moderate	Medium	Short Term
8	Cultural heritage & Religious sites, Social Infrastructure	Unlikely	Moderate	Low	No residual Impact
9	Impacts due to natural hazards	Unlikely	Moderate	Low	No residual Impact

[Red Box] Critical Risk Level

[Yellow Box] Significant Risk Level

[Orange Box] Medium Risk Level

[Blue Box] Low Risk Level

**Table ES-2: Screening of Possible Impacts during Construction Phase**

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short Term, Long Term)
1	Construction of landfill not in accordance with finalized design	Likely	Major	Medium	Long Term
2	Degradation of air quality due to construction works	Likely	Moderate	Medium	Short Term
3	Potential accidents and injuries to communities in project area during construction works	Likely	Moderate	Medium	Short Term
4	Injuries to workers from lack of necessary training and/or not using PPEs etc.	Likely	Moderate	Medium	Short Term
5	High noise levels from construction activities	Likely	Moderate	Medium	Short Term
6	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Moderate	Medium	Short Term
7	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium	Short Term
8	Soil Erosion and Sedimentation	Likely	Moderate	Medium	Short Term
9	Soil Contamination	Likely	Moderate	Medium	Short Term
10	Employment Conflicts	Likely	Moderate	Medium	Short Term
11	Communicable diseases incl. COVID-19	Likely	Moderate	Medium	Short Term
12	Vegetation and Wildlife Loss	Unlikely	Moderate	Low	No residual Impact
13	Historical/Archaeological Sites	Unlikely	Moderate	Low	No residual Impact
14	Construction of Administration Building and Other Infrastructure	Likely	Moderate	Medium	Short Term
15	Construction/Widening of Access Road	Likely	Moderate	Medium	Short Term
16	Sexual Abuse, Exploitation and Harrassment (SEAH)	Unlikely	Moderate	Low	No residual Impact

■ Critical Risk Level

■ Significant Risk Level

■ Medium Risk Level

■ Low Risk Level

**Table ES-3: Screening of Possible Impacts during Operation Phase**

S/No.	Potential Issues	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short Term, Long Term)
1	Generation of Leachate	Likely	Major	Medium	Long Term
2	Possible Contamination of Soil and Groundwater	Likely	Major	Significant	Long Term
3	Generation of Landfill Gas	Likely	Major	Medium	Long Term
4	Generation of objectionable Odor and impact on air quality	Likely	Major	Medium	Long Term
5	Attraction of Vermin and disease vector generation	Likely	Major	Medium	Long Term
6	Occupational Health and Safety	Likely	Major	Medium	Long Term
7	Waste Collection and Hauling Impacts	Likely	Major	Medium	Long Term
8	Wind Blown Litter	Likely	Major	Medium	Long Term
9	Impacts on Scavengers and Waste Pickers	Likely	Major	Medium	Long Term
10	Inefficient management and disposal of septage from administration building toilets	Unlikely	Moderate	Low	Short Term
11	Improved management of solid waste & health and sanitation	Positive impacts expected			Long Term Positive Impact
12	Improvements in Public Health	Positive impacts expected			Long Term Positive Impact
13	Improvements in Aesthetic Impacts	Positive impacts expected			Long Term Positive Impact

■ Critical Risk Level

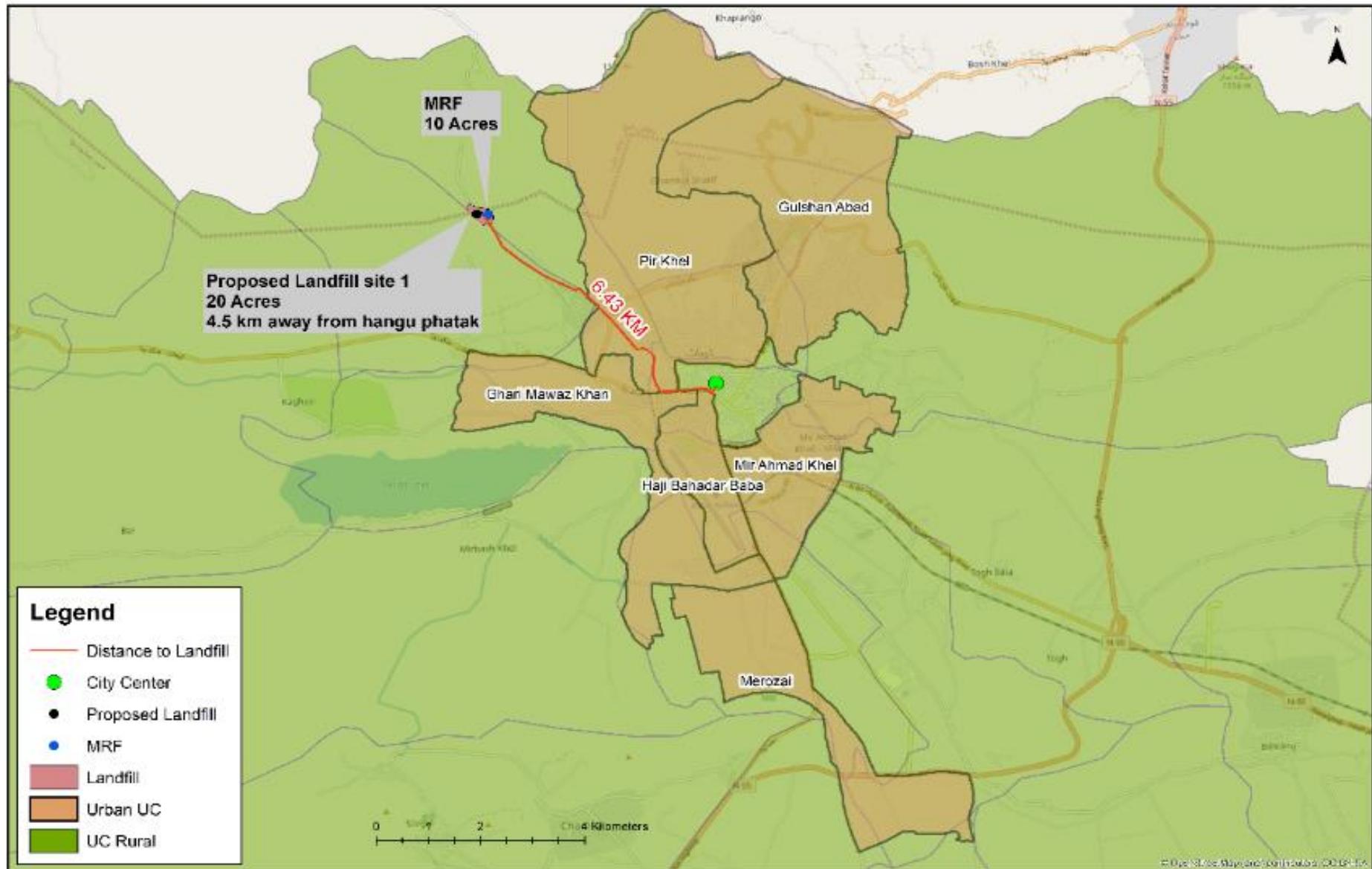
■ Significant Risk Level

■ Medium Risk Level

■ Low Risk Level

■ Positive Impacts

**District Kohat KPK**  
**Proposed Landfill Sites with Urban UC's Boundary & Distance to City Center**



# 1 Introduction

## 1.1 Overview

48. The Khyber Pakhtunkhwa Cities Improvement Projects (KPCIP) will improve the quality of life of the residents of five KP cities, including Abbottabad, Kohat, Mardan, Mingora, and Peshawar, directly benefitting about 6 million of urban population. KPCIP will help selected cities improve their access to quality urban services through three interlinked outputs: (i) Climate resilient and gender friendly urban infrastructure improve, (ii) Institutional capacities of urban service providers and governments strengthened, and (iii) Increased women's participation in urban governance and access to economic opportunities.
49. KPCIP will support the Government of Pakistan's development priorities, established in (i) the National Water Policy (2018), (ii) the Local Government Act (2019), and (iii) Pakistan Vision 2025. The project is also aligned with ADB's operational priorities of (i) addressing remaining poverty and reducing inequalities; (ii) accelerating progress in gender equality; (iii) tracking climate change, building climate and disaster readiness; (iv) making cities more liveable; and (v) strengthening governance and institutional capacity, outlined in ADB's Strategy 2030, and is included in ADB's country operations business plan for Pakistan, 2021–2023.
50. The project readiness financing (approved in March 2019) has financed the preparation and engineering design of the KPCIP. The Department of Local Government, Elections and Rural Development Department (LGE&RDD), the Government of Khyber Pakhtunkhwa, will be the executing agency for the project and the city governments of the five target cities, including the respective Water and Sanitation Services Companies, will be the implementing agencies.
51. Total daily waste generation of Kohat city is 146 tons/day in year 2021 assuming waste generation rate of 0.33 kg/cap/day for all waste streams i.e., residential, commercial and bulk waste etc. An additional allowance of waste i.e., 21% is accounted for in the above tonnage which is bulk waste. Since the design life of the project is 10 years, the consultant has taken the waste generation and population growth rate for the year 2025 for the resource calculation purpose.
52. The current practice of material recovery and recycling often leads to additional littering in streets when rag pickers are rummaging the waste bags and bins. A denial to rag pickers in the streets forces them to collect recyclables from containers and open dumpsites as well. This practice leads to even higher health threats and environmental pollution. The development of a properly engineered and designed solid waste management facility (SWMF) will ensure that the solid waste generated from Kohat city is managed in accordance with international good practices on solid waste management.
53. This Initial Environmental Examination (IEE) document focuses solely on the scope of works of the development of the SWMF and assesses any potentially significant impacts and proposes required mitigation measures, which shall be implemented by the Contractor and monitored by the Project Management Unit (PMU), KP Local Government, Elections and Rural Development Department (LGERDD) and ADB using the Environmental Management Plan (EMP).

## 1.2 Project Location

54. The proposed SWMF is located about 2.6 km away from Peer Faridullah Shah Chowk, about 3 km from Hangu Bypass road and about 6.5 km from the city center.
55. The total area of the landfill is approximately 27 acres. The site has silty soils strata with rock formation, and mainly comprises of unconsolidated surficial deposits of silts, sands and gravel. No agricultural activity is taking place on the site. The access road to the landfill from main road is not in a good condition, which can be used for waste carrying vehicles.
56. The key map and the project area map for the proposed SWMF are provided as **Figures 1.1 and 1.2** respectively.

## 1.3 Environmental Category of Project

57. According to ADB's Safeguard Policy Statement (SPS) 2009, a Rapid Environmental Assessment (REA) Checklist was prepared for the proposed SWMF works (**Annexure A**). The Pakistan Environmental Protection Agency's "Guidelines for the Preparation and Review of Environmental Reports (2000)" were also consulted. As per guidelines, the proposed project is falling in Schedule II (G) and requires an IEE to be prepared and submitted to KP EPA for review and necessary approval.
58. Based on the initial findings, it was ascertained that certain adverse environmental impacts are expected due to development of the proposed SWMF, and thus the subject project is considered as Category "B" for Environment as per ADB SPS, 2009. Therefore, an IEE has been conducted.

## 1.4 Objectives of the IEE Study

59. Following are the objectives of this IEE study:
  - Assess the existing environmental conditions of Kohat SWMF area, including the identification of environmental sensitive receptors and develop a baseline of its prevalent environmental and socioeconomic conditions;
  - Identify and investigate all impacts of the proposed SWMF pre-construction/design, construction, operation, closure and post closure on the physical, biological and socioeconomic environment of the project area;
  - To propose mitigation measures that would help KP LGERDD and WSSCK in conducting the proposed project activities in an environmentally sustainable manner;
  - To uncover the planning and operational phase impacts up to microenvironment levels in which project is proposed to be sited; and
  - To develop an Environmental Management Plan (EMP) that would assist KP LGERDD and WSSCK in the effective implementation of the recommendations of the IEE.

## 1.5 IEE Team

60. The IEE study team comprised of following experts.
  - Environment Specialists by ADB, PMU KP LGERDD and EDCM
  - Environmental associate

- SWM expert
- IWMS design experts
- Integrated Environmental Laboratory
- Climate change expert
- Social Safeguard Expert
- Social safeguard team of EDCM
- Gender Expert
- ADB and PMU technical team

## 1.6 Methodology of IEE Study

61. The following methodology was employed for this IEE study:

### 1.6.1 Understanding of the Proposed Operation

62. This involved collecting information from the ADB, PMU KP LGERDD and Engineering Design and Construction Management technical team on the proposed project activities and understanding the activities to identify potential impacts of implementing them.

### 1.6.2 Review of Legislation and Guidelines

63. National legislation, international agreements, environmental guidelines, both of KP EPA, and ADB, and best industry practices have been reviewed to set environmental standards that KP LGERDD, as the Implementing Agency, will adhere to during implementation of the project.

### 1.6.3 Secondary Data Collection

64. Available published and unpublished information pertaining to the background environment has been obtained and reviewed. All data sources have been carefully reviewed to collect the following information:

- **Physical environment** – topography, geology, seismology, geomorphology, soils, surface and groundwater resources and climate;
- **Biological environment** – habitat types, flora and fauna (particularly rare or endangered species), critical habitats, vegetation and communities within the area;
- **Physical cultural resources** – sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance; and,
- **Socio-economic environment** – settlements, socio-economic conditions, infrastructure and land use.

### 1.6.4 Field Data Collection (Baseline Survey)

65. Field visits were undertaken consisting of preliminary scoping through survey and assessment activities to establish the potential impacts and categorization of activities and

the Rapid Environmental Assessment (REA) Checklist was completed. The key receptors and stakeholders within the project area were identified.

66. Baseline surveys required to identify and establish physical and biological conditions and ecosystems in the project area has been carried out by IEE team and results have been incorporated in this report. The socio-economic environment in the project areas has been obtained through the socio-economic profiles and social impact assessment carried out by social safeguard team. Climate risk and vulnerability assessment findings have also been presented and discussed.
67. Primary data collection in a two-kilometer area of influence, such as ambient noise levels, ambient air quality and ground water quality at the key receptor locations in the project area and particularly in close proximity to the project site was conducted.
68. Review of secondary information on the physical, biological and ecological aspects, physical cultural resources and infrastructure utilities in the Kohat SWMF area was conducted.

#### **1.6.5 Public Consultations**

69. Public consultations (PC) were carried out with all key stakeholders, particularly local communities residing in the project area, local businesses and government and local government bodies in line with ADB SPS 2009 Guidelines. Under ADB requirements, the environmental assessment process must also include meaningful public consultations during the completion of the study. In this IEE study, the public consultation process was carried out, including verbal disclosure regarding the project development with stakeholders to brief them about the project and to seek their response/recommendation.

#### **1.6.6 Impacts Identification and Assessment**

70. Potential impacts arising from each phase of the proposed project have been identified and assessed based on field data, secondary data, expert opinions and examining previous similar projects in Pakistan. These include effects on physical, biological and socio-economic environment.

#### **1.6.7 Recommendations for Mitigation Measures**

71. Mitigation measures to minimize, eliminate or compensate the potential environmental impacts have been recommended. The mitigation measures have been recommended based on past experiences, best industry practices, legislative requirements and professional judgement.

#### **1.6.8 Development of Environmental Management Plan (EMP)**

72. An Environmental Management Plan (EMP) has been developed for effective implementation of the recommended mitigation measures. The EMP includes controls to minimize the identified impacts and monitoring program to monitor effect of mitigation measures implemented and residual impacts, if any, during implementation. The EMP has identified roles and responsibilities of all concerned parties during the implementation of the project.

## 1.7 Proponent of Project

73. The LGERDD, GoKP is the Executing Agency (EA) for this SWMF development while the project will be implemented through WSSCK with support from PMU.
74. Contact details of the EA are provided as **Table 1.1** below.

**Table 1.1: Executing Agency Contact Details**

Executing Agency Details	Information
Name of EA	Project Management Unit (PMU), Local Government, Elections and Rural Development Department (LGERDD), GoKP
Address	Ground Floor, Afzal Apartments, Jamrud Road, Phase-3 Chowk, Hyatabad, Peshawar
Telephone	0092-91-5854555
E-mail	<a href="mailto:pdkpcip@gmail.com">pdkpcip@gmail.com</a> , <a href="mailto:info@kpcip.gov.pk">info@kpcip.gov.pk</a>
Web	Kpcip.gov.pk

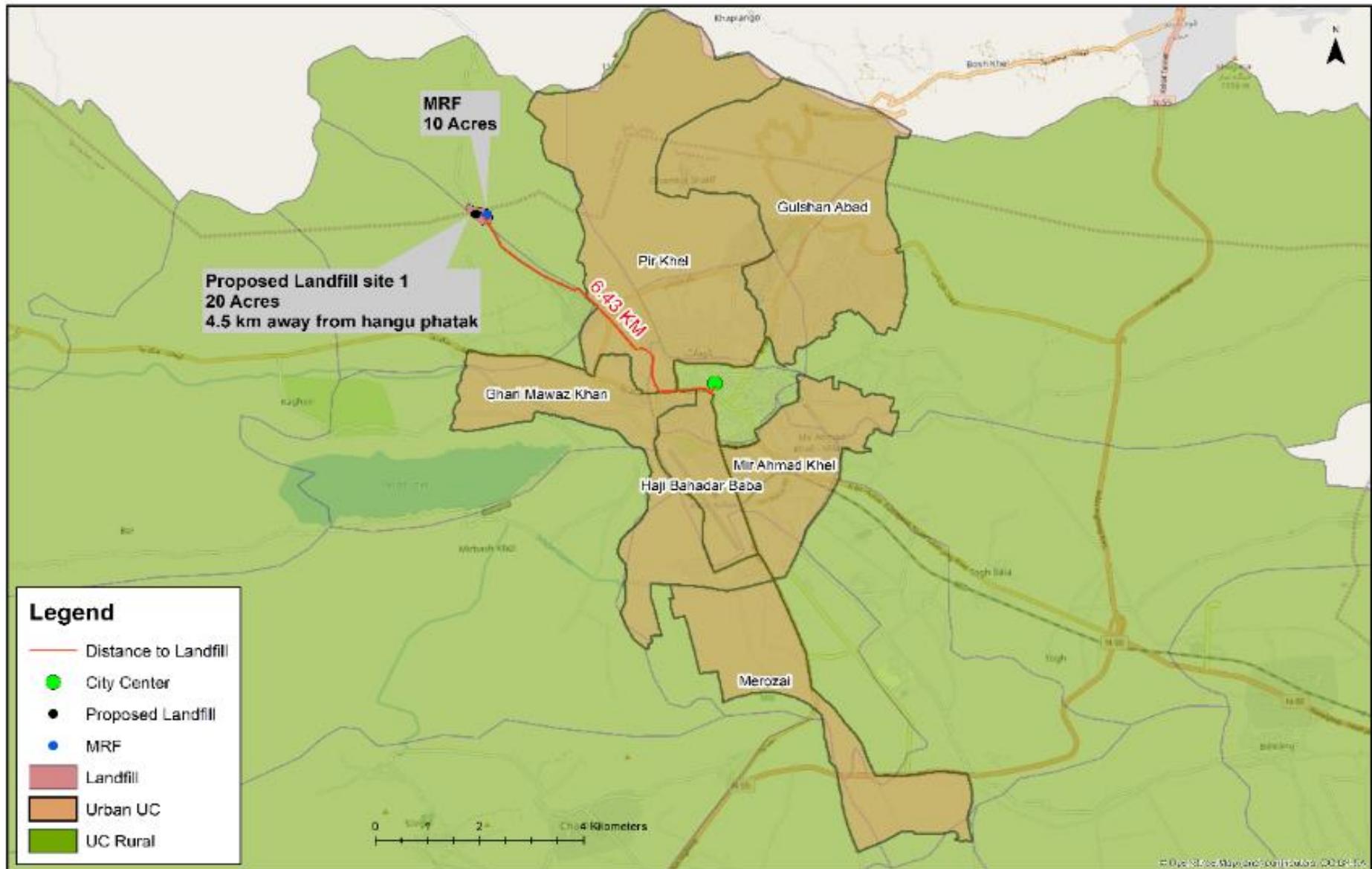
## 1.8 Structure of the Report

75. The IEE report contains eleven chapters as follows:
  - Introduction
  - Policy and Legal Framework
  - Description of the Project
  - Description of Environment
  - Analysis of Alternatives
  - Assessment of Environmental Impacts and Mitigation Measures
  - Institutional Requirements Environmental Management Plan
  - Public Consultation
  - Grievance Redressal Mechanism
  - Findings, Recommendations and Conclusions
  - References

## **1.9 Further Additions & Updating of IEE Study**

76. This version of the report will be further updated once the detailed design is completed and any other details of the proposed SWMF become available over the coming weeks and months. These revisions shall be incorporated into any subsequent updated versions of this IEE report.

**District Kohat KPK**  
**Proposed Landfill Sites with Urban UC's Boundary & Distance to City Center**



## 2 Policy and Legal Framework

### 2.1 General

77. This section provides an overview of the policy framework and national legislation that applies to the proposed SWMF development in the outskirts of Kohat city, Pakistan. The project will comply with all national legislation relating to the environment in Pakistan and will obtain all the regulatory clearances required from the financing agency, ADB.

### 2.2 National Policy and Legal Framework

78. The Pakistan National Conservation Strategy (NCS) that was approved by the federal cabinet in March 1992 is the principal policy document on environmental issues in the country (EUAD/IUCN, 1992). The NCS outlines the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed landfill development are pollution prevention and abatement and increasing energy efficiency while conserving biodiversity.
79. Prior to the adoption of the 18th Constitutional Amendment, the Pakistan Environmental Protection Act (PEPA) 1997 was the governing law for environmental conservation in the country. Under PEPA 1997, the Pakistan Environmental Protection Council (PEPC) and Pak EPA were primarily responsible for administering PEPA 1997. Post the adoption of the 18th Constitutional Amendment in 2011, the subject of environment was devolved and the provinces have been empowered for environmental protection and conservation.

### 2.3 Regulations for Environmental Assessment, Pakistan EPA

80. Under Section 12 (and subsequent amendment) of the PEPA (1997), a project falling under any category specified in Schedule I of the EIA/IEE Regulations (SRO 339 (I)/2000), requires the proponent of the project to file an IEE with the concerned provincial EPA. Projects falling under any category specified in Schedule II require the proponent to file an IEE with the provincial agency, which is responsible for its review and accordance of approval or request any additional information deemed necessary.

### 2.4 Regulatory Clearances, KP EPA

81. In accordance with provincial regulatory requirements, an IEE/EIA satisfying the requirements of the KP Environmental Protection Act (2014) is to be submitted to KP environmental protection agency (KP-EPA) for review and approval, and subsequent issuance of NOC before the commencement of construction.
82. As per guidelines project is falling in Schedule II (G) of IEE/EIA regulation, 2000 and requires that an IEE shall be prepared and submitted to KP EPA for review and necessary approval.

## 2.5 Guidelines for Environmental Assessment, Pakistan EPA

83. The Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. The guidelines that are relevant to the proposed sub-project are listed below:
- Guidelines for the Preparation and Review of Environmental Reports, Pakistan, EPA1997;
  - Guidelines for Public Consultations; Pakistan EPA May 1997;

## 2.6 National Environmental Quality Standards (NEQS) 2000

84. The National Environmental Quality Standards (NEQS), 2000, specify the following standards:
- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment facilities, and the sea (three separate sets of numbers);
  - Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources;
  - Maximum allowable concentration of pollutants (two parameters) in gaseous emissions from vehicle exhaust and noise emission from vehicles;
  - Maximum allowable noise levels from vehicles;
85. These standards apply to the gaseous emissions and liquid effluents discharged by construction machinery.

## 2.7 Other Environment Related Legislations

86. The national laws and regulations are provided in **Table 2.1** below.

**Table 2.1: Environmental Guidelines and Regulations**

Legislation/Guideline	Description
National Environmental Policy (2005) (NEP)	NEP is the primary policy of Government of Pakistan addressing environmental issues. The broad Goal of NEP is, "to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development". The NEP identifies a set of sectoral and cross-sectoral guidelines to achieve its goal of sustainable development. It also suggests various policy instruments to overcome the environmental problems throughout the country.
The Forest Act (1927)	The Act empowers the provincial forest departments to declare any forest area as reserved or protected. It empowers the provincial forest departments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce, quarrying and felling, lopping and

<b>Legislation/Guideline</b>	<b>Description</b>
	topping of trees, branches in reserved and protected forests. No protected forest is situated in the project area for the development of the SWMF.
<b>Khyber Pakhtunkhwa Wildlife and Biodiversity Act, 2015</b>	It empowers the government to declare certain areas reserved for the protection of wildlife and control activities within these areas. It also provides protection to endangered species of wildlife. As no activities are planned in these areas, no provision of this law is applicable to the proposed project.
<b>The KP Antiquities Act (2016)</b>	It ensures the protection, preservation, development and maintenance of antiquities in the province of KP. The Act defines "antiquities" as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GoKP to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the subproject proponents are obligated to ensure that no activity is undertaken in the proximity of a protected antiquity, report to the Department of Archaeology, GoKP, any archaeological discovery made during the course of the project.
<b>Pakistan Penal Code (1860)</b>	It authorizes fines, imprisonment or both for voluntary corruption or fouling of public springs or reservoirs so as to make them less fit for ordinary use.
<b>NATIONAL ENVIRONMENTAL AND CONSERVATION STRATEGIES</b>	
<b>National Conservation Strategy</b>	Before the approval of NEP, the National Conservation Strategy (NCS) was considered as the Government's primary policy document on national environmental issues. At the moment, this strategy just exists as a national conservation program. The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas.
<b>Biodiversity Action Plan</b>	The plan recognizes IEE/EIA as an effective tool for identifying and assessing the effects of a proposed operation on biodiversity.
<b>INTERNATIONAL CONVENTIONS</b>	
<b>The Convention on Conservation of Migratory Species of Wild Animals (1981.21)</b>	The Convention requires countries to take action to avoid endangering migratory species. The term "migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. The parties are also required to promote or cooperate with other countries in matters of research on migratory species. There are no endangered species of plant life or animal life in the vicinity of the proposed project areas for the landfill works.
<b>Convention on Biological Diversity (June 1992)</b>	The Convention requires to: (a) Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or

<b>Legislation/Guideline</b>	<b>Description</b>
	programmes which shall reflect, inter alia, the measures set out in this Convention relevant to the Contracting Party concerned; and (b) Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.
<b>Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora (1973 – Amended 1979)</b>	The convention requires Pakistan to impose strict regulation (including penalization, confiscation of the specimen) regarding trade of all species threatened with extinction or that may become so, in order not to endanger their survival further.
<b>Convention on Wetlands (1987)</b>	Each Contracting Party shall designate suitable wetlands within its territory for inclusion in a List of Wetlands of International Importance, hereinafter referred to as "the List" which is maintained by the bureau. The boundaries of each wetland shall be precisely described and also delimited on a map and they may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands, especially where these have importance as waterfowl habitat.
<b>International Union for Conservation of Nature and Natural Resources Red List (2000)</b>	Lists wildlife species experiencing various levels of threats internationally. Some of the species indicated in the IUCN red list are also present in the wetlands of Pakistan.
<b>International Convention to Combat Desertification (1994)</b>	The objective of this Convention is to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels, supported by international cooperation and partnership arrangements, in the framework of an integrated approach with a view to contributing to the achievement of sustainable development in affected areas.

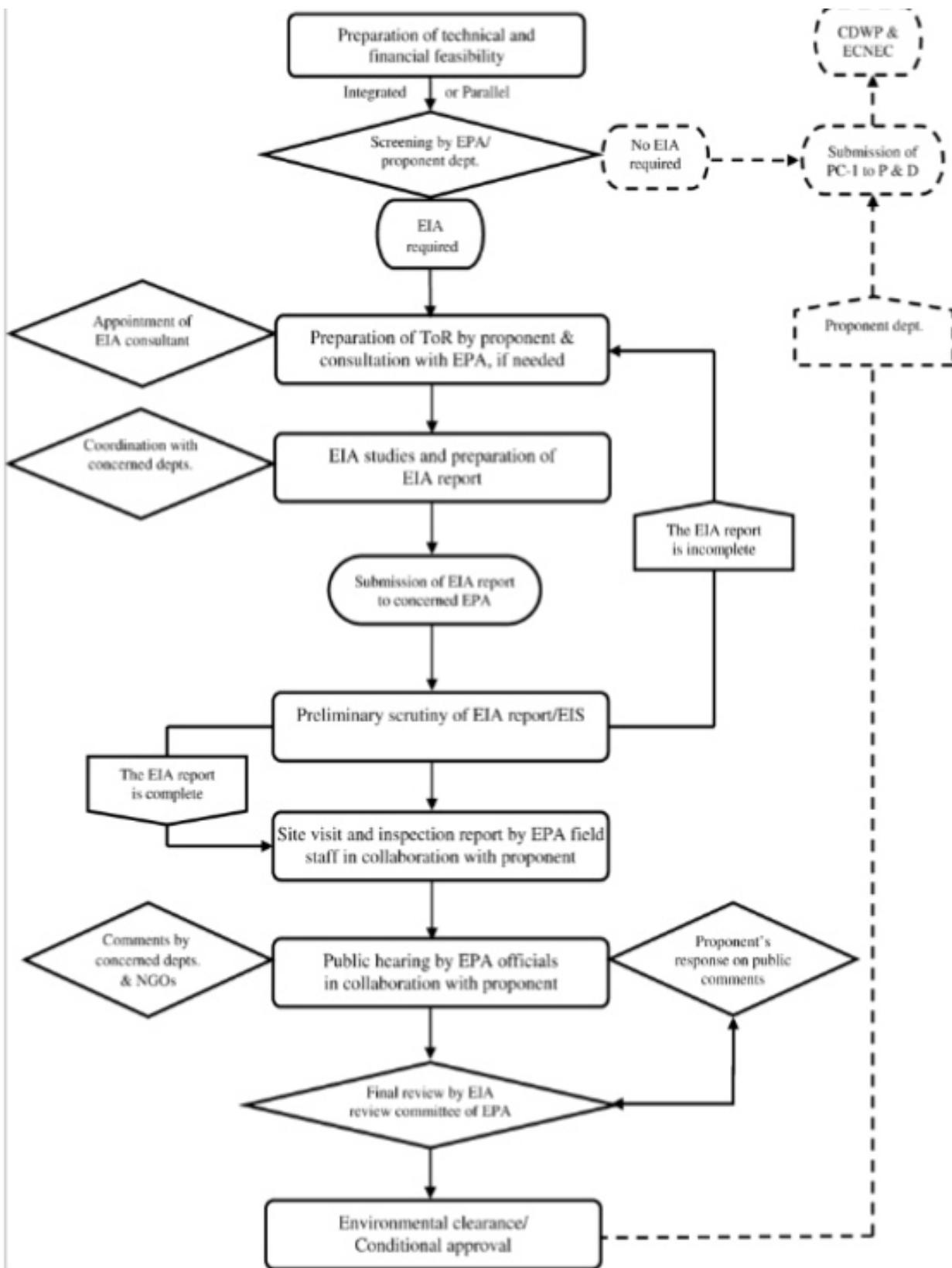
## 2.8 Implications of national policies and regulations on proposed project

87. The Pak-EPA formulated regulations in 2000 for 'Review of IEE and EIA' which categorise development projects under three schedules-Schedules I, II and III. Projects are classified on the basis of expected degree and magnitude of environmental impacts and the level of environmental assessment required is determined from the schedule under which the project is categorised.
88. The projects listed in Schedule-I include those where the range of environmental issues is comparatively narrow and the issues can be understood and managed through less extensive analysis. Schedule-I projects require an IEE to be conducted, rather than a full-fledged EIA, provided that the project is not located in an environmentally sensitive area.
89. The projects listed in Schedule-II are generally major projects and have the potential to affect a large number of people in addition to significant adverse environmental impacts. The impacts of projects included in Schedule-II may be irreversible and could lead to

significant changes in land use and the social, physical and biological environments. The proposed SWMF development project has been categorized as Schedule I (G) and requires an IEE.

90. The LGERDD, GoPK, being the Executing Agency for the Project is responsible for management of project impacts, and have to undertake the commitments and mitigation measures proposed in this environmental report and in the subsequent review and approval conditions.
91. According to the regulations, no construction, preliminary or otherwise, relating to the project shall be undertaken until and unless approval of the IEE report has been issued by the KP EPA.
92. The LGERDD will submit the IEE Report on a prescribed application along with the processing fee to KP EPA. After submission of the IEE report, a thirty (30) day period for public comments will be provided. The assessment will be completed within a period of one hundred and twenty (120) days from receipt of the complete documents, and earlier than this wherever practicable. Following the completion of public hearing, if required, and the provision of any further data from the proponent, the decision shall be made and conveyed after thirty days thereafter.

The IEE approval process as per environmental legislation applicable in Pakistan is summarized in Figure 2.1 below.

**Figure 2-1: IEE Review and Approval Process of Pakistan EPAs**

## 2.9 ADB's Safeguard Policy Statement (SPS), 2009

93. The ADB's SPS 2009 requires that environmental considerations be incorporated into ADB funded projects to ensure that the project will have minimal environmental impacts and be environmentally sound. Occupational health & safety of the local population should also be addressed as well as the project workers as stated in SPS. A Grievance Redress Mechanism (GRM) to receive application and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance is also established.
94. All loans and investments are subject to categorization to determine environmental assessment requirements. Categorization is to be undertaken using Rapid Environmental Assessment (REA) checklists, consisting of questions relating to (i) the sensitivity and vulnerability of environmental resources in project area, and (ii) the potential for the project to cause significant adverse environmental impacts. Projects are classified into one of the following environmental categories:
95. **Category A:** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.
96. **Category B:** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE) is required.
97. **Category C:** A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
98. **Category FI:** A proposed project is classified as category FI if it involves investment of ADB funds to or through a financial intermediary (FI).

## 2.10 ADB's Access to Information Policy (AIP) 2018

99. ADB's new Access to Information Policy (AIP), reflects the ADB's ongoing commitment to transparency, accountability, and participation by stakeholders. The policy contains principles and exceptions to information sharing with external stakeholders, led by a new overarching principle of "clear, timely, and appropriate disclosure."

## 2.11 ADB's Accountability Mechanism Policy 2012

100. The objectives of the Accountability Mechanism is providing an independent and effective forum for people adversely affected by ADB-assisted projects to voice their concerns and seek solutions to their problems, and to request compliance review of the alleged noncompliance by ADB with its operational policies and procedures that may have caused, or is likely to cause, them direct and material harm. The Accountability Mechanism is a "last resort" mechanism.

## 2.12 Implications of ADB's safeguard policies on proposed project

101. The objectives of ADB's safeguards are to:
- avoid adverse impacts of projects on the environment and affected people, where possible;
  - minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
  - help borrowers/clients to strengthen their safeguard systems.
102. ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:
- environmental safeguards,
  - involuntary resettlement safeguards, and
  - Indigenous Peoples safeguards.
103. The objective of the environmental safeguards is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. ADB's policy principles are summarized in **Table 2.2** below.

**Table 2.2: ADB Policy Principles**

No.	Policy principle	Summary
1	Screening and categorization	Screening process initiated early to determine the appropriate extent and type of environmental assessment.
2	Environmental assessment	Conduct an environmental assessment to identify potential impacts and risks in the context of the project's area of influence.
3	Alternatives	Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts, including no project alternative.
4	Impact mitigation	Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts. Prepare an environmental management plan (EMP).
5	Public consultations	Carry out meaningful consultation with affected people and facilitate their informed participation. Involve stakeholders early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with

No.	Policy principle	Summary
		stakeholders throughout project implementation. Establish a grievance redress mechanism.
6	Disclosure of environmental assessment	Disclose a draft environmental assessment in a timely manner, in an accessible place and in a form and language(s) understandable to stakeholders. Disclose the final environmental assessment to stakeholders.
7	Environmental management plan	Implement the EMP and monitor its effectiveness. Document monitoring results and disclose monitoring reports.
8	Biodiversity	Do not implement project activities in areas of critical habitats.
9	Pollution prevention	Apply pollution prevention and control technologies and practices consistent with international good practices. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges. Avoid the use of hazardous materials subject to international bans or phaseouts.
10	Occupational health and safety/Community safety.	Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities
11	Physical cultural resources	Conserve physical cultural resources and avoid destroying or damaging them. Provide for the use of "chance find" procedures.

104. The basic environmental assessment requirements for Category 'B' projects are provided in **Table 2.3**.

**Table 2.3: EADB Environmental Assessment Requirements for Category ‘B’ projects**

<b>Aspect</b>	<b>Environmental Assessment &amp; Management Requirements</b>
<b>Project processing</b>	
<b>Reporting</b>	<ul style="list-style-type: none"> <li>▪ Prepare IEE study.</li> </ul>
<b>Public consultations</b>	<ul style="list-style-type: none"> <li>▪ Conduct consultations at the early stage of IEE field work and when the draft IEE report is available during project preparation, and before project appraisal by ADB.</li> </ul>
<b>Disclosure of environmental assessment report</b>	<ul style="list-style-type: none"> <li>▪ Disclose final version of IEE report that has been cleared by ADB.</li> </ul>
<b>Project implementation</b>	
<b>Reporting</b>	<ul style="list-style-type: none"> <li>▪ Submit semiannual reports during project construction, and annual reports during project operation to ADB for disclosure.</li> </ul>

## 2.13 IFC Sector Specific Guidelines on Solid Waste Management<sup>1</sup>

105. The IFC guidelines provide guidance with regards to development and operation of SWM sites. In terms of site selection of the landfill site, these guidelines require the location of the landfill to take into account potential impacts associated with releases of polluting substances, including the following:
- Proximity to residential, recreation, agricultural, natural protected areas, or wildlife habitat and areas prone to scavenging wildlife, as well as other potentially incompatible land uses:
    - Residential development should be typically further than 250 meters from the perimeter of the proposed landfill cell development to minimize the potential for migration of underground gaseous emissions;
    - Visual impacts should be minimized by evaluating locational alternatives;
    - Siting should be further than 3 km of a turbojet airport and 1.6 km of a piston-type airport or as permitted by the aviation authority fully considering potential threats to air safety due to attraction and presence of birds;
  - Proximity and use of groundwater and surface water resources:
    - Private or public drinking, irrigation, or livestock water supply wells located downgradient of the landfill boundaries should be further than 500 meters from the site perimeter, unless alternative water supply sources are readily and

<sup>1</sup> <https://www.ifc.org/wps/wcm/connect/5b05bf0e-1726-42b1-b7c9-33c7b46ddda8/Final%2B-%2BWaste%2BManagement%2BFacilities.pdf?MOD=AJPERES&CVID=jqeDbH3>

economically available and their development is acceptable to regulatory authorities and local communities;

- Areas within the landfill boundaries should be located outside of the 10-year groundwater recharge area for existing or pending water supply development;
- Perennial stream should not be located within 300 meters downgradient of the proposed landfill cell development, unless diversion, culverting or channeling is economically and environmentally feasible to protect the stream from potential contamination;
- Site geology and hydrogeology:
  - Landfills should be located in gently sloped topography, amenable to development using the cell (bund) method, with slopes which minimize the need for earthmoving to obtain the correct leachate drainage slope of about 2%;
  - Groundwater's seasonally high table level (i.e. 10 year high) should be at least 1.5 meters below the proposed base of any excavation or site preparation to enable landfill cell development;
  - Suitable soil cover material should be available on-site to meet the needs for intermediate (minimum of 30 cm depth) and final cover (minimum of 60 cm depth), as well as bund construction (for the cell method of landfill operation). Preferably, the site would have adequate soil to also meet required cover needs (usually a minimum of 15 cm depth of soil)<sup>2</sup>
- Potential threats to landfill site integrity from natural hazards such as floods, landslides, and earthquakes:
  - Landfills should be sited outside of a floodplain subject to 10-year floods and, if within areas subject to a 100- year flood, amenable to an economic design which would eliminate the potential for washout;
  - There should be no significant seismic risk within the region of the landfill which could cause destruction of berms, drains or other civil works, or require unnecessarily costly engineering measures; otherwise, side slopes should be adjusted accordingly to prevent failure in the event of seismic activity;
  - No fault lines or significantly fractured geologic structure should be present within 500 meters of the perimeter of the proposed landfill cell development which would allow unpredictable movement of gas or leachate;
  - There should be no underlying limestone, carbonate, fissured or other porous rock formations which would be incompetent as barriers to leachate and gas migration, where the formations are more than 1.5 meter in thickness and present as the uppermost geologic unit above sensitive groundwaters.

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<sup>2</sup> Daily cover needs can be alternatively met by using removable tarps, other relatively inert materials (i.e., compost residuals), or by removing the previously laid daily soil cover at the start of each day for reuse at the end of the same day.

106. All the guidelines mentioned above with regards to site selection for the landfill site have been taken into consideration during finalization of the site for the landfill development.
107. The IFC guidelines also provide guidance on the operational aspects of landfill sites, such as measures to prevent, minimize and control leachate generation, groundwater and leachate monitoring, measures for controlling of landfill gas emissions, controlling of dust and odor emissions from landfill site, measures for controlling dispersal of litter along with closure and post closure activities.

## 2.14 Comparison of International and Local Environmental Legislations

108. The ADB SPS requires application of pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards. The SPS states that when host country regulations differ from these standards, the EA will achieve whichever is more stringent.
109. In order to select the most stringent standards applicable, a mix of local (NEQS) and international (IFC) regulations have been selected. The IFC Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines and Environmental standards are also applicable. It shall be ensured that all necessary noise mitigation measures are implemented to minimize the noise levels in the project area.
110. The **Table 2.4** presents IFC workplace noise standards that are applicable to the construction workers. It should also be noted that IFC EHS guidelines advise that where existing ambient noise levels already exceed thresholds, the project should not result in an increase of more than 3 dB over existing ambient noise levels at the nearest receptor location off-site.
111. A comparison of applicable local and international guidelines for ambient air quality has been provided in **Table 2.5** below. In the case of most pollutants, the Pak NEQS standards for ambient air quality are more stringent in comparison to USEPA and WHO/IFC standards. The applicable and most stringent parameters for each respective pollutant are highlighted in green.
112. Similar to the standards for air quality, the comparison of noise standards provided in **Table 2.6** clearly shows that the Pakistan NEQS standards for noise are more stringent in comparison to the IFC standards. The only exception is the daytime noise level standard for Industrial areas where the IFC standard is more stringent (70 dB(A)) in comparison to NEQS (75 dB(A)) and so for this particular parameter, the IFC standard will be used. Apart from this one exception, the NEQS standards have been used for the proposed landfill development project.
113. As far as regulations regarding other environmental parameters are concerned such as acceptable effluent disposal parameters, the local regulations i.e. NEQS take precedence over any other international regulations such as IFC.

**Table 2.4: IFC Work Environment Noise limits**

Type of Work, workplace	IFC General EHS Guidelines
Heavy Industry (no demand for oral communication)	85 Equivalent level L <sub>eq,8h</sub>
Light industry (decreasing demand for oral communication)	50-65 Equivalent level L <sub>eq,8h</sub>

**Table 2.5: Comparison of International and local Air Quality Standards\***

Pollutants	USEPA		WHO/IFC		Pak. NEQS	
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard
SO <sub>2</sub>	3 hrs 1 hr	0.5 ppm 75 ppb	24 hr 10 min	20 ug/m <sup>3</sup> 500 ug/m <sup>3</sup>	Annual Mean 24 hrs	80 ug/m <sup>3</sup> 120 ug/m <sup>3</sup>
CO	8 hrs 1 hr	9 ppm (11 mg/m <sup>3</sup> ) 35 ppm (43 mg/m <sup>3</sup> )	-	-	8 hrs 1 hr	5 mg/m <sup>3</sup> 10 mg/m <sup>3</sup>
NO <sub>2</sub>	Annual Mean 1 hr	100 ug/m <sup>3</sup> (53 ppb) 100 ppb	1 yr 1 hr	40 ug/m <sup>3</sup> 200 ug/m <sup>3</sup>	Annual Mean 24 hrs	40 ug/m <sup>3</sup> 80 ug/m <sup>3</sup>
O <sub>3</sub>	8 hrs	0.07ppm (148 ug/m <sup>3</sup> )	8 hrs	100 ug/m <sup>3</sup>	1 hr	130 ug/m <sup>3</sup>
TSP	-	-	-	-	Annual Mean 24 hrs	360 ug/m <sup>3</sup> 500 ug/m <sup>3</sup>
PM <sub>10</sub>	24 hrs	150 ug/m <sup>3</sup>	1 yr 24 hr	20 ug/m <sup>3</sup> 50 ug/m <sup>3</sup>	Annual Mean 24 hrs	120 ug/m <sup>3</sup> 150 ug/m <sup>3</sup>
PM <sub>2.5</sub>	Annual Mean 24 hrs	15 ug/m <sup>3</sup> 35 ug/m <sup>3</sup>	1 yr 24 hr	10 ug/m <sup>3</sup> 25 ug/m <sup>3</sup>	Annual Average 24 hrs 1 hr	15 ug/m <sup>3</sup> 35 ug/m <sup>3</sup> 15 ug/m <sup>3</sup>

\*: The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.

\* In instances where the airshed is significantly degraded and the pollutant levels are already exceeding the ambient pollutant concentrations provided in the table above, it shall be ensured that the project activities cause as small an increase in pollution levels as feasible, and amounts to a fraction of the applicable short term and annual average air quality guidelines or standards as established in the project specific environmental assessment.

**Table 2.6: Comparison of International and Local Noise Standards**

Category of Area/Zone	Limit in dB(A) Leq			
	NEQS		WHO/IFC	
	Day Time 06:00 – 22:00	Night Time 22:00-06:00	Day Time 07:00 – 22:00	Night Time 22:00-07:00
Residential area (A)	55	45	55	45
Commercial area (B)	65	55	70	70
Industrial area (C)	75	65	70	70
Silence zone (D)	50	45	55	45

\*: The standards highlighted in green for each respective Area/Zone are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.

\* In instances where baseline noise levels are already exceeding the standards above, it will need to be ensured that the project activities do not cause an increment of more than 3 dB(A) from the baseline noise levels.

**Table 2.7: Comparison of International and Local Water Quality Standards**

Parameter	Unit	NEQS	WHO/IFC
<b>Bacterial</b>			
E-Coli	numbers/ml	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
Total Coliform	numbers/ml	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
<b>Physical</b>			
Color	TCU	< 15 TCU	-
Taste	No objectionable/Acceptable	-	-
Odor	No objectionable/Acceptable	-	-
Turbidity	NTU	< 5 NTU	
Total Hardness	mg/l	< 500 mg/l	
TDS	mg/l	< 1000	
pH		6.5-8.5	
<b>Chemical</b>			
Aluminum	mg/l	<0.005 (P)	0.2
Antimony	mg/l	<0.005 (P)	<0.005 (P)
Arsenic	mg/l	<0.005 (P)	0.01
Barium	mg/l	0.7	0.3
Boron	mg/l	0.3	0.3
Cadmium	mg/l	0.01	0.0003
Chloride	mg/l	<250	250
Chromium	mg/l	<0.05	0.05
Copper	mg/l	2	2
Cyanide	mg/l	<0.05	0.07

Parameter	Unit	NEQS	WHO/IFC
<b>Fluoride</b>	mg/l	<1.5	1.5
<b>Lead</b>	mg/l	<0.05	0.01
<b>Manganese</b>	mg/l	<0.5	0.5
<b>Mercury</b>	mg/l	<0.0001	0.0001
<b>Nickel</b>	mg/l	<0.02	0.02
<b>Nitrate</b>	mg/l	<50	50
<b>Nitrite</b>	mg/l	<3	-
<b>Selenium</b>	mg/l	0.01	0.01
<b>Residual Chlorine</b>	mg/l	0.2-0.5 at consumer end	-
<b>Zinc</b>	mg/l	5	3

\*: The standards highlighted in green for each respective Area/Zone are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.

### 3 Project Description

114. The proposed Integrated Waste Management System (IWMS) has the following two main components:
- **Component 1:** Improvement of existing waste collection & transport system in Kohat City
  - **Component 2:** SWMF Development & Operation
115. The IWMS within Kohat city is crucial for successful operation of the SWMF as it provides strategic approach to sustainable management of solid waste covering all sources and all aspects, including generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency. The operational protocols and modalities of the IWMS have been established to improve environmentally sound practices with respect to waste management and attempting to close existing bottlenecks in the system.
116. The waste generated can be broadly categorized as residential, commercial, construction demolition, animal waste, institutional, or medical. The inorganic waste collected will be used as Refuse Derived Fuel (RDF), while organic component, plus the animal waste and organic kitchen waste will be used for preparing compost. This would significantly reduce the spatial requirements of the landfill and increase its useful life.
117. The development of the proposed SWMF is designed to support the WSSCK and other involved agencies, to completely transform the SWM system in Kohat. Complete with institutional strengthening, recycling and other support initiatives, the project includes the installation of primary and secondary Municipal Solid Waste (MSW) collection systems and the development of an international standard MSW management facility that will accommodate Kohat's residual MSW for at least 20 years.
118. The Component 1 is an existing activity that is proposed to be further enhanced and improved in turns of its operational efficacy. On the other hand, the proposed Component 2 is the environmentally sensitive proposed intervention and thus this IEE report focuses on this Component.
119. The proposed Component 2 consists of the development of a well engineered and designed solid waste management facility (SWMF), which will ensure the solid waste generated from Kohat city is managed in accordance with international good practices on solid waste management.

#### 3.1 Component 1: Waste Collection & Transport to SWMF

120. The operational modalities devised for successful implementation of this component are provided below.

##### 3.1.1 Existing and proposed waste collection system in Kohat

121. The existing system of SWM by the Water and Sanitation Services Kohat (WSSCK) is a continuation of the traditional system that was being managed by the Tehsil Municipal Administration (TMAs). Equipment used for waste collection includes the collection bins,

containers, rickshaws, trucks, trolleys and compactors. The **Table 3.1** below details the waste generation area and mode of waste collection and proposed improved practice for IWMS for Kohat city.

**Table 3.1: Modes of Waste Collection**

<b>Waste Generation Area</b>	<b>Mode of Collection</b>	<b>Existing Practice</b>	<b>Proposed Improvements in existing practices</b>
<b>Residential Units</b>	Door to door collection using compactors, mini dumper, motorcycle rickshaws or handcart depending on accessibility.	Information about timing of waste collection is provided to residents. WSSC complaint number and area supervisors' contact details are publically available.	Awareness among general public to encourage door to door collection of solid waste is proposed.
<b>Commercial areas</b>	Placing of communal bins or containers for large commercial area Door to door collection for business in residential area.	Optimized timing of waste collection vis-a-vis commercial activities.	Underground bins are proposed where containers cannot be placed due to congestion and less space.  Waste segregation at source particularly in commercial areas and institutional buildings is proposed.  Periodic awareness campaigns by WSSCs with respect to waste segregation in commercial areas and institutional buildings are proposed.  It is proposed that WSSCs shall support/facilitate commercial markets committees and institutes in developing color coded waste collection system to promote segregation at the source.
<b>Construction Demolition Waste</b>	Construction waste is collected through use of special vehicles usually dump trucks along with loader	WSSC is collecting waste free of charge.	Protocols for builders to pay for debris removals are proposed.
<b>Animal Waste</b>	No organized mode of collection is available.	WSSC is collecting waste through use of special vehicle.	Organized waste collection system of animal waste is proposed as this waste can be used for composting.
<b>Institutional Waste</b>	Communal storage outside premises	WSSC is collecting waste from communal containers.	Placing of appropriate containers within premises of institutes by WSSCs is

<b>Waste Generation Area</b>	<b>Mode of Collection</b>	<b>Existing Practice</b>	<b>Proposed Improvements in existing practices</b>
			proposed. Such container will be emptied by WSSCs at regular interval.
<b>Hospital Waste</b>	Communal storage within premises	Non-hazardous municipal waste is being collected by WSSC. Infectious waste is being mixed with municipal waste by healthcare facilities.	Treatment of infectious waste within hospital premises is proposed to avoid its reach at landfill site.

**Figure 3-1: Modes of waste collection in Kohat**

122. The Residential and Commercial waste collection process flows are provided as **Figure 3.2 and 3.3.**

123. The **Table 3.2** below provides the audit findings that was conducted to assess the existing activities being conducted from an environmental and social safeguards perspective and the required corrective measures that will be implemented.

**Figure 3-2: Residential Waste Collection Process Flow**



### **Figure 3-3: Commercial Waste Collection Process Flow**



**Table 3.2: Audit of Existing Facility and Required Corrective Actions**

S/No.	Component	Existing Practice	Required Corrective Action
1	<b>Storage of waste at source</b>	<ul style="list-style-type: none"> <li>▪ Lack of public awareness, motivation, and education</li> <li>▪ Lack of civic sense and bad habits of people to litter</li> <li>▪ Lack of cooperation from households, trade, and commerce</li> <li>▪ Lack of litter bins in the city</li> <li>▪ Long distance between community bin</li> <li>▪ Resistance to change the public attitude</li> </ul>	<ul style="list-style-type: none"> <li>▪ Door to Door collection will reduce littering in the streets</li> <li>▪ Strong behavior change communication programs will improve citizen's behavior.</li> <li>▪ Removal of roadside communal bins would have a major impact on the street environs.</li> </ul>
2	<b>Segregation of recyclables</b>	<ul style="list-style-type: none"> <li>▪ Lack of wide publicity through electronic and print media</li> <li>▪ Lack of public awareness and motivation, resulting in poor response from citizens</li> <li>▪ Lack of citizens' understanding how to use separate bins for storage of recyclables</li> <li>▪ Lack of sufficient knowledge of benefits of segregation</li> <li>▪ Lack of cooperation and negative attitude of people</li> <li>▪ Lack of finances to create awareness</li> <li>▪ Difficulty of educating scavengers</li> <li>▪ Absence of by-laws</li> </ul>	<ul style="list-style-type: none"> <li>▪ Segregation and materials recovery facilities will be developed at the transfer stations &amp; /or at the LFS;</li> <li>▪ Refuse Derived Fuel (RDF), facility shall be made part of the MRF;</li> <li>▪ Organic component of waste shall be converted to organic compost;</li> <li>▪ In the medium term (3rd year onwards), efforts will be made to encourage segregation at source, with a 2-bin system.</li> </ul>
3	<b>Collection</b>	<ul style="list-style-type: none"> <li>▪ Citizens throw waste on streets instead of communal bins.</li> <li>▪ Workers need to collect all scattered waste manually.</li> <li>▪ Multiple transactions of waste till disposal site</li> <li>▪ Lack of awareness and motivation</li> <li>▪ Unavailability of adequate primary collection vehicles like mini tippers, handcarts etc.</li> <li>▪ Insufficient response from citizens</li> </ul>	<ul style="list-style-type: none"> <li>▪ Improved citizens behavior throw communication programs would encourage better management of waste;</li> <li>▪ Collection vehicles pool will be suited to door to door collection;</li> <li>▪ All collection staff will have PEP, in order to safeguard their health and safety;</li> <li>▪ Citizens will hold the key to accountability, to ensure that the daily door to door collection is performed.</li> </ul>
4	<b>Daily sweeping of streets</b>	<ul style="list-style-type: none"> <li>▪ 100% manual sweeping system makes difficult for the sanitary workers to cover WSSP jurisdiction each day.</li> <li>▪ Manual attendance management system is inefficient and leads to inefficiencies.</li> <li>▪ Unavailability of workers on Sundays and public holidays</li> </ul>	<ul style="list-style-type: none"> <li>▪ With full Door to Door collection, the need for daily sweeping of all streets will be minimized to max twice a week;</li> <li>▪ Focus will be on outcome-based indicators and not running after the workers attendance.</li> <li>▪ No need to sweep on Sundays.</li> </ul>

5	<b>Communal Storage</b>	<ul style="list-style-type: none"> <li>▪ Shortage of containers</li> <li>▪ Lack of financial resources leading to broken and ill maintained bins;</li> <li>▪ Lack of planning for waste storage depots or temporary storage locations;</li> <li>▪ Inaccessible areas and narrow lanes that do not allow sufficient space for container</li> </ul>	<ul style="list-style-type: none"> <li>▪ All unnecessary communal storage points in residential areas shall be removed.</li> <li>▪ No containers, no throwing by households into the streets;</li> <li>▪ Only commercial areas and institutions will have communal bins;</li> <li>▪ User charges will be levied to induce financial sustainability.</li> </ul>
6	<b>Transportation &amp; Transfer Stations</b>	<ul style="list-style-type: none"> <li>▪ Many open vehicles for transport</li> <li>▪ Old vehicles that are difficult to replace</li> <li>▪ No route planning</li> <li>▪ No scheduling for lifting of containers</li> <li>▪ Lack of or no transfer stations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Waste will be carried out in fully covered vehicles, in order to avoid any littering and pollution.</li> <li>▪ Number of vehicles will be minimized, with transfer stations and larger hauling containers.</li> <li>▪ Environment friendly transfer facilities with dust &amp; odor control.</li> </ul>
7	<b>Waste Treatment</b>	<ul style="list-style-type: none"> <li>▪ Hardly any waste treatment in the formal sector - Lack of technical know-how for a scaled-up treatment facility</li> <li>▪ Lack of institutional capacity - No success story in the country</li> </ul>	<ul style="list-style-type: none"> <li>▪ Materials Recovery Facility (MRF) will be an integral component of the treatment and disposal system.</li> <li>▪ Options for Private sector participation will be explored in operations of the MRF centers.</li> <li>▪ Specialized skilled workers will be operating the transfer stations, and MRF.</li> </ul>
8	<b>Disposal of Waste</b>	<ul style="list-style-type: none"> <li>▪ Lack of financial resources for a scientifically designed land fill site;</li> <li>▪ Lack of technical personnel for LFS management;</li> <li>▪ Lack of technical know-how for scientific disposal of waste</li> <li>▪ Unavailability of appropriate land - Lack of institutional capacity</li> </ul>	<ul style="list-style-type: none"> <li>▪ Landfill shall be properly designed and operated.</li> <li>▪ Segregation, MRF and Composting facilities will enhance the useful life of Landfill.</li> <li>▪ LFs shall have proper facilities like reception areas, weigh bridge, CCTV, RFID, access road, daily soil cover, security, lighting for 24 / 7 usage and professionally trained workers to operate and supervise.</li> </ul>

### 3.1.2 Procurement of SWM Equipment, Machinery and Vehicles

124. The project design consultant, Engineering Design Construction Management (EDCM), has analyzed the future waste generation of the city and identified SWM equipment, machinery and vehicle requirements for current year and for project life span. The procurement plan has been established based on the review of existing waste collection fleet of WSSCK and taking into consideration the current total available volumetric capacity of WSSCK. Estimating waste generation figures is difficult, based only on one waste characterization, however, with the available information it is estimated that, approximately 150 t/d waste is generated in the city and the waste generation is projected from 2020 to 2030. Any system would be designed keeping in view the next 10 years requirements when the waste generation would be around 180-220 t/d. PMU/WSSC will adopt energy conservation strategies through procurement of energy efficient equipment and vehicles. WSSC will consider optimization of such equipment/machinery during operation phase to adopt energy conservation.
125. Proposed procurement of SWM fleet for solid waste carrying machinery, non-waste carrying machinery and future machinery requirements for year 2030 are shown in **Tables 3.3, 3.4 and 3.5** below.

**Table 3.3: Current SWM Waste Carrying Machinery Procurement**

Machinery	Vol. Cap m <sup>3</sup>	Total Required	Additional 10%
Minitippers 1m <sup>3</sup>	13	13	14
Minitippers 2m <sup>3</sup>	24	12	14
Compactors 07m <sup>3</sup>	75	11	12
Compactors 13m <sup>3</sup>	140	12	13
Dumpers 10m <sup>3</sup>	84	08	10
<b>Total</b>	<b>348</b>	<b>55</b>	<b>63</b>

**Table 3.4: Current Non-waste Carrying Machinery Procurement**

S/N	Machinery	Qty	Working (Km's)/Machinery	Total daily Working (Km's)
1	Mechanical Sweeper – Vacuum	02	35	70
2	Mechanical Sweeper – Tractor	03	20	60
3	Mechanical Washer	03	15	45
4	Drainovator	02	10	20
5	Green Shredders	03	As required	
6	Tractor Loaders	03	As Required	
<b>Total</b>		<b>16</b>		

**Table 3.5: Total SWM Fleet Required**

Source	Machinery	Year			
		2,021		2,030	
		No's	Vol. Cap m <sup>3</sup>	No's	Vol. Cap m <sup>3</sup>
<b>Residential Waste Collection</b>	Mini Tipper 1m <sup>3</sup>	13	13	15	16
	Mini Tipper 2m <sup>3</sup>	09	18	11	22
	Compactor 7m <sup>3</sup>	11	75	13	98
	Hand Carts	162		194	
<b>Commercial Waste Collection</b>	Compactor 13m <sup>3</sup>	03	41	04	52
	Mini Tipper 2m <sup>3</sup>	03	06	05	10
	Hand Carts	101		121	
<b>Bulk Waste</b>	Dumpers 10 m <sup>3</sup>	09	84	10	110
<b>Secondary Residential Waste</b>	Compactor 13m <sup>3</sup>	08	99	09	130
<b>Lifting Machinery</b>	Tractor Loader	03		05	
<b>Total (Excl. Handcarts)</b>		<b>59</b>	<b>336<sup>3</sup></b>	<b>72</b>	<b>407</b>

### 3.1.3 Waste Transport

126. In the case of residential areas, the handcarts, Minitippers and compactor (7m<sup>3</sup>) shall be deployed to collect the waste from each household on a defined schedule, whereas the compactor (13 m<sup>3</sup>) shall be used as mobile transfer stations, which shall receive waste from Minitippers and in some cases handcarts as well. Both the compactor types shall finally go to the landfill site for final disposal.
127. In the case of commercial areas, 13m<sup>3</sup> compactors shall be used for two purposes, i.e. as a mobile TS and also to collect waste from bins. The waste collected via handcarts shall be transferred either directly to the mini tipper or compactor, which shall be parked at locations in commercial areas and upon receiving a full load of 8 tons, shall move towards the landfill site.

### 3.1.4 Transfer Stations

128. In order to improve the overall waste management system and urban environment, waste transfer stations would be developed and used to minimize the number of smaller vehicles commute to the Landfill site, thus reducing negative environmental impact. Depending upon the site, location and collection vehicles, we can have one of three types of transfer stations. Currently, only Mini and Mobile transfer stations are proposed for SWMF of Kohat as the city is small and hauling routes are also short.

<sup>3</sup> In table 9, values for the volumetric capacity are rounded up and are not presented in fractional form. Since the table is driven from excel work sheet and with rounded up numbers, the final numbers may little vary

- **Mini Transfer Station** – Arm Roll vehicles containers of 15-20 m<sup>3</sup> size, placed along a ramp in enclosures
- **Mobile Transfer Station for vehicle to vehicle transfer** – where space is constrained, large vehicles, like compactor trucks, could be used for emptying small collection vehicles.
- **Main Transfer Station** – for transport convergence into trailers. These transfer stations could be coupled with segregation or Material Recovery Facilities (MRFs), reducing load on the actual landfill site. Transfer stations will serve for transfer of waste from small capacity to large capacity vehicles to haul waste at SWMF. Waste management plan for transfer stations will be prepared prior to start of operations by the WSSCK. Main transfer stations in Kohat shall be constructed, if required in future.

## 3.2 Component 2: SWMF Development & Operation

### 3.2.1 Objective of SWMF Development

129. The proposed SWMF is an urban development project with the objective of providing waste collection and disposal services for the residents of Kohat city. The project aims to benefit the current population of approximately 0.35 million that are estimated to increase to about 0.59 million by 2043 (i.e. an estimated project life of 20 years). The project is designed with the objective to cater to adverse environmental impacts from uncontrolled dumping and last of a proper solid waste management system:

- Haphazard waste spread in nearby agriculture lands
- Odor problems due to emission of CH<sub>4</sub>, SO<sub>2</sub> and H<sub>2</sub>S
- Risk of vector spread
- Risk of fire and explosion of dump site gas
- Uncontrolled leachate infiltration causing land degradation
- Surface water and groundwater pollution
- Aesthetic Impacts of the open dumpsite
- Economic loss due to disposal of recyclable materials
- Increased scavenging activity in the Kohat

### 3.2.2 Capacity of SWMF

130. Comparison of the prevalent technologies and waste characterization results for Kohat city indicates that incineration may not be suitable considering the high moisture content and organic fraction; and composting, bio-methanation and MBT are relatively more suitable technologies. Bio-methanation as a technology is highly sensitive and requires highly segregated waste or pre-processing of waste to make it successful.
131. Hence, Bio-methanation is suggested as a technology for processing the entire organic waste of Kohat (can be used only for segregated waste from hotels and market places that can be up to 30 tons/day and reject of the MRF facility making a total of around

100tpd). Composting technology is also a proven technology, but it failed badly with respect to the amount of rejects it transfers to the landfill (40-50%) and in terms of acceptability of the compost from the mixed waste. Mechanical Biological Processing Technology is found relatively more suitable, adaptable and flexible technology for the type of waste generated in Kohat. Project design report has proposed a set of mechanical & biological treatment (MBT) options after detailed techno-economic assessment:

- Sorting line with capacity of 120-150 tpd consisting of bags opener, trommel screens, magnets, ballistic separator and baling units.
- 30 tpd of the green waste collected from the hotels, restaurants, fruits and vegetable markets will be used for the anaerobic digestion.
- After sorting and segregation, 100-120 tpd green waste will be subjected to Anaerobic Digestion and subsequent composting using aerated piles.
- Approximately 60 tpd of RDF will be produced which may be sold to the cement industries or brick kilns.
- Around 3- 5tpd recyclables will be sorted which may be sold to the recycling industry.
- Remaining 2-5 tpd of the inert waste will be landfilled.
- Landfill area would comprise of number of waste cells separated by access road for each cell, liner system at the bottom and provision of daily cover during the active phase of operation of each cell. Every cell will include gas and leachate collection piping network which will be transported on site for treatment and disposal. Other than the technical components of landfill, the site will house administration building, weighbridge for recording incoming waste data, wheel washing and parking yard.

132. The process flow of the proposed SWMF for Kohat is provided in **Figure 3-4** while the key plan for the proposed facility is provided as **Figure 3-5** below.

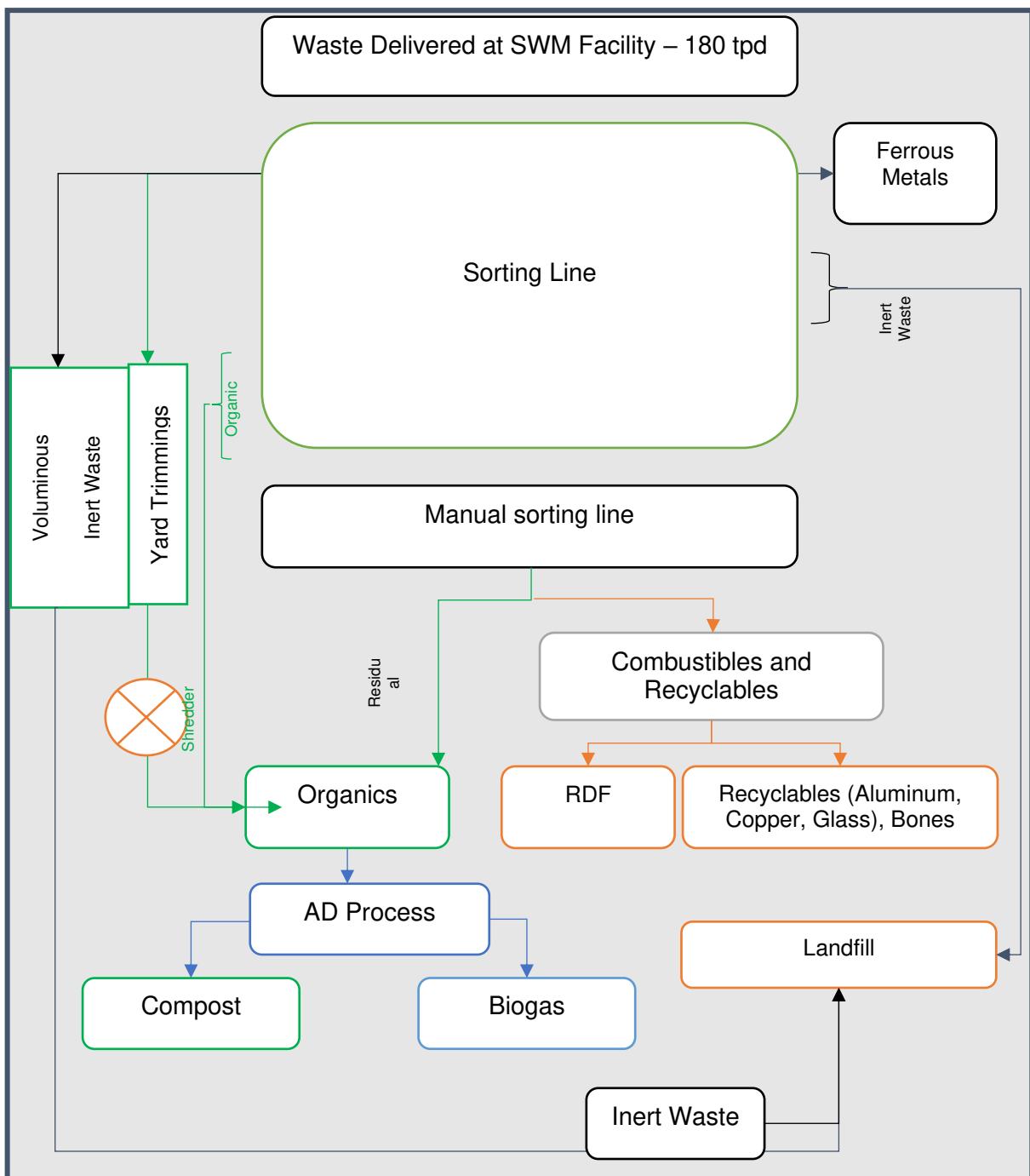
### **3.2.3 Scope of Works for SWMF development**

133. In order to understand the impact of all the project phases to the receiving environment, it is necessary to provide details of the activities to be performed, its magnitude and duration.
134. The general step wise sequence of activities to be conducted for the SWMF development are described below. It shall be ensured that staging of activities takes place to manage any potential impacts, including traffic management issues.

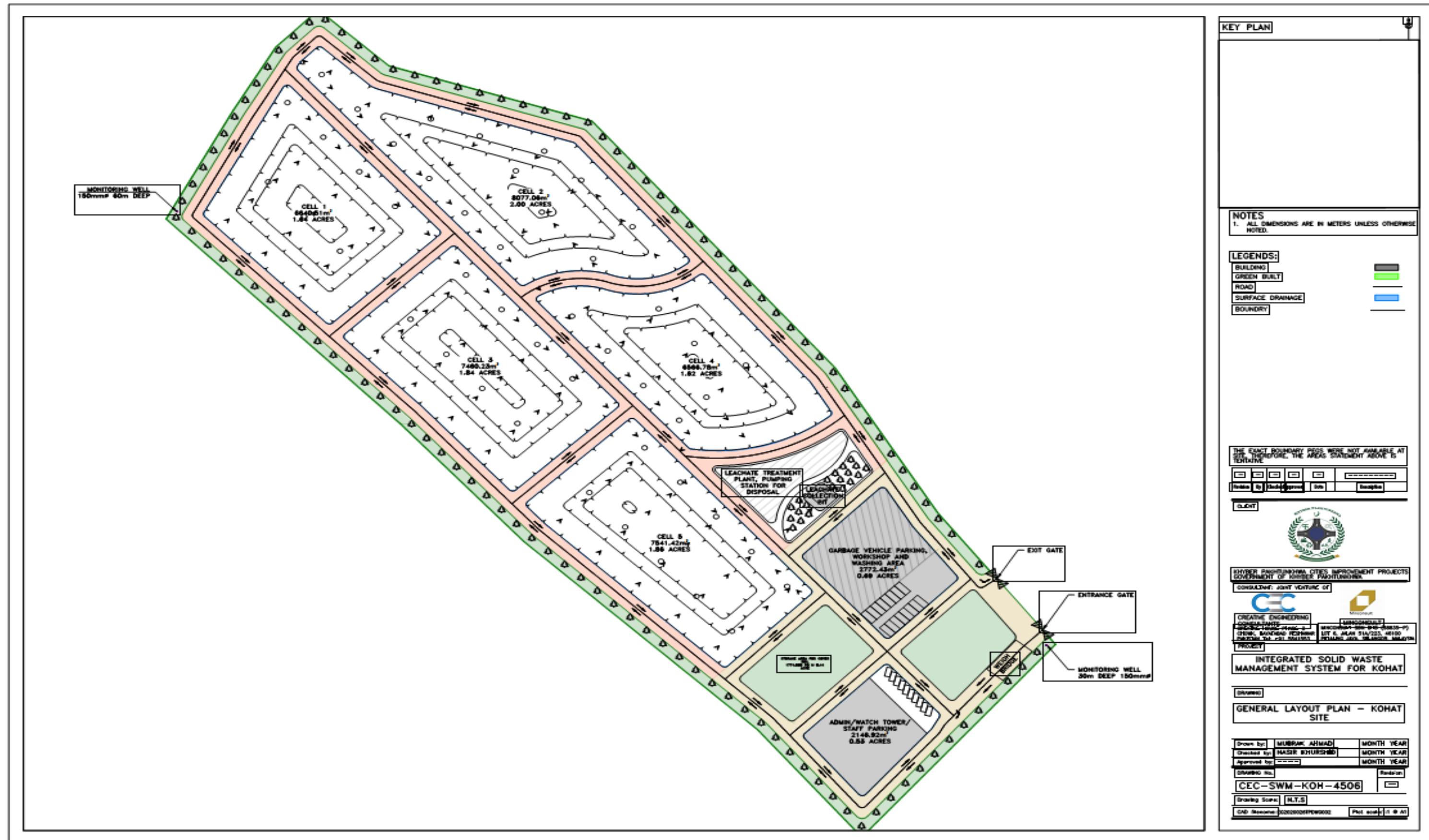
#### ***Pre-Construction phase activities***

135. The following activities have already been completed by PMU KPCIP and Engineering Design Construction Management (EDCM) consultant:
- PMU and EDCM consultant mobilization
  - Situation analysis and condition assessment

- Geotechnical and topographic survey
- Detailed Engineering Design
- Social safeguard assessment
- Preparation of tender document, cost estimates and BOQs

**Figure 3-4: Proposed SWM Facility for Kohat**

**Figure 3-5: Key Layout map of Kohat SWMF**



### 3.2.4 Project Need

136. Out of the 110 tons of waste generated per day in Kohat city, an estimated 53.6% comes from households and the rest from other sources, including bulk waste. At source storage of waste is yet not practiced in Kohat city as most households, shops, and establishments throw their waste just outside their premises, on streets, in drains, in open spaces, in water bodies, and in other inappropriate places.
137. Considering the climatic conditions of Kohat City, where humidity is moderate and temperatures provides a conducive environment for the microbes to rapidly degrade, the organic fraction of the waste which produce smell and attract animals, thus contributing to spread of filth and disease. Furthermore, there is common practice of burning waste which poses an even greater risk to safety of neighboring households.
138. Throwing of waste into the running water body, such as stream or a canal, is a common practice. WSSCK aims to counter these practices and has deployed containers and litter bins on main roads and streets. Sanitary workers, after sweeping the streets, collect waste in wheelbarrows to their designated waste storage points in the area, usually containers.
139. Proposed installation of primary and secondary MSW collection systems and the development of an international standard MSW management facility have been designed to address SWM issues of Kohat city.

### 3.2.5 Rationale for Site Selection

140. The proposed SWMF has been selected on the basis that it must comply with basic KP government regulations, IFC EHS guidelines for waste management facilities and the ADB SPS, 2009. Proposed selection of this SWMF must consider impacts from leachate, litter, dust, vector and odor on surrounding environment. The various factors that have been kept in focus while selecting the proposed SWMF site are provided in **Table 3.6** below.

**Table 3.6: Criteria for Site Selection**

Factors considered for site selection	Rational for Site Selection
Landfill area and capacity to meet requirement of landfill site	There is adequate land area (approx. 27 acres) available at the proposed site which can be used for landfilling for next 20 years.
Accessibility of landfill site	Site is accessible through already developed road network in the project area. Transfer distance is about 3 km from Hangu Bypass road.
Site Stability	Site is located outside areas susceptible to natural or human-induced events or forces capable of impairing the integrity of landfill components. Examples of unstable areas are those with poor foundation conditions, areas susceptible to mass movements (landslides, rock falls, etc.) and areas with karst terrains (sinkholes). Geotechnical report has been carried out for the site and design is based on the findings of this report.

<b>Factors considered for site selection</b>	<b>Rational for Site Selection</b>
Land Use	The site is not presently in use for any specific purpose
Critical Habitat/Sensitive ecosystem	Site is falling outside of critical habitats of plants, wildlife and sensitive ecosystems.
Restricted Zone, Wildlife/Forest Protected areas	Site is falling outside of restricted zone/wildlife/forest protected areas.
Site should be located outside of the 10-year groundwater recharge area for existing or pending water supply development	Site is located outside of the 10-year groundwater recharge area for existing or pending water supply development. However, the area naturally causes the subsoil water recharge during the high rainy seasons.
Perennial stream	No perennial stream is present in the project area, The bottom lining of each landfill cell and leachate collection system will ensure that no contamination of groundwater takes place. Surface drainage network has been provided in the detailed design to avoid risk of surface runoff and contamination.
Topography	Landfill site is located in mildly sloped topography.
Ground Water Table	<p>The groundwater table was encountered lower than 11 m below existing ground level in boreholes during geotechnical investigation in June 2020.</p> <p>Considering the high-water table, it will be ensured that the landfill operation is conducted from the EGL upwards to ensure no groundwater contamination takes place.</p>
Flood plain & other climate risks	<p>Site is located outside of flood plain, however, in case of high precipitation there are chances of urban flooding. Surface drainage network has been provided in detail design of landfill site to avoid risk of surface runoff and contamination.</p> <p>Please refer to <b>Section 3.3</b> below for a detailed assessment of the climate risks facing the project.</p>
Seismic Risk/Fault lines	Site is located outside of seismically active area as it falls in Zone 2B with peak ground acceleration (PGA) in range of 0.16g to 0.24g on seismic map of Pakistan. No fault lines or significantly fractured geologic structure is present within 500 meters of the perimeter of the proposed landfill cell development that may allow unpredictable movement of gas or leachate.

<b>Factors considered for site selection</b>	<b>Rational for Site Selection</b>
Private/ Public water supply wells	No private and/or public water supply wells are located in the project area.
Airports	Airport is located at a distance of about 46 km from the site; therefore, no impacts of scavenging birds are anticipated on flight operations.
Sensitive Receptors	There are no sensitive receptors in the project area of the proposed landfill site Furthermore, LARP is in process for site.

### 3.2.6 Proposed Design Considerations for SWMF

141. The design selection has a major influence on the construction, operation and restoration of the facility. The design concept depends on the ground conditions, the geology and hydrogeology of the site, the potential environmental impacts and the location of the waste disposal site. In order to incorporate advancement in technology and changes, a periodic review of the design shall be carried out, as the lifespan of a disposal site from commencement to completion is long compared to other construction projects. Aspects that have been considered in the design are briefly discussed below.

#### ***Nature and Quantity of the Waste***

142. Nature of waste that will be landfilled at Kohat would be only MSW. It is regarded as waste generated by households and waste of similar nature generated by commercial and industrial premises, institutions such as schools, hospitals and other facilities inhabited by people, construction and demolition of buildings, and from public spaces such as streets, markets, slaughter houses, public toilets, bus stops, parks and gardens.
143. As per the estimates, Kohat city generates about 110 tons of waste per day in 2020. For the purpose of calculation of useful life of landfill, if 25% extra waste generated from all other sources is factored-in, total waste reaching the landfill is considered to be 169 tons in 2025. Main criteria used for estimation waste generation rate is given in **Table 3-7** below.

**Table 3.7: Waste Generation Estimation Criteria**

<b>Criteria</b>	<b>Description</b>
SWM Planning Horizon (2020-2030)	10 Years
Population	Projections based on 1998 Census
Population growth rate (%)	2.13%
Per Capita Waste Generation	0.33 Kg/ca/d

<b>Criteria</b>	<b>Description</b>
Per capita waste generation annual increment (%)	1.5%
Additional allowance (%)	25%
Loose waste density (kg/m <sup>3</sup> )	305

144. For waste projection in the future, an annual growth rate of 1.5 % is applied to current waste generation of 0.33 kg/ca/d. Similarly, population projection is also made at the population growth rate as suggested by Pakistan Bureau of Statistics at 2.13% annually. Kohat has a total waste generation rate of 110 tons per day in 2020. For purposes of design for waste treatment, the calculation has been made at 169 tpd, considering the growth till 2025. Keeping in view the infrastructure investment required for landfill, 20 years useful life of landfill is considered for design.

#### ***Protection of Soil and Water***

145. Bottom and cap lining system for each landfill cell has been designed for the protection of soil, groundwater and surface runoff. The liner system may consist of a natural or artificially established mineral layer combined with a geo-synthetic liner that must meet prescribed permeability and thickness requirements.

#### ***Leachate Control and Management***

146. An efficient leachate collection system has been provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum. The leachate system will consist of a leachate collection layer of either natural granular (sand, gravel) or synthetic drainage material (e.g. geonet or geo-composite) with pipe network to convey the leachate to treatment facility.

#### ***Gas Control***

147. The accumulation and migration of gases from landfill facility will be controlled. Landfill gas will be collected through installation of perforated pipes within the cells. At start of landfill operation, venting is proposed as small quantity of gas will be produced. The passive gas collection system is planned with simple venting of landfill gas to the atmosphere without any treatment before release. This is appropriate, considering that only a small quantity of gas is produced and no people live or work nearby. Common methods to treat landfill gas include combustion and non-combustion technologies, as well as odor control technologies. For the landfill operations, after few years when significant quantity of gas is produced, open flame flare technology, consisting of a pipe through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow is proposed. The simplicity of the design and operation of an open flame flare is an advantage of this technology.

#### ***Odor/Litter/Vector Control***

148. Daily cover will be provided at end of each day to avoid risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill. Working surface of waste will be covered

with a soil layer called “daily cover” at the end of each working day. Amount of soil to be used in daily cover will be about 10% of the waste volume. Suitable quality of excavated material can be used as daily cover material.

### ***Stability***

149. Consideration has been given to the stability of the sub-grade, the base liner system, the waste mass and the capping system. The sub-grade and the base liner will be sufficiently stable to prevent excessive settlement or slippage.

### ***Visual Appearance and Landscape***

150. Consideration has been given to the visual appearance of the landfill site during operation and at termination of landfill site and its impact on the surrounding landforms. Necessary plantation will be carried out which will act as buffer zone from surrounding environment. Reasonable area has been allocated for plantation within and at boundary of facility to improve landscape of the area.

### ***Operational and Restoration Requirements***

151. Landfill will be operationalized in a phased manner. Site infrastructure has been included for the provision of; administration building, lookout tower, weighbridge, waste inspection area, wheel wash area, site services and security fencing to meet operational and restoration requirement.

### ***Monitoring Requirements***

152. One groundwater monitoring well was maintained out of the drills made for geotechnical investigation. However, more wells may be constructed, if required once the landfill starts operation.

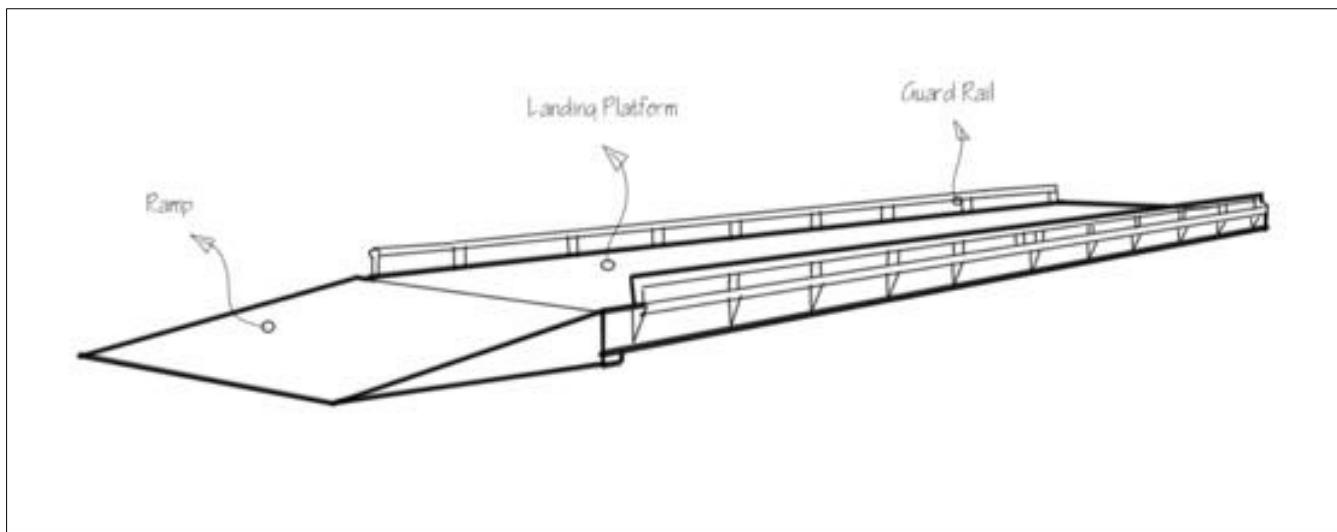
#### **3.2.7 Detailed Process Description**

153. Following are the major operations that will be performed at the SWMF in Kohat:
  - Reception of the incoming waste stream;
  - Placement and volume reduction of the waste through mobile compactors such as bulldozers;
  - Installation of material recovery facility, Aerobic Digestion (AD) system and composting; and
  - Installation of the landfill and environment control facilities
154. In a SWMF, waste is spread in thin layers, compacted to the smallest practical volume and covered with the soil or other suitable material at the end of each day. When the disposal site reaches its ultimate capacity, a final layer of cover material is applied.
155. The detailed process description for disposal of MSW at the proposed site is presented in the following sections.

### **Weigh Bridge and Unloading Bay**

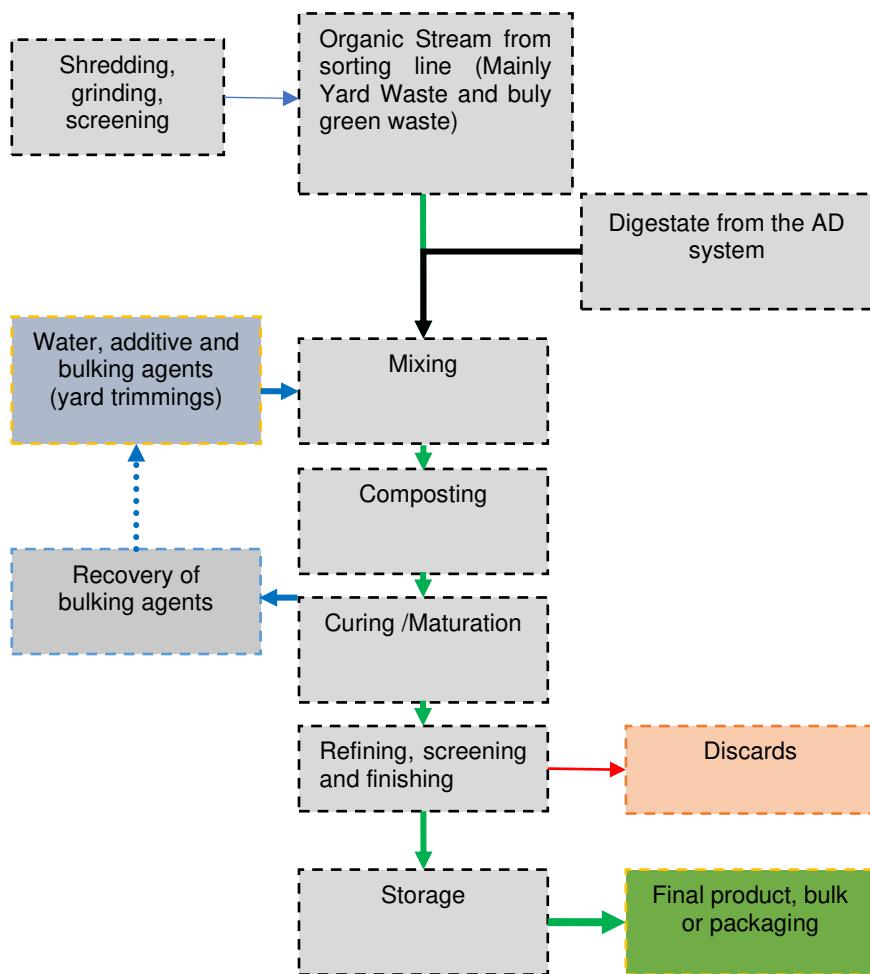
156. Prior to the unloading, the trucks will pass over a weight bridge to determine the exact amount of collected garbage from the city every day. In order to minimize the solid waste collection vehicle's circulation inside the landfill boundary and to reduce emissions and odours, an unloading bay has been incorporated in the design. To reduce the possibility of littering, incoming collection vehicles will empty the waste on the tipping floor outside the building to reduce the circulation at the site. Weighbridge of 100 tons capacity will be installed at the entrance gate for Kohat landfill site. A pit type weigh bridge of size 20x5 m having modular cubical bolting assembly will be installed on steel platform which will be fixed on RCC raft. Schematic diagram of weighbridge is shown in **Figure 3-6** below.

**Figure 3-6: Schematic Diagram of Weigh Bridge**



### **Composting and Biogenerators**

157. During the detail design phase, feasibility of choice of organic waste treatment has been discussed in detail, nonetheless, area for biological treatment of organic waste has been set aside. All the waste collected from the city will first reach MRF for sorting and segregation. From there, organic waste and residual waste will be transported to bio digester and composting area for final treatment and disposal. Compost pad of Plain Cement Concrete (PCC) will be constructed for windrow composting. After segregation and sorting, the yard waste will be sent to AD system where it will be dried and then sent to composting process.
158. The general process flow diagram for the AD system and composting facility is provided as **Figure 3-7**.

**Figure 3-7: General process flow diagram for AD System and Composting**

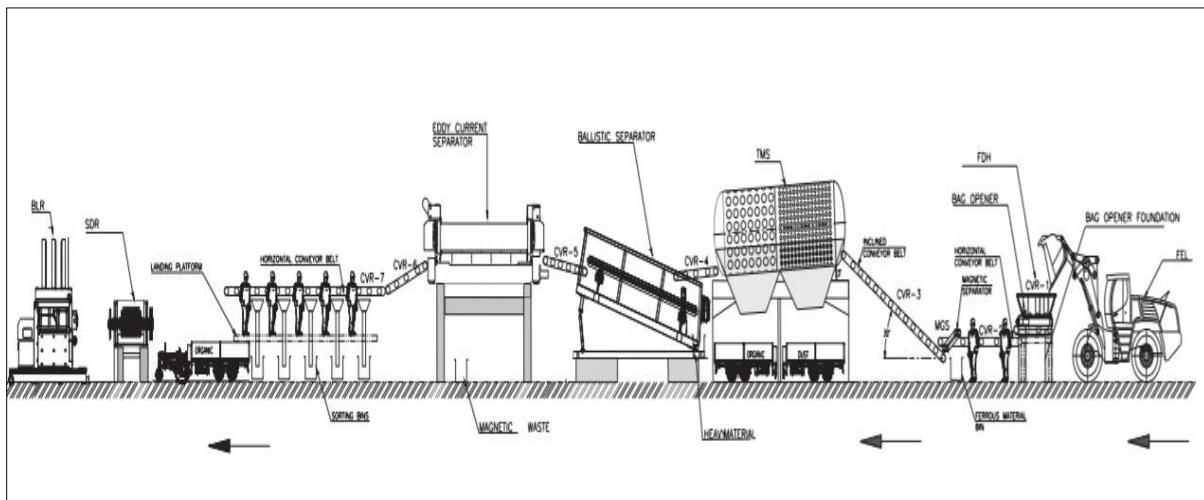
159. Typical preparation steps include: (a) sorting of salvageable material (b) removal of non-putrescible (c) grinding (d) addition of wastewater sludge if necessary. Following conditions are essential for effective composting. For optimum results, the size of the waste should lie between 2 and 8 cm. Size reduction is accomplished through shredding. Sufficient number of microorganisms must be present to perform digestion and so sewage sludge is added for this purpose. The following conditions will be achieved for composting of MSW:
- C/N ratio should be 30 to 50;
  - C/P ratio should be 100 or less;
  - Moisture content should be 50 to 60%. Addition of water is done to raise moisture contents, if required;
  - pH should vary between 5.5 to 8.5 throughout the process;
  - Air should be thoroughly dispersed throughout the organic waste. This is done by frequently turning and mixing the wastes;

- Temperature should be maintained between 50 to 60°C for active composting period.
160. For Aerobic digestion system (AD system), the following options are proposed:
- Wet or dry AD;
  - Single or two stage ADS;
  - Thermophilic or mesophilic AD;
  - Continuous, plug flow or batch AD.
161. The design decisions would need to be combined with pre-treatment decisions to create an overall AD design which would best meet the needs of the project, depending upon the waste characterization. Project design report suggests that AD system should not be prescribed at this stage and KP government may invite AD vendors/EPC contractors to provide customized approaches to AD and pre-treatment options.
162. WSSCK/GoKP may set out performance specifications that AD vendors/EPC Contractor will need to meet and vendors/EPC Contractor will pick the combination of technologies and approaches which they feel will work best for the feedstock to be treated. For example, a dry AD vendor could put a wet pre-processing system on the front end of their system. Understanding risks and benefits is important background, but this information should not be used in making a procurement decision (either by dictating requirements in an RFP and/or in the evaluation of proposals). Specifying the AD system design at this stage may limit the competition and thereby cost escalation of the proposed system.

### ***Material Recovery Facility (MRF)***

163. The MRF area is located adjacent to landfill facility. The sorting area will be constructed with steel structures for roof with a ceiling height reaching approximately two stories' high. Dedicated machinery will be provided for sorting and segregation area such as a front-end loader and fork lifter. Process flow description is provided in **Figure 3-8** below.

**Figure 3-8: Process flow of Material Sorting Facility**



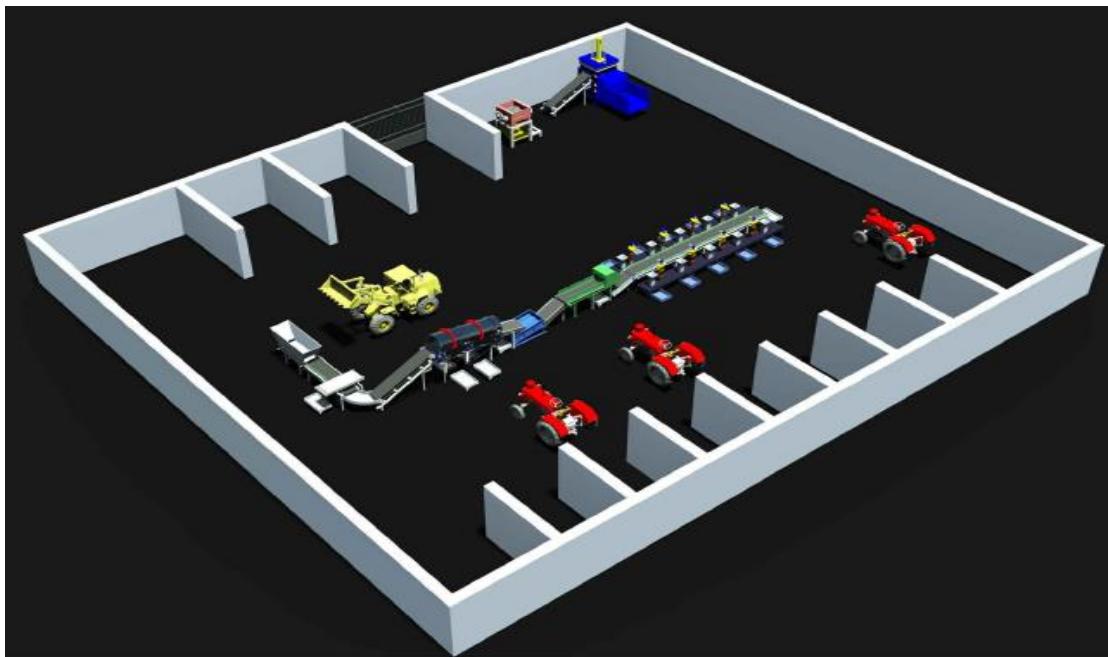
164. The operations involved in MSF are as follows:

- Waste will be off-loaded on a tipping floor at the MRF. The floor is divided into three chambers to ease the operations on first-in, first-out basis. The overall area can cater for 'two days' offloads, keeping a safety cushion for routine maintenance shutdowns.
- From tipping floor, front end loader will carry waste in batches and load into hopper.
- A bag opener is installed at the beginning of the segregation process. It will be used to open the closed bags. It will also work as a metering input device to control the throughput.
- After passing the bag opener, the waste will pass through a small horizontal conveyor belt, where larger components of the waste will be removed manually before entering other sorting equipment. The removal of large items from sorting line will not only safeguard the facility against unnecessary loading of bulk waste, but it will also save the mechanical equipment from avoidable wear and tear.
- At the end of pre-sorting conveyor belt, a magnet will be installed to recover ferrous metals.
- A Trommel screen with two distinct opening sizes of <90 mm and <6 mm is incorporated afterwards. Material below 90 mm is mostly organic, which will be dropped into trolleys placed right underneath the trommel. Once filled, the trolleys will be transported by tractors for further processing. As for the material < 6 mm which is primarily inert or fines, it will also be collected in a trolley and taken to landfill cells. This reject from MRF can be used as cover soil in waste cells.
- Waste stream after the trommel screen will pass from a Ballistic Separator and separated into two main streams: a) 3D or rolling fraction where all PET, HDPE, PP and other heavy fractions tend to jump towards the lower end of the system and b) 2D or flat fraction where all film and flat material tends to move upwards. During this process, material is continuously shaken and consequently the dust and 'fines' are screened by the perforated surface of the blades.
- Another chamber separates non-ferrous metals with the help of Eddy-Current technique of aluminum sorting.
- Afterwards, the material is fed onto a manual sorting conveyor belt located inside the picking station where plastics, glass, paper, cloth and other materials are picked before non-ferrous metals. Waste sorting manually will be collected in containers placed beneath the chutes, which will be emptied in their designated areas within the sorting facility. These materials can then be consolidated with the help of baler for ease of transportation.
- Recyclables and RDF materials are fed onto a baler automatically to be packed in the shape of blocks. These are then stored for transportation to market.
- Industrial size shredder is proposed for reducing the size of larger waste components.
  - The whole facility will have ventilation installed for creating a comfortable

environment for the waste picking team. The installed ventilation will also reduce the spread of COVID-19.

A 3D view of a typical MRF is provided as **Figure 3-9** below.

**Figure 3-9: 3D View of proposed MRF for SWM Facility - Kohat**



### 3.2.8 Construction of Landfill Facilities

165. Following activities are involved in construction of sanitary landfill:

- Landfill Cell Development
- Landfill Gas Management
- Leachate collection and treatment system
- Associated Infrastructure and Buildings

### 3.2.9 Landfill Cell Development

#### *Landfill Cell Size*

166. The landfill site is planned to contain 5 waste cells. The size of waste cell ranges between 1.62 to 2 acres. The leachate collection pond is planned to be positioned towards the eastern side of the site. An area is reserved for the leachate treatment facility next to leachate collection pond, which is proposed to be designed as activated sludge treatment with advance level treatments for heavy metals and other pollutants potentially present in leachate.

167. Layers of composite barrier will be constructed to prevent any percolation of leachate into groundwater. Excavation slopes will be maintained at 1:3 with five landfill cells of different sizes proposed for the landfill site and the location of the landfill cells is provided in **Figure 3-3** (project key plan). The size and depth of the proposed landfill cells are provided in **Table 3-8** below.

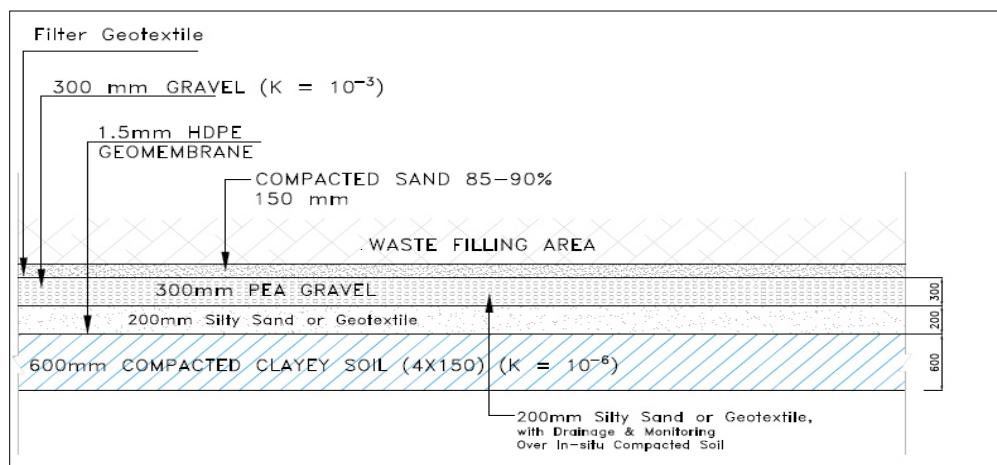
**Table 3.8: Size and Depth of Landfill Cells**

Landfill Cell ID	Size (Acres)
Landfill Cell-1	1.64
Landfill Cell-2	2
Landfill Cell-3	1.84
Landfill Cell-4	1.62
Landfill Cell-5	1.86

#### **Bottom Lining of Landfill Cells**

168. The liner system at the base of waste cells is aimed to protect the surrounding environment. It includes soil, groundwater and surface water protection through containment of leachate, controlling ingress of groundwater, and assisting in the control of the migration of landfill gas. The liner system must achieve consistent performance and has to be compatible with the expected leachate for the useful life of the facility. Bottom lining of the landfill cells will be carried out through provision of lining at subsoil comprising of plastic and clay material. Specifications of bottom liner designed for the proposed landfill are provided in **Figure 3-10** below.

**Figure 3-10: Bottom Liner of the Landfill Cells**



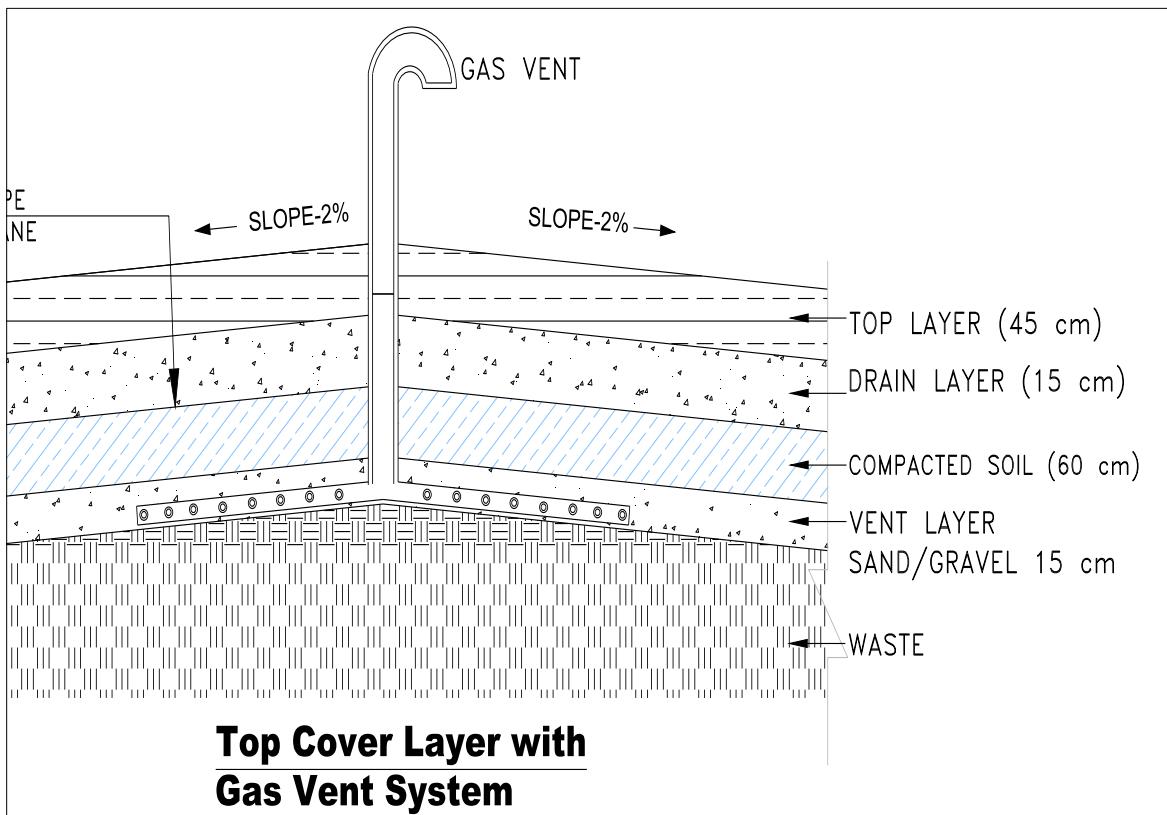
169. As illustrated in the **Figure 3.8** above, the specification of bottom lining of the proposed landfill site are as follows:

- A total of 600 mm clay liner of permeability of  $1 \times 10^{-6}$  cm/sec will be compacted at the bottom in series of 150mm layers each compacted to 95% of compaction, followed by 150 mm base layer for drainage and monitoring. This layer will be topped by 1.5 mm HDPE geomembrane.
- As soon as HDPE is placed, 200 mm silty sand will be covered on top of HDPE for the protection of the HDPE on the side slopes. The main purpose of this sand layer on top of HDPE geomembrane serves as leakage detection layer.
- Above this 300 mm PEA gravel layer will be placed followed by 150 mm compacted (85-90%) sand layer.

#### ***Final Capping Layer of Landfill Cell***

170. Final capping of landfill cells will be carried out in order to limit and control the amount of precipitation that enter the waste and to limit wind and water erosion and burrowing animals' activity. Main objectives of the capping system are: minimizing infiltration into landfill, maximize surface drainage and run-off and gas control migration.
171. The **Figure 3-11** below illustrates the typical final cover layer designed for landfill cells.

**Figure 3-11: Capping of Landfill**



172. The top cover system will consist of the following arrangements:

- Thick top soil layer of 45 cm capable of supporting vegetation in order to protect the landfill surface from wind and water erosion.
- Drain Layer of 15 cm at bottom to maximize runoff of precipitation while minimizing infiltration and preventing ponding of water on the landfill.
- Compacted soil layer or barrier of 60 cm of low permeability to limit and control the amount of precipitation that enters the waste.
- Vent layer of 15 cm thickness comprised of sand and gravel

#### **Daily Cover**

173. Daily cover is placed on working surface of waste in order to reduce the risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill. It is a soil layer and is placed on each working day. Generally, the amount of soil to be used in daily cover will be about 10% of the waste volume. Suitable amount of daily cover is usually stocked at the landfill sites during landfill cell excavation. However, any suitable excavated material from construction works can be used as daily cover.

#### **3.2.10 Landfill Gas Management**

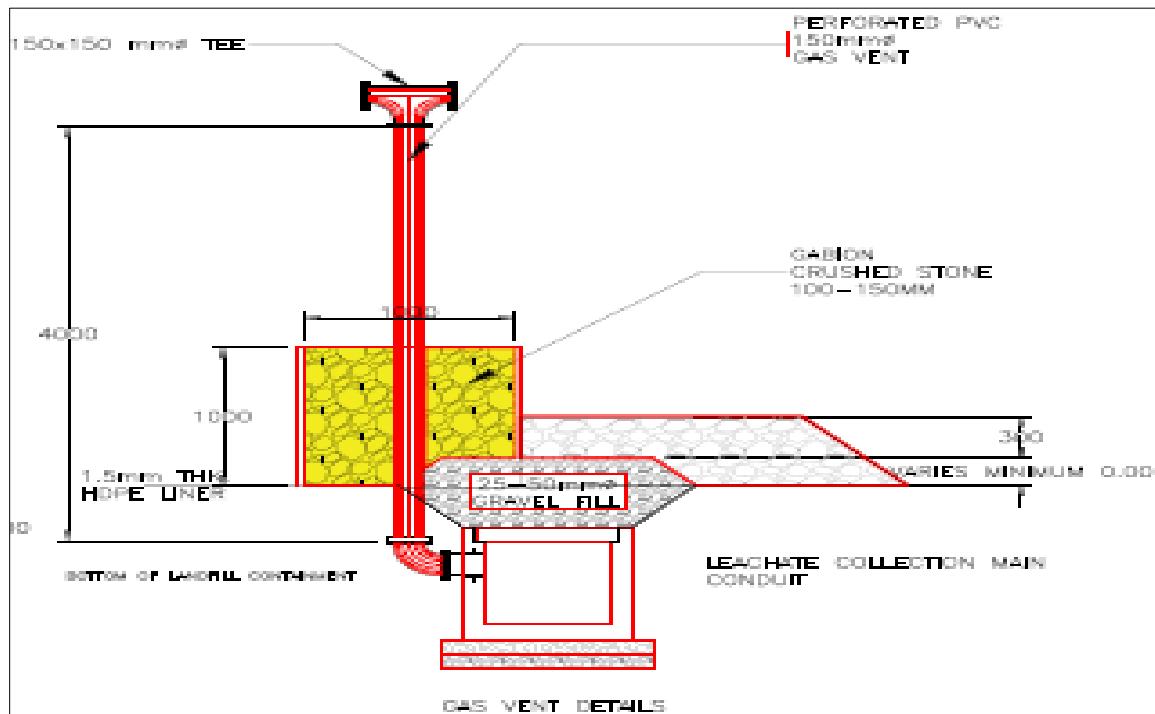
174. Landfill gas is produced through decomposition of organic fraction present in the MSW deposited to the landfill site by microbial activity. Landfill gas is composed of roughly 50 percent methane (the primary component of natural gas), 50 percent carbon dioxide (CO<sub>2</sub>) and a small amount of non-methane organic compounds. Methane is a potent greenhouse gas 28 to 36 times more effective than CO<sub>2</sub> at trapping heat in the atmosphere over a 100-year period, as per the latest Intergovernmental Panel on Climate Change (IPCC) assessment report (AR5)<sup>4</sup>. Methane possesses the combustible and explosive properties and also a Green House Gas responsible for global warming. In order to limit landfill gas entrance into environment and to avoid fire and explosive hazards, land fill gas collection system has been designed.
175. The average height of the waste body in waste cells is recommended at 25 meters. Therefore, vertical gas collection systems will be implemented in the facility. The gabion of the gas collection wells will be 1 m square filled with gravel, and these will be constructed with iron mesh. There will be a perforated HDPE pipe 150 mm in diameter and with pressure class of PN16 in the center of the gas collection wells. The gap between the iron mesh and the perforated pipe will be filled with 16/32 mm pebble stone. The proposed gas vent system designed for Kohat landfill site has been shown in **Figure 3.14** below.
176. At start of landfill operation, venting is proposed as small quantity of gas will be produced. The passive gas collection system is planned with simple venting of landfill gas to the atmosphere without any treatment before release. This is appropriate, considering that only a small quantity of gas is produced and no people live or work nearby. Common methods to treat landfill gas include combustion and non-combustion technologies, as well as odor control technologies. For KPCIP, landfill operations after few years when significant quantity of gas is produced open flame flare technology, consisting of a pipe

<sup>4</sup> <https://www.epa.gov/lmop/basic-information-about-landfill-gas>

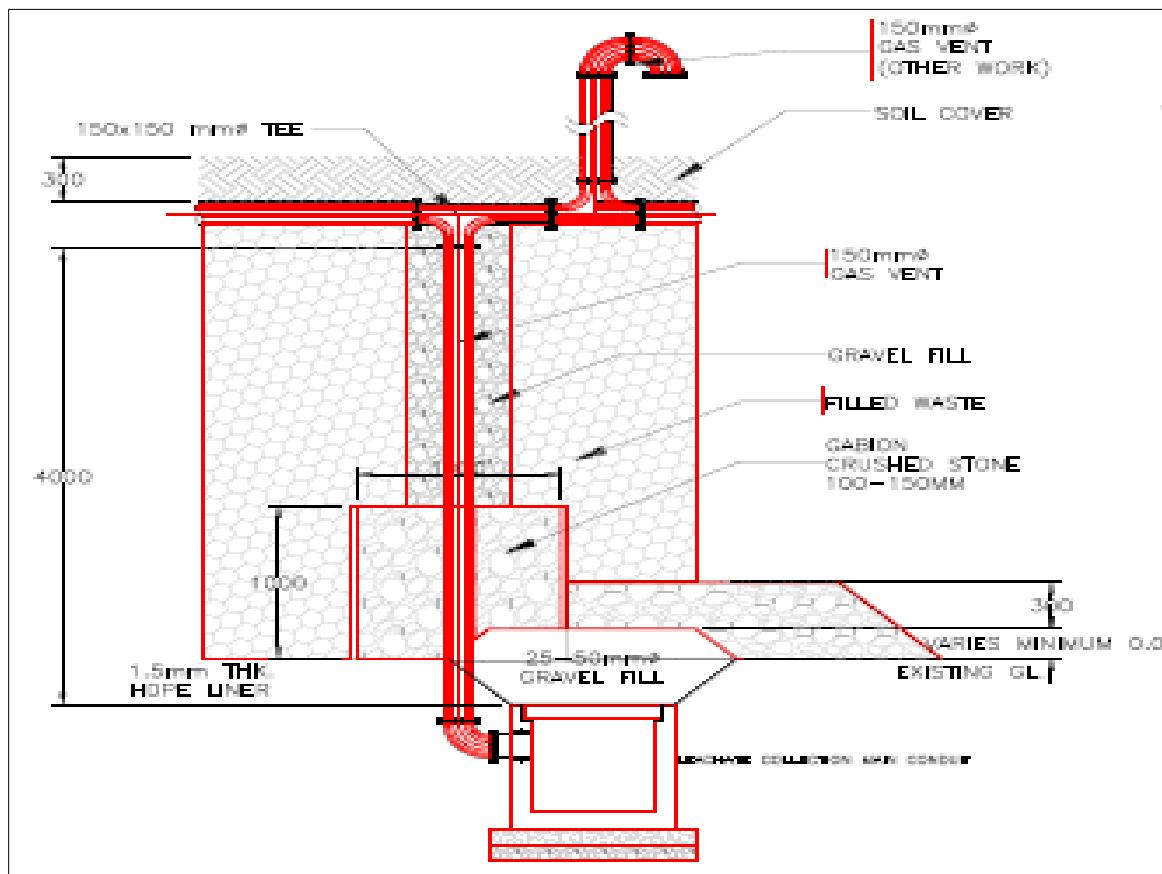
through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow is proposed. The simplicity of the design and operation of an open flame flare is an advantage of this technology.

177. With gas generation starting in 2023, a model Land GEM is used to forecast the volumes of gas and accordingly, gas collection and venting system within landfill cells is designed as shown as **Figures 3-12 and 3-13** below.

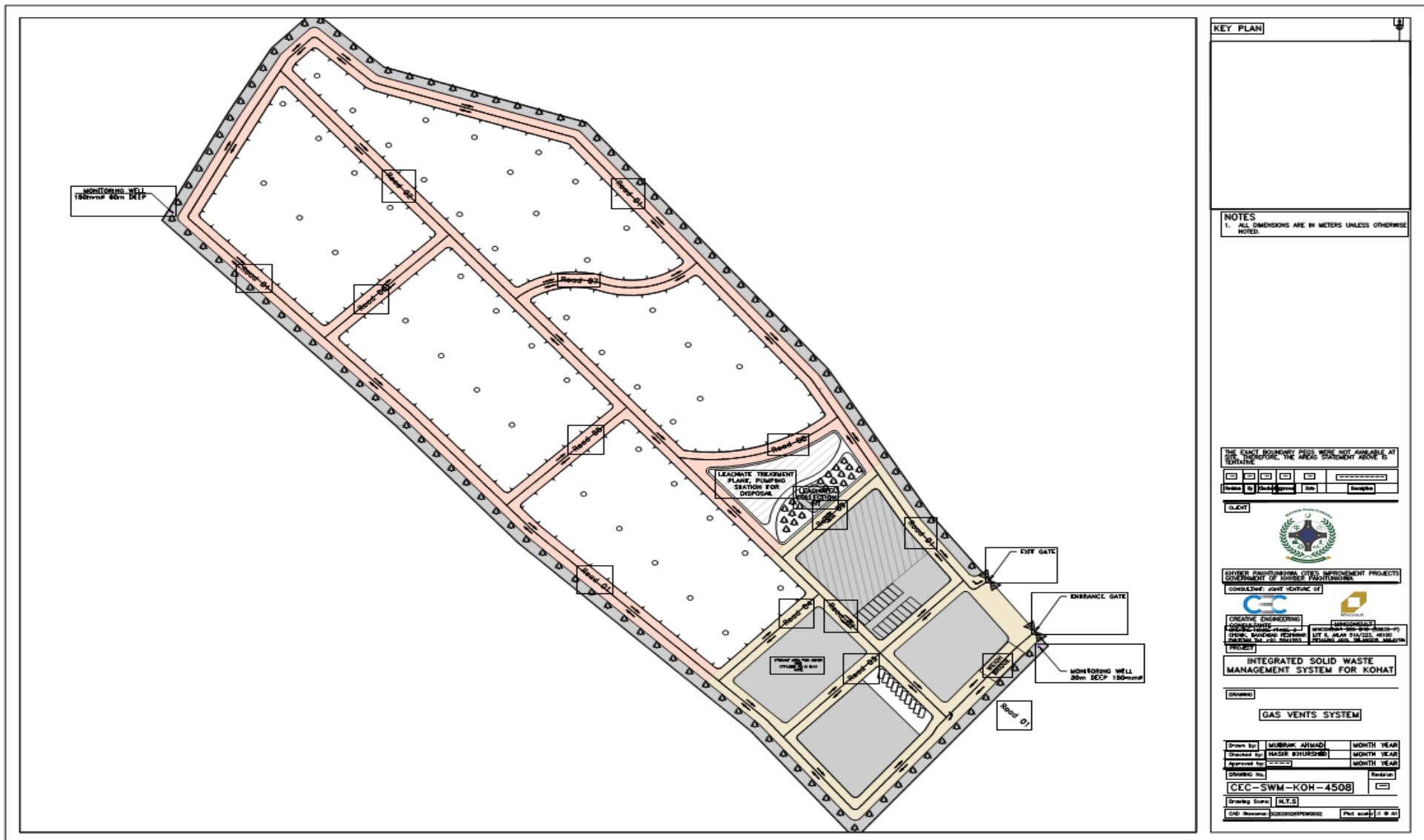
**Figure 3-12: Design Specification of Gas Vent**



**Figure 3-13: Extension of Gas Vent in Landfill Operations**



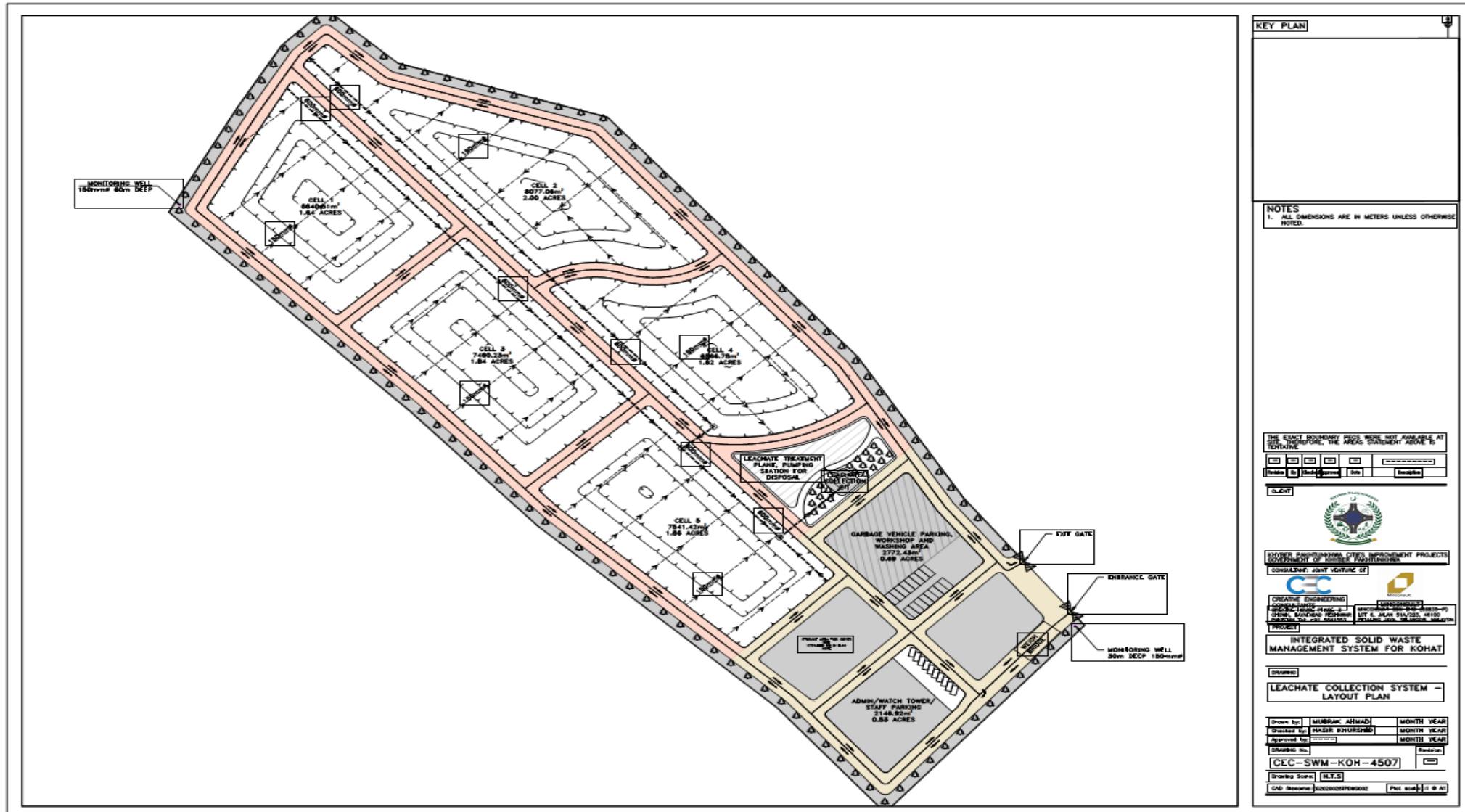
**Figure 3-14: Gas Vent System of Kohat Landfill Site**



### 3.2.11 Leachate Collection and Treatment System

178. Leachate produced in a landfill is a liquid which percolates through the waste carrying suspended and soluble materials that originate from or are products of the degradation of the waste. This liquid needs to be managed on site to avoid any seepages into the ground, any spill-over into ditches and drains, influence on gas collection system or effect on the stability of waste fill. For Kohat landfill site, leachate collection and treatment system has been designed which is explained below.
- **Leachate Collection System**
179. Leachate is a waste product produced as a result of decomposition of organic fraction of waste by microorganisms in the landfill site. The mass balance in the leachate generally depends on the biological decomposition in the garbage body, amount of precipitation, temperature changes, and treatment of the leachate and/or transfer rate of the leachate to the treatment facility. This balance will be controlled and arranged according to the conditions during the operation phase. The leachate is collected via main and auxiliary leachate pipes. The longitudinal elevation of the leachate collection pipes laid inside the pebble stone drainage bed at 1% minimum.
180. Auxiliary leachate collection pipelines are planned in each waste cell to be placed at 30 m distance apart. In addition to that, 2 main leachate collection pipes will be placed longitudinally across the 5 waste cells. The main leachate collection pipes shall be HDPE pipes 600 mm in diameter and in PN16 pressure class. The auxiliary leachate collection pipes shall be perforated uPVC pipes 300 mm in diameter and in PN16 pressure class. The main leachate collection pipes conjoin on a common line and connect to the leachate collection pond.
181. A leachate collection system comprising of a drainage layer of either natural granular (sand, gravel) or synthetic drainage material (e.g. geonet or geo-composite) will be considered. Synthetic drainage material may be used on sidewalls of the landfill cells, where the construction and operation of granular material may be difficult. Perforated leachate collection pipes and filter layer will complete the piping network for the waste cell. Leachate collection and treatment system proposed for the landfill site is illustrated in **Figure 3.15** below.

Figure 3-15: Leachate Collection Network for Kohat Site



▪ **Leachate Storage**

182. Leachate production is calculated based on previous climate data and leachate generation model. The leachate collection pit is planned to be positioned to the east of the cells. A leachate holding tank of 500 m<sup>3</sup> (sufficient to store 15 days leachate production) will collect the leachate before it enters the treatment plant. Inside the plant, a second over-sized holding tank of 125 m<sup>3</sup> will be provided for condensed liquid (membrane refuse) which will be reinjected into the landfill. The sludge from leachate treatment system will be dewatered to 60% water content by air drying followed by disposal in the landfill.

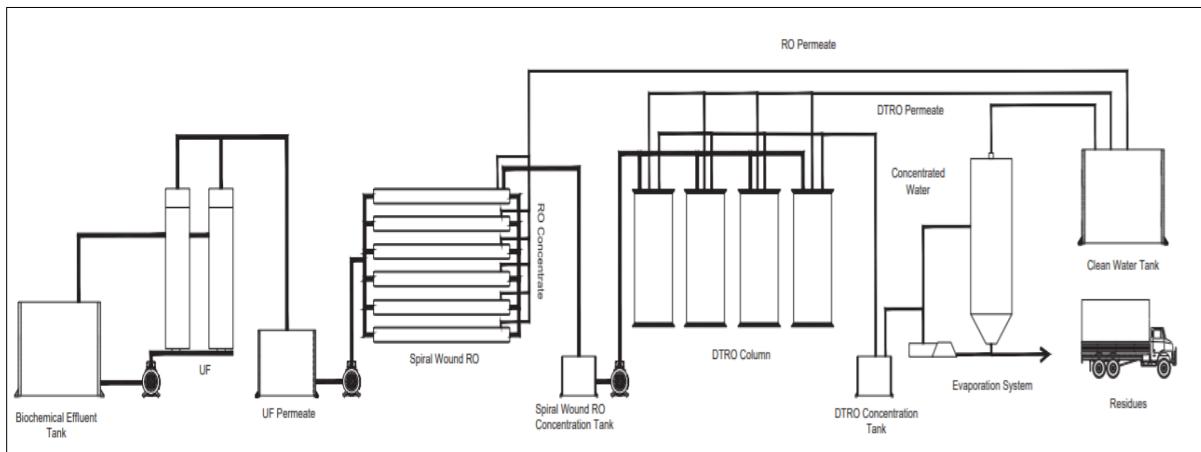
▪ **Leachate Treatment**

183. A leachate treatment plant and pumping station for disposal over an area of 0.36 acres will be developed as shown in **Figure 3-15** above.

**Containerized Leachate Treatment solution AIO-DTRO Series**

184. The Disk Tube Reverse Osmosis (DTRO) plant will be used for leachate treatment. These are commercially available as package unit which may be procured from the vendor directly and installed. DTRO is a kind of RO (Reverse Osmosis). It has the advantages compared with other processes, such as unaffected by biodegradability and C/N ratio, stable effluent quality, flexible system operation and fast start-up and better handling of the heavy metals which is the major concerns. It has been widely used for landfill leachate treatment as construction costs for leachate treatment have been gradually reduced by these systems over past 10 years.
185. The process flow diagram within DTRO and typical AIO-DTRO series proposed for Kohat facility are shown in **Figures 3-16** and **3-17** below.

**Figure 3-16: Process Process Flow Diagram within DTRO**



**Figure 3-17: Proposed AIO-DTRO Series for leachate treatment*****Concentration Basin***

186. An over-sized holding tank to handle 11m<sup>3</sup>/day will be provided for condensed liquid (membrane refuse) which will be re-injected into the landfill.

***Degassing Unit***

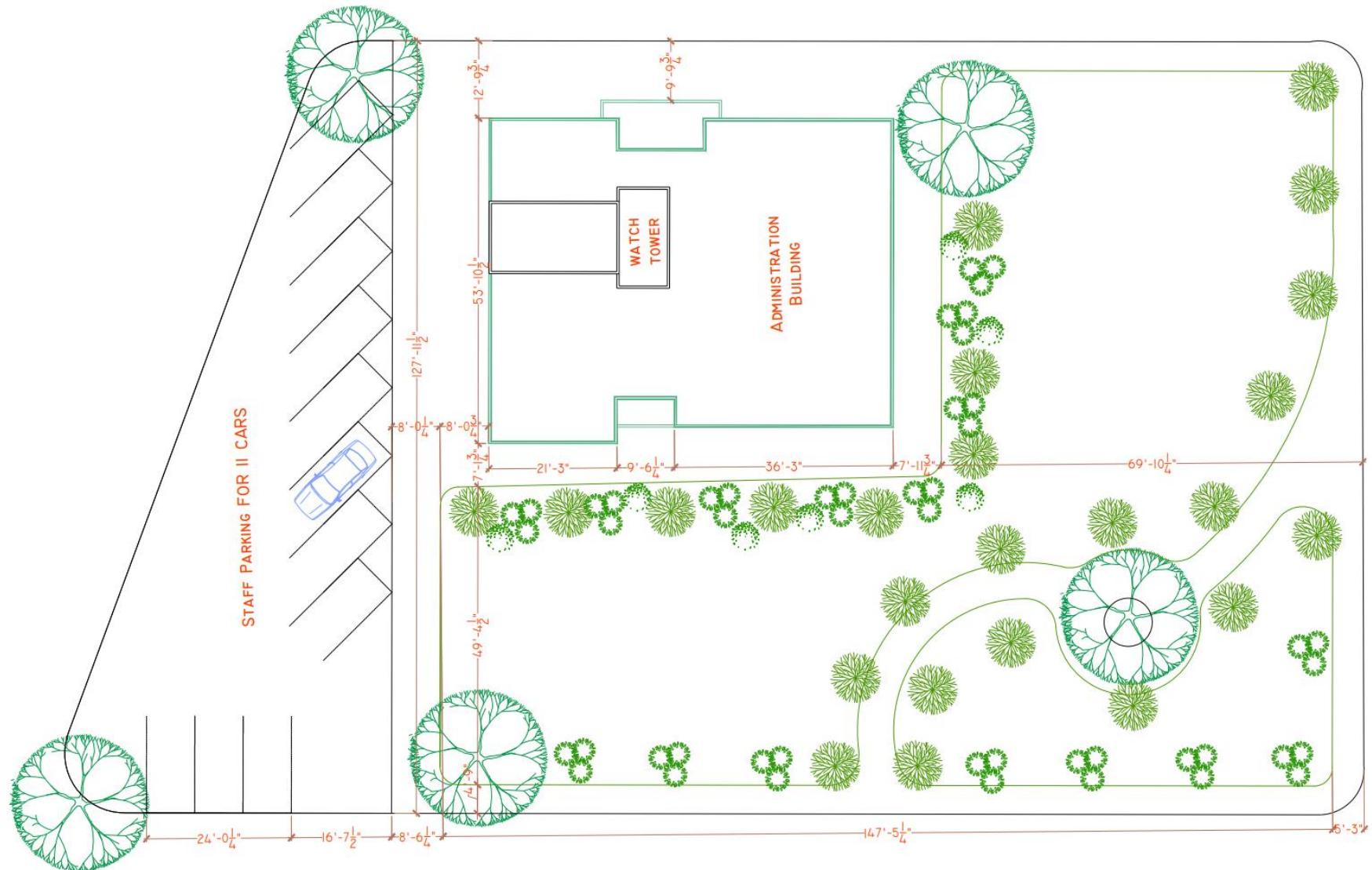
187. A degassing tower is provided to act as the stripper which eliminates surplus CO<sub>2</sub> by stripping with air in order to raise the pH of the permeate, which was sent to the top of the stripper and was rinsed downwards through the column counter currently with up flowing air sent by blowers. The stripper will remove 95% of inorganic carbon, and 68% of TOC.
188. Treated water will be stored for application like landscaping and sprinkling or it can be discharged to municipal drains after compliance with NEQS.

***Infrastructure / Buildings***

189. The proposed landfill will have proper facilities such as administration building, waste reception areas, weigh bridge, CCTV, RFID, access roads, daily soil cover, security, lighting for 24 / 7 usage and professionally trained workers to operate and supervise.
190. The following building infrastructure is proposed:
- **Administration building and Lookout Tower**
191. A 3-storey high administration building has been designed within the landfill premises. It is planned such that it will accommodate landfill operations team, has a laboratory for quality control and MIS monitoring room for data acquisition and transfer to head office. The building also contains a conference room for meetings at landfill, an inventory room for storing supplies for repair and maintenance of landfill machinery and vehicles. There are showers, prayer area, rest rooms and a kitchen in the building. A car park outside the building is also designed for personnel's vehicles. The area of the administrative building is surrounded by landscaping and greenery. The building has a look-out tower on the fourth level for viewing operations at the facility. A Lookout tower of height 49'-6" will be

constructed for visual surveillance of the landfill facility. The layout of admin building, including lookout tower, is presented in **Figure 3-18**.

**Figure 3-18: Layout of administration building at Kohat SWMF**



### ***Construction of roads***

192. Roads inside the premises will cover all periphery. Road width will be 10 m wide with two lanes each 4 m for two-way traffic of waste carrying vehicles. Access roads within cells will be kept 8 meters wide while the longitudinal slope has been designed at 1:10. Vehicle parking shed for waste carrying vehicles has been designed along with a workshop for routine repair and maintenance work.

### ***Surface Drainage Network***

193. The runoff at landfill will be managed through the provision of surface water diversion channels and collection systems. Drainage for surface runoff along periphery is proposed through a network of RCC drainage channels.

### ***Storage area for Soil Cover***

194. Soil or similar inert material shall be used for the lifetime of the landfill site, to cover the waste on a regular basis. Extra thickness of "final cover" material shall also be required once the site has reached completion. The simple spreading of daily cover is a highly effective way to reduce the attraction of waste to birds, suppress odor, prevent fly infestations, discourage rats and other animals and to reduce exposure to atmospheric conditions and to reduce wind blown litter.
195. Ideally, cover material will be taken from within the site, increasing the available space for waste disposal and reducing the need to bring material from elsewhere. The material excavated from the site is estimated to be adequate for use as temporary and final cover material. Final confirmation will be made on remolded permeability of the representative samples taken from the borrow source, if adopted. At this time, we expect that the soil removed during excavation will be used. The soil will be compacted to at least 95 percent of the modified proctor density within a moisture content range of 0 to 3 percent wet of optimum.

### ***Wheel Washing and Vehicle Parking***

196. A vehicle parking shed for landfill vehicles and occasional parking of waste carrying vehicles has been designed along with a workshop for routine repair and maintenance work. There will be pumps and nozzles that spray pressurized water to clean the wheels. The wheel washing unit will comprise of a sedimentation tank. The dirt on the wheels of vehicles will settle and the water in the pool will be transferred to wastewater sedimentation tank while the stale water can be used for washing the vehicles.

### ***Workshops***

197. There will be two different sections for greasing and oil/filter change for the vehicles, and a waste oil storage tank for storing the waste oil while there will be separate units for welding and electrical repairs.

### ***Tree Plantation/Buffer Zone***

198. Inside the boundary wall, tree plantation will be conducted to create an environmental barrier between the external and internal environment. Indigenous tree plantation will be

carried out which will serve as the buffer zone. Green belt provided in project key plan is shown in **Figure 3.3** (Project Key plan). For the landfill to present a clean and aesthetically pleasing view, buffer zone with tree plantation and landscaped berms will be done. Plantation will start as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds mobilized, plantation activity can be started in collaboration with KDA or WSSCK can outsource the activity separately.

### ***Boundary Wall***

199. The boundary around the landfill will be a wall constructed of brickwork of 9" thickness all around the premises.

## **3.2.12 Construction Phase Details for SWMF**

### ***Construction Schedule***

200. The project construction phase is expected to last for a total of 2 years with the activity expected to commence in the second quarter of 2021 and completed by mid of 2023.

### ***Construction phase activities***

201. The activities to be conducted during construction phase of the project are provided below:
  - **Development of Construction and Labor Camps**
202. One of the first activities to be completed by the Contractor shall be the establishment of the construction and labor camp. The Contractor will also establish construction yards and sites (including storage and batching plant), offices and a workshop.
203. The construction of the proposed landfill will be divided into construction work packages and these packages will be awarded to the selected project Contractors.
204. The construction activity has to span over approximately twenty-four months. There shall be a number of contracts for a variety of works. The selected Contractors shall have the option to select suitable site(s) located near the project sites to establish his labor camps. If private land is selected, the Contractor shall enter into contract with the private owner. During construction phase, an estimated 150-200 persons consisting of both semi-skilled and skilled human resource will be required.
205. Essential for the work bases is easy approach, availability of a suitable place for temporary storage of material and availability of water for construction in the vicinity. Presence of shade from trees close to the work bases can add to the comfort of the labor while taking rest during the hot season.
206. The location of storage materials and camps will be critical. Since the project contractor(s) will be responsible for identifying the suitable locations for storage and labor camps from the private sector, thus there will need to be clear guidelines for this process, which will need to be closely monitored by the implementing agency. As far as possible, the project design team shall be assigned the task to identify the suitable location(s) for storage of materials since inappropriate storage of materials may result disruption of the traffic movement.

207. The proposed site for the Contractor's camp shall include the following facilities:

- **Labor camp site**
  - Accommodation
  - Kitchen
  - Dining area
  - Sanitation facilities
  - Septic tank
  - Liquid and solid waste disposal facilities
  - Generator(s), for operation when the power supply from the grid station was not available
- **Construction camp site**
  - Uncovered material storage
  - Covered material storage
  - Parking for vehicles and plant
  - Batching plant
  - Generator(s)
  - Site offices
- **Workshop site**
  - Workshop
  - Storage area
  - Generator(s)
- **Site preparation**

208. There may be a need to carry out cutting and filling of the land in order to attain the designed ground elevation. During the process, areas above the design elevation shall be cut and spoils shall be used to fill areas below the designed elevation. The area is to be clean of any obstructions in areas where the general design elevation is already attained. Cut and fill activities will be carried out using mostly heavy mechanical equipment. Manual labor will be negligible.

209. The ground will be compacted until the desired ground bearing capacity is attained. This is to ensure that all structures, particularly the foundations to be erected are stable and will not be subject to subsidence, settlements and other earth pressures.
- **Development of Access Roads & Internal Roads, drainage facilities and other horizontal earth works**
210. Haul roads from the reception area to the entrance to each phase shall be designed to a standard adequate to allow trafficking of heavy vehicles. Haul roads may need to accommodate the passage of heavy construction vehicles e.g. steel wheel compactors and tracked bulldozers. Service roads to other facilities on site e.g. leachate treatment plant, gas extraction system, shall be to an adequate standard to allow access by service vehicles.<sup>5</sup>
211. Particular attention should be given to the access point to each cell. It is important that the access routes chosen do not put the liner at risk. Typical access ramps will be up to 6m in width and have slopes up to 10%.
- **Construction of building infrastructure**
212. Site building infrastructure must be designed, constructed and maintained to a high standard and shall include the following facilities:
- Administration building consisting of an administration office, first aid area and general reception area;
  - Sanitary facilities: showers and toilets along with septic tank;
  - Staff facilities: lockers and mess room;
  - Waste reception area;
  - Monitoring equipment store;
  - Equipment maintenance and fuel storage; and
  - Parking area.
- **Properly installed ventilation to reduce the spread of COVID-19**
213. The required ventilation equipment shall be installed within the construction closed spaces to ensure adequate ventilation to limit the spread of COVID-19 pandemic as far as possible.
214. Purpose built buildings will be constructed with on-site laboratory facilities provided as necessary. The administration building would include a working telephone, a facsimile machine and would be suitable for the storage of records.

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<sup>5</sup> [https://www.epa.ie/pubs/advice/waste/waste/EPA\\_landfill\\_site\\_design\\_guide.pdf](https://www.epa.ie/pubs/advice/waste/waste/EPA_landfill_site_design_guide.pdf)

- **Construction of the weighbridge system and Unloading Bay and its components**
215. The weighbridge shall be located adjacent to the waste reception area and sufficiently far enough away from the public road to avoid queuing onto the road. Weighing facilities shall be adequate to accommodate the weighing of both incoming and outgoing traffic if necessary.
- **Construction of MRF & Allied Machinery**
  - **Landfill Site Construction**
216. The development of the landfill area will consist of the following activities:
- Excavation for landfill cell and bottom lining along with leachate collection and treatment pond & gas collection pipes;
  - Construction of the access ramps, leachate collection and treatment pond;
  - Run off and run on collection network;
  - Final capping and arrangements for gas venting and flaring;

***Construction Machinery Requirement***

217. For storing materials, stocking equipment and parking machinery and vehicles, the Contractor(s) shall require open and accessible sites close to the labor camps. The Contractor(s), at his own expense, but keeping in view his contractual obligations to honor the applicable national and international guidelines regarding level of pollution, shall make the arrangements.
218. The **Table 3.9** below outlines the approximate number of major machinery and vehicles that are envisaged to be required for the project construction works.

**Table 3.9: Estimated Contractor's Equipment and Machinery**

Sr. No.	Machinery / Equipment	Quantity required*
1	Excavators	4
2	Dumpers	2
3	Batching Plants	1
4	Loaders	2
5	Power Generators	4
6	Rollers	2
7	Tractor Trolley	6
8	Transit Mixer	1

Sr. No.	Machinery / Equipment	Quantity required*
9	Compactor / Roller	2
10	Crane	1
11	Crush Plant	1
12	Concrete Pump	1
13	Vibro Hammer	1
14	Welding Generators	2
15	Watering Tanks (moveable)	3
16	Haulage Trucks	20
17	Cars/Pickups	8

\* Number of machinery is indicative and can be changed subject to working schedule.

### **Construction Materials Requirement**

219. During the construction phase, construction materials in considerable volumes will be required. Typical material required for landfill cell development include base mineral liner, cap barrier layer, leachate drainage blanket; other drainage layers e.g. capping layer and groundwater/surface water, gas collection and venting system, road material and daily cover. The common source of the materials required for civil works are described in **Table 3.10** below.

**Table 3.10: Source of Raw Material**

Sr.#	Raw Material	Source
1	Earth Material	Available locally, borrowed from the lands acquired for the project.
2	Aggregate	Available at many sources within the vicinity of the site.
3	Rip-rap material	Available locally from nullah bed deposits and rock excavations.
4	Sand	Sand is available in near vicinity and river bed.
5	Water	Ground water is available at depth of lower than 11 meters and it will be used for construction purpose.
6	Cement	Ordinary Portland Cement is suitable, which is available at various factories in Pakistan mainly from Kohat.
7	Reinforcement steel	Steel re-rolling mills in Kohat meeting the standards from the billet produced either by Pakistan steel or imported. These will serve the purpose of steel availability.
8	Energy	A WAPDA grid station exists about 11 kilometres from main Kohat road, Kohat city.

### 3.2.13 Operation Phase Details for SWMF

#### **Scope of Activities**

220. The activities to be conducted during the operational phase of proposed project are provided in **Table 3.11** below.

**Table 3.11: Operation Phase Activities**

<b>Landfill Development</b>	<b>Operation activities involved</b>
<b>Waste hauling to LFS</b>	The compactor truck will transfer waste from Kohat city to the landfill site.
<b>Weigh Bridge and Unloading Bay</b>	<ul style="list-style-type: none"> <li>▪ Weighing operation</li> <li>▪ Maintenance of mechanical and electrical equipment</li> </ul>
<b>Landfill site operations</b>	<ul style="list-style-type: none"> <li>▪ Waste inventory management</li> <li>▪ Material Recovery Facility</li> <li>▪ AD and Composting Facility</li> <li>▪ Daily cover</li> <li>▪ Leachate management (i.e., collection, treatment and disposal)</li> <li>▪ Landfill gas management (i.e., monitoring, collection, flaring)</li> <li>▪ Environmental monitoring</li> </ul>
<b>General Operations</b>	<ul style="list-style-type: none"> <li>▪ Admin block operations</li> <li>▪ Maintenance of equipment and machinery</li> <li>▪ Vehicle servicing</li> <li>▪ Disposal of solid waste and waste water generated during operations</li> <li>▪ Workers Health and Safety</li> <li>▪ Site Security</li> </ul>

#### **Operation Equipment and Machinery**

221. The equipment required during the operation phase of the landfill site can be divided into three functional categories: waste movement and compaction, earth cover transport and compaction, and support functions. The **Table 3.12** below provides the equipment expected to be required for operation phase of the landfill site.

**Table 3.12: List of Equipment and Machinery for operation phase of Landfill Site**

<b>Sr. No.</b>	<b>Machinery / Equipment</b>	<b>Equipment use in landfill operations</b>	<b>Quantity required*</b>
1	Bucket Loader	It is used to fill earth cover material into vehicles at landfill site.	1
2	Chain Dozer	It is used for leveling of waste or excavated soil at the landfill site.	1
3	Trash Compactor	It is used for compaction, propulsion and spreading of waste in a landfill.	1
4	Hydraulic Excavator	It is used for Excavation purposes.	1

\* Number of machinery is indicative and can be changed subject to working schedule.

### ***Manpower Requirement***

222. It is expected that existing organizational capacity of WSSCK may not be able to successfully run the future model, therefore, ISWM system along with human resource requirement will be proposed. The institutional design of the WSSCK and its linkage with line reporting departments would be reviewed. The agreement will be reviewed and KPIs would need to be aligned with the design of the solid waste management system.
223. An institutional review and capacity building firm has been engaged under the project to successfully operationalize the project and improve the capacity of WSSCK in terms of efficient SWM service delivery.
224. Estimated manpower requirements during construction phase of the project would be about 150-200 persons while during operation phase would be 50 persons.

### **3.2.14 Closure and Post Closure Plan for SWMF**

225. Both the Closure and Post Closure plans will come into effect towards the end of the SWMF's useful life, usually 40 to 50 years from commencement of operation of the SWMF. In this time, there could be marked changes made to them depending on how environmental and socioeconomic conditions in and around the site and Kohat city have evolved.
226. The closure plan will include:
  - Landfill cover and landscaping of the completed site;
  - Long term plans for the control of runoff, erosion, gas and leachate collection & treatment.
227. Post closure plan will include:
  - Routine inspection of completed landfill;
  - Maintenance of surface water diversion facilities, landfill surface grades, the condition of liners;
  - Maintenance of landfill gas and leachate collection equipment;
  - Long term environmental monitoring plan so that no contaminants are released from the landfill site.
228. These plans have yet to be developed but will be customized to the proposed SWMF facility and will be prepared within first few years after commencement of the SWMF.

### **3.3 Institutional Review and Capacity Building (IRCB) Contract**

229. In order to execute successful operation of SWMF facility at Kohat, institutional review and capacity building (IRCB) component is included in the project design to enhance services delivery of WSSCK. PMU KPCIP has awarded IRCB contract to consortium of four firms in November, 2020. It is an integral part of the larger multi-year KPCIP. IRCB contract will

facilitate improvements to the business model to ensure operational efficiency and sustainability. IRCB firm will conduct an applicable training needs assessment and training plans.

230. IRCB contract will facilitate performance benchmarking of KPCIP based on an understanding of current operations and developing an output-based monitoring system for impact of the planned sub-project investments. IRCB will evaluate business model by considering following options.
- Service delivery by the WSSCK (or other government or quasi-government entity)
  - Service delivery by outsourcing to a private sector provider
  - Service delivery via a hybrid of the above two options
  - Service delivery by other, innovative means, such as community initiative, that may not have been initially identified
231. PMU KPCIP will design capacity building interventions using participatory approach through IRCB contract. PMU KPCIP will define monitoring of IRCB contract in project administration manual and will closely monitor the effectiveness of IRCB contract within WSSCK.

### **3.4 Climate Risks from Project**

#### **3.4.1 Climate Change Trends and Extremes in Kohat**

232. Increases in precipitation, urban flooding and possibly high temperature are considered as the key potential climate change impacts for Kohat city. These are expected to increasingly effect household and business assets, livelihoods and water supply. In addition, high speed winds resulting from mini-cyclones type storm events are expected. They are also expected to exacerbate the challenges associated with urban and transport infrastructure development, choking of drains, community health and energy supply (ADB 2017a). Union Councils (UCs) in Kohat face floods from main nullahs, rivers, streams together with urban flooding. Rivers and streams floods are mainly due to intense rainfalls events, while urban flooding is due to intense rainfall events as well as due to changes in land-use (converting bare soil to concrete surface during residential area growth) and due to inadequate sewage and drainage system.
233. Dominated by the monsoon seasonal patterns, Kohat's climate can be categorised as comprising winter (November to March) and summer (June to September) seasons, including western disturbances entering from Afghanistan and Iran. Based on Risalpur climate station data (1954-2015), monthly average temperature during winter ranges from 17.1°C to 9.7°C, where the highest monthly average temperature was 35.4°C, observed in June 1984. During summer, the monthly average temperature ranges from 28.5°C to 33°C. There are no statistically significant increasing trends in historic maximum temperature except for the month of May, where about 1.55°C rise occurred during last 62 years. Summer days (temperature > 25oC) are projected to be increased by 92.6 days during 2011-2100. These will eventually affect different infrastructure as well as will increase energy consumption, will decrease human work efficiency, and will adversely affect human health.

234. Average annual rainfall was 657 mm during the period 1954-2015 as recorded by the Pakistan Meteorological Department, (PMD), Risalpur climate station. The highest annual rainfall was recorded in 1959 (1,273mm), whilst the second highest annual precipitation (1,077mm) was recorded 2013. Annual precipitation of 2010 stands at fourth highest record (1,065mm). Historic precipitation data show an increase in overall annual precipitation together with an increase in local streams/nullahs flows. One of the major nullah in Kohat is Kalpani, where an increase in flows is statistically significant during 1980-2015. Future precipitation is also expected to rise, although extreme events are not statistically significant. Such increase in flow events and increase in precipitation may rise potential urban flooding together with seasonal flooding in Kohat. Increase in such events will also affect waste water and solid waste disposals.
235. Future climate projections based on GCM (CanESM214) show increase in summer days ( $>25^{\circ}\text{C}$ ) under RCP15 8.5 scenario. Annual average temperature and annual precipitation also show rise under RCP 4.5 and RCP 8.5 during 2011-2040, 2041-2070 and 2071-2100 periods compared to 1976-2005 period. However, some of the future projection trends are not statistically significant.
236. Based on CSIRO-CCAM16 RCM, precipitation is expected to rise between 142 mm/yr to 174 mm/yr during 2011-2100, compared to 1976-2005 period, based on both scenarios. Maximum temperature is also expected to rise between  $-0.1^{\circ}\text{C}$  to  $5.45^{\circ}\text{C}$  during 2011-2100 compared to 1976-2005. Similarly, minimum temperature is expected to rise between  $0.94^{\circ}\text{C}$  to  $4.8^{\circ}\text{C}$  during 2011-2100 compared to 1976-2005. There is no clear monthly precipitation pattern change during 2011-2100 compared to base period. However, maximum precipitation rise is expected during summer monsoon period. Overall precipitation may rise during the future whereas decadal precipitation does not show any linear rise. In contrast both maximum and minimum decadal temperature show linear rise.
237. Sudden rise and fall in terrestrial temperatures cause low air pressures, bringing whirling winds since during April and May days are relatively warmer and the nights are cooler in Kohat where frequency of wind storms is higher in these months as compared to other seasons according to a study<sup>6</sup>.
238. These climate change patterns and socio-economic changes including rapid urbanization can cause urban flooding events. Intense precipitation as well as infrastructure developments that have reduced urban surface interception, flash floods are increasing, which are likely to continue to become more severe in the future. Urban flooding is largely due to intense precipitation and changes in land use (especially increased concrete surfaces due to residential and commercial area growth) and due to inadequate sewerage and drainage systems while the main nullahs, rivers, streams are flooded due to intense rainfall.
239. Moreover, due to lack of open spaces, water storage ponds and a properly designed urban drainage system, increased surface water due to heavy rainfall has been transported through the existing sewerage systems. This lack of capacity to drain away surface water due to heavy precipitation is most likely the potential cause of increased urban and seasonal flooding in Kohat as well as disrupted waste water and solid waste disposal

<sup>6</sup> Ata Hussain , Hazrat Mir & Muhammad Afzal (2005). Analysis of dust storms frequency over Pakistan during 1961-2000, Pakistan. Journal of Meteorology Vol. 2: Issue 3: (March 2005) 49 (quoted in ADB 2017a)

systems. The observed climatic changes and their potential impacts are summarized in **Table 3.13** below.

**Table 3.13: Climate Change and potential impacts for Kohat**

<b>Climate Trend</b>	<b>Description</b>	<b>Current/ Potential Impact</b>
<b>Temperature rise</b>	<p>A temperature rise of 1.55°C observed in the month of May over last 62 years.</p> <p>Monsoon period shows a decline in maximum as well as minimum temperature</p> <p>Future climate projections show that during the period 2011– 2100, maximum temperature could further rise by 1.55°C to 5.5°C, while minimum temperature could rise by 1.96°C to 6.61°C</p>	<p>Risk of more frequent and intense heatwaves in Kohat, leading to increased mortality and morbidity in the region</p> <p>Increased per capita demand for water consumption due to warmer weather</p> <p>Decline in ground and surface water availability leading to drought like conditions</p> <p>Crop failure in surrounding peri-urban areas that could reduce regional food security</p> <p>Increased demand for electricity, and damages to power lines and infrastructure</p> <p>Increased damages to road surface and other communication infrastructure</p>
<b>Increased summer days</b>	<p>Summer days (temperature &gt; 25°C) are projected to be increased by 92.6 days during 2011-2100.</p>	<p>Increased demand for water and Electricity</p> <p>Increased incidence of vector borne diseases including dengue, malaria and cholera</p>
<b>Increased annual precipitation and changes to hydrological regime</b>	<p>Historic precipitation data show an increase in overall annual precipitation together with an increase in local streams/nullahs flows. Shifting monsoonal patterns are also observed over the area</p> <p>Future level of annual precipitation is also projected to increase during 2011-2100 under RCP 4.5 and RCP8.5 scenarios. According to RCP 4.5 precipitation may reach to 972 mm/yr during 2071-2100 compared to base period (1976-2005).</p>	<p>Increased flooding from storms and heavy rainfall (especially flash and riverine flooding in Kalpani) in the area, resulting in damages to life and assets (infrastructure including communication, electricity, water supply etc.). Greater water runoff from storms, instead of normal rainfall retention in ground</p> <p>Increased demands on drainage and storm water management systems; sewer overflow</p> <p>Higher levels and period of humidity caused by high temperatures combining with increased precipitation, affecting human health and infrastructure.</p> <p>Increased water supply contamination and health effects.</p>

### 3.4.2 Climate Change Considerations for Landfill Site

240. Climate change can impact different aspects of the landfill site due to projected increased temperatures and intense floods from heavy rainfalls at the location of the landfill site. These climatic changes in the nearby areas can also have serious consequences at the landfill site due to flash flooding.
241. In addition to the impacts of changing climate, landfill sites can also be a source of greenhouse gas emissions which need to be considered for climate change mitigation options. These gases can also create a fire hazard due to a change in the decomposition rates caused by increased temperatures.
242. Based on the Climate Risk and Vulnerability Assessment (CRVA) theoretical framework, it is important to assess the climate change exposure and sensitivity of the landfill site and suggest possible adaptation measures with respect to the identified elements. The suggested adaptation measures need to be monitored and re-evaluated as a continuous process during the operations for any required changes to ensure that the suggested measures are sustained over the life span of the landfill site. Three aspects of landfill sites are assessed for potential climate change impacts (temperature, precipitation, winds, fire hazard) in terms of exposure and sensitivity: 1) underground components, 2) over-ground components and 3) Site infrastructure and operations, provided as **Table 3.14** below.
243. **Climate Change Exposure of Landfill Site:** This includes identification of climate change hazards in the context of potential climate scenarios. For example, precipitation changes can degrade covers of landfill. Moreover, a number of anthropogenic stressors, socio-economic and land-use changes near and around the landfill site in the future may complicate and exacerbate the above-mentioned climate change events and increase exposure of the site. Temperature changes can impact the composting process and also can impact the decomposition process responsible for leachate production. For example, land-development can affect natural protective barriers. Some of these non-climatic stressors are provided in **Table 3.15** below.
244. **Climate Change Sensitivity of Landfill Site:** Likelihood of climate change related hazards are included in sensitivity assessment that could negatively affect the functioning of the landfill site including direct impacts (accessibility, physical damage, water damage) and indirect impacts (accidental fire, explosion or ecosystem damage). These direct and indirect impacts can affect the landfill site in terms of damage to liner or cover materials, washout of contaminated contents, leachate collection and removal, landfill gas management etc.

**Table 3.14: Sensitivity Considerations for Landfill Site**

	<b>System Components</b>	<b>Vulnerabilities</b>		
		<b>Physical Damage</b>	<b>Water Related Damage</b>	<b>Access</b>
<b>Landfill Components</b>	Pipe systems for leachate treatment and disposal of landfill gas collection and transfer	X	X	X
	Transfer pumps for leachate and landfill gas	X	X	
	Treatment pond for leachate	X		X
	Pre-treatment of landfill gas (coolers, condensers, blowers)	X	X	
	Landfill gas flares	X	X	X
	Storage containers for chemicals	X	X	X
	Disposal system for treatment residuals	X	X	X
	Discharge system for treated leachate	X	X	
	Auxiliary and monitoring equipment	X	X	
	Synthetic materials (e.g. geomembrane in liners or cover system, geotextile for leachate filtration)	X	X	
	Bottom layer of unlined waste		X	
	Vegetative layer for an evapotranspiration cover	X	X	
	Groundwater or landfill gas monitoring wells	X		X
	Composting facility & AD system	X	X	
	Material Recovery Facility	X	X	
<b>Infrastructure and Landfill Site Operations</b>	Surface water drainage systems	X	X	X
	Fencing, boundary walls for access control and litter prevention	X		
	Unpaved road to landfill site			X
	Buildings, sheds etc.	X	X	X
	Natural gas and electricity connections/lines	X	X	X
	Fuel storage and transfer	X	X	X
	Water supply	X	X	X
	Machinery and vehicles	X	X	X

**Table 3.15: Non-climate Stressors and Potential Impact on Landfill Site**

<b>Non-climatic Events</b>	<b>Potential Impacts on Landfill Site</b>
Land-use changes (e.g. new housing schemes, commercial buildings, small businesses and other built environment etc.)	<ul style="list-style-type: none"> <li>Road leading to the site might be encroached or get congested in the future</li> <li>Wastewater generation and its disposal from the new commercial and domestic activities</li> </ul>
Agriculture practices (changes in cropping patterns and water usage)	<ul style="list-style-type: none"> <li>Seepage near the landfill site</li> </ul>
Modification /construction of irrigation networks	<ul style="list-style-type: none"> <li>Seepage near the landfill site, flooding due to increased water usage</li> </ul>
Construction of new roads	<ul style="list-style-type: none"> <li>Obstruction natural water ways might cause flooding</li> </ul>
Groundwater contamination	<ul style="list-style-type: none"> <li>Groundwater aquifers contamination due to leachate</li> </ul>

245. The above-mentioned sensitivity and exposure analysis is based on available information in the concept designs, detailed design, other reports and information on general components of a landfill site.

## **4 Description of Environment**

### **4.1 General**

246. Kohat is a city in the Khyber Pakhtunkhwa (KPK) province of Pakistan, which serves as the capital of Kohat district and is located at the north-west end of Pakistan, about 174 km west of federal capital Islamabad. The proposed SWMF site is in the outskirts of Kohat city at a distance of approximately 7 km from the city center.
247. The description of various features of the project area environment including the physical, ecological, cultural and socio-economic environmental aspects are presented in the following sub-sections.

## 4.2 Physical Resources

### 4.2.1 Topography

248. Kohat, town, south-central Khyber Pakhtunkhwa province, Pakistan. The town lies just north of the Kohat Toi River at the entrance to the Kohat Pass, through which a military road was opened in 1901.
249. The city is located at an altitude of 489 metres (1,604 ft). Kohat Pass lies to the north. It is situated on the left bank of the Toi River at a point where after running nearly due east for 50 miles (80 km), it turns to the south. The total area of the district is 2,545 square kilometers (983 sq. mi).

### 4.2.2 Soils

250. Soil of the project area fall under the ranges in silt loam with pH ranging from 5.6 to 8. The surface soil materials are less deposits, residual mantle on sandstones and shale bedrocks, or narrow strips of silty/loam alleviation along major streams. The cropping pattern and intensity vary spatially as well as temporarily with the moisture availability. The soil characteristics vary within the area depending upon the parent material and the soil age. Inceptisols, Entisols and Ardisols are the dominant soil types.
251. In addition, a summary of the ground soil conditions based on different boreholes conducted across the proposed project site are provided as **Table 4.1** below.

**Table 4.1: Summary of ground conditions across Project Site**

Borehole No.	Top Depth (m)	Bottom Depth (m)	Description Title	Description
BH-01	0	7	GM	Grey, Dense to Very Dense, Subangular and Subrounded, Moderately Sorted, Clayey Silty Gravel. Both Fine and Coarse Gravel are of Sedimentary Rock Origin Limestone. Maximum Gravel Size is 7.00cm.
BH-02	0	7	GM	Grey, Dense to Very Dense, Subangular and Subrounded, Moderately Sorted, Clayey Silty Gravel. Both Fine and Coarse Gravel are of Sedimentary Rock Origin Limestone. Maximum Gravel Size is 15.00cm.
BH-03	0	8	GP-GM	Grey, Dense to Very Dense, Subangular and Subrounded, Poorly Sorted, Clayey Silty Gravel. Both Fine and Coarse Gravel are of Sedimentary Rock Origin Limestone. Maximum Gravel Size is 17.00cm.

Borehole No.	Top Depth (m)	Bottom Depth (m)	Description Title	Description
BH-04	0	6	GM	Grey, Dense to Very Dense, Subangular and Subrounded, Moderately Sorted, Clayey Silty Gravel. Both Fine and Coarse Gravel are of Sedimentary Rock Origin Limestone. Maximum Gravel Size is 5.50cm.
BH-05	0	11	GP-GM	Grey, Dense to Very Dense, Subangular and Subrounded, Poorly Sorted, Clayey Silty Gravel. Both Fine and Coarse Gravel are of Sedimentary Rock Origin Limestone. Maximum Gravel Size is 22.00cm.

252. In addition, the recommendations of the geotechnical investigation of the project site are as follows:

#### ***Formation of Temporary and Final Cover***

- Soil or similar inert material shall be used for the lifetime of the landfill site, to cover the waste on a regular basis. Extra thickness of "final cover" material shall also be required once the site has reached completion.
- The simple spreading of daily cover is a very effective way to reduce the attraction of waste to birds, suppress odor, prevent fly infestations, discourage rats and other animals, to reduce exposure to atmosphere conditions and to reduce wind blow litter.
- Ideally, cover material shall be taken from within the site, increasing the available space for waste disposal and reducing the need to bring material from elsewhere.
- The material excavated from the site shall be adequate for use a temporary and final cover material. Final confirmation shall be made on remoulded permeability of the representative samples taken from the borrow source if adopted. At this time, it is expected that the soil removed during excavation will be used.
- The soil shall be compacted to at least 95 percent of the modified proctor density within a moisture content range of 0 to 3 percent wet of optimum.

#### ***Excavation at Site***

- The excavation required for the construction of foundation up to a shallow depth of about 1.0 m, can be made without provision of any supporting system. The provision of dewatering must be kept in the scope of work of construction due to possibility of rainy season, during construction and adjacent Nulla effects.
- The excavation for the land fill area can be done with simple mechanical means like excavators. Since the adjacent areas are open therefore, no major stability issues are anticipated to results in to property loss, however, it is recommended to excavate at a

slope angle established by hit and trial method at site for an excavation of about 2 m, which is foreseen in the light of current ground conditions.

- As a broad guideline it is suggested to adopt a slope angle of 2H:1V, however, based on hit and trial method adopted at site, the angle can be further steepened.

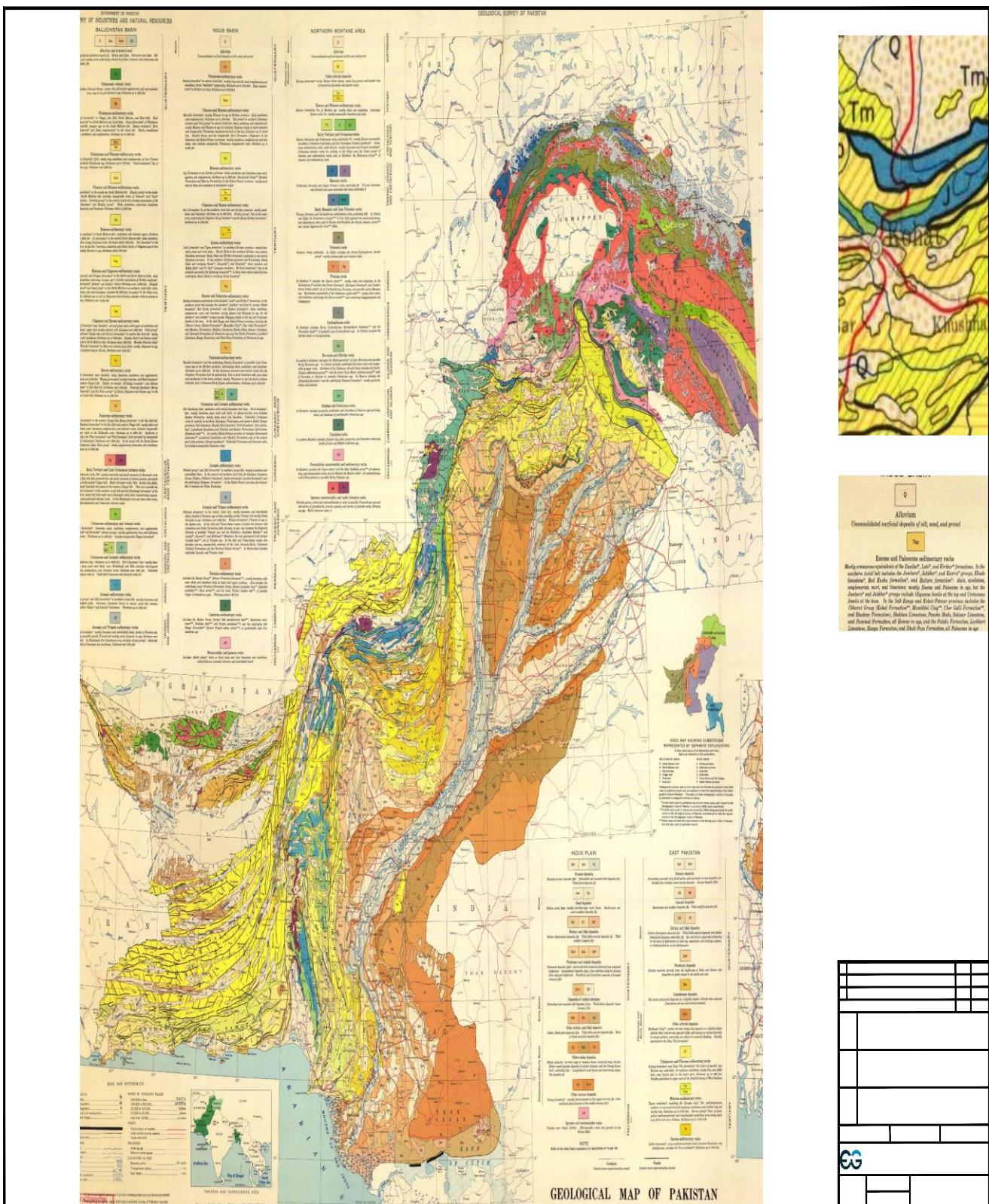
#### ***Liquefaction Potential***

- Liquefaction is a loss of the shear strength of a soil that occurs when the ground experiences strong ground shaking. The phenomenon may result in large total and/or differential settlement beneath Structures founded on the liquefying soils. In order for the potential effects of liquefaction to be manifested at the ground surface, the soils generally have to be granular, loose to moderately dense, saturated relatively near the ground surface, and must be subjected to a sufficient magnitude and duration of shaking.
- According to the grading plans for the proposed Landfill Site, surficial soils will be removed so that the proposed filling will be directly underlain by dense silty sandy gravels. Due to the lack of a weak sandy soil, the design site acceleration being in zone 2B, absence of regular ground water table and the competency of the ground, the potential for significant, large-scale liquefaction effects and associated dynamic settlement to cause damage to the composite liner system and other site facilities is very low.

253. In addition, the following additional recommendations have been made:

- Proper paving should be provided along the periphery of the Structure.
- All the backfilling of the foundation above concrete pad shall be done with cohesive material to avoid seepage of water in the foundation base. Alternatively, the top 30 cm of any backfilling should be carried out with non-swelling cohesive soil.
- Adequate water proofing/damp proofing shall be provided for the structure. To avoid problem regarding moisture, it is recommended to adopt water-reducing admixtures in concrete.
- If any soft and loose material encountered, at foundation excavation level, during construction, then it should be further excavated and replaced with suitable granular material in proper compaction.
- Cement coatings shall also be provided to avoid moisture movement through the concrete.

## **Figure 4-1: Geology of Project Area**



#### 4.2.3 Climate

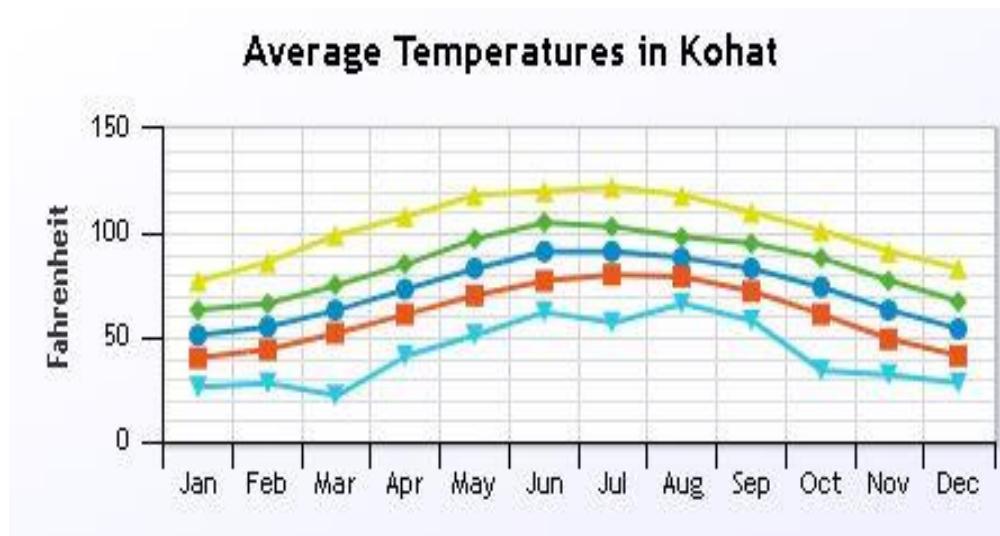
254. Kohat has semi-arid to sub humid subtropical climate. Kohat is classified as a subtropical triple season semiarid sub-mountainous area. Summer season prevails from April to October. Average monthly maximum and minimum temperatures during summer are 40°C and 15°C respectively. Hottest month is June, during which temperature sometime rises as high as 40°C. Winter occurs from November to mid-February. Average maximum and minimum temperatures during winter are 25°C and 40°C respectively. The rainfall is received throughout the year. The monsoon rain is received from May to October. August is the wettest month with an average rainfall of about 141 mm. The winter rains occur from November to April. The highest winter rainfall was received in the month of February.
255. In winter a strong west wind known as 'hangu breeze' often blows down the Miranzai valley towards Kohat & Karak for weeks.

#### 4.2.4 Temperature

256. Winter in Kohat starts from mid November to the end of March. The mean minimum temperature during winter is 4 °C and maximum is 24 °C. Summer months are May to September. The mean maximum temperature in summer is over 38 °C and the mean minimum temperature is 30 °C (77 °F).

The temperature profile for Kohat is shown as **Figure 4.2** below.

**Figure 4-2: Year-round Temperature Profile of Kohat City**

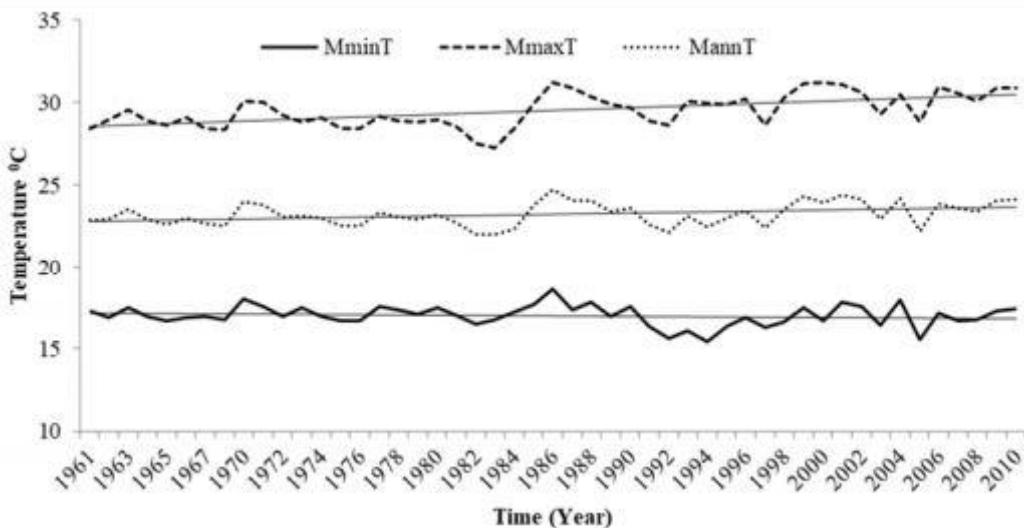


257. From the temperature perspective it was revealed that temperature has escalated up to 0.7 °C in the past century alone, roughly ten times faster than the average rate of ice-age recovery warming. The duration of winters is decreasing slightly, shaping a longer span of heat waves.
258. Analysis of historical data for Kohat<sup>7</sup> for 1950-2016 shows an overall increasing trend where the maximum temperature has increased by 0.57°C while minimum temperature has increased by 0.49°C. The mean annual maximum temperature was 28°C to 31°C

<sup>7</sup> The weather data and information in this section is sourced from ADB (2017): UCCRTF TA-8913 PAK: Mainstreaming Climate Risk Management into Urban Infrastructure Investments through Urban Resilience Assessments (URAs), Kohat City, Khyber Pakhtunkhwa, Pakistan.

while the mean minimum temperature ranged between 15°C to 17.7°C. Temperature trend analysis of Kohat is shown in **Figure 4.3** below.

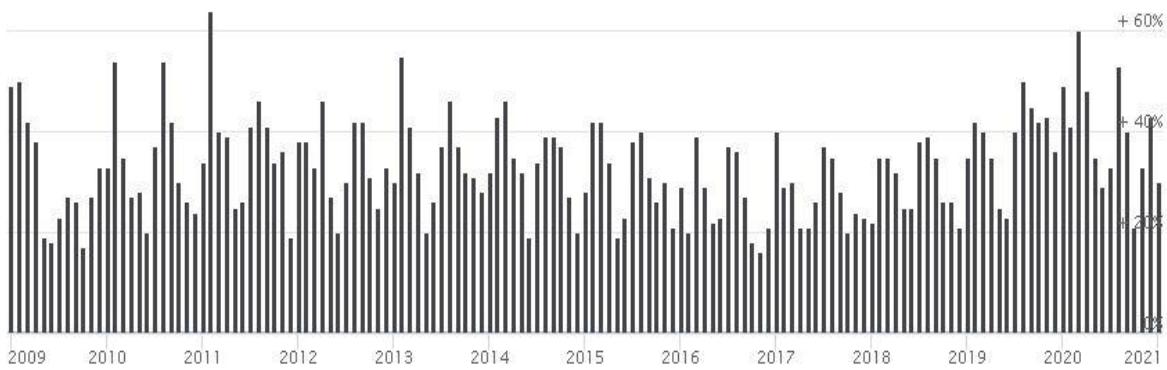
**Figure 4-3: Temperature trend analysis of Kohat (1961-2010)**



### **Relative Humidity**

259. The relative humidity typically ranges from 24% (dry) to 89% (very humid) over the course of the year, rarely dropping below 15% (dry) and reaching as high as 99% (very humid) as can be seen in **Figure 4.4** below.

**Figure 4-4: Humidity Profile of Kohat City**



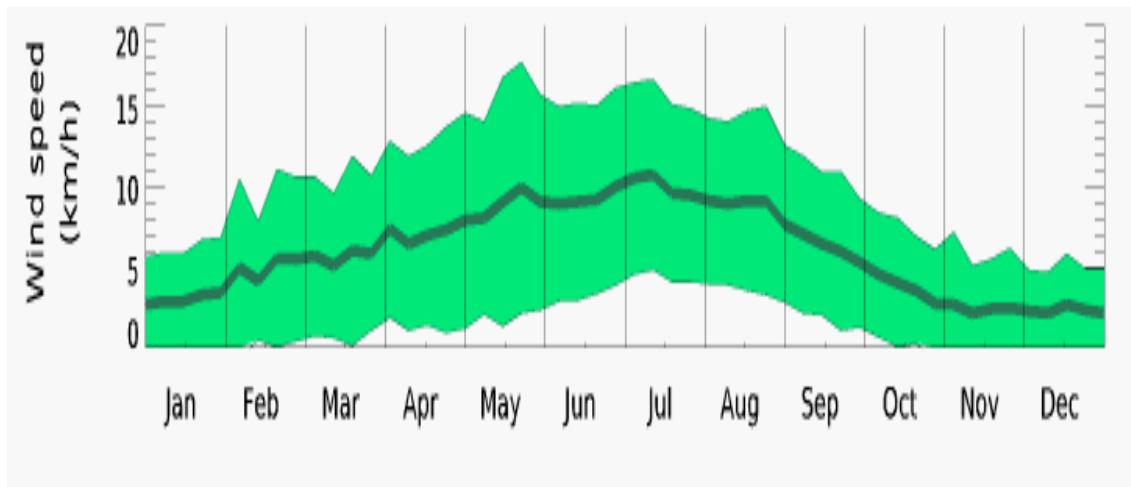
260. Although heatwaves<sup>8</sup> do not have a statistically significant trend in Kohat, longer periods of rate of increase of maximum and minimum temperature together with heat waves and increased precipitation can cause increases in humidity and water consumption.

### **Wind Speed**

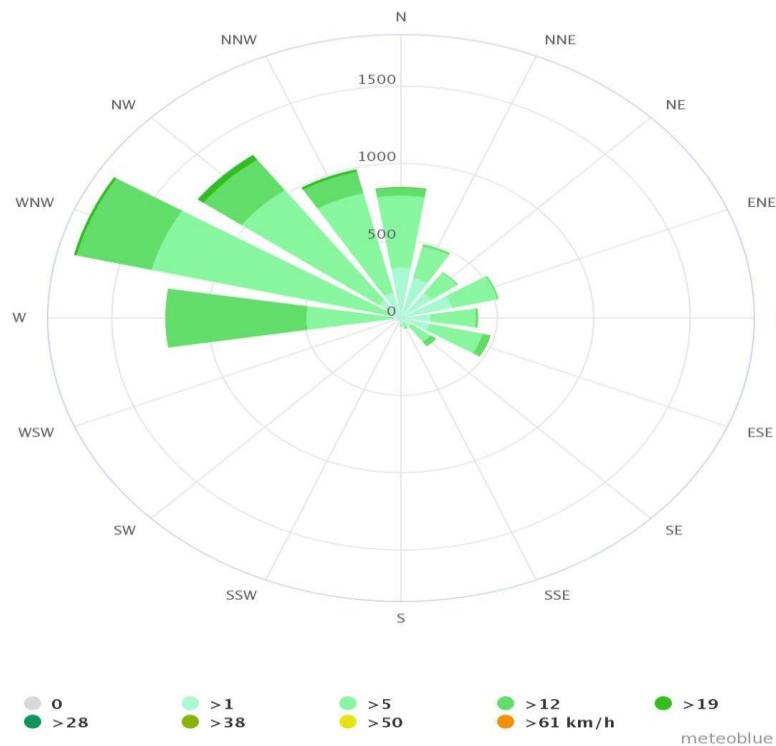
<sup>8</sup> Heatwaves period can be defined as when consecutive 3-days temperature remains >45°C/day.

261. Over the course of the year, the typical wind speed varies between 0 m/s and 6 m/s (calm to moderate breeze), rarely exceeding 12m/s (strong breeze) as can be seen in **Figure 4.5** below while probable wind direction is WNW and NW.

**Figure 4-5: Wind Speed Profile of Kohat City**



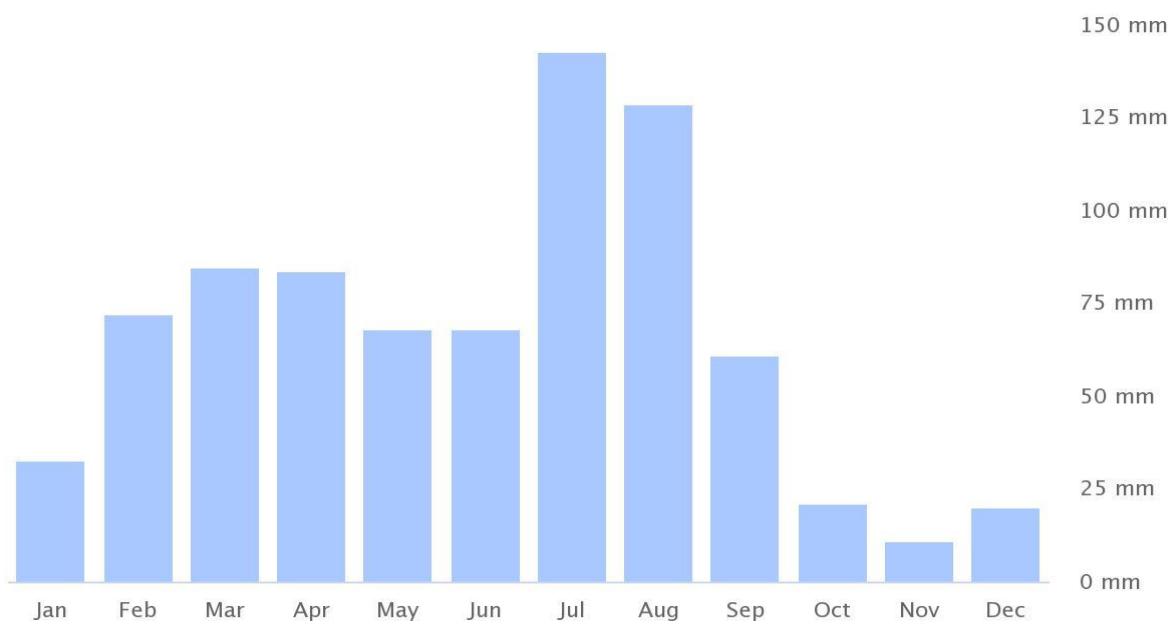
262. The Windrose profile for Kohat is provided as **Figure 4.6**.

**Figure 4-6: Windrose for Kohat<sup>9</sup>**

### Precipitation

263. The rainfall is received throughout the year. The monsoon rain is received from May to October. August is the wettest month with an average rainfall of about 141 mm. The winter rains occur from November to April. The highest winter rainfall was received in the month of February. The average rainfall for the years 2000-2012 was recorded at about 700 mm as shown in **Figure 4-7** below.

<sup>9</sup> [https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/Kohat\\_pakistan\\_1168197](https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/Kohat_pakistan_1168197). The meteoblue climate diagrams are based on 30 years of hourly weather model simulations and available for every place on Earth at 30 Km spatial resolution.

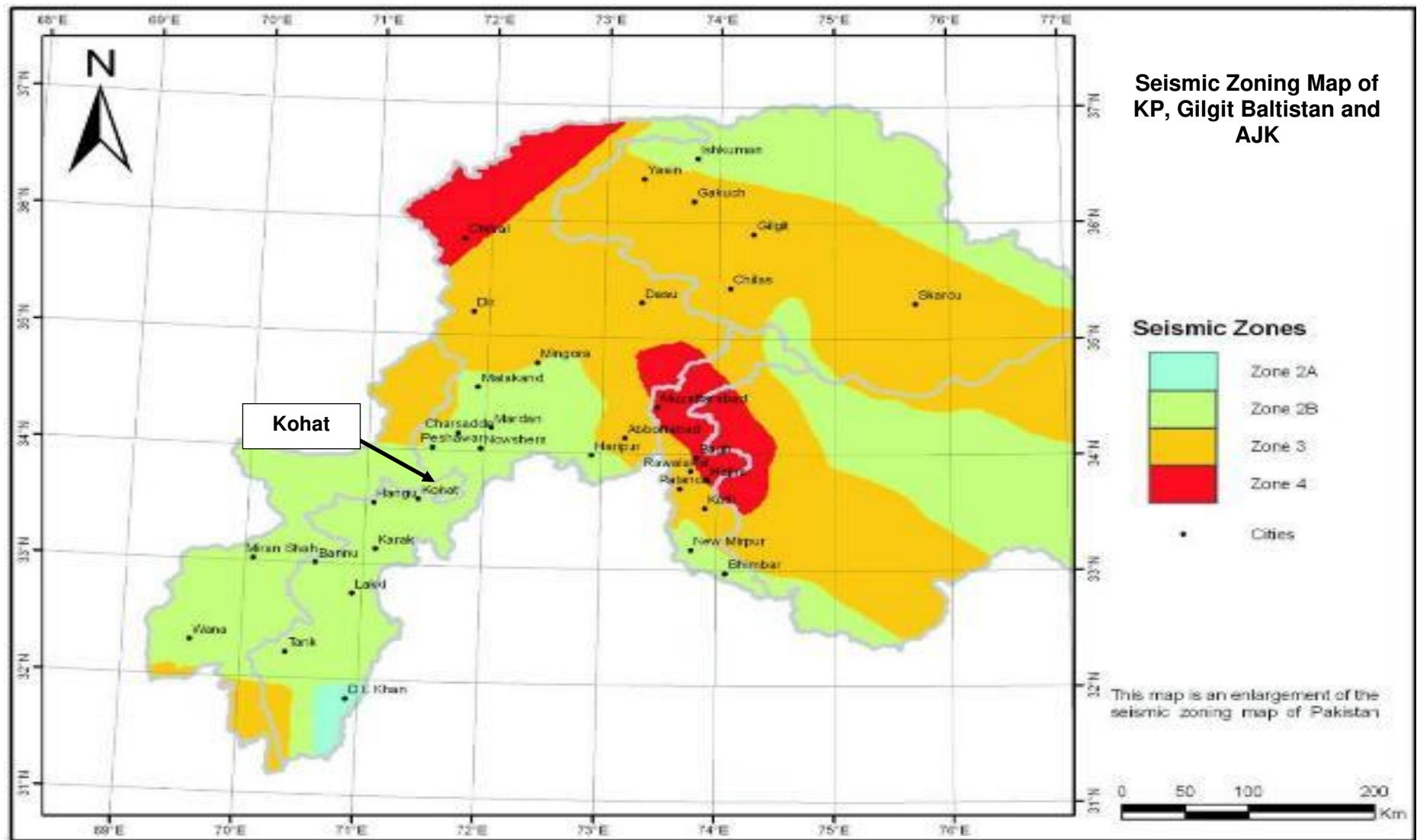
**Figure 4-7: Average Rainfall Profile of Kohat City**

264. Careful analysis of climatic conditions of the area will reveal that annual rainfall may continue to increase during the coming years with a rate of 5% per decade subjecting this region to flooding risks. Various studies show that the winter rainfall is continuously decreasing with a significant rate by every passing year. However, the spring rainfall is continuously increasing while the summer (monsoon) rainfall rates show increasing trend while, the fall season indicates a continuous decreasing trend. As a whole, rainfall in winter and fall is on a decreasing trend, whereas spring and summer rains are increasing.

#### 4.2.5 Seismology

265. The seismic hazard in Kohat is aggravated by increasing vulnerability due to population growth and expansion in infrastructure due to its political and regional importance. It is located in the western Himalayan region characterized by high seismicity rates due to its vicinity to the active plate boundary between the Indian and Eurasian plates. The seismic zone map of Pakistan is shown in **Figure 4.8** below.
266. Kohat is placed in Zone 2B. The Zone 2B has Peak Ground Acceleration (PGA) in the range of 0.16g to 0.24g for a return period of 475 years and is considered to be at 'Moderate' risk of a major earthquake event.
267. It is therefore, recommended that the project structures shall be designed to cater for the requirements of Zone 2B of Building Code of Pakistan (2007).

Figure 4-8: Seismic Zones of Pakistan



#### 4.2.6 Surface water

268. Water resources of the area is a combination of surface water and ground water. Surface water mainly comes from Toi River while groundwater is accessed during dry months. Toi River is fed by rainfall in its catchment area in the hills in north and western side. Various streams exist in the Kohat which originate from surrounding hilly areas and considered as non perennial streams since they are rain fed and do not provide water round the year. All these streams discharge into Toi river.
269. No streams are flowing in the project area of the proposed SWMF.

#### 4.2.7 Groundwater

270. Groundwater is the major source of water in the study area, which is extracted with the help of pumps and motors. The groundwater extracted is used to fulfill various domestic and irrigation needs.
271. Underground water is plentifully available which is being harnessed by the local community of respective districts and will continue as the source of water even for the project. Under ground water from a depth of around 25-40 feet as the first aquifer is harnessed by the locals for human consumption and irrigation on a limited scale.

#### 4.2.8 Noise

272. The comparison of the results also presented in **Table 4.2** below. The results indicate the ambient noise levels being within the most stringent guidelines during the daytime. There are no sensitive receptors with regards to noise levels within proximity from the proposed landfill site.
273. As already indicated in the footnote to **Table 4.2** below, these readings may not be considered representative due to the COVID-19 pandemic lockdown, leading to significantly reduced traffic volumes in the project area. Thus, ambient noise measurements will need to be repeated prior to commencement of the construction works.

#### 4.2.9 Air Quality

274. The comparison of the results presented as **Table 4.3** below. Ambient air quality has been carried out in main settlements around STP location have been selected keeping in view the wind direction during the monitoring day.
275. As can be observed, in general the air shed seems to be of good quality with the ambient air quality within the acceptable NEQS standards with PM10 being the only pollutant that is exceeding the guidelines at all four monitored locations.

**Table 4.2: Ambient Noise Monitoring Results (24 hrs) in Project Area**

Monitoring Location	Parameter	Noise Reading Results	Noise Guideline (Commercial Area)	Compliance Status for Commercial Areas
<b>Day Time Readings (0600 to 2200)</b>			<b>Day time</b>	
Landfill site	dB(A) Leq	49.95	65	
Recyclcing Plant		47.0		
Laal Maila		53.24		
Oblan Camp		54.7		
<b>Night Time Readings (2200 to 0600)</b>			<b>Night time</b>	
Landfill site	dB(A) Leq	48.0	55	
Recyclcing Plant		48.3		
Laal Maila		48.36		
Oblan Camp		53.07		

 Exceedance from applicable guidelines

 'Within' applicable guidelines

Note: It is recommended to repeat the ambient noise measurements at selected locations in project area since the readings presented above may not be representative due to the COVID-19 pandemic, there was a nationwide lockdown at the time of this monitoring activity, leading to considerably reduced traffic volumes.

**Table 4.3: Comparison of ambient air quality results versus applicable Air Quality standards**

<b>Monitoring Location</b>	<b>Parameter</b>	<b>NO (ug/m<sup>3</sup>)</b>	<b>NO<sub>2</sub> (ug/m<sup>3</sup>)</b>	<b>CO (ug/m<sup>3</sup>)</b>	<b>SO<sub>2</sub> (ug/m<sup>3</sup>)</b>	<b>PM<sub>2.5</sub> (ug/m<sup>3</sup>)</b>	<b>PM<sub>10</sub> (ug/m<sup>3</sup>)</b>
<b>Applicable Guideline (ug/m<sup>3</sup>) for 24 hrs</b>	<b>Average</b>	-	80	-	20	25	50
Landfill site	-	11.4	11.98	.82	11.64	15.23	51.73
Recycling Plant	-	10.3	11	0.8	10.9	17.1	54.5
Laal Maila	-	10.9	10.5	0.8	10.2	18	56.7
Oblan Camp	-	10	11.3	0.8	10.7	17.6	55.6

■ Exceedance from applicable guidelines

■ ‘Within’ applicable guidelines

Note: It is recommended to repeat the ambient air quality measurements at selected locations in project area since the readings presented above may not be representative due to the COVID-19 pandemic, there was a nationwide lockdown at the time of this monitoring activity, leading to considerably reduced traffic volumes.

### 4.3 Ecological Environment

276. In order to identify ecological resources, ecological baseline survey was carried out by EDCM team. Detailed surveys were conducted for project scoping during the start of March and mid of April 2020. The city of Kohat consists of an urban landscape with patches of plants and trees present across the city for the purpose of beautification and landscaping.
277. Integrated Biodiversity Assessment Tool (IBAT) screening was carried out to identify the biodiversity features and species that are located within the following buffers: 1 km, 5 km and 10 km. There were no protected and/or key biodiversity areas found within 10 km buffer from the STP site. There are 23 threatened species that are potentially found within 50 km from area of interest consisting of a mix of terrestrial, marine and freshwater species. As project area is located in urban sprawl of Kohat city and habitats have been converted into human settlements at large scale, therefore, no impact on such species is expected from project activities. IBAT screening report is attached as **Annexure O**.

#### 4.3.1 Flora

278. In the Kohat valley, subsistence agriculture is widely practiced with wheat, barley, millet, corn, cotton, pepper and sugarcane being the primary crops. The annual cycle is divided into two planting and harvesting periods, one for wheat and barley in winter and another for corn in summers. Planting and harvesting of sugarcane overlaps both the periods. These crops are supplemented with a variety of vegetables and with clover, which is used in conjunction with millet as a fodder.
279. In many villages in the Kohat valley, there are extensive pear, peach and apricot orchards and grape vineyards.
280. The present flora of the irrigated areas is exotic. The common trees are mesquite, ber, different species of acacia and jand. The most common shrubs are *Gymnosporia Royleana*, *Ziziphus nummularia* and *Monotheeca Buxifolia* and common/fodder grasses. Existing dominant flora in the project area is given in **Table 4.4** below.
281. Vegetation of the project area is dry deciduous scrub type. The stocking on the whole is poor. There are some species such as trees, grasses and shrubs are found near the project area. Good quality fodder grasses are also found at the moist places, where the incidence of grazing is less.

**Table 4.4: Existing Flora in Project Area**

Scientific Name		Common Name	IUCN Status
<b>Tree</b>	<i>Acacia Modesta</i>	Phulai	Data Deficient (DD)
	<i>Olea Cuspidata</i>	wild olive	Data Deficient (DD)
	<i>Dodonaea Viscosa</i>	Broad leaf hopbush	Least Concern (LC)
<b>Shrub</b>	<i>Gymnosporia Royleana</i>	Royle's Spike Thorn	Data Deficient (DD)
	<i>Ziziphus nummularia</i>	Jujube	Data Deficient (DD)
	<i>Monotheeca Buxifolia</i>	-	Data Deficient (DD)
<b>Grass</b>	<i>Aristida Depressa</i>	Aristida	Data Deficient (DD)
	<i>Cymbopogon Jawarnica</i>	East Indian lemongrass	Data Deficient (DD)
	<i>Eleusine Flagellifera</i>	Goosegrass	Data Deficient (DD)
<b>Fodder Grass</b>	<i>Bothriochloa Pertusa</i>	Indian bluegrass	Data Deficient (DD)
	<i>Digitaria Bicornis</i>	Crabgrass	Data Deficient (DD)

Source: EDCM Ecology Survey, April 2020

### 4.3.2 Fauna

#### 4.3.2.1 Birds

282. Common bird species found in suburbs of Kohat are mentioned in **Table 4.5**. It is important to mention that the project area for the proposed SWMF contains urban settlements and does not contain habitats of any bird species of special importance, hence, no impact on avifauna is anticipated from the project.

**Table 4.5: List of Birds in Kohat Region**

No.	Common Name	Scientific Name	Status		Occurrence		
			Migratory	Resident	Common	Abundant	Less Common
1.	Black drongo	<i>Dicrurus macrocercus</i>	x		x		
2.	Black kite	<i>Milvus migrans</i>	x		x		
3.	Black partridge/Francolin	<i>Francolinus francolinus</i>	x	x			
4.	Blue rock pigeon	<i>Columba livia</i>	x	x			
5.	Cattle egret	<i>Bubulcus ibis</i>	x	x			
6.	Common/Indian myna	<i>Acridotheres tristis</i>	x		x		
7.	Collared dove	<i>Streptopelia decaocto</i>	x		x		
8.	Common babbler	<i>Turdoides caudatus</i>	x		x		
9.	Crested lark	<i>Galerida cristata</i>	x		x		
10.	Greater grey shrike	<i>Lanius excubitor</i>	x	x			
11.	Grey partridge	<i>Francolinus pondicerianus</i>	x	x			
12.	Hoopoe	<i>Upupa epops</i>	x	x			
13.	House sparrow	<i>Passer domesticus</i>	x		x		
14.	House crow	<i>Corvus splendens</i>	x		x		

No.	Common Name	Scientific Name	Status		Occurrence		
			Migratory	Resident	Common	Abundant	Less Common
15.	House swift	<i>Apus affinis</i>	x		x		
16.	Indian cliff swallow	<i>Hirundo fluvicola</i>	x	x			
17.	Indian robin	<i>Saxicoloides fulicata</i>	x	x			
18.	Indian roller	<i>Coracias benghalensis</i>	x	x			
19.	Indian sparrowhawk/Shikra	<i>Accipiter badius</i> <i>cenchorides</i>	x	x			
20.	Indian tree-pie	<i>Dendrocitta vagabunda</i>	x	x			
21.	Koel	<i>Eudynamys scolopacea</i>	x	x			
22.	Little brown dove	<i>Streptopelia senegalensis</i>	x		x		
23.	Little green bee-eater	<i>Merops orientalis</i>	x		x		
24.	Pied bushchat	<i>Saxicola caprata</i>	x		x		
25.	Purple sunbird	<i>Nectarinia asiatica</i>	x	x			
26.	Red-vented bulbul	<i>Pycnonotus cafer</i>	x	x			
27.	Red wattled lapwing	<i>Hoplopterus indicus</i>	x		x		
28.	White breasted kingfisher	<i>Halcyon smyrnensis</i>	x	x			
29.	White eyed buzzard	<i>Butastur teesa</i>	x		x		
30.	White/Pied wagtail	<i>Motacilla alba</i>	x		x		
31.	White cheeked bulbul	<i>Pycnonotus leucogenys</i>	x		x		

Source: IEE of Drilling of Manzali South-1, 2018

#### 4.3.2.2 Mammals

283. Important mammal species found in the vicinity of the project area are mentioned below in the **Table 4.6** with their respective IUCN status in the Red List. No endangered species are available in the project area.

**Table 4.6: IUCN Status of Fauna in Project Area**

	Scientific Name	Common Name	IUCN Status
<b>Mammals</b>	Vulpes	Red Fox	Least Concern (LC)
	Canis Aureus	Golden Jackal	Least Concern (LC)
	Hystrix Indica	Indian Crested Porcupine	Least Concern (LC)
	Sus Scrofa	Wild Boar	Least Concern (LC)

\*IUCN Red List for species status of Pakistan. EDCM Ecology Survey April 2020

#### 4.3.2.3 Reptiles

284. The common reptiles of project area include; Garden lizard, Spotted Indian house gecko and Yellow-bellied house gecko. The snakes reported in project area are; Indian cobra, Saw scaled viper and Dhaman/Common rat snake. Dhaman is non-poisonous being farmer friendly species controlling rodent/vermin population.

### 4.4 Socio-economic Environment

285. This section includes a summary of the prevailing socio-economic conditions in the project area and the population that will be potentially affected by the Project. To ascertain the socio-economic condition of the project area, primary and secondary data was collected including social and physical infrastructure in the project area.
286. To assess the socioeconomic conditions of the project area, 6 FGDs were carried out with 55 participants. Households (HH) have been studied during focus group discussions/public consultations. These people belong to the nearest area of the project, FGDs were held with them to brief them about project and to seek their views. In addition, the secondary data, including Economic Survey of Pakistan (2018-19), Bureau of Statistics (2017-18), District Population Census 2017 of KPK, Crop Reporting Services KP (2017-18) and MICS of KP; and KPID have been consulted.
287. Detailed surveys were conducted for project scoping during the start of May and start of June 2020. For the purpose of the environmental and social assessment and sensitive receptor data collection, a two-kilometer-wide, corridor along the proposed project site has been considered as the study area or the project area. Most of the field data collection was carried out within this corridor though where relevant data was also collected from a wider area along the proposed project site. The reason for selecting this corridor is to cover those areas that have a potential to be affected by the project activities.
288. The names of the major settlements falling in the project area are Oblan camp, Muhammad Zai, KDA Phase 02, Laal Maila. Photographs depicting socio-economic conditions in the project area are provided in **Figure 4-9**.



**Figure 4-9: Socio-economic conditions of the project area**

	
Consultation with secondary stakeholders in KDA Phase 02, Kohat	Consultation with secondary stakeholders in Laal Maila, Kohat
	
Consultation with secondary stakeholders in Oblan Campt, Kohat	Consultation with secondary stakeholders in Recycling plant, Kohat
	
Consultation with secondary stakeholders in Muhamad Zai, Kohat	Consultation with secondary stakeholders in LaalMaila, Kohat

#### **4.4.1 Administrative Setup**

289. The project area falls in the jurisdiction of Union Council (UC) Muhammad Zai, Kohat in Khyber Pakhtunkhwa Province. Under the latest revision of Pakistan's administrative structure, promulgated in 2001. Like any other district in the country, district Kohat is headed by District Coordination Officer (DCO) assisting Zila Nazim and is accountable to him. DCO, appointed by provincial government from the federal or provincial civil service, coordinates with Executive District Officers (EDOs), who head district offices including health. District Kohat has two Tehsils i.e. Kohat & Lachi. Each tehsil comprises of certain numbers of union councils. There are 27 union councils in district Kohat.

#### **4.4.2 Demography and Population**

290. The population of Kohat district in 1998 was 562,644. The city's annual growth rate is estimated at 3.03% per year, and the population of Kohat district is 993,874 according to the 2017 census. The people of the district are of light brown complexion with black hair and eyes. Some are nearly as fair as Europeans, and brown hair and blue or grey eyes are not uncommon. The upper classes, as usual, are a good deal fairer than the ordinary population. Both Bangashes and Khattaks, who form the main portion of the population, vary a good deal in dress and appearance in different parts of the district. District wise population chart of project areas mentioned below:

Districts	Headquarters	Area (km <sup>2</sup> )	Population (2017)	Density (people/km <sup>2</sup> )
Kohat	<u>Kohat</u>	2,991	993,874	390

\*Source District wise population Census 2017 by Pakistan Bureau of Statistics: Government of Pakistan.Religion

291. The population of the district is almost entirely Muslim, constituting 99.51 of the total population. The main minorities are Ahmadi and Christian who are 0.32 and 0.14 percent, respectively. Other minority is Hindu who is 0.02 percent of the total population. The population of rural and urban area is mostly Muslim which is 99.69 and 98.81 percent, respectively. The percentage of minorities i.e. Christian and Ahmadi is greater in urban area which is 0.62 and 0.46 as compared to rural area which is 0.29 and 0.02 percent.

#### **4.4.3 Cultural and Archaeological sites**

292. No archaeological and cultural site was observed in proximity of Kohat landfill site. Archaeological Chance Find Procedure is attached as **Annexure G**.

#### **4.4.4 Ethnicities in Project Area**

293. The primary data collected by the EDCM team during IEE baseline survey and public consultation shows the following ethnic diversity in the project area. None of these castes may be considered as indigenous people (IP) based on ADB SPS definition. The ethnicities present in the project area are provided in **Table 4.7**.

**Table 4.7: Ethnicities in Project Area**

<b>Settlement</b>	<b>Caste/ Tribe</b>	<b>Decision Making Process in Settlements</b>	<b>Locally Used Language</b>
Muhammmad Zai	Bangash/Awaan	Court of Law, Within caste group	Pashto
Oblan Camp	Afridi/Bangash	Court of Law, within caste group	Pashto
Laal Maila	Afridi/Bangash/Awaan	Court of Law, within caste group	Pashto

#### **4.4.5 Languages**

294. The primary native language spoken in Kohat is Pashto as reported by 98.44 percent. Though English is used in the city's educational institutions, while Urdu is understood throughout the city. The district of Kohat is overwhelmingly Pashto-speaking; though the Hindko-speaking minority is concentrated in Kohat's old city, Hindko speakers in Kohat increasingly assimilate elements of Pashto and Urdu into their speech. Punjabi, Sindi, Balochi, Saraiki the other languages spoken as mother tongue are 0.33, 0.49, 0.02, 0.01, 0.03 percent of the population respectively.

#### **4.4.6 Dress/Clothing**

295. People wear the traditional pakhtoon Shalwar Kameez; a tunic (Kurta), loose trousers and sandals (Kheri). In winters, men wear waist coat in addition to Shalwar Kameez. Women comparatively wear colorful clothing but wear Burqa/Chaddar while travelling outside.

#### **4.4.7 Marriages/Deaths**

296. Marriages are arranged according to the traditions of Pakhtun society. The parents of the boys and girls usually arrange the majority of the marriages when they reach the age of 20/25 years. Parents prefer their close relations when choosing bride/groom for their children. Commonly most marriages are held with customs.
297. The death ceremony is performed in sorrowful but respectable manner. The neighbours jointly prepare the grave and men and women assemble in the house of the deceased for Taziat (mourning). Nemaz-e-Janaza (Funeral prayers) is offered at the time fixed by family of the deceased and is attended by large number of men of the society. The men / women visit the hujra / house of the deceased for offering Fatiha (prayers) up to three days. The family of the deceased gives food to the poor and relatives as Khairat (charity).

#### **4.4.8 Dwellings**

298. Housing conditions of the respondents have been analyzed according to the type of houses in which they were residing. The house or building constructed with concrete or

burnt bricks fall in pacca category whereas house or building constructed with burnt bricks with mud comes under semi-pacca category while house constructed with mud bricks or temporary wooden logs etc. are categorized as kacha house. Project area most population is living in semi-pacca and pacca houses.

#### **4.4.9 Main Sources of Livelihood/Income**

299. Most of the people are farmers in profession in the nearby villages. They are engaged in agriculture either directly or indirectly. Industrial labor has increased after the establishment of factories in different places of the district. Some people are engaged in business and Government service also.

#### **4.4.10 Education Facilities in project area**

300. Education plays a pivotal role in changing social and economic condition of the individuals. Local community has access to educational facilities. Both primary and secondary schools for boys and girls are available in the project area.

#### **4.4.11 Social Amenities in project area**

301. During the field survey, the access/availability of the social amenities/ basic infrastructure in the vicinity of the proposed landfill site was asked from the surveyed households as well as physically observed at site. It was noted that facilities such as Electricity, Sui Gas, Water Supply, Telephone, Sewerage Drainage, school are available in the settlement or in its vicinity.
302. For health care, BHU and a childcare centre is present to facilitate the health of people in the project area and its near inhabitants.

#### **4.4.12 Major Source of Drinking Water**

303. The major sources of drinking water within the vicinity of the project area include community tube wells, individual and communal hand pumps. There are no proper water supply schemes available in the project area.

#### **4.4.13 Distance to nearest airport from project site**

304. The nearest airport to the proposed landfill site is the Bacha Khan International Airport, located at an 'aerial' distance of around 52 km from the site.

#### **4.4.14 Types of Dwellings**

305. Housing conditions of the respondents have been analyzed according to the type of houses in which they were residing. The house or building constructed with concrete or burnt bricks fall in pacca category whereas house or building constructed with burnt bricks with mud comes under semi-pacca category while house constructed with mud bricks or temporary wooden logs etc. are categorized as kacha house. Project area most population is living in semi-pacca and pacca houses.

#### **4.4.15 Archaeological and Cultural Heritage**

306. There are no sites of archaeological or cultural heritage located in the project area.

#### **4.4.16 Energy Supplies**

307. The residents of project area are reliant on electricity available from the grid. Due to long duration of load-shedding particularly during summer, there is an increasing trend of using diesel generators and installing solar PV systems in both residences and businesses in order to ensure energy reliability.

#### **4.4.17 Available Social Amenities in the project area**

308. During the field survey, the access/availability of the social amenities/ basic infrastructure in the vicinity of the proposed landfill site was asked from the surveyed households as well as physically observed at site. It was noted that facilities such as Electricity, Sui Gas, Water Supply, Telephone, Sewerage Drainage, school are available in the settlement or in its vicinity.

#### **4.4.18 Gender Assessment**

309. The focus group discussions with females were made from the main settlements/ villages located in the project area. Detailed gender assessment study will be planned to mainstream gender elements in the development of Kohat SWMF.

310. A Gender Action Plan (GAP) will be proposed to support the gender element of affected as well as the other households in the project. PMU Gender specialist will facilitate women specifically (elderly and single women without male support) in preparation of requisites for compensation, which may include the following:

- Opening of bank accounts of women in their name and ensure transparency of transferring compensation allowance
- Provide priority to vulnerable women/women headed families in compensation provision
- Maintain gender segregated database
- Ensure that women are aware about the amount of compensation provisions
- Include gender disaggregated data in the monitoring and evaluation system
- Ensure that women specific concerns and priorities are considered in resettlement process.

#### **4.4.19 Existing Scavenging Practices**

311. It is estimated that nearly 110 tons of waste is being generated and collected in Kohat, most of it is being dumped in open dumping sites. These open dumping sites are openly accessible to scavengers that search through and collect items of a recyclable nature i.e.

paper, metals, plastic. These items they then either sell to scrap dealers or bring to their specific godowns to be sold onwards.

312. The process of consultation was planned to begin with contacting the workers collecting waste door-to-door every morning and progressing step by step through scrap collection and sorting facilities of various capacities, possibly including the transporters associated along the way, up till the larger scrap recycling or management facilities.
313. The visits conducted by the environmental team, covering most of the groups, yielded some useful data which projects a picture of the current operations within the informal waste management system structure. Studies on a limited scale have tried to assess their socioeconomic conditions, from their mean monthly income figures to their motivation for this line of work and their working conditions (Alam et al, 2011). Generally, a scavenger on average makes between PKR 2000 and 3000 per month (Dawn, 2017). In most cases, this income supports the primary income source in the household, but there are cases where the scavenger's income is the primary or even sole income of the household (Alam et al, 2011). The major concern observed within this line of work is the overall health and safety risk that scavengers are under, as they constantly must deal with sharp or dangerous objects with usually no protective measures or gear. Scavenging activities are observed to be mostly concentrated in commercial market areas of the city, with not as much outreach into residential neighborhoods.
314. The ISWM system will certainly influence these scavenging practices which is effectively almost an industry. There is a considerable potential to positively channelize the work that these scavengers put in towards waste reduction and recycling, possible immediately after door-to-door collection takes place as well as at a Material Recovery Facility (MRF). The informal networks of scavengers can be brought on board by the WSSCK operations by subcontracting them these waste sorting activities. This is likely to significantly secure both their livelihoods and their working conditions. Some level of vocational training will be required to ensure a uniform basic skill level, however, it is expected that these workers will bring to the job considerable experience from having performed it in an informal and unregulated sector.
315. The images provided below as **Figure 4-10** depict how much of tendency there is in the scavenging industry to employ young children. Once under a formalized umbrella, care will be taken to ensure that Child Labour Laws and best practices are fulfilled. Examples of global brands like Levi's and Nike (Dawn, 2017) retaining their underage workforce in Bangladesh, investing in their education and bringing them to work once they were of legal age, is a good precedent to look up to, determined ultimately by financial feasibility in addition to ethical considerations.
316. A study places the present rate of recovering recyclables from Kohat's total waste at 47%, which is predominantly done by these scavengers. Making use of their service in a formal, regulated system of operation which emphasizes can improve this rate to as high as 90% (Hussain, 2013).
317. Considering all these factors, it is clear that an overall positive effect is anticipated from the ISWM system on scavenging and recycling. In addition, detailed consultations with

scavengers, scrap dealers and personnel involved in the waste management business were conducted and the details are provided in **Chapter 8**.

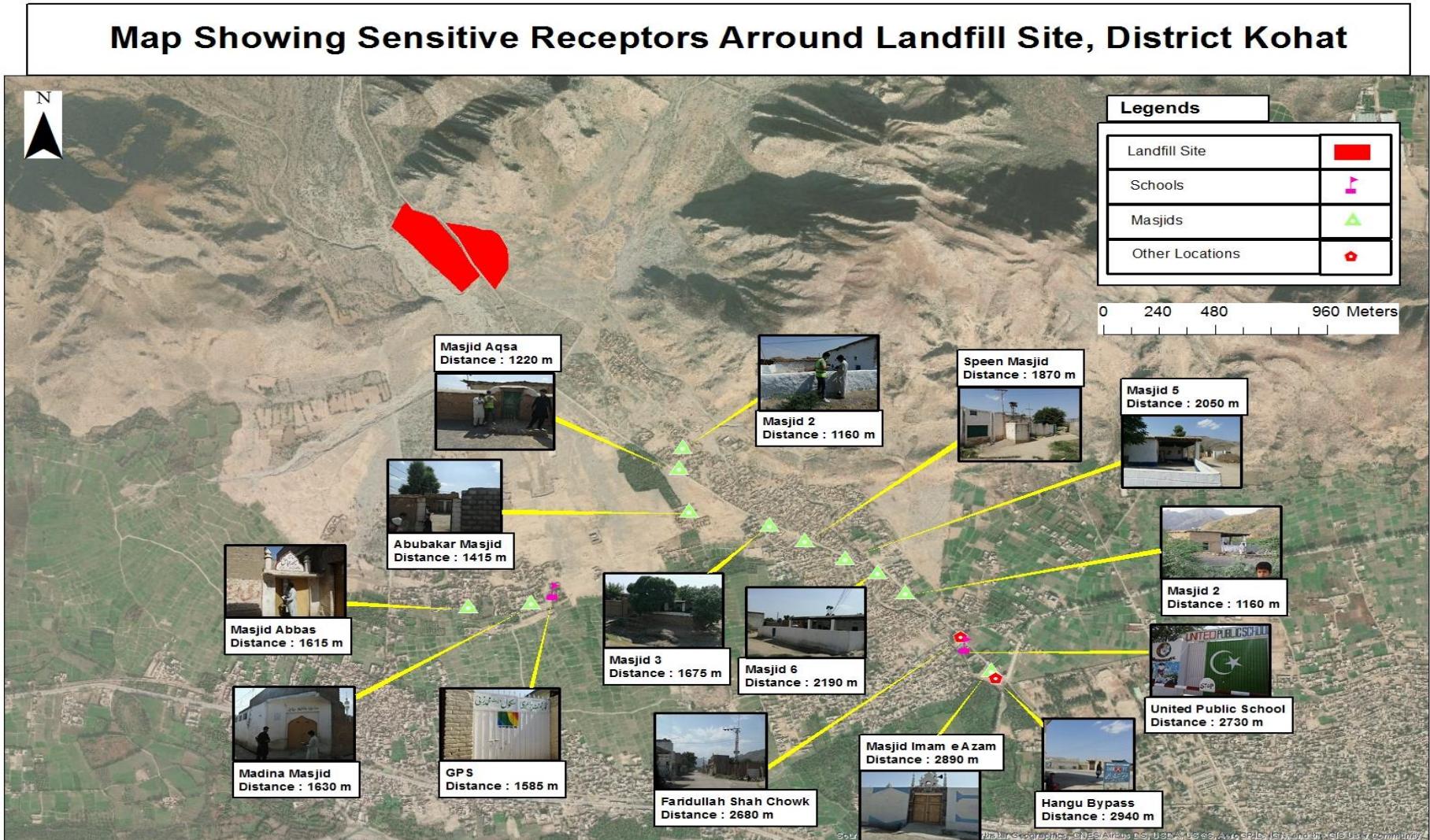
**Figure 4-10: Illustrating young children engaged in scavenging as an essential means of their livelihood**



#### 4.5 Sensitive Receptor Mapping

318. The proposed landfill site location with the sensitive receptors i.e. residential settlements in the form of clusters and individual settlements are shown in **Figure 4.11**. The respective distances of these sensitive receptors from the proposed site are provided in **Tables 4.8**. It can be observed that project area in general consists of settlements, which adds to the sensitivity of this project considering the scale of the project and potential impacts to be expected during both the construction and operation phases of the project.

**Figure 4-11: Sensitive Receptors and Prominent Structures within radius of 2 km from the proposed Landfill Site**



**Table 4.8: Sensitive Receptors and Prominent Structures within radius of 2 km from the proposed Landfill Site**

Sr. No.	Pictorial View	Coordinates	Distance from site (meters)	Description
1.		71.40630 33.61232	1220	Masjid Aqsa
2.		71.40643 33.61328	1160	Masjid 02

Sr. No.	Pictorial View	Coordinates	Distance from site (meters)	Description
3.		71.41060 33.60983	1675	Masjid 03
4.		71.41228 33.60916	1870	Speen Masjid

Sr. No.	Pictorial View	Coordinates	Distance from site (meters)	Description
5.		71.41417 33.60839	2050	Masjid 05
6.		71.41568 33.60780	2190	Masjid 06

Sr. No.	Pictorial View	Coordinates	Distance from site (meters)	Description
7.		71.41702 33.60690	2540	Speen Masjid 02
8.		71.41965 33.60489	2680	Peer Syed Faridullah Shah Chowk

Sr. No.	Pictorial View	Coordinates	Distance from site (meters)	Description
9.		71.41988 33.60454	2730	United Public School
10.		71.42116 33.60345	2890	Masjid Imam Azam

Sr. No.	Pictorial View	Coordinates	Distance from site (meters)	Description
11.		71.42138 33.60304	2940	Nisar Chowk, Hangu Bypass
12.		71.40686 33.61036	1415	Masjid Hazrat Abu Bakkar

Sr. No.	Pictorial View	Coordinates	Distance from site (meters)	Description
13.		71.40075 33.60645	1585	Govt Primary School West Mumdaza
14.		71.39974 33.60593	1630	Madina Masjid

Sr. No.	Pictorial View	Coordinates	Distance from site (meters)	Description
15.		71.39685 33.60567	1615	Masjid Abbas

#### 4.6 Sensitive Receptor Mapping to assess compliance with IFC EHS Clause<sup>10</sup>

319. The IFC EHS clause specific to Landfill Siting states the following:

*"The location of the landfill shall take into account potential impacts associated with releases of polluting substances including the following:*

- *Proximity to residential, recreation, agricultural, natural protected areas, or wildlife habitat and areas prone to scavenging wildlife, as well as other potentially incompatible land uses:*
  - ***Residential development should be typically further than 250 meters from the perimeter of the proposed landfill cell development to minimize the potential for migration of underground gaseous emissions.***

320. The field visits for social safeguard assessment by PMU and EDCM team has been carried out in September'20 to identify any sensitive receptors falling within 250 m distance from landfill cells. Assessment findings show that none of the receptors are considered as sensitive as all are falling outside of 250 meters perimeter from landfill cells.

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<sup>10</sup> <https://www.ifc.org/wps/wcm/connect/5b05bf0e-1726-42b1-b7c9-33c7b46ddda8/Final%2B-%2BWaste%2BManagement%2BFacilities.pdf?MOD=AJPERES&CVID=jqeDbH3&id=1323162538174>

## 5 Analysis of Alternatives

### 5.1 Overview

321. Project alternatives have been studied as a part of this IEE process. Alternatives analysis has been conducted in detail to foresee environment, economic and social impact of each alternative. This chapter also provides an overview of the various commercially available technologies for the treatment and processing of waste in an environmentally sound manner and is successfully running in developed countries in particular and recommends the most suitable set of options for Kohat city keeping in view its waste generation and composition.
322. Project alternatives has been studied keeping in view number of parameters including; waste quantum, physio-chemical properties of waste, suitability for mixed waste handling, land requirements, technical complexities, social acceptability, environmental and legal compliance, and OPEX & CAPEX requirements.
323. The development of the proposed SWMF is based on detailed feasibility assessments focusing on assessing the city requirements with regards to SWM and then determining the most suitable and effective technology and location for development of the required infrastructure.
324. This process of analysis of the different alternatives for development of the landfill site ensures that a well-informed decision is taken regarding the selection of the most optimal option amongst the possible options that are brought into consideration.

### 5.2 Alternatives Types

325. Types of alternatives considered for detailed analysis for Kohat SWM facility are given below;
  - No Project Option
  - Site Selection Alternatives
  - Landfill Type Alternatives
  - Landfill Construction Alternatives
  - Waste Disposal Alternatives
  - Technological Alternatives for AD
  - Material Recovery Facility
  - Scenario Analysis for all possible treatment options for Kohat
  - Economic Analysis

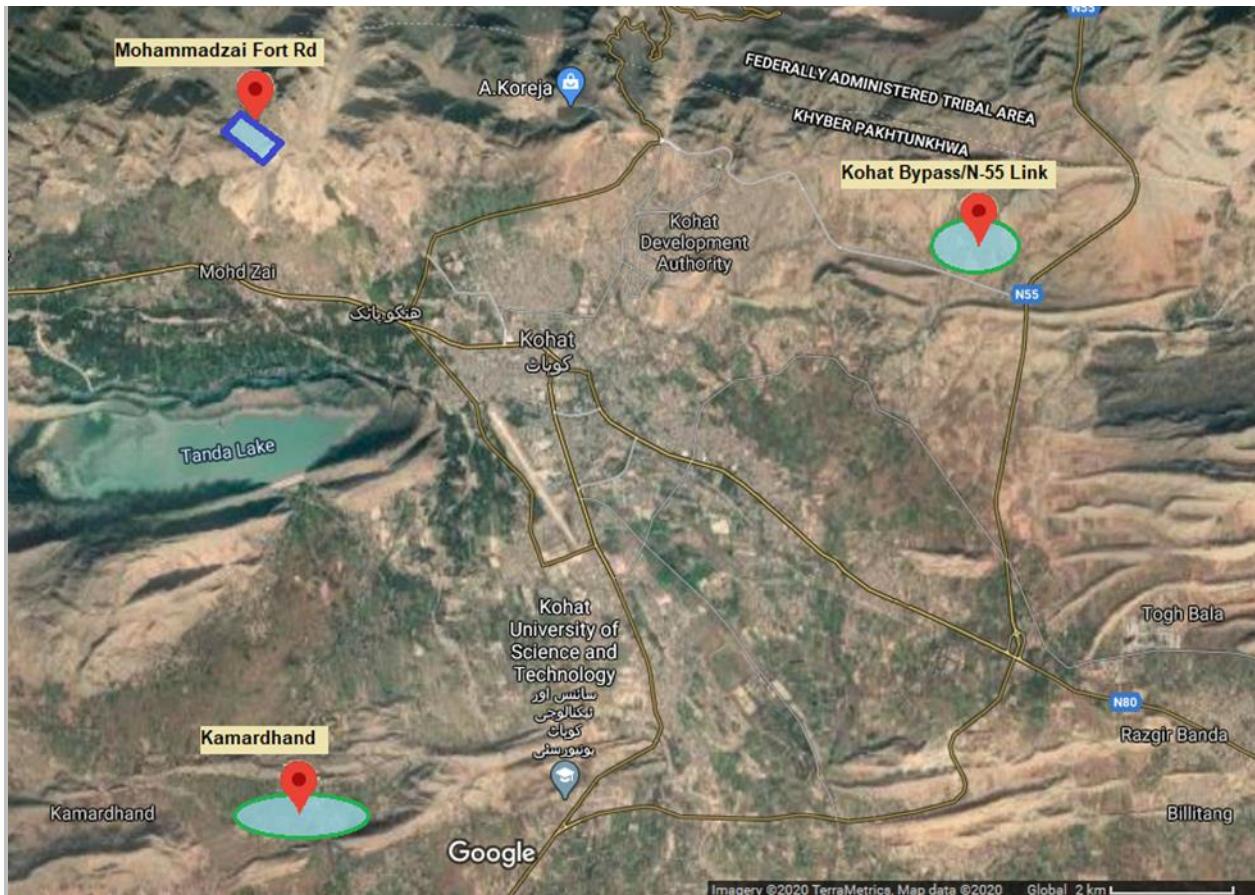
- Closure/Post Closure Plan

### 5.3 ‘No Project’ Option

326. If ‘no project’ option is triggered, it will result in loss of all positive impacts caused that project will pose on Kohat city; such as eradicating open dumping of solid waste, improving civic services in terms of integrated waste management, removing existing bottlenecks in the system and improving the aesthetic aspects of the city. If the project is not implemented, urban environmental quality will be further degraded. It also limits the urban development of the area in a sustainable manner.
327. On the other hand, if the project is implemented, it will result in improved SWM system services and improved urban environment quality. Furthermore, project implementation will also create job opportunities during construction, thereby improving the socioeconomic condition of the local people and help in improving their quality of life. Thus, the ‘no project’ option is not a viable option.

### 5.4 Site Selection Alternatives

328. The site initially considered for a proposed sanitary landfill is situated on Mohammadzai Fort Road a few kilometers outside of the Hangu Bypass Road. At the time, no other alternative option was explored for the landfill site. Subsequently, relevant land acquisition and resettlement protocols had been initiated in some form at various times in the past. For the current project, the environmental experts proactively sought out alternative site options in order to determine the most environmentally and socioeconomically sustainable location for the landfill. Considerations in line with the criteria detailed above were kept in view when comparing any other sites with the original and it was determined that environmental sensitivity, availability of infrastructure, existing utilities, land availability in terms of acquisition and ownership, and the particular working modalities of the project would be the factors most influential in determining which site would eventually be deemed most feasible.
329. The sites analysed in this exercise thus included:
- Mohammadzai Fort Rd: located North West of the city, 7 km from the city center.
  - Kohat Bypass/N-55 Link Rd: area located East of the city, 8km from the city center.
  - Kamardhand: area located South West of the city, 8-9 km from the city center.
330. These sites are shown in the **Figure 5.1** below and the comparison of these different site alternatives is provided in **Table 5.1** below.

**Figure 5-1: Location map of site alternatives****Table 5.1: Comparison of Site Alternatives**

Parameters	Site Alternatives		
	Mohammadzai Fort Rd	Kohat Bypass/N-55 Link Rd	Kamardhand
Environmental Sensitivity	Low due to barren land, rugged terrain and no significant presence of waterbodies. Fairly flat ground slope at site.	Low as surrounding area is mostly barren, with little vegetation close to potential site area. Slope will be minimal.	Fairly high as land use is agricultural in this area.

<b>Parameters</b>	<b>Site Alternatives</b>		
	<b>Mohammadzai Fort Rd</b>	<b>Kohat Bypass/N-55 Link Rd</b>	<b>Kamardhand</b>
<b>Infrastructure</b>	Convenient access through road network. Traffic remains light.	Easy access through major roads. High traffic density as the link road is a major thoroughfare in and out of the city.	Lack of direct access to potential site through existing road network.
<b>Site capacity</b>	70-80 Acres, adequate for landfill site operations.	Exact site location and area not defined.	Exact site location and area not defined.
<b>Land Acquisition</b>	Land acquisition is under way. Resettlement activities in advanced planning stages.	Property value anticipated to be high given the current and future industrial and commercial land use in the area.	Land acquisition will trigger social safeguard particularly in the case of agricultural land.
<b>Social Acceptability</b>	Relatively easy due to the ongoing public awareness and consultation activities.	Likely to be potentially complicated given the variety of potential stakeholders involved.	Difficult as agricultural practice is an essential source of income for the surrounding population.
<b>Distance from City Centre</b>	7 km (4 km from urban periphery)	8 km (2 km from urban periphery)	9 km (3 km from urban periphery)

331. The shape of the urban sprawl in Kohat is elongated in the North and South directions. The future growth trajectory is also in these directions as well as in the Northeast and Southeast directions. Therefore in a comparison the respective sites' distance from the center of the city is perhaps not quite as influential a factor as the distance from the nearest urban residential and built-up areas of the city.
332. The original site located on Mohammadzai Fort Road is approximately 7 km from the city center and 4 km outside of the closest built-up area periphery. Its major drawing factor is the relatively less sensitive environment at and around the proposed landfill site given the rugged, mountainous, and barren topography of the surroundings. Its access via road is

quite convenient. Furthermore the process of land acquisition and resettlement is in fairly advanced stages. Regarding social acceptability of the project at this site, the nearby population, which is scarce at present, has been taken into confidence regarding the merits of the project and most have already expressed consent.

333. A potential site in the area east of the city near the interchange of N-55 Indus Highway and the Link Road connecting it to the city was also studied in light of the relevant parameters. This area is generally 7 to 8 km from the centre of the city, but the nearest urban built-up areas, the KDA Housing Society and Sheikhan Village, are only about 2 km away. The environmental sensitivity is also lower as the barren landscape continues here, although past some hills 2 km south of the area, the land is utilized for agricultural purposes. Although no site has been particularly identified as an alternate option yet, to go ahead with the option would require land acquisition which will likely be complicated as well as expensive since the future development of the area, being so close to existing built-up area, is anticipated to be in line with residential, commercial, and possibly industrial land-uses.
334. The site in vicinity of Kamardhand village was also studied similarly to determine its suitability. The area is 8 to 9 km away from the city center, and 2 to 3 km away from both the nearest urban built-up area, comprising of institutions such as Kohat University of Science and Technology, and the nearby village settlement. The area is predominantly agricultural and in closer proximity to the Kohat Toi River and a seasonal tributary, which certainly makes it more environmentally sensitive compared to the other options discussed. A particular site has not been specified here either, so land acquisition will again be a complicated, expensive and cumbersome task, triggering social safeguards. With agriculture being the primary source of income in the area, the social acceptability of the project at this site is expected to be considerably more complicated and potentially problematic. The lack of adequate road access to the area is also a major factor to influence its suitability as an option.
335. Considering these potential sites according to the above given parameters, the site observed to most sustainable was the Mohammadzai Fort Road site. There are much less anticipated environmental impacts associated with this site in comparison to other possible areas considered around the city of Kohat. These impacts, along with the climatic and hydrological factors, will be addressed by comprehensive technical design and management plans, particularly during the operation phase where environmental monitoring will comprise an essential part of the landfill operation.

## 5.5 Landfill Type Alternatives

336. There are various types of landfills that are designed and constructed worldwide to manage MSW, such as sanitary landfill, bio-reactor landfill and secured landfill. The safe and effective operation of landfill depends on sound planning, administration, and management of the entire MSW management system and selection of appropriate landfill type.

### 5.5.1 Sanitary Landfill

337. An engineered disposal location fully equipped and operation with leachate and landfill gas collection and treatment system. A disposal technique resulting in burial of waste using an engineered method intended to protect the environment, typically employing plastic liner and drains in the bottom to collect the liquids and cover on the top to keep rainwater out and to keep methane and other gases to escaping.

### **5.5.2 Bioreactor Landfill**

338. A bioreactor landfill is a municipal solid waste landfill (MSWLF) in which liquids are added to help bacteria break down the waste. The increase in waste degradation and stabilization is accomplished through the addition of liquid and air to enhance microbial processes.

### **5.5.3 Secured Landfill**

339. Secured landfill is a carefully engineered depression in the ground (or built on top of the ground) into which wastes are dumped to avoid pollution to the surrounding environment. Secured MSW landfill shall be restricted to non-biodegradable, inert waste and other waste not suitable for recycling or for biological processing.
340. Based on above information, the project design consultant suggested to construct a sanitary landfill for Kohat as it is relatively low in cost and requires less technical and operational maintenance as compared to other options.

## **5.6 Landfill Construction Alternatives**

### **5.6.1 Lining**

341. The purpose of the liner system is to prevent migration of leachate generated inside a landfill from reaching the soil and ground water beneath the landfill. Thus, the function of leachate collection facility is to remove leachate contained within the landfill by the liner system for treatment and disposal, control and minimize leachate heads within the landfill, and avoid damage to the liner system. The drainage layer comprises of granular soil having an appropriate permeability. The geo-membrane and layer of compacted clay barrier below must also have an appropriate thickness to protect the soil and water.
342. The alternative of concrete lining is not as favorable as the HDPE (high density polyethylene) geo-membrane due to its higher erosion factor, indirectly amounting to a higher maintenance cost and greater harm to the environment.

### **5.6.2 Leachate Collection and Treatment**

343. The most suitable option is to spray the daily leachate back on the surface of the solid waste dumped at the landfill site. This is an economical and environmentally friendly leachate handling method. If the volume of the leachate production goes beyond the spraying capacity, leachate treatment will be required.
344. The alternatives regarding leachate management itself are:
- Discharge to lined drains
  - Discharge to waste water treatment system
  - Recirculation
  - Evaporation of leachate

- Treatment of leachate

345. There are various pros and cons to each option being studied and experimented with, including one where the practice of recirculation functions as a catalyst to increased gas production (Kumar et al. 2011) to assist in energy recovery.
346. For Kohat, a combination of leachate management options has been selected, which include leachate spraying and leachate treatment. Leachate will be primarily used for spraying on the waste and remaining leachate will be collected and sent to preliminary treatment and then sent to DTRO plant for final treatment.
347. Incorporating additional technology in the form of remote monitoring equipment to the leachate management system, as well as to the gas management system can include having remote sensor on pumps and storage tanks to transmit real time data and alerts to an online system, that will reduce the requirement for round the clock surveillance to only when required in emergency scenarios.
348. The use of control technologies within these systems will allow facility operators and supervisors to be able to remotely address routine or emergency issues, whenever notified, without physically being present at the site.

### **5.6.3 Gas collection and Treatment**

349. Landfill gas can migrate laterally and potentially cause explosions. Landfills are therefore provided with gas collection and processing facilities. The rate of gas production varies depending on the operating procedure. The rate and quantity of gas generation with time, is difficult to predict. Typical generation rates reported in literature vary from 1.0 to 8.0 litres/kg/year. Gas production rates of 60 m<sup>3</sup> per hour have been reported from landfill sites in India having an area of 8 hectares and a depth of 5 to 8 m (Dutta et al. 2012). The decision to use horizontal or vertical gas recovery wells depends on the design and capacity of the landfill. The decision to flare or to recover energy from the landfill gas is determined by the capacity of the landfill site and the opportunity to sell power produced.
350. Gas outputs of 10 to 20 m<sup>3</sup> per hour (corresponding to 50 to 100 KW of energy) have been recorded in wells of 15 to 20 cm diameter drilled 10 m into waste at spacing of 30 to 70 m. For 1 MW output from a landfill site, 15 to 20 such wells are required.
351. Alternative plans for gas management can be one of the following:
  - Uncontrolled release
  - Controlled passive venting
  - Controlled collection and treatment/reuse
352. The selection among these alternatives has to take into account not just the monetary cost incurred to apply the plan but also the environmental impact associated with it. In the case that using the gas for energy is feasible than even the more expensive management plan can produce financial paybacks.

353. For Kohat, flaring has been proposed for landfill gas management. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed.

## **5.7 Technological Alternatives for Anaerobic Digestion System (AD System)**

354. The Anaerobic Digestion System (AD system) is controlled biological conversion and treatment of organic material by bacteria and other microbes in the absence of oxygen. Oxygen is toxic to anaerobic bacteria and other micro-organisms (anaerobes). The AD process produces biogas (about 50-60% methane or natural gas, 40-45% carbon dioxide and traces of other gases), liquid effluent and a solid, partially stabilized organic material known as digestate which is generally sent for further aerobic composting to yield a stabilized product (compost).
355. Many AD system designs are available in the marketplace. AD system vendors/EPC contractors will choose between:
- Wet or dry AD
  - Single or two stage ADS
  - Thermophilic or mesophilic AD
  - Continuous, plug flow or batch AD
356. The design decisions would need to be combined with pre-treatment decisions to create an overall AD design which would best meets the needs of the Kohat SWMF depending upon the waste characterization. Project design consultant advised not to prescribe or limit the design options at the pre-feasibility stage of the assessment. AD vendors/EPC contractors may provide customized approaches to AD and pre-treatment options.

## **5.8 Technological Alternatives for Material Recovery Facility (MRF)**

357. Having already discussed their site selection criteria above, the analysis of technological specifications within MRF or composting facilities within the ISWMS will also determine how effectively they operate from both a financial as well an environmental point of view. The facilities for the proposed landfill can range from labour-intensive, lower initial costs but lower efficiencies, to machine-intensive, higher initial costs but greater efficiencies.

## **5.9 Waste Disposal Alternatives**

358. Broadly, four technologies including i) direct burn technologies, ii) physical processing technologies, iii) biological processing technologies and iv) combined treatment have been considered and assessed for their suitability for the proposed landfill site.

### **5.9.1 Thermal/Direct Burn Technologies**

359. Technologies involve the thermal decomposition of waste into gaseous, liquid and solid conversion products with release of heat energy. The main thermal processing technologies adopted internationally for the treatment of municipal waste are incineration,

gasification (pyrolysis) and plasma gasification. However, keeping in view the costs and regional scenarios, only incineration would be taken into account for the purpose of technological assessment of direct burning in the Kohat case.

### **5.9.2 Physical Processing Technologies**

360. Physical technologies involve altering the physical characteristics of the MSW feedstock. The MSW may be separated, shredded, and/or dried in a processing facility. The resulting material is referred to as refuse-derived fuel (RDF) and if the quality of the RDF is improved to meet the minimum criteria for required BTU. It may be densified or pelletized into homogeneous fuel pellets and transported and combusted as a supplementary fuel for industrial boilers, cement manufacturing facilities, brick kilns or even waste to energy incineration plants.

### **5.9.3 Biological Processing Technologies**

361. Biological treatment involves micro-organisms to decompose the biodegradable fraction of the waste. The biological process can be aerobic or anaerobic, and the main biological technologies adopted internationally for the treatment of municipal solid waste are composting and methanation (anaerobic digestion).

### **5.9.4 Combined Treatment**

362. These include technologies like Mechanical Biological Treatment (MBT), which is a combination of technologies including material recovery facilities, refuse derived fuels and aerobic/anaerobic digestion. All the aforesaid technologies have been reviewed in the following section and their suitability for Kohat city has been assessed.

### **5.9.5 Qualitative Assessment of Various Technologies**

363. In order to qualitatively assess the suitability of the technology for Kohat city, technology assessment criteria/ filters used are provided as **Table 5.2** below.

**Table 5.2: Qualitative Assessment criteria for waste treatment options**

<b>Criteria</b>	<b>Description</b>
Scale of Application (tpa) and with respect to population	Minimum quantum of waste for financial viability
Waste Suitability, moisture and organic fractions	Technologies that are suitable for MSW characteristics of Kohat city Technology must be capable of handling high organic waste & high moisture content – Waste Assessment and Composition (WAC) Study conducted under this project in May 2020 show high organic (53.6%) and moisture content (72.5%)
Suitability of technology for mixed waste and segregated waste and specific waste avoidance	Though there is no regulatory binding for the segregation of waste, putting segregation into practice requires a lot of efforts from WSSCK side and is a time-consuming process to make resident adhere to waste segregation practices. In addition, it requires additional infrastructure for segregated collection and transportation and has high operation cost due to increase in transportation cost and deployment of additional manpower

<b>Criteria</b>	<b>Description</b>
Volume reduction %	Effectiveness of the technologies for reducing the volume of the waste
Land requirements	Area per tons of the waste required
Technology Reliability	Technologies that are proven internationally and have successful application in the region and could be considered without reservations for Kohat
Operational Complexity	Least complex technology is mostly suitable for the developing counties owing to the fact that the little or no expertise are available to operate and maintain the system
State of Art and Clean Technology	Technologies with low emission & low negative environmental impacts (Low carbon footprint)
Waste technology value chain assessment	Technologies that require value addition of the MSW chain for sustainability against following parameters: <ul style="list-style-type: none"> <li>▪ Technology that can process mixed waste</li> <li>▪ Technology that requires pre-processing of waste to make it compatible</li> <li>▪ Technology that requires source-segregated waste and a higher degree of pre-processing</li> </ul>
Compliance with the regulatory requirement	The technology is in compliance with the regulatory requirements
Reject Diversion to the Landfill	Technologies with low diversion of rejects to the landfill are more acceptable
Social acceptability	Technology should be socially acceptable
Market sounding	Market for products and by products
Flexible	Modular and flexible plant to address the increasing waste supply in future
Lock-in Effect	Generally, refers to as a dedicated investment in a WtE project, and the requirement of a fixed amount of waste for incineration over the plant's life. The lock-in effect could lead to undermining waste prevention, reuse and recycling policies and programmes due to lack of funds to develop those systems, or "put or pay" contracts that mandate municipalities provide a fixed/minimum guaranteed amount of waste to the incinerator or pay a fine.
3Rs Trade-off	Technology be selected that is not impacted by the future recycling programs
Sustainability	Although it would be difficult to have a fully sustainable model. However, the CAPEX and OPEX of the system have to be looked in comparison with the cost per m <sup>3</sup> available airspace for landfill (with landfill infrastructure and maintenance and operational costs)

364. All the prevalent waste processing technologies discussed were assessed in comparison with landfill as per the above-mentioned criteria and details are presented in **Table 5.3** below.

**Table 5.3: Qualitative/Subjective assessment of various technologies for Kohat City**

Sr#	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
1	<b>Scale of Application (tpd)</b>	Minimum waste tonnage should be 25 TPD and above. For Kohat the waste tonnage is 127 TPD and thus a suitable option	500 tpd and above (smaller plants are not technoeconomically viable, given the cost of required environmental control equipment & boiler technology. For Kohat, due to less waste availability (127tpd) direct incineration is not feasible	500tpd and above (smaller plants are not technoeconomically viable, given the cost of required environmental control equipment & boiler technology. For Kohat, due to less waste availability (127tpd) direct incineration is not feasible	Centralized up to 500 tpd plant as well as decentralized plants are operational in the region. Therefore, scale of application may vary from 1-500 TPD.  Suitable for Kohat	Centralized up to 500tp plant as well as decentralized plants is operational in the region and globally. Therefore, scale of application may vary from 1-500 TPD.  Suitable for Kohat.	Applicable for small to large scales and there is no minimum waste tonnage required
	<b>Applicable with Population Size</b>	Suitable for cities with population more than 0.1 Million while Kohat is city with population less than 0.4 Million.	Suitable for cities with population more than 1 Million while Kohat is city with population less than 0.4 Million.	Suitable for cities with population more than 1 Million while Kohat is city with population less than 0.4 Million.	Suitable for cities with population more than 0.5 Million while Kohat is city with population less than 0.4 Million.	Suitable for cities with population more than 0.5 Million while Kohat is city with population less than 0.4 Million.	Suitable for city of any size

Sr#	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
2	<b>Waste Suitability/acceptability</b>	Food waste (including wastes from households, restaurants and markets), fats/oils/grease, paper and cardboard, landscaping and garden waste (e.g. hedge-clippings, leaves)	High moisture and organic content make it unsuitable. Requires waste with calorific value > 3000 BTU/lb  Calorific value of the waste is higher than 6000 BTU but due to high moisture content, it would be unsuitable without pre-drying of the waste.	High moisture content makes it unsuitable Calorific value requirement is 3000-6000 BTU/lb for RDF with moisture less than 20% which is difficult to achieve without preprocessing/predrying of the waste and that would add additional costs	Food waste (including wastes from households, restaurants and markets), fats/oils/grease, slaughterhouse waste> Kohat's waste contains high organic content (approximately 54%), Moisture content (72.5%) – suitable	Most suitable technology to handle heterogeneous waste with no initial requirement of segregation at source	Municipal solid waste, construction and demolition waste, wastewater sludge, nonhazardous industrial wastes
3	<b>Organic waste composition threshold or moisture content</b>	Higher fraction of organic content is required. Kohat's waste contains high organic content (approximately 54%) and Moisture content (72.5%) – suitable	<50% moisture content  Moisture content in Kohat's Waste is (72.5%) which makes it unsuitable for incineration	<12% moisture content  Moisture content RDF (e.g. from DG Khan cement plant is above (20%) which makes it unsuitable for incineration or direct combustion	>50% of the MSW  Kohat's waste contains high organic content (approximately 54%) and Moisture content (72.5%) – suitable	Low as possible to make the sorting process easier.	Low as possible to keep the leachate production lower. However, with leachate collection system in place moisture content does not impact the process of the

Sr#	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
							landfilling and its operations
4	<b>Waste to Avoid</b>	Non-biodegradable wastes (plastic, glass, metal, inserts)  Mixed waste in Kohat	Yard leaves or source separated food waste	C&D waste and sludge from the desilting of the drains	Non-biodegradable wastes (plastic, glass, metal, inserts), tree clippings	Medical infectious waste	Medical infectious waste
5	<b>Suitability of technology for mixed waste and segregated waste</b>	High – Feed stock should be free from non-biodegradable and debris and low on moisture	High – Feed stock should be free from inert and debris and low on moisture  Content. In Kohat, due to mixed waste/sludge collection and higher moisture content, it's unsuitable	High – Feed stock should be free from inert and debris and low on moisture content. In Kohat, due to mixed waste/sludge collection and higher moisture content, it's unsuitable	Unsuitable for mixed waste Pre-sorting/segregation is required for Kohat	Most suitable technology to handle heterogeneous waste with no initial requirement of segregation at source	Ultimate treatment for the mixed waste
6	<b>Pre-Processing</b>	High	Low	High	High	Not required	Not required

Sr#	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
		Required for mixed waste	Required for mixed waste	Required for mixed waste	Required for mixed waste		
7	<b>Volume reduction %</b>	50-70%	80-85%	80-85%	50%	80-85%	Nil
8	<b>Land requirements</b>	High (For 500 tpd of MSW, 6 ha of land is required)	Low land requirements 16-40 Sq.m per tons of the waste <sup>11</sup>	Low land requirements 16-40 Sq.m per tons of the waste <sup>12</sup>	Low to Moderate For small units: 500 sq. m for 5MT unit  For large scale: 300 TPD of MSW: 2 ha of land is required)	High (For 500 tpd of MSW: 6-8 ha of land is required)	Generally large
9	<b>Labor Requirements</b>	Labor intensive and Requires considerable technical capacity	Not labor intensive but Requires considerable technical capacity	Not labor intensive but Requires considerable technical capacity,	Labor intensive (based on current practice)	Labor intensive (based on current practice)	Not labor intensive but Requires considerable technical capacity
10	<b>Energy Requirements</b>	Moderate	High	High	Moderate	High	Low
11	<b>Reject</b>	30-50%	Up to 15%	Up to 15%	Up to 50%	Up to 15%	100%

<sup>11</sup> Incineration of Municipal Solid Waste February 2013, DEFRA UK<sup>12</sup> Incineration of Municipal Solid Waste February 2013, DEFRA UK

Sr#	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
12	<b>Reliability - proven internationally for large scale</b>	Proven technology	Internationally proven Developed countries moving away from mass burn technology to cleaner technologies	Proven technology	Internationally proven and many plants under operation	Highly sensitive process and plant performance is impacted by slight contamination	Proven technology
13	<b>Operational Complexity</b>	Least technically complex	Technically complex, requires highly skilled training and careful maintenance	Technically complex, requires highly skilled training and careful maintenance	Technically complex, requires highly skilled training and careful maintenance	Technically complex, requires highly skilled training and careful maintenance	Requires specialized training, careful maintenance, and post-closure care
14	<b>State of Art and Clean Technology</b>	High percentage of rejects i.e. 30-50% requires more space for disposal of the reject and have higher emissions.	High emission from waste incineration (SOx, NOx, heavy metals, Dioxins, Furans) Emission control system has high capital and operating cost	High emission from waste incineration (SOx, NOx, heavy metals, Dioxins, Furans) Emission control system has high capital and operating cost	No harmful emissions	No harmful emissions	Methane Emissions
15	<b>Leachate Pollution</b>	High	Low	Low	High to slurry production.	High	High

Sr#	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
					However, with the composting process, can be managed easily at site.		
16	<b>Carbon Foot Print</b>	Low	Least	Moderate	Low	Low	High
17	<b>Predominant skills for Operation and Management</b>	Skilled & Semiskilled labour	Highly Skilled Labor required	Highly Skilled Labor required	Skilled & Semiskilled labor	Skilled & Semiskilled labor	Skilled & Semiskilled labor
18	<b>Compliance with the regulatory requirement</b>	Low environmental pollution	High environmental pollution if not the air purification system is substandard and temperature is maintained below 850 °C	High environmental pollution if not the air purification system is substandard and temperature is maintained below 850 °C	Low environmental pollution	Low environmental pollution	High environmental Pollution if leachate and gas collection system is inadequate
19	<b>Social acceptability</b>	Odour issues in case of improper aeration  Public acceptance higher than waste to energy technologies	Negative public perception & low acceptability	Negative public perception & low acceptability	High public acceptance	High public acceptance	Negative public perception & low acceptability

Sr#	Criteria	Windrow Composting	Direct Incineration	RDF Incineration	Bio-Methanation	Mechanical Biological Treatment	Landfilling
20	<b>Market sounding</b>	Market for Products and byproducts. In Pakistan compost market is very low	Readily available market for energy from waste	Readily available market for energy from waste	High demand for energy and Bio-CNG	High demand for recyclables while low to moderate demand for RDF and compost	None
21	<b>Flexible/Modular and capable to adjust for lock-in effect</b>	Highly flexible and capable to adjust according to the quantum and composition of the waste as well the possible future intervention for source separation intervention.	Not flexible and prone to lock in effect	Not flexible and prone to lock in effect	Flexible and capable to adjust according to the quantum and composition of the waste as well the possible future intervention for source separation intervention.	Flexible and capable to adjust according to the quantum and composition of the waste as well the possible future intervention for source separation intervention.	None

Green – Highly favorable

Light Blue – Moderately favorable

Brick red – Least favorable

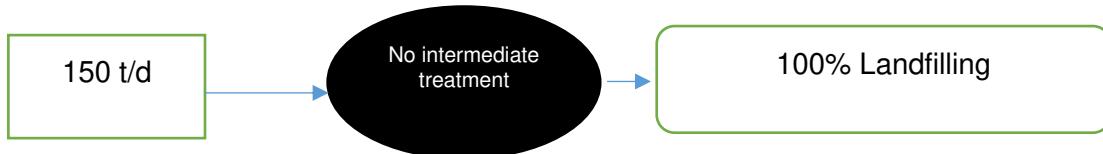
## 5.10 Proposed Solution for Kohat City

- 365. Comparison of the prevalent technologies and waste characterization results for Kohat city indicates that incineration may not be suitable considering the high moisture content and organic fraction; and composting, bio-methanation and MBT are relatively more suitable technologies.
- 366. Bio-methanation as a technology is highly sensitive and requires highly segregated waste or pre-processing of waste to make it successful. Hence, Bio-methanation is suggested as a technology for processing the entire organic waste of Kohat (can be used only for segregated waste from hotels and marketplaces that can be up to 30 tons/day and reject of the MRF facility making a total of around 100 tpd).
- 367. Composting technology is also a proven technology, but it failed badly with respect to the amount of rejects it transfers to the landfill (40-50%) and in terms of acceptability of the compost from the mixed waste. Mechanical Biological Processing Technology is found relatively more suitable, adaptable and flexible technology for the type of waste generated in Kohat.

### 5.10.1 Scenario Analysis for all possible treatment options

- 368. Based on the quantum of waste and composition, there are five possible scenarios which could be further ruled out through alternate technological comparative analysis. Landfill cannot be replaced because it would be needed in any case for the disposal of the reject and/or disposal of unsaleable compost and no single technology would be suitable for mixed waste.
- 369. **Scenario-1** can be without any intermediate treatment and 100% waste collected is landfilled as shown in **Figure 5.2** below.

**Figure 5-2: Scenario-1-No Intermediate treatment**



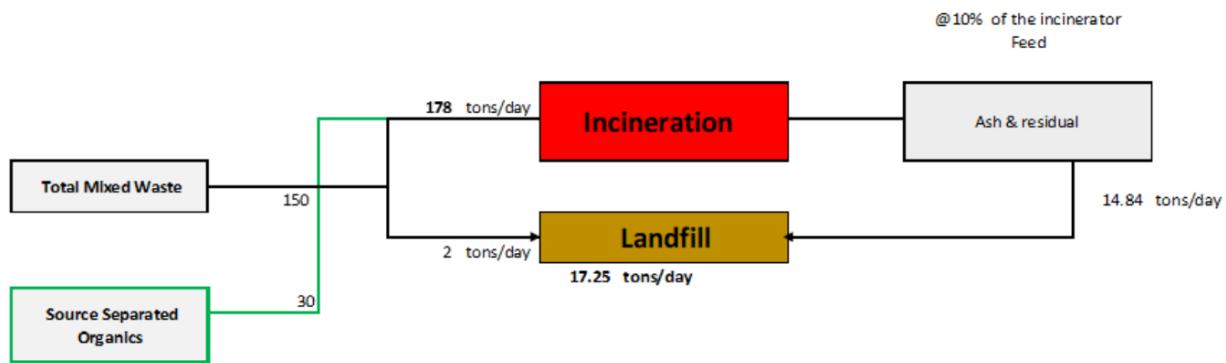
**Table 5.4:**

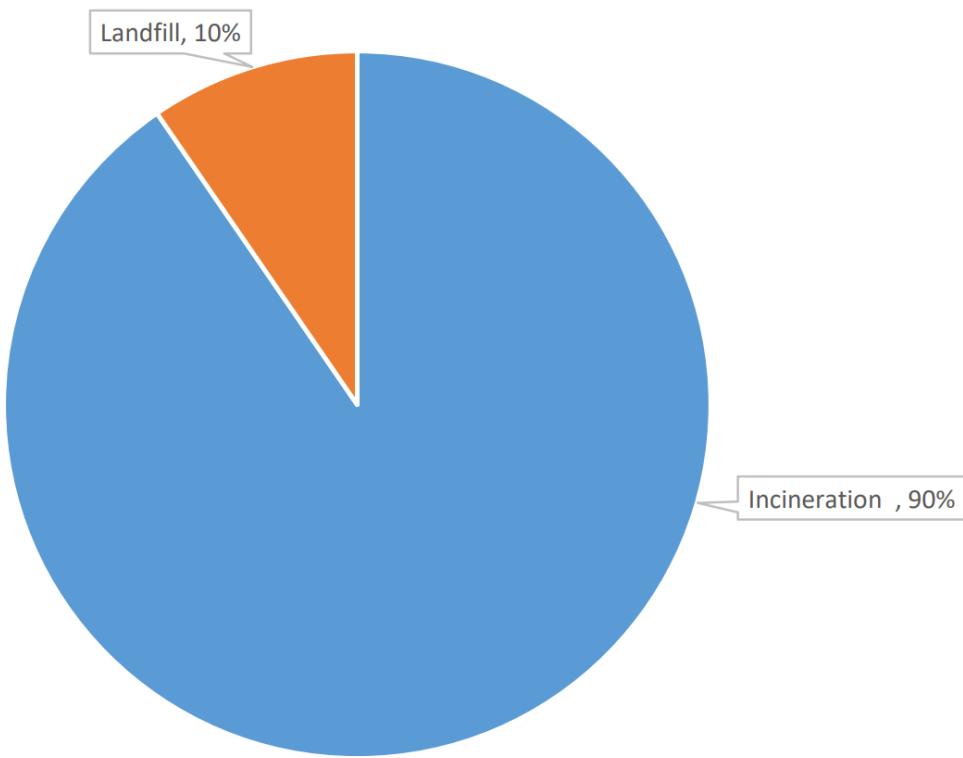
### Pros/Cons of Scenario-1

Pros	Cons
<ul style="list-style-type: none"> <li>▪ Most common method for ultimate treatment of the mixed waste in Asian countries.</li> <li>▪ Fewer technicalities involved as compared to advanced treatment options.</li> <li>▪ Lower risk of technology failures.</li> <li>▪ Easy to operate and maintain, however, institutional competencies must be gauged for O&amp;M of the landfills.</li> <li>▪ Less capital investment required as compared to other technologies</li> </ul>	<ul style="list-style-type: none"> <li>▪ Higher methane emissions in case of non-LFG capturing project.</li> <li>▪ No remedy in case of landfill liner failure</li> <li>▪ Higher O&amp;M and life cycle cost</li> <li>▪ 100% landfilling would require more landfill</li> <li>▪ 100% landfilling of the MSW is not in line with the SDGs and National Action plan</li> <li>▪ Limited opportunities for harnessing economic potential of the waste.</li> </ul>

370. **Scenario-2** is to look for options considering the highest volume reduction and energy production and landfilling only debris and ash produced in combustion process as shown in **Figure 5.3** below.

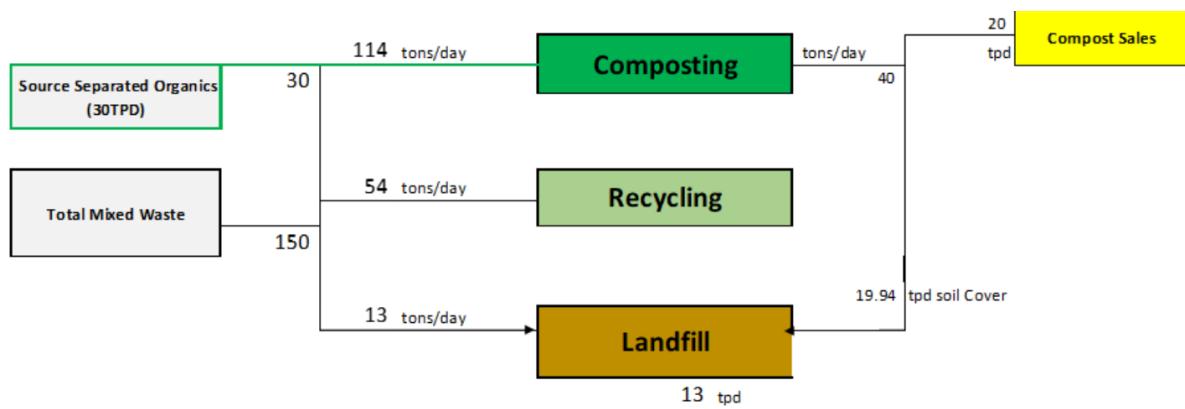
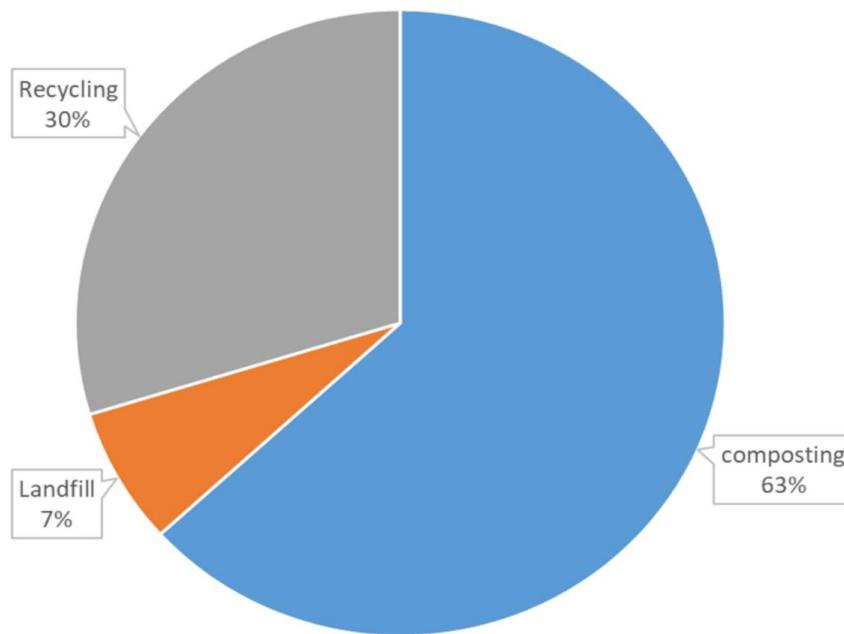
**Figure 5-3: Scenario-2 (2 streams)**



**Figure 5-4: Mass balance and %age waste treatment by different options with scenario-2****Table 5.5: Pros/Cons of Scenario-2**

Pros	Cons
<ul style="list-style-type: none"> <li>▪ Suitable option for mixed MSW</li> <li>▪ Less land requirements</li> <li>▪ Can handle infectious and industrial wastes too</li> <li>▪ Energy recovery</li> </ul>	<ul style="list-style-type: none"> <li>▪ Highly expensive and not financially viable due to low quantum of waste.</li> <li>▪ Not suitable because of higher moisture and lower calorific values</li> <li>▪ Low energy tariff</li> </ul>

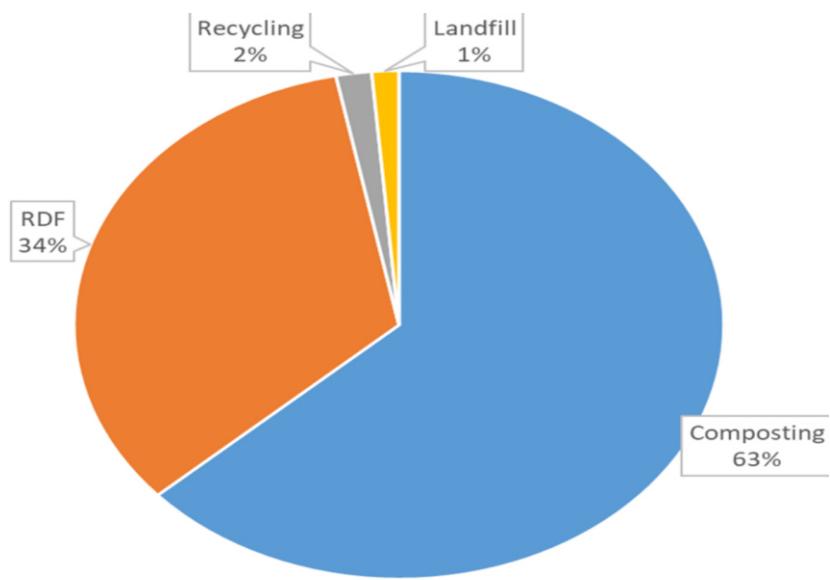
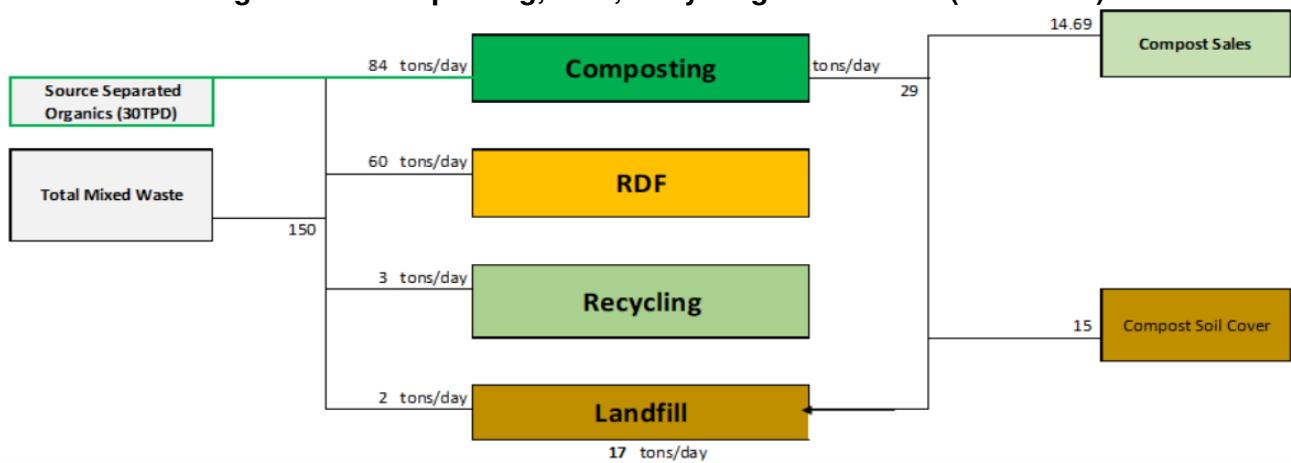
371. **Scenario-3** considers the recovery of the recyclables through sorting the mixed waste through mechanical means on conveyor belt after fine and coarse screening using trommels. Sorting may be done though magnetic separator and manual processes. Remainder organic fraction can be used for biological treatment using windrow composting (with sales of 50% of compost produced while using 50% as soil cover for landfill).

**Figure 5-5: Scenario 3 – Composting, Recycling and landfilling (3 streams)****Figure 5-6: Mass balance and %age waste treatment by different options with scenario-3**

**Table 5.6: Pros/Cons of Scenario-3**

<ul style="list-style-type: none"> <li>▪ Suitable for mixed municipal waste with higher organic fractions</li> <li>▪ Can recover recyclables</li> <li>▪ Organic stream can be converted to compost which can be solid as soil enrichment material or can be used as soil cover for the landfill. Composting helps to reduce the mass of the organic waste by 60-75% by volume. Even if there are limited compost sales, it's still economically and environmentally beneficial to convert the organic waste to the compost saving environmental emissions, landfill air space (improving the life of the landfill) and reducing the O&amp;M cost of the landfill.</li> <li>▪ Least expensive Option</li> <li>▪ Easy to operate and maintain the facility</li> <li>▪ Sorting facilities are available for manual to semi-automatic to fully automatic.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Without removal of the combustible fraction, the impurities (particularly plastic) may deteriorate the quality of the compost, Therefore, furthermore removal of combustible to prepare RDF will be beneficial but this would be a trade-off between the recyclables and combustible for a better calorific value RDF.</li> <li>▪ Recyclables entering the mixed waste stream and collected by the compactors are low quality and therefore would have limited sales and revenue potential.</li> <li>▪ Composting process does not recovery the energy potential of the organic waste. It means, CO<sub>2</sub> produced during the aerobic composting process is emitted in the air, though CO<sub>2</sub> is 21 times less harmful than CH<sub>4</sub></li> <li>▪ Feedstock management for composting might be challenging especially maintain the required CN ratio, moisture content an organic matter %age for better sales</li> </ul>
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372. **Scenario-4** is to employ mechanical and biological treatment process for recovery of recyclables and compostable and conversion of the organic waste to the compost using biological process of windrow composting. Although, recovery of the recyclable would be low when targeting for high quality RDF however it is necessary for removing the impurities from the organic waste stream.

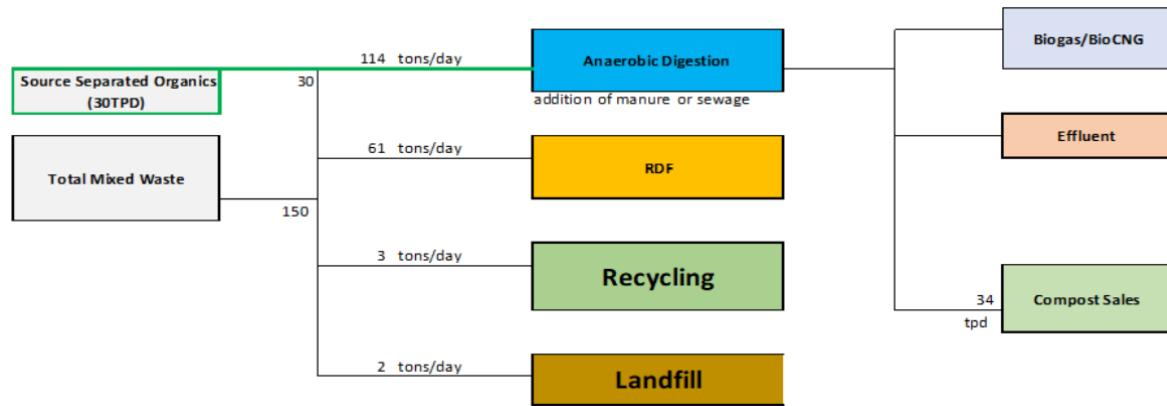
**Figure 5-7: Composting, RDF, Recycling and Landfill (4 streams)**


**Table 5.7: Pros/Cons of Scenario-4**

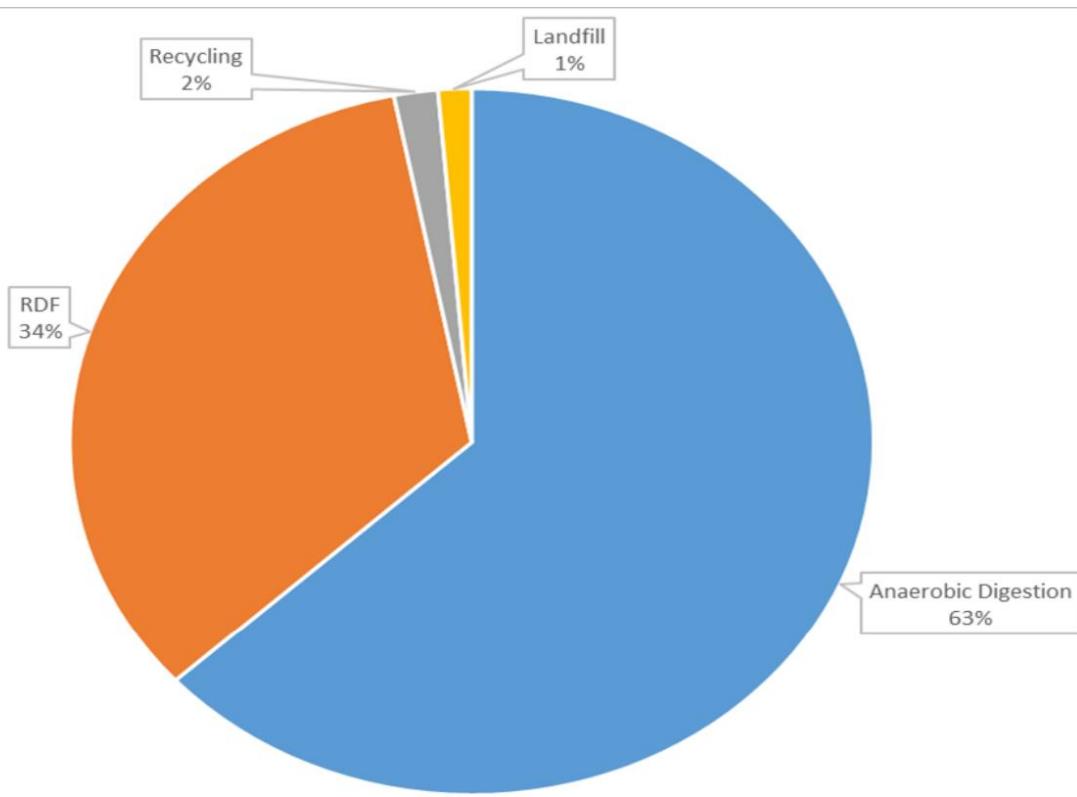
<b>Pros</b>	<b>Cons</b>
<ul style="list-style-type: none"> <li>▪ Suitable for mixed municipal waste with higher organic fractions</li> <li>▪ Can recover recyclables</li> <li>▪ Organic stream can be converted to compost which can be sold as soil enrichment material or can be used as soil cover for the landfill. Composting helps to reduce the mass of the organic waste by 60-75% by volume. Even if there are limited compost sales, it's still economically and environmentally beneficial to convert the organic waste to the compost saving environmental emissions, landfill air space (improving the life of the landfill) and reducing the O&amp;M cost of the landfill.</li> <li>▪ Least expensive Option</li> <li>▪ Easy to operate and maintain the facility</li> <li>▪ Sorting facilities are available for manual to semi-automatic to fully automatic.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Recyclables entering the mixed waste stream and collected by the compactors are low quality and therefore would have limited sales and revenue potential.</li> <li>▪ Composting process does not recover the energy potential of the organic waste. It means, CO<sub>2</sub> produced during the aerobic composting process is emitted in the air, though CO<sub>2</sub> is 21 times less harmful than CH<sub>4</sub></li> <li>▪ Feedstock management for composting might be challenging especially maintain the required CN ratio, moisture content an organic matter %age for better sales</li> <li>▪ No or limited market for the compost sales</li> <li>▪ NO or limited market for the RDF sales.</li> <li>▪ Environmental emission due to direct burning of the RDF by the Cement factories and brick kilns is not monitored.</li> </ul>

373. **Scenario-5** is again based on MBT technologies employing sorting of the recyclables and combustibles and diverting the organic waste toward dry anaerobic digestion process for biogas/energy production and then treating digestate with aerobic composting process used aerated piles. Benefits and risks associated with this scenario are summarized in **Table 5-8** below.
374. **Scenarios 4 and 5** are suitable options for Kohat keeping in view the analysis done. However, it's recommended to adopt and implement the option-5 for sustainable solid waste management. Institutional arrangement, operational plan business model would be key factors for the success of the proposed system. It is therefore necessary to review and develop an enabling environment for the implementation and success of the advanced treatment option.

**Figure 5-9: Digestion/Methanation, RDF, Recycling and Landfill (4 Streams)**



**Figure 5-10: Mass balance and %age waste treatment by different options with scenario-5**



**Table 5.8: Pros/Cons of Scenario-5**

Pros	Cons
<ul style="list-style-type: none"> <li>▪ Suitable for mixed municipal waste with higher organic fractions</li> <li>▪ Can recover recyclables</li> <li>▪ Easy to operate and maintain the facility</li> <li>▪ Sorting facilities are available for manual to semi-automatic to fully automatic.</li> <li>▪ Recovery of the Biogas and thus further reducing the environmental emissions</li> <li>▪ Digestate from the AD process can be converted to compost which can be sold as soil enrichment material or can be used as soil cover for the landfill. Composting helps to reduce the mass of the organic waste by 60-75% by volume and combined by AD process can go up to 85-95%. Even if there are limited compost sales, it's still economically and environmentally beneficial to convert the organic waste to biogas and the compost saving environmental emissions, landfill air space (improving the life of the landfill) and reducing the O&amp;M cost of the landfill.</li> <li>▪ Can handle the animal and sludge from the wastewater treatment plants.</li> <li>▪ Less land footprint.</li> <li>▪ Several success stories from region (India) as well as from the Europe and USA</li> </ul>	<ul style="list-style-type: none"> <li>▪ Recyclables entering the mixed waste stream and collected by the compactors are of low quality and therefore would have limited sales and revenue potential.</li> <li>▪ No or limited market for the compost sales</li> <li>▪ No or limited market for the RDF sales.</li> <li>▪ Environmental emission due to direct burning of the RDF by the Cement factories and brick kilns are not monitored.</li> <li>▪ Comparatively expensive Option</li> <li>▪ AD process is highly sensitive toward feedstock. maintain the required feedstock quality might be a challenging task</li> </ul>

375. Summary analysis of the all possible scenarios for Kohat city is provided below as **Table 5.9.**

**Table 5.9: Qualitative Evaluation of Possible Scenarios for Kohat City**

Scenario	Discussion	Recommendation
<b>Scenario-1: No treatment</b>	<ul style="list-style-type: none"> <li>▪ Landfilling of the waste is not in line with the SGDs and National Action plan.</li> <li>▪ 100% disposal of the waste to the landfill will require large landfill infrastructure. Furthermore, the approach is not in align with the sustainable development goals and national vision 2025.</li> <li>▪ Several landfills were developed under different initiatives, particularly in Punjab and majority of these are failures due to technical in competencies of the concerned waste management companies.</li> </ul>	Not recommended
<b>Scenario-2: Incineration &amp; landfilling</b>	<ul style="list-style-type: none"> <li>▪ Given the fact that waste produced in Kohat is less than minimum threshold of 275 tpd for financially viable WtE intervention. Furthermore, as discussed earlier incineration is not suitable for WtE due high organic fraction (54%) and moisture content (72.5%)</li> <li>▪ It is highly expensive options</li> <li>▪ There is not a single MSW incitation facility in Pakistan. Though there are several very small-scale incineration units available with the healthcare facilities and that too are poorly managed and are non-compliant to the environmental emission standard (NEQS).</li> </ul>	Not possible
<b>Scenario-3: Composting, Recycling and Landfilling</b>	<ul style="list-style-type: none"> <li>▪ Semi-Automatic sorting line to segregate the recyclables &amp; combustibles from organic stream is possible that would result in improving of the compost quality as well.</li> <li>▪ In addition to recyclables, there is fraction of combustible waste too. If it's not separated from the reminder organic stream it might impact the compost quality.</li> </ul>	Not recommended

Scenario	Discussion	Recommendation
	<ul style="list-style-type: none"> <li>▪ As discussed in the previous sections, there are several small -large scale composting initiatives by the private as well as on PPP basis. Small scale initiatives by the private sector are successfully running while the large-scale intervention in Lahore (1000tpd) failed due to the mixed waste processing and unable to meet the required quality.</li> </ul>	
<b>Scenario-4: Composting, RDF, Recycling and Landfilling</b>	<ul style="list-style-type: none"> <li>▪ With manual sorting of the recyclables it would be possible to segregate the combustible fraction as well leaving only pure organic stream that would have high C:N ratio, moisture content and further additives like animal manure, fecal sludge from WWTP bulking agents like rice husk could be added to improve the quality of the waste.</li> <li>▪ Kohat is not an agricultural city and therefore, marketability of the compost is questionable. The marketability of compost and RDF in Kohat region must be explored via consultations with the possible buyers.</li> <li>▪ Furthermore, keeping in view the failure of LCL, composting process may be replaced with other technology like AD process to produce product having economic value higher than compost and have strong market potential.</li> </ul>	Recommended
<b>Scenario-5: RDF, Recycling, Dry Anaerobic Digestion followed by composting and Landfilling</b>	<ul style="list-style-type: none"> <li>▪ After sorting of the MSW using the semi-automatic sorting line to segregate the recyclables and the combustible fractions, the remaining fractions could be subjected to Anaerobic Digestion.</li> <li>▪ Sorting line will help in improving the quality of the organic waste.</li> <li>▪ Supply of source segregated organics and sludge from the wastewater treatment units can improve the biogas production.</li> </ul>	Highly Recommended

Scenario	Discussion	Recommendation
	<ul style="list-style-type: none"> <li>▪ Anaerobic digestion process is highly sensitive process, a slight change in the feedstock might disrupt the entire process. Therefore, high quality feedstock would be required.</li> <li>▪ Anaerobic digestion would require highly technical skills to manage the process which are currently not available with the WSSCK nor with the local private operators of biogas plants. An international expertise may be acquired through engaging European or similar technology provider.</li> </ul>	

## 5.11 Economic Aspect Analysis

376. Economic aspect analysis of different waste treatment methods has been carried which also shows that for low income countries such as Pakistan, sanitary landfilling is the most economically viable option. The **Table 5-10** shows the estimated total cost of waste per ton for different waste treatment methods.

**Table 5.10: Economic aspect analysis of waste treatment methods<sup>13</sup> (UNEP, 2015)**

World Bank Project Data	Low Income Countries	Lower Middle Income	Upper Middle Income	High Income Countries
<b>Total Cost in US\$/ton</b>				
<b>Sanitary landfilling</b>	10-30	15-40	25-65	40-100
<b>Composting</b>	5-30	10-40	20-75	35-90
<b>Waste-to-energy incineration</b>	NA	40-100	60-150	70-200
<b>Anaerobic digestion</b>	NA	20-80	50-100	65-150

*Disclaimer: All estimates are for comparative purposes only and are not indicative of actual costs at any particular local site. Costs for reduction, reuse and recycling are not captured in this table.*

<sup>13</sup> Incineration of Municipal Solid Waste February 2013, DEFRA UK

## 6 Potential Environmental Impacts and Mitigation Measures

377. Potential impacts arising from designing, construction and operation phase of Kohat SWMF have been identified and assessed on the basis of field data, secondary data, expert opinion and examining previous similar projects in Pakistan. These include effects on physical, biological and socio-economic environments. Impacts associated with design, construction, operation and closure/post closure phases of SWMF components such as landfill cells, leachate collection network, landfill gas collection and venting system, AD and composting plant, material recovery facility and admin building have been detailed in the section. The impact assessment of Kohat SWMF has been carried in accordance with the requirements of KP EPA, 2014, Pak EPA-1997 and ADB SPS, 2009.
378. Impact-screening matrices during each of the SWMF development phases i.e. project design, construction, operation and closure/post closure are presented below.

### 6.1 Methodology for impact screening

379. The methodology for assessing the risk level associated with each potential impact is presented below.
380. Risk is assessed as the likelihood that the activity will have an effect on the environment as well as the consequence of the effect occurring. It is often described like this:

$$\text{Risk} = \text{Likelihood} \times \text{Consequence}$$

#### Likelihood Scale

Likelihood	Definition	Scale
Certain	Will certainly occur during the activity at a frequency greater than every week if preventative measures are not applied	5
Likely	Will occur more than once or twice during the activity but less than weekly if preventive measures are not applied	3
Unlikely	May occur once or twice during the activity if preventive measures are not applied	2
Rare	Unlikely to occur during the project	1

## Consequence Scale

Consequence	Definition	Score
Catastrophic	The action will cause unprecedented damage or impacts on the environment or surrounding communities	5
Major	The action will cause major adverse damage on the environment or surrounding communities	3
Moderate	No or minimal adverse environmental or social impacts	2
Minor	No or minimal adverse environmental or social impacts	1

## Risk Score Table

Likelihood	Consequence				
		Catastrophic	Major	Moderate	Minor
Certain	25	15	10	5	
Likely	15	9	6	3	
Unlikely	10	6	4	2	
Rare	5	3	2	1	

Risk: Significant: 15-25

Medium: 6-10

Low 1-5

381. Any 'Medium' to 'Significant' risk requires an environmental management measure to manage the potential environmental risk. Judgement will be required concerning the application of an environmental management measure to mitigate low risk situations.

## 6.2 Design/Pre-Construction Phase

### ***Impact Screening Matrix***

382. The ‘activity wise’ screening of potential impacts during the design/pre-construction phase is provided in **Table 6.1** below.

**Table 6.1: ‘Activity Wise’ screening of possible Impacts during Design/Pre-Construction phase**

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
1	Improper designing of landfill site leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.)	Likely	Moderate	Medium	Long Term
2	Improper selection of landfill site due to non-compliance with IFC guidelines for Landfills	Likely	Moderate	Medium	Long Term
3	Lack of integration of IEE/EMP requirements into Construction bid documents	Likely	Moderate	Medium	Short Term
4	Material Haul Routes	Likely	Moderate	Medium	Short Term
5	Contractor’s Environmental Safeguards Capacity	Likely	Moderate	Medium	Short Term
6	Improper location of worker camps leading to improper disposal of solid waste and sewage and privacy issues for residents in project area.	Likely	Moderate	Medium	Short Term
7	Land acquisition and resettlement impacts	Likely	Moderate	Medium	Short Term

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short term, Long term)
8	Cultural Heritage & Religious Sites, Social Infrastructure	Unlikely	Moderate	Low	No residual impact
9	Impacts due to natural hazards	Unlikely	Moderate	Low	No residual impact

█ Critical Risk Level      █ Significant Risk Level  
█ Medium Risk Level      █ Low Risk Level

### 6.2.1 Improper landfill design leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.)

#### *Impacts*

- 383. The possibility exists that in case the landfill is not designed in accordance with international standards and guidelines for landfill development, particularly with regards to EHS aspects, such as the IFC Guidelines on Waste Management Facilities for Landfills<sup>14</sup>, it could result in multiple potential impacts that could adversely affect the project area and all receptors located in it, with the most notable being the residential settlements.
- 384. If Project design shall not consider the consideration related to ground conditions, the geology and hydrogeology of the site, long term potential environmental impacts may arise.
- 385. Consideration like the nature and quantity of waste that will be landfilled is crucial for landfill operations, any change in waste stream may result in possible contamination to soil and water and other operational complexities.
- 386. If Project design shall not consider visual aspects, environmental and social receptors it will result in public grievances abd environmental nuisance in the project area.

#### *Mitigation Measures*

- 387. The following design related measures will be implemented to ensure the landfill operation does not result in unanticipated, long term and potentially irreversible impacts:
  - Landfill will be designed in accordance with international standards and guidelines for

<sup>14</sup> <https://www.ifc.org/wps/wcm/connect/5b05bf0e-1726-42b1-b7c9-33c7b46ddda8/Final%2B-%2BWaste%2BManagement%2BFacilities.pdf?MOD=AJPERES&CVID=jqeDbH3&id=1323162538174>

landfill development, including but not limited to the IFC Guidelines on Waste Management Facilities for Landfills.

- Consideration shall be given to the stability of the sub-grade, the base liner system, the waste mass and the capping system. The sub-grade and the base liner will be sufficiently stable to prevent excessive settlement or slippage.
- Bottom and cap lining system for each landfill cell must be designed for the protection of soil, groundwater and surface runoff.
- An efficient leachate collection system must be provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum.
- The accumulation and migration of gases from landfill facility must be controlled. Landfill gas will be collected through installation of perforated pipes within the cells.
- Consideration will be given to the visual appearance of the landfill site during operation and at termination of landfill site and its impact on the surrounding landforms. Necessary plantation will be carried out which will act as buffer zone from surrounding environment. Reasonable area has been allocated for plantation within and at boundary of facility to improve landscape of the area.
- Daily cover will be provided at end of each day to avoid risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill.
- One groundwater monitoring well will be maintained out of the drills made for geotechnical investigation. However, more wells may be constructed if required once the landfill starts operations.
- In order to incorporate advancement in technology and changes, a periodic review of the design will be carried out, as the lifespan of a disposal site from commencement to completion is long compared to other construction projects.

### **6.2.2 Improper selection of landfill site due to non-compliance with IFC Landfill guidelines**

#### ***Impacts***

- The IFC Guidelines contain specific criteria related to site selection for landfill sites that have been developed to ensure any potential Impacts resulting from landfill operation are minimized as far as possible. In case these Guidelines are not strictly implemented for the development of the proposed landfill, it could result in considerable irreversible, diverse or unprecedented impacts.
- Proposed landfill site shall be selected on the basis that it must comply basic KP government regulations, IFC EHS guidelines for waste management facilities, ADB SPS 2009.
- Proposed selection of landfill site must take into accounts impacts from leachate, litter, dust, vector and odors on surrounding environment.

***Mitigation Measures***

388. The following mitigation measures will be implemented:

- Site selection for the proposed landfill site has been conducted in accordance with international standards and guidelines for landfill development, including but not limited to the IFC Guidelines on Waste Management Facilities for Landfills.
- Factors such as site capacity, accessibility, acceptability, stability, environmental sensitivity, land use, socio-economic receptors and climate hazards have been studied and site has been selected accordingly.
- Site for Kohat Landfill has been selected keeping in view environmental and social sensitive receptors and necessary design considerations have been provided to manage impacts related to leachate, litter, dust, vector and odors on surrounding environment.

**6.2.3 Lack of integration of IEE/EMP requirements into Construction bid documents*****Impacts***

389. The bidding documents must reflect the requirement to select a qualified and experienced Contractor from the perspective of ensuring implementation of required safeguards during project development.

***Mitigation Measures***

- 390. The proposed ‘Safeguards unit’ that will be developed at the PMU will be assigned the task to check that design and bid documents are responsive to key environmental, social and safety considerations, and that the proposed method of work reflects the boundaries defined in the EMP. The bid documents must include the EMP and its implementation cost must be reflected in the BoQ.
- 391. IEE/EMP implementation and monitoring requirements must be part of bidding documents and necessary contractual binding must be agreed by project contractors before award of contract.
- 392. Project contractors shall have qualified and experienced environmental staff to plan, arrange, implement, monitor and report IEE/EMP requirements.

**6.2.4 Material Haul Routes*****Impacts***

- 393. Hauling of material can have significant impacts on the community, public safety, traffic congestion, air quality and lifespan of the Kohat city roadways.
- 394. In addition, the access road is presently not in a good condition and will be reconstructed prior to commencement of the SWMF operation.

***Mitigation Measures***

395. The construction vehicles hauling materials along the Kohat city roads and anywhere where there are sensitive receptors such as hospitals, schools and/or roadside residences will be limited and the PMU in collaboration with the focal agencies will establish a route plan to minimize this disruption which shall be appended to the EMP.
396. Vehicles to be used will be of good quality and well maintained and will meet the national emission standards for vehicles.
397. Idling of vehicles along the route will be limited to 3-5 minutes.

**6.2.5 Contractor's Environmental Safeguards Capacity*****Impacts***

398. Lack of contractor's environmental safeguard capacity or selection of environment non-responsive contractors may result in failure of EMP implementation and may be a source of number of non-compliances.
399. The responsibility of the PMU KP LGERDD in collaboration with the focal agencies is to review and finalize the bidding documents relating to environmental issues.
400. Contractors that do not possess the required capacity for safeguards management must not be pre-qualified and selected.

***Mitigation Measures***

401. PMU KP LGERDD shall review the contractor capacity with respect to safeguard management and contracts shall be awarded accordingly.
402. The Contractor will be required to define an Occupational and Environmental Health and Safety procedure for all work, including work camp operation, management of cement dust, and use of Personal Safety Equipment. These procedures shall be developed and approved by the PMU in collaboration with the focal agencies before the Contractor commences any physical works on ground.
403. PMU KP LGERDD shall ensure the project contractors are selected on merit and necessary funds have been allocated in the contract documents for EMP implementation and monitoring.

**6.2.6 Identification of Locations for Labor camps and ancillary facilities*****Impacts***

404. The duration of the construction activity for the landfill development is expected to be 24 months and a considerable amount of work force will be engaged. As a result, worker camps will need to be developed and ancillary facilities will need to be provided such as electricity, washrooms for labor with suitable effluent and sewage disposal facilities as well as water for their everyday use for drinking and bathing etc.

***Mitigation measures***

405. In order to prevent a nuisance, specific locations shall be designated for development of the labor camps. All necessary facilities and amenities shall be provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc.
406. The use of proper planning while identifying locations for the labor camps will ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labor camps being set up roadside next to the construction sites.

**6.2.7 Cultural Heritage & Religious Sites, Social Infrastructure*****Impacts***

407. No temples or religious sites are located in the proximity of Kohat landfill site.
408. The nearest sensitive receptors already identified in the project areas have been mapped and a minimum buffer distance of 250 meters from all boundaries of the landfill site will be maintained, as required by the IFC EHS Guidelines on Waste Management Guidelines for landfilling. As a result, no major significant impact would be expected from the works on any social infrastructure. However, consideration will be made not to construct at night, from 7 pm onwards till 6 am in the morning, to avoid nuisances.

***Mitigation Measures***

409. No mitigation measures are required.

**6.2.8 Land Acquisition and Resettlement Impacts*****Impacts***

410. Land acquisition process of the project is in process by KP government Social safeguard team of PMU and EDCM-KPCIP through notification and therefore, Land Acquisition and Resettlement Plan (LARP) is required.
411. The field visits for social safeguard assessment by PMU and EDCM team has been carried out in September'20 to identify any sensitive receptors falling within 250 meters distance from landfill cells. Assessment findings indicate that none of these receptors are considered as sensitive as all are falling outside of 250 meters perimeter from landfill cells.

***Mitigation Measures***

412. The PMU KP LGERDD shall ensure the following:
  - Pending payment to all landowners must be paid before mobilization of construction contractors.
  - Social safeguard unit shall ensure that project affected people has been paid following appropriate procedures and there are no grievances about land acquisition process.

- Accelerating the pending resettlement process in collaboration with DC Kohat and WSSCK.

### **6.2.9 Impacts due to Natural hazards**

#### **Impacts**

413. Site is located outside of seismically active area as it falls in Zone 2B with peak ground acceleration (PGA) in range of 0.16g to 0.24g on seismic map of Pakistan. No fault lines or significantly fractured geologic structure is present within 500 meters of the perimeter of the proposed landfill cell development that may allow unpredictable movement of gas or leachate.
414. Site is located outside of flood plain, however, in case of high precipitation, there are chances of urban flooding. Surface drainage network has been provided in detailed design of landfill site to avoid risk of surface runoff and contamination.
415. Furthermore, extreme rainfall events in Kohat do not show changing trends and also surface water drainage/diversion work is included in the project design to avoid percolation of rain water into the landfill cells.
416. In addition, high speed winds resulting from mini-cyclones type storm events are expected.

#### **Mitigation Measures**

417. The PMU KP LGERDD shall ensure the following:
  - Kohat SWMF infrastructure shall be designed keeping in view the seismic zone 2 B building considerations.
  - Surface water diversion shall be included in the design to protect landfill from urban/flash flooding.
  - Extreme precipitation events analysis shall be performed for landfill life i.e. 25 years, to predict and manage impacts of flash flooding.
  - On site waste storage at loading bay shall be kept to minimum during high precipitation events.
    - Infrastructure built by the project will be designed to withstand high speed winds.
  - Emergency response plan shall be prepared by construction and operation phase contractors and will be submitted to PMU for approval to manage impacts of natural hazards such as earth quakes and floods.

## **6.3 Construction Phase**

### ***Impact Screening Matrix***

418. The screening of potential impacts during the construction phase is provided in **Table 6.2** below.

**Table 6.2: Screening of Possible Impacts during Construction Phase**

S/No.	Potential Issue	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short Term, Long Term)
1	Construction of landfill not in accordance with finalized design	Likely	Major	Medium	Long Term
2	Degradation of air quality due to construction works	Likely	Moderate	Medium	Short Term
3	Potential accidents and injuries to communities in project area during construction works	Likely	Moderate	Medium	Short Term
4	Injuries to workers from lack of necessary training and/or not using PPEs etc.	Likely	Moderate	Medium	Short Term
5	High noise levels from construction activities	Likely	Moderate	Medium	Short Term
6	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Moderate	Medium	Short Term
7	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium	Short Term
8	Soil Erosion and Sedimentation	Likely	Moderate	Medium	Short Term
9	Soil Contamination	Likely	Moderate	Medium	Short Term
10	Employment Conflicts	Likely	Moderate	Medium	Short Term
11	Communicable diseases incl. COVID-19	Likely	Moderate	Medium	Short Term
12	Vegetation and Wildlife Loss	Unlikely	Moderate	Low	No residual Impact
13	Historical/Archaeological Sites	Unlikely	Moderate	Low	No residual Impact
14	Construction of Administration Building and Other Infrastructure	Likely	Moderate	Medium	Short Term
15	Construction/Widening of Access Road	Likely	Moderate	Medium	Short Term
16	Sexual Abuse, Exploitation and Harrassment (SEAH)	Unlikely	Moderate	Low	No residual Impact



### 6.3.1 Construction of landfill not in accordance with finalized design

#### *Impacts*

419. If the proposed landfill is not developed in accordance with the finalized design and its corresponding design parameters, it could lead to a number of unanticipated impacts such as groundwater contamination due to inadequate liner installation etc.

#### *Mitigation measures*

420. The following mitigation measures will be implemented:
- Method statements must be prepared by the Contractor and approved by the Construction Supervision Consultant (CSC) prior to commencement of construction works.
  - The CSC must closely monitor the construction works being conducted by the Contractor to ensure the finalized design is implemented in full and the landfill design is developed completely in compliance of the approved finalized designs.
  - Any deviation by the Contractor from following the finalized design must be immediately highlighted and corrective measures must be implemented to ensure full compliance with the finalized design of the landfill.
  - PMU KP LGERDD shall ensure that construction activities are being carried out in compliance to project design following best international practices. It will closely review and monitor the activities of CSC and contractors involved in construction activities.

### 6.3.2 Degradation of Ambient Air Quality

#### *Impacts*

421. The proposed landfill development will involve large scale earth works and transporting and dumping large quantities of dry material. This will likely lead to an increase in SPM (Suspended Particulate Matter) in and around the construction zones.
422. Potential sources of particulate matter emission during construction activities include earthworks (dirt or debris pushing and grading), exposed surfaces, exposed storage piles, truck dumping, hauling, vehicle movement on unpaved roads, combustion of liquid fuel in equipment and vehicles, land excavation, and concrete mixing and batching.
423. Vehicles carrying construction material are expected to result in increased Suspended Particulate Matter (SPM) levels near the haul roads. This can be of potential importance if the vehicles pass through the areas with a high concentration of sensitive receptors, such as residential areas, in this particular case.

424. At the construction yard, the dust levels are also expected to increase due to unloading of construction materials. It shall be ensured that most of the excavated material will be used within the project, with minimal cut and fill material to come from outside the site.
425. Poor air quality due to the release of contaminants into the workplace can result in possible respiratory irritation, discomfort, or illness to workers. Employers shall take appropriate measures to maintain air quality in the work area.
426. The quantity of dust that will be generated on a particular day will depend on the magnitude and nature of activity and the atmospheric conditions prevailing on the day. Due to the uncertainty in values of these parameters, it is not possible to calculate the quantity from a 'bottom-up' approach, that is, from adding PM<sub>10</sub> emissions from every activity on the construction site separately. Typical and worst-case PM<sub>10</sub> emissions from construction sites have been estimated<sup>15</sup> as 0.27 megagram per hectare per month of activity (Mg/ha-month) and 1.04 Mg/ha-month, respectively.

### ***Mitigation Measures***

427. The following mitigation measures will be adopted for preservation of the environment:
  - At the landfill site and the immediately adjoining areas, water will be sprinkled every three hours and at a higher frequency if felt necessary, at all construction sites to suppress dust emissions.
  - All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations.
  - Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions.
  - Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions.
  - Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin.
  - Limitations to speeds of such vehicles as felt necessary. Transport through densely populated area shall be avoided.
  - Concrete plants to be controlled in line with statutory requirements and shall not be close to sensitive receptors.
  - Stack height of generators will be at least 3 meters above the ground.
  - Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed roads within project area.

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<sup>15</sup> Gaffney, G. and Shimp, D. 1997. *Improving PM<sub>10</sub> Fugitive Dust Emission Inventories*. Sacramento, CA. California Air Resource Board. <[www.arb.ca.gov/emisinv/pubs/pm10tmp.pdf](http://www.arb.ca.gov/emisinv/pubs/pm10tmp.pdf)>

- A minimum distance of 300 meters will be ensured between batching plant(s) and the nearest community.
- The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles shall not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles ( $>25m^3$ ) of crushed materials are necessary, they shall be enclosed with side barriers and also covered when not in use.
- Dust emissions due to road travel shall be minimized through good construction practices (such as keeping stockpiles down wind and away from communities) and sprinkling water over the access road.
- Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects. .
- Developing and implementing work practices to minimize release of contaminants into the work environment including:
  - Direct piping of liquid and gaseous materials
  - Minimized handling of dry powdered materials; Enclosed operations.
  - Local exhaust ventilation at emission/release points
  - Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
  - Indoor secure storage, and sealed containers rather than loose storage
- Where ambient air contains several materials that have similar effects on the same body organs (additive effects).

### ***Fugitive Dust Control***

428. The source wise fugitive control measures are provided in **Table 6.3.**

**Table 6.3: Control measures for Fugitive Dust emissions**

<b>Source</b>	<b>Control Measures</b>
Earth Moving	For any earth moving that is to take place in the immediate vicinity from the site boundary, watering must be conducted as required to prevent visible dust emissions
Disturbed Surface Areas	Apply dust suppression measures (clear vegetation only from areas where work is to commence, plant or mulch areas that will not receive traffic, construct artificial wind breaks or wind screens) frequently to maintain a stabilized surface. Areas that cannot be stabilized, such as wind driven dust, must have an application of water at least twice a day
Inactive Disturbed Surface Areas	Apply dust suppressants (clear vegetation only from areas where work is to commence, plant or mulch areas that will not receive traffic, construct artificial wind breaks or wind screens) in sufficient quantity and frequency to maintain a stabilized surface
Unpaved Roads	Periodic sprinkling on all roads used for any vehicular traffic at least twice per day during active operations and restrict vehicle speed to 20 kmph.
Open Storage Piles	Apply water to at least 80 percent of the surface areas of all open storage piles on a daily basis when there is evidence of wind driven fugitive dust or install an enclosure all along the storage piles Tarpaulin sheet shall be provided on the storage piles to avoid dust emisisons.
Track-out Control	Wash down of construction vehicles (particularly tyres) prior to departure from site.

***Vehicular & Equipment Emissions***

429. It shall be ensured that the following measures are taken to control emissions from vehicles being used in the construction activity:
- Periodically check and conduct maintenance of the construction machinery and haul vehicles. Generators, compressors and vehicles used during construction works will be maintained in a good condition to ensure that emissions are kept to a minimum level.
  - Regularly change the engine oil and use new engines/machinery/equipment having good efficiency and fuel burning characteristics.
  - Controlled technology generator and batching plants will be used to avoid excessive emissions.
  - Burning of waste at any site will not be allowed.
  - The stack height of generators will be at least 3 meters above the ground.
  - Idling of vehicles on the site will be limited to 3-5 minutes.
  - Training of the technicians and operators of the construction machinery and drivers of the vehicles.

- All type of machinery and generator must comply with the NEQS. Vehicles, which are not in compliance with NEQS will not be allowed to be used.
- Periodic emission monitoring of vehicles, generator and batching plants is proposed.
- Project activities shall be planned to avoid harsh weather conditions.

### 6.3.3 Community Health and Safety

#### *Impacts*

430. The landfill development will involve the use of considerable heavy machinery at the project site along with posing the risk of community members falling into trenches. In addition, the risk to commuters on the road during the construction works will be significant and thus a number of precautionary measures will be necessary to minimize the risk of possible accidents. Community Health & Safety may be compromised during road travel particularly in night hours if adequate barriers and lighting is not provided at construction sites.

#### *Mitigation Measures*

431. The following mitigation measures will be implemented:
- Work areas outside the project site, especially where machinery is involved, will be barricaded, and will be constantly monitored to ensure that local residents, particularly children stay away while excavated areas being prepared for landfill related infrastructure will also be cordoned off. Also, no machinery will be left unattended, particularly in running condition.
  - Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children.
  - Speed limit of 20 km/hr will be maintained by all project related vehicles and nighttime driving of project vehicles will be limited where possible.
  - Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.
  - Contractor must take proper safety measures (placing warning tapes around excavations) to avoid people, especially children, accidentally falling into excavations.
  - All the working platforms must be cordon off with special care by well-trained skilled workers.
  - Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area.
  - PMU KP LGERDD shall ensure the contractor staff working in the the project are well trained and educated in the Health, Safety and Environment (HSE) hazards

associated with their duties, and that of the public, in the project area.

#### **6.3.4 Occupational Health and Safety (OHS)**

##### ***Impacts***

432. There is invariably an OHS risk when construction works for the landfill are conducted, and precautions will be needed to ensure the safety of the workers.
433. The major OHS hazards expected during the proposed activities are as follows:<sup>16</sup>

##### ***Accident Hazards***

- Falls from height, especially when standing/working on ladders;
- Slips, trips and falls, especially while carrying heavy or bulky loads;
- Cuts and injuries caused by sharp instruments and tools;
- Hazard of suffocation from asphyxiant gases released or from oxygen deficiency, during maintenance and cleaning operations;
- Burns caused by hot parts of equipment, steam lines etc, by release of hot water or steam;
- Electric traumas, caused by defective installations and equipment, especially portable;
- Musculoskeletal injury (especially of back), resulting from lifting and moving of heavy loads;

##### ***Physical Hazards***

- Exposure to cold and/or heat stress, as a result of rapid movement between cold and hot areas;
- Exposure to UV radiation during welding operations;

##### ***Chemical Hazards***

- Exposure to various chemicals, such as: adhesives, caulking compounds, fluxes (solder), hydrochloric acid, zinc chloride, tar and solvents, various greases and inorganic lead;

##### ***Biological Hazards***

- Exposure to parasites, such as hookworm, ascaris, and various mites, chiggers and ticks;

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<sup>16</sup> [https://www.ilo.org/wcmsp5/groups/public/---ed\\_protect/---protrav/---safework/documents/publication/wcms\\_192256.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_192256.pdf)

***Ergonomic, psychosocial and organizational factors***

- Psychological stress due to dissatisfaction at work due to issues with peers, superiors etc.;
- General ill feeling as a result of work in confined spaces and development of 'sick building syndrome';

***Mitigation Measures******General***

434. The Contractor will be required to prepare and implement an effective OHS Plan that is supported by trained OHS personnel and emergency response facilities. Construction contracts will include standard OHS measures and contractors will be bound to implement these fully.
435. Monitoring will be required to ensure that the health and safety plan based on contract specifications is followed.
- Cement feed hopper areas will be inspected daily to ensure compliance with the requirement of dust masks.
  - Surfaces (including flooring and work surfaces) in camps, kitchens, dining areas and workshops shall be solid and easy to clean. Flooring for work camps must be float finished concrete or better.
  - All drivers engaged by Contractors must hold a valid license for the vehicle they are operating.
  - Work in confined space shall be executed with available safety standards. Adequate monitoring and equipment shall be available to detect deficient oxygen levels.
  - The Contractor shall submit to the Engineer for approval an emergency evacuation plan and practice the procedure annually.
  - The Contractor shall submit to the Engineer for approval a site layout plan, identifying work areas, accommodation, kitchen, dining area, sanitary facilities, location of generators, plant and vehicle parking, transport routes through the camp, pedestrian routes through the camp, evacuation routes, emergency exits, batching plants, storage areas, waste facilities etc.
  - Fire extinguishers shall be provided throughout camps and work sites. Fire extinguishers shall be inspected monthly and maintained as necessary.
  - An adequate and reliable supply of safe drinking water shall be made available at readily accessible and suitable places including at all camps.
  - The Contractor shall take samples from each supply of drinking water and arrange for analysis of these samples at EPA certified laboratory prior to its use by the Contractor's

staff. The results of these tests for each supply must be submitted to the Engineer and must demonstrate that each water supply meets national and World Health Organisation standards for drinking water.

- The Contractor shall provide and maintain adequate hygienic kitchens which are sheltered and separated from the living quarters. Kitchens shall include raised and washable surfaces suitable for food preparation.
- The Contractor shall provide and maintain adequate hygienic dining areas for staff. Work places and camps shall be provided with both natural& artificial light. Artificial lighting shall be powered by generator in the event of power cuts.
- Public sensitization training shall be provided to workers to avoid social conflicts between residents and the construction contractor, Occurrence of any such impacts can be avoided by community sensitive project planning and implementation and through effective involvement of local administration.
- All OHS protocols shall be implemented in true letter and spirit.
- Contractor must appoint an OHS resource to implement, monitor and report the HSE management plan to concerned authorities.
- Contractor must ensure the provision of first aid facility at construction site and camps through hiring medics and establishing a dispensary at the campsite.
- Reasonable number of first aid kits shall be available on construction sites and within contractor camps.
- Site personnel will be provided appropriate type of personal protective equipment (PPEs). Contractor will ensure consistent use of PPEs.

436. Based on the type of hazard applicable during the proposed works at site, the following mitigation measures as per IFC guidelines for Occupational Health and Safety (OH&S) must be implemented:<sup>17</sup>

### ***Mitigation Measures for Physical Hazards***

#### ***Rotating and Moving Equipment***

437. Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unobvious movement during operations. Mitigation measures related to rotating and moving equipment on workers are provided below:

- Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions.

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<sup>17</sup> <https://www.ifc.org/wps/wcm/connect/1d19c1ab-3ef8-42d4-bd6b-cb79648af3fe/2%2BOccupational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES&CVID=ls62x8l>

- Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment shall be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards shall be designed and installed in conformance with appropriate machine safety standards.
- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance.
- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms.

### ***Vibration***

438. Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, shall be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and action values. Exposure levels shall be checked on the basis of daily exposure time and data provided by equipment manufacturers.
439. Other sources of vibration at construction site are rollers, compactors or any loose part of machinery exposure which may cause serious injury or workplace sickness. No equipment and machinery with loose or vibratory parts will be allowed to work. Such issues will be fixed through maintenance of the machinery on periodic basis. Use of rollers for land grading will be carried out during day times and with intermittent intervals to reduce the impacts of vibration on surrounding environment.

### ***Electrical***

440. Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or grounded metal objects brought into proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:
  - Marking all energized electrical devices and lines with warning signs; .
  - Locking out (de-charging and leaving open with a controlled locking device) and tagging out (warning sign placed on the lock) devices during service or maintenance;
  - Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools; .
  - Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits; .

- Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas; .
- Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work.

### ***Eye Hazards***

441. Solid particles from a wide variety of industrial operations, and/or a liquid chemical spray may strike a worker in the eye causing an eye injury or permanent blindness. Recommended measures include:

- Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full-face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding shall conform to standards published by organizations such as CSA, ANSI and ISO.

### ***Welding/Hot Work***

442. Welding creates an extremely bright and intense light that may seriously injure a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes to which prolonged exposure can cause serious chronic diseases. Recommended measures include: .

- Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific workstation (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. .
- Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) shall be implemented if welding or hot cutting is undertaken outside established welding workstations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels that have contained flammable materials.

### ***Industrial Vehicle Driving and Site Traffic***

443. Poorly trained or inexperienced industrial vehicle drivers have increased risk of accident with other vehicles, pedestrians, and equipment. Industrial vehicles and delivery vehicles, as well as private vehicles on-site, also represent potential collision scenarios. Industrial vehicle driving and site traffic safety practices include:

- Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits.

- Ensuring drivers undergo medical surveillance.
- Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms.
- Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction.
- Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate.

### ***Ergonomics, Repetitive Motion, Manual Handling***

444. Injuries due to ergonomic factors, such as repetitive motion, overexertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems shall be minimized or eliminated to maintain a productive workplace. Controls may include:
- Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind.
  - Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds.
  - Selecting and designing tools that reduce force requirements and holding times and improve postures. .
  - Providing user adjustable workstations.
  - Incorporating rest and stretch breaks into work processes and conducting job rotation.
  - Implementing quality control and maintenance programs that reduce unnecessary forces and exertions.
  - Taking into consideration additional special conditions such as left-handed persons.

### ***Working at Heights***

445. Fall prevention and protection measures shall be implemented whenever a worker is exposed to the hazard of falling more than two meters; into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface. Fall prevention / protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include:
- Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area. .
  - Proper use of ladders and scaffolds by trained employees. .

- Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines. .
- Appropriate training in use, serviceability, and integrity of the necessary PPE. .
- Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall.

### ***Fire and Explosions***

446. Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:
- Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The volume of the containment area shall be equal to 120% of the total volume of fuel stored.
  - Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area shall be:
    - Remote from entry and exit points into camps
    - Away from facility ventilation intakes or vents
    - Have natural or passive floor and ceiling level ventilation and explosion venting
    - Use spark-proof fixtures
    - Be equipped with fire extinguishing devices and self closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time .
  - Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment).
  - Providing specific worker training in handling of flammable materials, and in fire prevention or suppression.

### ***Corrosive, oxidizing, and reactive chemicals***

447. Corrosive, oxidizing, and reactive chemicals present similar hazards and require similar control measures as flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases, and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant personal injury upon direct contact, regardless of any intermixing issues. The

following controls shall be observed in the work environment when handling such chemicals:

- Corrosive, oxidizing and reactive chemicals shall be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills.
- Workers who are required to handle corrosive, oxidizing, or reactive chemicals shall be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc).
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid shall be ensured at all times. Appropriately equipped first-aid stations shall be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers shall be provided close to all workstations where the recommended first-aid response is immediate flushing with water.

#### ***Mitigation Measures for Biological Hazards***

448. Biological agents represent potential for illness or injury due to single acute exposure or chronic repetitive exposure. Biological hazards can be prevented most effectively by implementing the following measures:

- The contractor shall review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs.
- Project contractor must provide good working and sanitation conditions at camp and wok sites. Disease surveillance shall be carried out to identify any exposure to parasites, such as hookworm, ascaris, and various mites, chiggers, ticks and dengue.
- Measures to eliminate and control hazards from known and suspected biological agents at the place of work shall be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.

#### **6.3.5 High Noise Levels**

##### ***Impacts***

449. The landfill development will result in different construction equipment and machinery being used which will generate high noise levels at the project site and in the project area.

450. The detailed mapping of sensitive receptors has been conducted and the types of receptors and their respective distances from the work sites are provided earlier. However, any required mitigation measures that shall be proposed will be to control potential impacts on noise to prevent any long-term impacts within the project area.

451. The assessment of the noise impacts on the sensitive receptors that have been identified at various locations in the project area depends upon:
  - Characteristics of noise source (instantaneous, intermittent or continuous in nature)
  - Time of day at which noise occurs, and
  - Location of noise source
452. Each construction activity has its unique noise characteristics due to use of different equipment items. The potential sources of noise during the preparation, construction, and worksite closure phases for the landfill works include equipment, machinery, and transportation used for the construction activities. The equipment used for construction will be the major source of noise.
453. The construction activities will include use of a large number of trucks, generators, excavators etc., which can generate significant noise.
454. Since various modern machines are acoustically designed to generate low noise levels, any high noise levels that might be generated will only be for a short duration during the construction phase.
455. Depending on the construction equipment used and its distance from the receptors, the community and the workers may typically be exposed to intermittent and variable noise levels. During the day, such noise results in general annoyance and can interfere with sleep during the night. In general, human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as a doubling or halving of sound level.
456. Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the project site. The movement of heavy vehicles, loading, transportation and unloading of construction materials produces significant noise during the construction stage. However, these increased noise levels will prevail only for a short duration during the construction phase.
457. The **Table 6.4** below represents typical noise levels from various construction equipment items. It should be noted that the values indicated in the table may differ depending on the brand and age of machinery provided/used by construction contractors.

**Table 6.4: Construction Equipment Noise Ranges, dB(A)**

<b>Equipment</b>	<b>Peak Noise Range at 15 m</b>	<b>Typical Peak Sound Level in a Work Cycle<sup>a</sup> at 15 m</b>	<b>Typical 'Quieted Equipment' Sound Level<sup>b</sup> at 15 m</b>	<b>Construction Phase</b>		
				<b>Earthworks</b>	<b>Structures</b>	<b>Installation</b>
<b>Batching plant</b>	82-86	84	81		Y	
<b>Concrete mixers</b>	76-92	85	82		Y	
<b>Cranes</b>	70-94	83	80		Y	Y
<b>Excavators</b>	74-92	85	82	Y		
<b>Front loader</b>	77-94	85	82	Y	Y	Y
<b>Water bowlers</b>	85-93	88	85	Y	Y	Y
<b>Graders</b>	72-92	85	82	Y		
<b>Bulldozers</b>	65-95	85	80	Y		
<b>Pavers</b>	87-89	88	80	Y		
<b>Pumps</b>	68-72	76	75	Y	Y	Y
<b>Diesel generators</b>	72-82	81	77		Y	Y
<b>Drilling machines</b>	82-98	90	87		Y	Y
<b>Compressors</b>	74-88	81	71		Y	
<b>Dumpers</b>	77-96	88	83	Y	Y	
<b>Dump/flatbed Truck</b>	75-85	80	77	Y	Y	Y

Sources: USEPA, 1971; <http://www.waterrights.ca.gov/EIRD/text/Ch11-Noise.pdf>;  
[http://www.lacsd.org/LWRP%202020%20Facilities%20Plan%20DEIR/4\\_6\\_Noise.pdf](http://www.lacsd.org/LWRP%202020%20Facilities%20Plan%20DEIR/4_6_Noise.pdf).  
<http://newyorkbiz.com/DSEIS/CH18Construction.pdf>

**Notes:**

- a. Where typical value is not cited in literature, mean of the peak noise range is assumed
- b. Quieted equipment can be designed with enclosures, mufflers, or other noise-reducing features. Where data is not available, a 3 dB reduction is assumed

458. Precise information on the type, quantity and location of equipment to be used during the construction phase is not available at this stage and will be dependent on the working methods of the selected contractors. However, preliminary calculations have been conducted to provide a general magnitude of the noise levels during various construction phases.

459. Nearest sensitive receptors with respect to noise are located at a distance of more than 250 meters and also these are scattered settlements, therefore, no significant impacts from noise are envisaged. Furthermore, no equipment which is generating high noise levels will be permitted to work at site.
460. The mitigation measures listed below shall be implemented to minimize noise levels during the construction activity as far as possible.

### ***Mitigation Measures***

461. The following mitigation measures will be implemented:
  - Equipment noise will be reduced at source by proper design, maintenance and repair of construction machinery and equipment. Noise from vehicles and power generators will be minimized by use of proper silencers and mufflers.
  - Excessive noise emitting equipment will not be allowed to operate and will be replaced.
  - Blowing of horns will be prohibited on access roads to work sites.
  - As a rule, the operation of heavy equipment shall be conducted in daylight hours.
  - Construction equipment, which generates excessive noise, shall be enclosed or fitted with effective silencing apparatus to minimize noise.
  - Well-maintained haulage trucks will be used with speed controls.
  - Use of ear plug and ear muffs must be ensured during construction. No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
  - Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.
  - Periodic medical hearing checks should be performed on workers exposed to high noise levels.
  - All the equipment and machinery used during construction phase should be well maintained and in compliance with NEQS.
  - Grievance redress mechanism will be established.

#### **6.3.6 Hazardous and Non-Hazardous Waste Management**

##### ***Impacts***

462. During construction/civil works potential sources of waste will include spoils generated during landfill cells excavation, excavation waste for other civil works, domestic wastes

(solid & wastewater), fuel or oil leakages or spills, onsite effluents from vehicle wash & cleaning, and cement spills.

463. Waste disposal of materials containing contents of both hazardous and non-hazardous nature such as scrap wood, bricks, concrete, asphalt, plumping fixtures, piping, insulation (asbestos and non-asbestos), metal scraps, oil, electrical wiring and components, chemicals, paints, solvents etc. can potentially become a serious environmental issue, particularly with the local contractors. To avoid any potential issue, the PMU in collaboration with focal agencies will need to impose adequate internal controls.
464. Domestic wastes generated during construction Kohat SWF will include sewage, grey water (from kitchen, laundry, and showers), kitchen wastes, combustible wastes and recyclable wastes from contractor camps.

#### ***Mitigation measures***

465. A waste management plan will be developed prior to the start of construction. This plan will cater to sorting of hazardous and non-hazardous materials prior to disposal, placing of waste bins at the project sites for waste disposal and an onsite hazardous waste storage facility i.e. designated area with secondary containment.
466. Licensed waste contractors will be engaged to dispose off all non-hazardous waste material that cannot be recycled or reused.
  - Excavated material from landfill cells will be stored at site and it will be used as daily cover within landfill cells.
  - All types of combustible and non-combustible waste including plastic or glass bottles and cans will be temporarily stored on site and later sold/handed over to a waste/recycling contractor who will utilize these wastes for recycling purposes.
  - Waste management training for all site staff to be included in Contractor's training plan.
  - Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The volume of the containment area should be equal to 120% of the total volume of fuel stored.
  - Fuel and hazardous material storage points must be included in camp layout plan to be submitted for approval. Hazardous material storage areas shall include a concrete floor to prevent soil contamination in case of leaks or spills. Fuel tanks will be checked daily for leaks and all such leaks will be plugged immediately.
  - Designated vehicles/plant wash down and refuelling points must be included in camp layout plan to be submitted for approval.
  - Hazardous waste will be initially stored on site at designated area and then handed over to EPA certified contractor to final disposal.
  - Record of waste generation and transfer shall be maintained by project contractors.

- Spill kits, including sand buckets (or other absorbent material) and shovels must be provided at each designated location.
- At the time of restoration, septic tanks will be dismantled and backfilled with at least 1m of soil cover keeping in view landscape of surrounding natural surface.
- It will be ensured that after restoration activities, the campsite is clean and that no refuse has been left behind.
- Clinical wastes will be temporarily stored onsite separately and will be handed over to approve waste contractor for final disposal.
- Training will be provided to personnel for identification, segregation and management of waste.
- The structure of a Framework waste management plan has been prepared for the project and attached as **Annexure O** and contractors will be required to prepare waste management plan for the site in light of guidelines provided in the waste management plan and submit to PMU for approval.

### **6.3.7 Camp & Batching Plant Effluent**

#### ***Impacts***

467. The staff and labor camps for the construction of the proposed landfill will be a source of wastewater generated from the toilets, washrooms and the kitchen. The wastewater will not meet the national environmental standards and will therefore need treatment prior to disposal.
468. The project sites where construction is being conducted must not be treated by the project staff and/or labor as a public toilet or for disposal of camp effluent.

#### ***Mitigation measures***

- It will be ensured that no untreated effluent is released to the environment.
- A closed sewage treatment system including soak pits and septic tank will be constructed to treat the effluent from the construction/labor camps.
- Sewage treatment system will be installed at each respective labor camp based on the number of laborers residing at the respective camp.
- Wastewater from laundry, kitchen washings and showers will be disposed-off into soak pits or septic tank (where soak pit cannot be constructed) and after treatment it will disposed of in TMA provided drains in the project area.
- Soak pits will be built in absorbent soil and shall be located 300 m away from a water well, hand pump or surface water body. Soak pits in non-absorbent soil will not be constructed.

- Ensure that the soak pits remain covered all the time and measures are taken to prevent entry of rainwater into them.
- Sprinkling of grey water or sewage will not be allowed; in case the septic tank gets filled with sludge, septic tank shall be emptied through vacuum truck and material shall be transferred to treatment facility or approved municipal drain.
- Water being released from any batching plant(s) must be treated as per requirements of NEQS prior to release to sewerage system/any other water body.
- Sewage at the end of construction period to be disposed of in nearest municipal drains after getting approval from concerned municipal authorities.

### **6.3.8 Soil Erosion and Sedimentation**

#### ***Impacts***

469. Most of the works proposed for development of the landfill may result in soil erosion and sedimentation. Spoils will be generated from the excavation activities, particularly during construction of landfill cells. Potential impacts from spoils and their disposal are (i) land for disposal of spoil, (ii) potential erosion from the spoil areas and spoil material reaching the waterways, and (iii) aesthetic impacts. Excavated soil will be stored at site and will be used as daily cover during landfill operations. Approximately 6,253,848 ft<sup>3</sup> of soil will be generated from excavation of the four landfill cells and this soil will be stored at designated area for use as daily cover.

#### ***Mitigation measures***

470. Any drainage structures, culverts or pipes crossing the project site may need to be modified or protected and the detailed designs must make provisions to protect or re-provision all infrastructure that may be affected by the construction works.

### **6.3.9 Soil Contamination**

#### ***Impacts***

471. During the project construction, spills of fuel, lubricants and chemicals can take place while transferring from one container to another or during refueling. Also, during maintenance of equipment and vehicles, through leakages from equipment and containers and as a result of traffic accidents.
472. Depending on the nature of the material, location of spill and quantity of spill, the soil can get contaminated.

#### ***Mitigation measures***

- It will be ensured that spill prevention trays are provided and used during refueling. Also, on-site maintenance of construction vehicles and equipment will be avoided as far as possible. In case on-site maintenance is unavoidable, tarpaulin or other impermeable material will be spread on the ground to prevent contamination of soil.

- Regular inspections will be carried out to detect leakages in construction vehicles and equipment and all vehicles will be washed in external commercial facilities.
- Fuels, lubricants and chemicals will be stored in covered bounded areas, underlain with impervious lining. Appropriate arrangements, including shovels, plastic bags and absorbent materials will be available near fuel and oil storage areas.

### **6.3.10 Employment Conflicts**

#### ***Impacts***

473. The proposed construction of Kohat SWMF is not likely to create any significant permanent job opportunities. Even unskilled and semi-skilled employment opportunities that are likely to be created will be for a short period, while the landfill project is constructed. As persons with relevant skills may be available locally, people from the project area are likely to fill a significant number of the semi-skilled and skilled jobs.
474. This issue of provision of jobs can become particularly problematic if it is perceived by the local population that a significant number of construction-related jobs opportunities are not given to people from the local community. This can result in friction between residents and construction workers from outside of the community.

#### ***Mitigation measures***

- The Construction Contractor will adopt a transparent hiring policy. Prior to the commencement of the construction activity, the local communities in the project area will be informed of the employment policy in place and number of people that can be employed for this project.
- It will be ensured that maximum number of unskilled and semi-skilled jobs will be provided to the residents of the project area.
- The PMU KP LGERDD will ensure a balanced process of employment of the communities in the project area with preference given to those most directly affected by the project.

### **6.3.11 Communicable diseases incl. COVID-19**

#### ***Impacts***

475. Communicable diseases such as COVID-19 and HIV may be introduced due to the immigration of workers associated with the project.
476. Ministry of National Health Services, Regulations and Coordination, GoP has issued guidelines in April, 2020 for Health & Safety of Building and Construction Workers during COVID-19 outbreak. These guidelines are prepared for the workers involved in building and construction work during the current epidemic of COVID-19. These guidelines provide the safety measure to be implemented at the construction site having a dusty environment, continuous flow of different materials and make-shift type of arrangements for storage,

food and sanitation calls for implementation of safety precautions at the very basic level of personal hygiene only.

### ***Mitigation measures***

477. A communicable diseases prevention program will be prepared for construction workers or residents near the construction sites.

### ***COVID-19 specific measures***

- All workers must perform complete sanitization at the site as per SOPs/guidelines issued by WHO and the national guidelines issued by the Government of Pakistan (GOP)<sup>18</sup>.
- All workers must wear a mask as soon as they arrive at site and must keep wearing it at all times while present at the work site/hospital premises. The WHO guidelines on biosafety and use of masks are provided as **Annexures M and N**.
- As soon as workers arrive at work site, their body temperature must be checked and in case any worker is assessed to be running a fever or suffering from a flu or cough, he must be informed to leave immediately and self-isolate for a two-week period and not report for work until this two week mandatory period has been completed.
- At the work site(s), social distancing measures must be strictly implemented and gathering of workers at any location at the work site(s) must be strictly forbidden. In case of workers not taking this measure seriously, strict penalties must be imposed to ensure implementation.
- The work tasks must be divided into shifts, as far as possible, to reduce the workforce present at the work site(s) at any one moment and improve the working speed/efficiency.
- All workers will be strictly advised to wash their hands as frequently as practicable and not to touch their face during work.
- A supply of safe drinking water will be made available and maintained at the project site(s).
- COVID awareness sign boards must be installed at the camp clinic and at the work site(s).
- The required ventilation equipment shall be installed within the construction closed spaces to ensure adequate ventilation to limit the spread of COVID-19 pandemic as far as possible.
- Contact details of all workers will be kept in a register on site in order to efficiently trace

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<sup>18</sup> <https://covid.gov.pk/guideline>

and manage any possible workers that might experience symptoms of COVID-19.

- Prohibition of entry for local community/any unauthorized persons at work sites.
- Proper hygiene practices in the toilets and washrooms will be implemented with proper and adequate use of soaps and disinfectant spray.
- Social distancing must be maintained during the pick-up and dropping off of workers from their residences to and from the work site(s).

### ***COVID-19 specific measures GOP***

#### **Advice for Site Managers:**

- Every construction project shall make proper arrangements for uninterrupted building services including but not restricted to, electricity, fuel, water supply, water disposal and sanitation, communication links, washrooms with hand hygiene and shower facility and with proper and adequate supply of soaps and disinfectants.
- Workers shall not use biometric attendance machines or crowd during attendance, entry or exit to the premises of the construction site.
- Ensure the availability of the thermal gun at the entry and exit of the construction site and no worker shall be allowed without getting his/her temperature checked.
- Site manager must maintain a register of all contact details with NID number and addresses of all present at the site in case a follow up or tracing and tracking of contacts is required at a later stage.
- Develop the employee roaster to decrease the number of people on the site very day. Split the shifts of the workers in morning and evening with limit of each shift to 8 working hours.
- Every worker must change into standard working attire at the time of commencement of duty and change back to their regular dress after taking shower when their duty hours end.
- In addition to all other internationally recognized safety precaution for construction workers and other staff, every individual must be provided with a face mask. It must be ensured that everyone during his or her presence at the site continues to wear the mask. Face mask shall be replaced as and when soiled or otherwise removed. Outer surface of face mask must not be touched with hands.
- Non-essential work trainings must be postponed avoiding gathering of people.
- Ensure the physical distance by creating more than one route of entry and exit to the site.
- Instruct the workers to inform the construction manager (or authorities) if

- They develop any symptoms of cough, flu or fever.
- They have been exposed to someone suspected or confirmed with COVID 19.
- They have met someone who has a travel history of COVID 19 endemic country. They have travelled in last couple of days or plan to travel soon.
- All incidences of appearance of the symptoms of COVID-19 shall be immediately documented and maintained at the site and information regarding which shall be immediately communicated through e-mail or else, to the designated health facility, and the sick worker shall be transported to the health facility for further advice and action. The site manager must establish a link with a nearby healthcare facility with arrangements for quick transportation of workers in case of an emergency.
- Persuade the workers to inform the authorities for their safety and of other if they observe any signs and symptoms in a colleague
- Do not allow any worker at the construction site who has the symptoms
- Display the awareness banners about hand hygiene and physical distancing, where you can, around the work site.
- Everyone on the construction site must observe sneezing and coughing etiquettes.
- Workers shall be requested and required to wash their hands as frequently as practicable and shall also be advised not to touch their face with their hands during work.
- Workers must maintain no less than two arm lengths between them before, during after work at all the times. They shall not make physical contact and shall be required to maintain separate personal gears and assets which must be clearly labelled and stored without intermix.
- Only sanitizable dining surfaces shall be used, which must be cleaned before each service.
- The lunch breaks and stretch breaks of the workers must be staggered to avoid the clustering of workers. Workers must not sit at less than 2 meters distance while having meals and while any other activity requiring interpersonal communications.
- In the wake of current restrictions on transportation, site managers will ensure safe transport arrangements for worker which shall not be crowded and shall have social distancing in place during the entire process from pickups till drops at destination.
- In case of workers sleeping in at the site of construction, a safe distance of 2 meters must be ensured in the sleeping rooms, in well ventilated areas.
- A supply of safe drinking water must be made available at the project site and maintained.

### **Advice for Construction Workers:**

- All possible and prescribed measures shall be taken to ensure your and others health. Enter your contact details in the register maintained at the site, in case a follow up or tracing and tracking of contacts is required at a later stage.
- Follow hygiene practices at washrooms and shower facility with proper and adequate use of soaps and disinfectants.
- Every worker must change into standard working attire at the time of commencement of duty and change back to their regular dress after taking shower when their duty hours end.
- In addition to all other internationally recognized safety precaution for construction workers and other staff, every individual must use face mask. Face mask shall be replaced as and when soiled or otherwise removed. Outer surface of face mask must not be touched with hands.
- Workers shall wash their hands as frequently as practicable and shall not touch their face with their hands during work.
- Everyone on the construction site must observe sneezing and coughing etiquettes.
- Workers must maintain no less than two arm lengths between them before, during after work at all the times. They shall not make physical contact and shall be required to maintain separate personal gears and assets which must be clearly labelled and stored without intermix.
- Sick worker shall immediately inform the site manager and must get medical advice from nearby health centre.
- Only sanitizable dining surfaces shall be used.
- Do not sit at less than 2 meters distance while having meals and while any other activity requiring interpersonal communications.
- Do not use biometric attendance machines or crowd during attendance, entry or exit to the premises of the construction site.
- Use safe transport arrangements which shall not be crowded and shall have social distancing in place during the entire process from pickups till drops at destination.
- In case sleeping in at the site of construction, a safe distance of 2 meters must be ensured in the sleeping rooms in well ventilated areas.

### **Deliveries or Other Contractors Visiting the Site:**

- Non-essential visits to the construction sites shall be cancelled or postponed.
- Delivery workers or other contractors who need to visit the construction site must go

through temperature check before entering and shall be given clear instructions for precautions to be taken while on site.

- Designate the workers, with protective gears or at least gloved and mask, to attend to the deliveries and contractors.
- Make alcohol-based hand sanitizer (at least 70%) available for the workers handling deliveries.
- Instruct the visiting truck drivers to remain in their vehicles and whenever possible make use of contactless methods, such as mobile phones, to communicate with your workers.

### **6.3.12 Vegetation and Wildlife Loss**

#### ***Impacts***

478. The project consists of a semi-urban environment located in the outskirts of Kohat city with limited human settlements and activities and thus contains limited vegetation cover and limited wildlife of any significance as common in areas located close to urban centers.
479. No impact on vegetation and wildlife is expected since no trees are expected on the project site. There are only minor shrubs and bushes that will be cleared up, if felt necessary, during the site preparation stage of the project.

#### ***Mitigation measures***

- Consideration has been given to the visual appearance of the landfill site during operation and at the time of closure of the site and its impact on the surrounding land forms. Necessary plantation will be carried out, which will act as buffer zone from surrounding environment. Reasonable area has been allocated for plantation within and at boundary of facility to improve landscape of the area.
- Inside the boundary wall, tree plantation will be conducted to create an environmental barrier between the external and internal environment. Indigenous tree plantation will be carried out, which will serve as the buffer zone. Green belt has been provided in project key plan. For the landfill, to present a clean and aesthetically pleasing view, buffer zone with tree plantation and landscaped berms will be developed. Plantation will commence as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds have been mobilized, plantation activity will be started in collaboration with Kohat Development Authority or WSSCK may outsource the activity separately.
- Camp/s will be located in existing clearings; as much as possible.
- Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project. and
- Vehicle speed will be regulated and monitored to avoid excessive dust emissions.

- No hunting or killing of animals will be permitted.
- No cutting down of vegetation or using vegetation or trees as firewood will be permitted.

### **6.3.13 Historical/Archaeological Sites**

#### ***Impacts***

480. No historical/archaeological sites have been identified in the project area or project site.

#### ***Mitigation measures***

481. If evidence of any archaeological remains is found during the construction activities, the excavation work will be stopped immediately, and necessary next steps taken to identify the archaeological discovery based on the 'Chance Find' procedures provided as Annexure G.

### **6.3.14 Construction of Administration Building and other infrastructure**

#### ***Impacts***

482. Kohat LFS will have proper facilities like administration building, waste reception areas, weigh bridge, CCTV, RFID, access roads, daily soil cover, security, lighting for 24 /7 usage and professionally trained workers to operate and supervise.
483. An Administration building will be constructed within SWMF to house administration staff and manage the facility operations within Kohat SWMF. It is planned such that it can accommodate landfill operations team, has a laboratory for quality control and MIS monitoring room for data acquisition and transfer to head office. The building also contains a conference room for meetings at landfill, an inventory room for storing supplies for repair and maintenance of landfill machinery and vehicles. There are showers, prayer area, rest rooms and a kitchen in the building. A car park outside the building will be constructed for personnel's' vehicles. The area of the administrative building is surrounded by landscaping and greenery. The building has a look-out tower on 4<sup>th</sup> level for viewing operations at the facility. Lookout tower of height 49'-6" will be constructed for visual surveillance of the landfill facility.
484. Roads inside the premises will be constructed. Road 10 m wide with two lanes each 4 m for two-way traffic of waste carrying vehicles will be constructed. Access roads within cells (8 meters wide) will be constructed at 1:10 longitudinal slope. Vehicle parking shed for waste vehicles, a workshop for routine repair and maintenance work will be constructed.
485. Soil erosion is main impact during construction of admin building and associated infrastructure. Construction of roads or other facilities has also been historically perceived and in some cases has actually led to soil erosion. The possibility of soil erosion has been assessed in detail in the following paragraphs.

486. The possibility of soil erosion from human activity increases when soil particles are detached from the soil mass. This is true for agricultural lands where a certain landscape is changed and the area is left exposed to wind and water erosion and also for dirt tracks which are developed through continual use by vehicles and the soil surface is subject to continual erosion for as long as the track is used. However, these cases are different from scenarios in which the soil surface initially disturbed is sealed or compacted by engineering means. For example, metalled roads are not subject to soil erosion, similarly neither would the gravel-topped roads which will be compacted to sustain loads.
487. Other environmental impacts from construction of administration building include construction debris, unattended concrete and cement waste, brick waste, littering and empty cement bags which required to be disposed off as per waste management plan. Flooring works will add to slurry waste resulting from grinding activities. Noise from mixing plants, steel fixing works, wood works is another source of environmental nuisance which need to be managed. Use of generators, vehicles and machinery may be source of air pollution if not managed.
488. On the basis of the above it can be assessed that on a macro level environmental impacts from construction of admin building and associated infrastructure will not be a significant issue as all these impacts will be managed through implementation of site specific EMMP prepared by contractors and approved by CSC/PMU.

#### ***Mitigation measures***

489. Following are the mitigation measures that will be employed to manage impacts from construction of building and associated infrastructure:
  - Water will be sprinkled regularly to suppress dust emissions. Off road travelling of vehicles will be prohibited.
  - Stock piles will be appropriately located and out of wind to avoid dust emissions. Dry dusty materials shall be sprinkled with water and properly covered to avoid dust emissions.
  - No cement and concrete waste will be left unattended. Construction debris will not be thrown from height to avoid dust emissions. Return unpaved areas to original or improved contours following construction.
  - Solid waste generated from construction of admin building will be managed through site specific EMMP and no waste will be stored at site to improve housekeeping at site and to avoid environmental nuisance.
  - Set protocols for proper and regular maintenance of construction machinery, vehicles and generators. Generators that will be used will be placed at suitable locations.

- Contractor will not be allowed to store bulk quantities of fuel or hazardous material at site.
- Any fuel or chemicals stored at site (in small quantities) will be stored at designated site and containers/storage vessels be properly marked for their contents. Storage area will be provided with hard impervious surface and secondary containment.
- Equipment and machinery with loose vibratory parts will not be allowed to use. Used equipment and machinery will be in compliance to NEQS.
- Waste bins will be provided at appropriate places to manage waste. Daily housekeeping of the construction area will be carried out.
- CSC will ensure that proper amounts of insulation in the walls and roof will be used.
- Proper weather stripping and caulking will be carried out to ensure energy efficiency.
- High quality windows that utilize low-e coatings and gas filling will be installed.
- CSC will ensure that energy efficient appliances such as LED lights, energy savers, inverters) are installed in the buildings.

### **6.3.15 Construction of Access Road**

#### ***Impacts***

490. The proposed 3.3 km access road from expressway up to the landfill is proposed as the primary approach road, its construction is included as part of external development component of landfill construction. Road width will be 10 meters wide with two lanes of 4 meters each for two-way traffic of waste carrying vehicles. Road construction may impact physical and chemical soil conditions, water flow and air and water quality, as well as plants and animals.
491. Major activities of road works will include preparation of sub-grade, sub-base, base and wearing course. Major equipment to be involved in road widening works are tractor, bulldozer, roller, compactor, shovel, grader, dumper, aggregate distributor and spreader, asphalt mixer, bitumen boiler and sprayer, concrete mixer and paver, batching plant and finisher.
492. The development of the access road will involve earth works and transporting and dumping large quantities of debris material. This will likely lead to an increase in SPM (Suspended Particulate Matter) at the road construction site. Construction of roads has been historically perceived and, in some cases, has actually led to soil erosion. The landfill development will involve the use of considerable heavy machinery at the project site along with posing the risk to commuters on the road during the construction works.
493. Main impacts associated with road widening are noise, dust and vibrations and construction waste. Noise mainly occurs during road construction phases but it can also

occur to a lesser degree during maintenance operations. Dust is created during the construction of roads and unbound aggregate layers. Dust is an almost inevitable consequence of roadwork. Gravel and crushed gravel and hard rock aggregates always contain a proportion of fines, and if the material is dry, a fairly heavy dust cloud can be raised when it is mobilized. The resulting dust can disturb both the population and the local environment.

494. Excess dust production can be treated by a range of measures such as watering, use of alternative materials and by using dust binders near houses. Vibration can be caused by uneven road surfaces and can pose significant impacts and problems to houses close to the source. Vibrations disturb people close to roads but they may also cause damage to buildings and sensitive equipment. Scarification, material cutting, formworks and foundation works and poor material management are the sources of waste generation during widening of roads.

### ***Mitigation Measures***

495. The following mitigation measures will be implemented during construction of the proposed access road:
- The road widening will be to a standard that is suitable for movement of high-capacity waste carrying vehicles.
  - WSSCK/PMU will maintain close coordination with the residents falling close to road widening works, project information leaflet will be distributed to them and awareness with respect to impacts (noise, dust and vibrations) associated with construction will be provided. If people are notified, their acceptance of the disturbance is usually higher.
  - WSSCK/PMU will arrange community consultation session before commencement of construction works to make public sensitization which will facilitate smooth execution of project activities.
  - Compaction with heavy vibration rollers shall be avoided or minimized in built-up areas.
  - Work areas outside the project site, especially where machinery is involved, will be barricaded and will be constantly monitored to ensure that local residents, particularly children stay away.
  - Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children.
  - Traffic diversions will be planned in such way that it does not create traffic congestion during road widening works. Road closure for the works will be avoided.
  - PMU KPCIP through CSC will ensure that road widening structure shall be as similar as

existing part.

- Proper drainage system will be provided in order to achieve sustainability.
- Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project.
- Vehicle speed will be regulated and monitored to avoid excessive dust emissions.
- Blowing of horns will be prohibited on access roads to work sites.
- Periodic sprinkling on access road at least twice per day during construction phase and restrict vehicle speed to 20 kmph.
- Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed part within project area.
- Traffic is not disrupted by labor camps being set up roadside next to the construction sites.
- Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area.
- PMU KP LGE&RDD shall ensure the contractor staff working in the project are well trained and educated in the Health, Safety and Environment (HSE) hazards associated with their duties, and that of the public, in the project area.
- Record of waste generation and transfer shall be maintained by project contractor.
- Periodic water sprinkling will be carried out during widening works to suppress dust.
- Fuel-efficient and well-maintained equipment and machinery shall be employed to minimize exhaust emissions.
- The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles shall not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles ( $>25\text{m}^3$ ) of crushed materials are necessary, they shall be enclosed with side barriers and also covered when not in use.
- Prior to starting of work, the contractor shall prepare a method statement for water supply

pipeline works. This should be simple and explain the contractor's work process that is actually conducted on site, with safety and safeguard concerns.

- Method Statement is very important, particularly for the road widening works.
- Method Statement can be prepared for each stretch (say 1 km) /specific site based on the project area.
- Method Statement shall be in a Table format with appended site layout map and cover the following:
  - Work description
  - No. of workers (skilled & unskilled)
  - Details of Plant, equipment & machinery, vehicles
  - Work duration (total, and activity-wise, for example for preparation of sub grade, sub-base, base and wearing coarse
  - PPE (helmet, gloves, boots, etc.) details for each type of work
  - Details of materials at each site (type & quantity)
  - Risks/hazards associated with the work
  - Construction waste/debris generated (details & quantity)
  - Detail the sequence of work process (step-by-step) including specific details of each work
  - Contractor's supervision & management arrangements for the work
  - Emergency: Designate (i) responsible person on site, and (ii) first aider
  - Typical site layout plan including placement of material, excavated earth, barricading etc.
- The following shall be included in the site layout plan:
  - Provide barricading/security personnel at the site to prevent entry/trespassing of pedestrian/vehicles into the work zone.
  - Location of temporary stockpiles and provision of bunds
  - Separation of stockpiles areas with workers/vehicle movement paths to avoid disturbing the stockpiled soil
  - Wetting of soil to arrest dust generation by sprinkling water

- Waste/surplus soil utilization and disposal plan – indicate expected duration of temporary stockpiling along the road and identify final surplus soil utilization/disposal site in consultation with CSC/PMU.
- PMU KPCIP will ensure the identification of disposal sites for unsuitable excavated material in consultation with WSSP.
- CSC will inspect and monitor the borrow material areas prior to procurement to ensure that it is being used in sustainable way and no significant disfiguration of landscape is going on at quarry site.
- Stock piling of excavated material at places that are congested will be avoided as these piles can create traffic issues and public nuisance.
- Already available quarry sites for additional backfill material will be utilized. Development of new quarry site will be discouraged.
- Record of borrow materials will be maintained including details of quarry site, agreement and necessary approvals from concerned government authorities.

### **6.3.16 Sexual Abuse, Exploitation and Harrasement (SEAH)**

#### ***Impacts***

496. Acts of violence committed against women and children including, *inter alia*, sexual violence, sexual harassment and other discriminatory practices based on gender, all fall within the ambit of SEAH. Sexual harassment against women might occur as a consequence of mixing of men and women at the construction site however keeping in view the culture of the area women involvement in construction works is not expected.

#### ***Mitigation Measures***

497. The contractor will manage the potential risks of sexual exploitation and abuse, and sexual harassment by taking following actions:
- The contractor's COC shall cover a program to promote awareness of the construction workers on avoiding any gender-based violence;
  - The contractor's monthly training program will cover topics related to COC such as sexual harassment particularly towards women and children, violence, including sexual and/or gender-based violence;
  - Measures to protect the privacy of women and girls by the contractor, sub-contractors and service providers;
  - The contractor will make sure that no discrimination is made on the basis of gender while hiring of workers;
  - The contractor will set the employment relationship on the code of equal opportunity and fair treatment and develop COC for workers to address these issues;

- The employment decisions will not be made on the basis of personal characteristics unrelated to inherent job requirements, including race, gender, nationality, religion or belief, disability, age, sexual orientation, or ethnic, social and indigenous origin;
- Special measures will be taken to address harassment, intimidation, and/or exploitation, especially in relation to women;
- No Sexual Harassment Policy will be established and strictly endorsed in accordance with provincial law;
- World Bank Good Practice Note on Addressing GBV will be used as guidance.<sup>19</sup>

#### **6.4 Impacts Associated with Operation of SWMF**

498. The potential impacts from operation of the SWMF are provided as **Table 6.5** below.

##### ***Operation Phase***

**Table 6.5: Screening of Possible Impacts during Operation Phase**

S/No.	Potential Issues	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short Term, Long Term)
1	Generation of Leachate	Likely	Major	Medium	Long Term
2	Possible Contamination of Soil and Groundwater	Likely	Major	Significant	Long Term
3	Generation of Landfill Gas	Likely	Major	Medium	Long Term
4	Generation of objectionable Odor and impact on air quality	Likely	Major	Medium	Long Term
5	Attraction of Vermin and disease vector generation	Likely	Major	Medium	Long Term
6	Occupational Health and Safety	Likely	Major	Medium	Long Term
7	Waste Collection and Hauling Impacts	Likely	Major	Medium	Long Term
8	Wind Blown Litter	Likely	Major	Medium	Long Term
9	Impacts on Scavengers and Waste Pickers	Likely	Major	Medium	Long Term
10	Inefficient management and disposal of septage from administration building toilets	Unlikely	Moderate	Low	Short Term

<sup>19</sup> <http://documents.worldbank.org/curated/en/399881538336159607/Environment-and-Social-Framework-ESF-Good-Practice-Note-on-Gender-based-Violence-English.pdf>

S/No.	Potential Issues	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)	Residual Impact (Short Term, Long Term)
11	Improved management of solid waste & health and sanitation		Positive impacts expected		Long Term Positive Impact
12	Improvements in Public Health		Positive impacts expected		Long Term Positive Impact
13	Improvements in Aesthetic Impacts		Positive impacts expected		Long Term Positive Impact

■ Critical Risk Level

■ Significant Risk Level

■ Medium Risk Level

■ Low Risk Level

■ Positive Impacts

#### 6.4.1 Generation of Leachate

##### *Impacts*

499. The general risks from leachate generated from wastes are due to its normally high organic contaminant concentrations and high ammoniacal nitrogen. Pathogenic microorganisms and hazardous substances that might be present in it are often cited as most dangerous, but pathogenic organism counts have been found to reduce rapidly with time in the landfill, so this only applies to fresh leachate.
500. The generation of leachate is inevitable in most landfill areas. Leachate generation rates are completely dependent on the amount of liquid the waste originally contains and the amount of rainfall in the area. Some factors that can influence leachate generation are the following:
- Climate;
  - Site topography;
  - Final landfill cover material;
  - Vegetative cover;
  - Site phasing and operating procedures;
  - Type of waste materials in the landfill

501. The climate at the site will significantly influence the rate of leachate generation in the landfill. Since the site is located in an area of low precipitation, it can be expected that leachate generation is relatively low, although plans to handle and treat even these minute quantities are incorporated in the design.
502. The temporary and final landfill covering can also influence the amount of water percolating into the landfill.
503. Finally, it is a given that vegetation will, by evapotranspiration, re-direct a portion of the infiltrating precipitation back into the atmosphere. The presence of vegetation in the landfill can also influence the generation of leachate in the landfill.

#### ***Mitigation measures***

504. Depending on moisture content of the waste, leachate can be generated from the dumped waste. On the other hand, as envisaged that with the low expected precipitation, it is expected that leachate generation will be relatively low. Nonetheless, the following control measures will be implemented:
  - A leachate holding tank of 500 m<sup>3</sup> sufficient to store (15 days leachate) will collect the leachate before it enters the treatment plant. Leachate treatment is based on DTRO, which is potable arrangement for treatment of leachate and can be operationalized during monsoon for 24/7 basis. During monsoon season, recirculation of leachate will be increased to avoid operational constraints of leachate collection, storage and treatment system at landfill site.
  - Operate the landfill in accordance with applicable internationally recognized standards to minimize leachate generation, including the use of low-permeability landfill liners to prevent migration of leachate as well as landfill gas, a leachate drainage and collection system, and landfill cover (daily, intermediate, and final) to minimize infiltration;
  - Minimize the daily exposed working face and use perimeter drains and landfill cell compaction, slopes and daily cover materials to reduce infiltration of rainfall into the deposited waste;
  - Leachate collection will be augmented by a leachate recirculation system in the landfill design.
  - The operators of the landfill must ensure that an effective and efficient leachate control and monitoring system is maintained. This may be complimented by establishment of groundwater monitoring wells and regularly collecting samples for laboratory analysis. Results of the analysis could aid the operators to determine the final fate of the collected leachate and/detect any potential leakages. Final decision rests with the landfill operator on the final number of wells as well as the frequency of sampling for groundwater quality.
  - The final vegetative cover plays an integral part in leachate production control. Its basic functions are to limit infiltration by intercepting precipitation directly, thereby improving evaporation from the surface, and to reduce percolation through the cover material by taking up soil moisture and transpiring it back to the atmosphere. Preferred plant

species shall be of those that do not have deep roots in order to protect the surface sealing. Further, these species shall require minimal maintenance and human intervention.

- Landfill operators must be properly and adequately trained to operate and maintain the installed control system.
- A procedure for the rapid repair of leaks in the pipes, pumps and other equipment must be part of landfill operations.
- An inventory of spare parts and repair equipment must be continuously in place to ensure immediate remedial action against breakdowns.
- Strict quality assurance and construction guidelines during the installation of the HDPE liner shall be strictly implemented.

#### **6.4.2 Possible Contamination of Soil and Groundwater**

##### ***Impacts***

505. Contamination of the groundwater resources is among the most recognized impact of landfill development. In cases of leakages, the contaminated leachate will percolate into the ground and may find its way into existing groundwater resources.
506. In the case of the proposed site, the ground water level is quite high and thus the risk of groundwater contamination remains high. However, the solid waste will be disposed off on a concrete base with liner lining placed under the concrete base. As a result, the likelihood of the liner bursting for a new landfill site is quite remote since high quality liner will be installed and in addition, it will be ensured that all countermeasures in terms of liner design are in place to prevent breakage of liner. Furthermore, active life of landfill cell is about 4-5 years and after that Final capping will be placed. After that, there are minimal chances of percolation of water in the landfill cell and hence limited leachate production.
507. Five (5) storage cells are proposed by the designer of LFS in Kohat. A leachate leak from any of the storage cells may result in the contamination of the water table below the LFS. The geology of the site is clayey silty gravel/poorly sorted silty gravel up to maximum investigated depth of 11.0 m, the other studies conducted in the area suggest that depth of the water table is around 65 to 70m below natural surface level with impervious clay strata at around 80m depth.
508. The actual data from site as well as the surroundings of the proposed SWMF shows that the water table is sloping towards nearby storm water drain and then towards the valley.
509. Project design consultant EDCM has estimated the leachate leaking effect on ground water quality of Kohat LFS. This report focuses on checking the source, identify transport mechanisms and potential targets affected by the contamination using a qualitative and quantitative risk assessment of the problem. This involved computation of contaminant concentration at the targets identified in a conceptual model, estimating the concentration at various target points. Analysis findings are discussed below and detailed working for estimation of leachate leaking effect on ground water quality is provided as **Annexure Q**.

**Table 6.6: Data of Existing Water Sources around LFS**

S.No	Name of TW	Depth of Water Table (ft)
1	Mohammadzai fort	222
2	Residential Bore 1	183
3	Residential Bore 2	147
4	Bore at Crush Plant Near Fort	195
5	Ublam Adda Masjid	108

510. As per **Table 6.6** above, the nearest communities with respect to the proposed LFS and in the direction of the flow is Mohammad zai village at 2000m distance from the site. Due to the greater depth of water table and no surface water flow, it is unlikely that the contamination will reach Mohammad Zai village before getting neutralized due to dispersion, chemical diffusion and bio-decay.

#### ***Mitigation measures***

511. Even though there is very limited risk of any groundwater contamination reaching the settlements in a 2000 meter distance from the SWMF, however, in the interest of caution, the following measures will be implemented:
- Appropriate liner and collection systems in compliance with international guidelines/criteria are part of the design and will be installed.
  - An efficient leachate collection and treatment system has been provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum.
  - The leachate system will consist of a leachate collection layer of either natural granular (sand, gravel) or synthetic drainage material (e.g. geonet or geo-composite) with pipe network to convey the leachate to treatment facility.
  - A total of 600 mm clay liner of permeability of  $1 \times 10^{-6}$  cm/sec will be compacted at the bottom in series of 150mm layers each compacted to 95% of compaction, followed by 150 mm base layer for drainage and monitoring. This layer will be topped by 1.5 mm HDPE geomembrane.
  - As soon as HDPE is placed, 200 mm silty sand will be covered on top of HDPE for the protection of the HDPE on the side slopes. The main purpose of this sand layer on top of HDPE geomembrane serves as leakage detection layer.
  - Above this 300 mm PEA gravel layer will be placed followed by 150 mm compacted (85-90%) sand layer.
  - Leachate collection pond shall be in opposite direction from nearest surface water body.
  - A leachate treatment facility with a design capacity of 50 m<sup>3</sup> /d will be constructed.

Leachate treatment is designed on activated sludge treatment with advance level treatments (Disc Tube Reverse Osmosis-DTRO) for heavy metals and other pollutants potentially present in leachate.

- Slope of the landfill site shall be away from nearest surface water body.
- Cut-off drains around active landfill site and peripheral drains around landfill site shall be provided.
- Ground water monitoring wells shall be dug keeping in view of the flow of ground water on both upstream and downstream of the disposal site and monitor the ground water quality of the upper strata for any contamination for disposal site every month.
- In the worst-case scenario, if leachate contamination is detected during ground water monitoring after few years of landfill operation, Ground water modelling to determine possible contamination of leachate will be carried out and necessary design changes will be implemented.
- Detailed ground water quality baseline will be developed during operation phase of the project to trace any ground water contamination from landfill operations.
- Waste hauling vehicles shall be covered during transport of waste to landfill site
- Hauling vehicles shall not wash at the surface water bodies along the route as the wash water shall drain into the canal and will pollute the surface water source which is used by the animals of the nearby communities and for agriculture purpose.
- Domestic sewerage of Kohat facility shall not be discharged untreated in open area and drains,
- Waste water generated from vehicle wash area shall be contained and treated before final discharge
- In order to augment this system, regular quality control checks on the equipment /accessories will be implemented and incorporated during construction and operations.

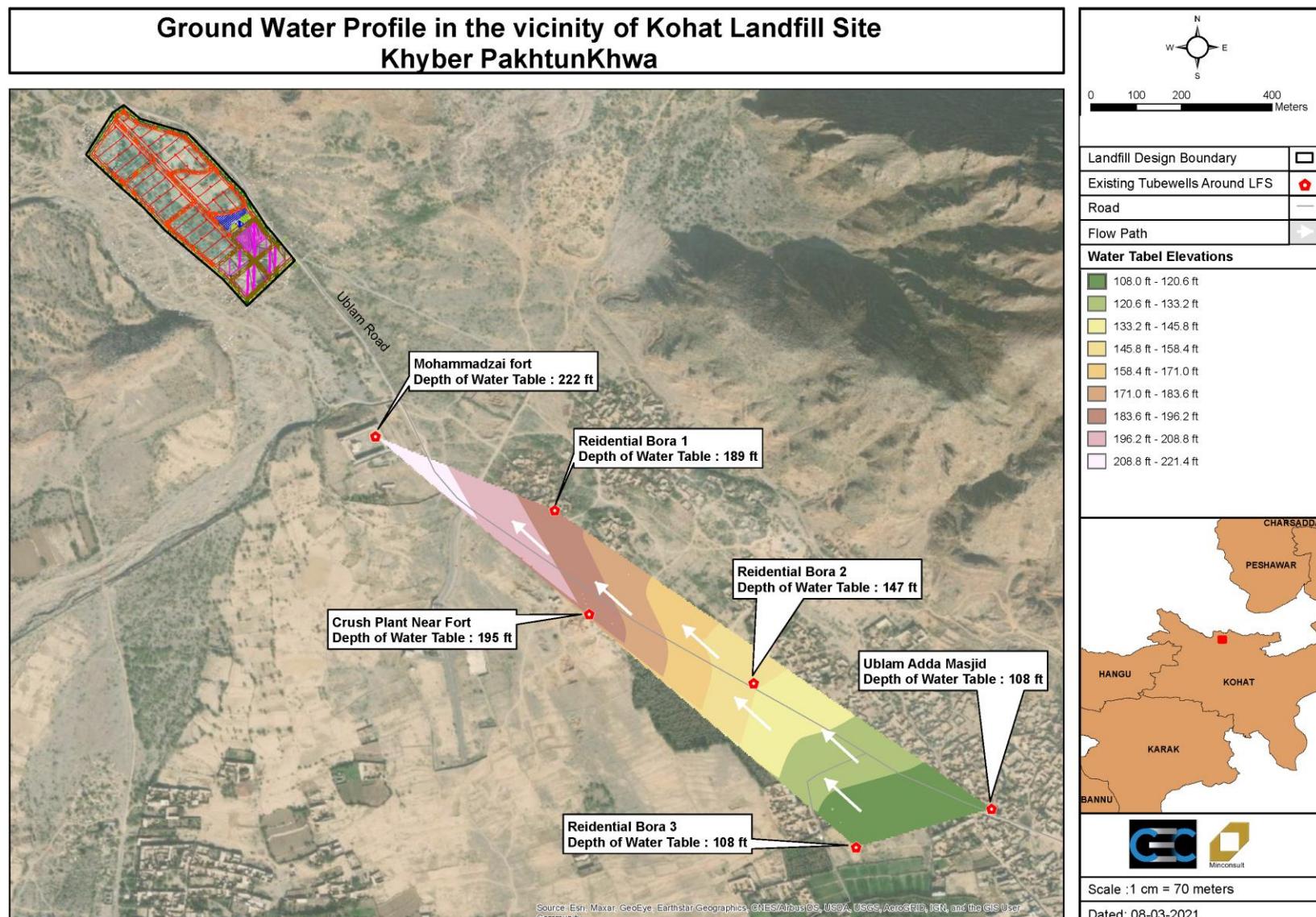
**Figure 6-1: Location of tube wells and groundwater levels showing underground flow direction**

Figure 6-2: Kohat Landfill Site location showing direction of flow (Google earth, 2021)



### 6.4.3 Generation of Landfill Gas

#### ***Impacts***

512. Studies and research indicate that landfill gas is approximately 40-60% methane (CH<sub>4</sub>) and the remaining being mostly carbon dioxide (CO<sub>2</sub>). There is another group of chemicals, called non-methane organic compounds (NMOCs), which may be present in the air near a landfill, though they are not likely to reach harmful levels. They are nitrogen, oxygen, water vapor, sulfur and hundreds of other contaminants. NMOCs may occur naturally, or be formed by chemical processes. There is concern that long-term exposure to high levels of NMOCs could lead to health problems, but health studies have been largely inconclusive. The **Table 6.7** shows a list of the various components of a typical landfill gas.
513. Though NMOCs usually make up only less than 1% of landfill gas, many of these are hazardous chemicals like benzene, toluene, chloroform, vinyl chloride, carbon tetrachloride and 1,1,1 trichloroethane. At least 41 of these are halogenated compounds. Many others are non-halogenated toxic chemicals. More exhaustive test for contaminants in landfill gas has found hundreds of different NMOC contaminants.

**Table 6.7: Typical Landfill Gas Components**

Component	Percent by Volume	Characteristics
Methane	45-60	Methane is a naturally occurring gas. It is colorless and odorless. Landfills are the single largest source of U.S. man-made methane emissions
Carbon Dioxide	40-60	Carbon dioxide is naturally found at small concentrations in the atmosphere (0.03%). It is colorless, odorless, and slightly acidic.
Nitrogen	2-5	Nitrogen comprises approximately 79% of the atmosphere. It is odorless, tasteless, and colorless.
Oxygen	0.1-1	Oxygen comprises approximately 21% of the atmosphere. It is odorless, tasteless, and colorless
Ammonia	0.1-1	Ammonia is a colorless gas with a pungent odor
NMOCs (non-methane organic compounds)	0.01-0.6	NMOCs are organic compounds (i.e., compounds that contain carbon). (Methane is an organic compound but is not considered an NMOC.) NMOCs may occur naturally or be formed by synthetic chemical processes. NMOCs most commonly found in landfills include acrylonitrile, benzene, 1, 1-dichloroethane, 1, 2-cis dichloroethylene, dichloromethane, carbonyl sulfide, ethyl-benzene, hexane, methyl ethyl ketone, tetrachloroethylene, toluene, trichloroethylene, vinyl chloride, and xylenes

Component	Percent by Volume	Characteristics
Sulfides	0-1	Sulfides (e.g., hydrogen sulfide, dimethyl sulfide, mercaptans) are naturally occurring gases that give the landfill gas mixture its rotten egg smell. Sulfides can cause unpleasant odors even at very low concentrations
Hydrogen	0-0.2	Hydrogen is an odorless, colorless gas
Carbon Monoxide	0-0.2	Carbon monoxide is an odorless, colorless gas

**Source:** Tchobanoglou, Theisen, and Vigil; EPA 2015

514. These landfill gases are released into the atmosphere. Whenever unabated, these gases might affect the general environment, including the welfare of its employees and host community in general. Landfill gas is the main carrier of landfill generated odor, which is classified to be objectionable.
515. Landfill gas may cause temporary discomfort, but it is not likely to cause permanent health effects. At extremely high concentrations, persons exposed may experience eye irritation, headaches, nausea, and soreness of the nose and throat. People with respiratory ailments such as asthma are especially sensitive to these effects. However, these temporary conditions are reversed as soon as the gases are reduced or eliminated. Engineered Sanitary Landfills normally have landfill gas capture systems.
516. Land GEM results for pollutant emissions show that emissions of Methane (CH<sub>4</sub>) are minimal with only 215 m<sup>3</sup>/day (0.0025 m<sup>3</sup>/s) of CH<sub>4</sub> being emitted. Also result shows very limited yearly volumes of emissions of NMOC and Hazardous Air Pollutants (HAPs) from landfill site. Keeping in view these limited volumes and after controlled flaring, no deterioration in air quality is expected from the facility. Furthermore, the project area consists of a rural and open setting with no built area located in close proximity to the site, thus any minimal pollutant emissions will be rapidly diluted upon release and thus will not result in any significant impact on the airshed of the project area. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed.

### **Mitigation Measures**

- Landfill gas capture and flaring systems will be in place as part of the landfill design and thus no significant impacts on occupational or community health and safety are envisaged from landfill gas exposure.
- Landfill gas will be collected through installation of perforated pipes within the cells. At start of landfill operation, venting is proposed as small quantity of gas will be produced. The passive gas collection system is planned with simple venting of landfill gas to the atmosphere without any treatment before release. This is appropriate, considering that only a small quantity of gas is produced and no people live or work nearby. Common methods to treat landfill gas include combustion and non-combustion technologies, as well as odor control technologies. For the landfill operations, after few years when significant quantity of gas is produced, open flame flare technology, consisting of a pipe

through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow is proposed. The simplicity of the design and operation of an open flame flare is an advantage of this technology.

- The vertical gas recovery wells will be designed keeping in view the capacity of the landfill.
- The passive gas collection system is planned with simple venting of landfill gas to the atmosphere without any treatment before release. This is appropriate considering that only a small quantity of gas will be produced and no people live or work nearby. Common methods to treat landfill gas include combustion and non-combustion technologies, as well as odor control technologies. For KPCIP landfills, Open flame flare technology, consisting of a pipe through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow is proposed. The simplicity of the design and operation of an open flame flare is an advantage of this technology.
- For Kohat, flaring is proposed for landfill gas management. Keeping in view the amount of gas production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed. As presently amount of gas generation is not known, therefore, quantitative assessment is not possible at this stage.
- PMU KP LGERDD shall ensure that during operation phase of the project, if there are changes in the baseline ambient air quality based on monitoring results, then quantitative assessment will be carried out for flaring and necessary design changes will be incorporated to avoid air quality impacts from flaring.
- As part of closure plan of existing dumping site, GHG monitoring will be carried out and necessary gas venting system will be done.
- Periodic GHG monitoring will be carried out during operation phase of the project and accordingly, necessary design changes will be incorporated, if required.

#### **6.4.4 Generation of objectionable Odor and impact on air quality**

##### ***Impacts***

517. Objectionable odor is expected at the landfill site from landfill cells, composting facility and material recovery facility, depending on various factors. Some of which are the types of wastes being handled, humidity, temperature and moisture content, among others. Uncontrolled composting and poor house keeping at site will be the source of objectionable odor. Furthermore, ambient dust may be generated from sorting lines of MRF which need to be managed through proper ventilation and necessary arrangements for dust collection/suppression. Haphazard waste tipping at unloading bay and weighbridge will create nuisance and objectionable odour, if not attended on at frequent intervals.
518. At composting plant, odors originate with the incoming ingredients, which may have been stored anaerobically (without oxygen) for a week or more before transport to the site. Once these ingredients are incorporated into the composting system, subsequent odor problems

are usually a result of low oxygen or anaerobic conditions. Anaerobic odors include a wide range of compounds, most notoriously the reduced sulfur compounds (e.g. hydrogen sulfide, dimethyl sulfide, dimethyl disulfide, and methanethiol), volatile fatty acids, aromatic compounds and amines. Ammonia is the most common odor that can be formed aerobically as well as anaerobically, and thus has its own set of management options.

519. The closest receptors will be the personnel who will be onsite monitoring the status of the facility. Some of the anticipated problems that may be raised during the operation of the landfill are as follows:
- Discomfort of working with offensive odors; and
  - Concerns for the mental or psychological welfare of exposed communities
520. It is noted that based on the prevailing wind patterns, communities or settlements lying in South-West and South-East directions of the site may also be affected.
521. The Wind Rose for Kohat City (shows that the predominant wind direction is from the North-West and North-East directions. As a result, the potential impact on the households from any airborne related impacts, particularly during landfill operations, such as odor, can be seen in the Corridor of Impact provided as **Figure 6.1** below. Since most of the houses which are being used for residential purposes are falling located at a minimum distance of over 250 meters from the proposed landfill, therefore, any potential impacts from objectionable odor are expected to be minimal and manageable.
522. Daily cover will be provided at end of each day to avoid risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill. Working surface of waste will be covered with a soil layer called “daily cover” at the end of each working day. Amount of soil to be used in daily cover will be about 10% of the waste volume. Suitable quality of excavated material will be used as daily cover material.
523. Keeping in view these design considerations and operational modalities, no significant impact of odour and air quality is anticipated.

#### ***Mitigation measures***

524. Best management practices and good housekeeping measures will be implemented to minimize the release of objectionable odours. Potential odours impacts can be minimized or eliminated by adopting the following measures:
- Daily cover will be placed on working surface of waste in order to reduce the risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill.
  - Suitable amount of daily cover will be stocked at the landfill site.
  - Final capping of landfill cells will be carried out in order to limit and control the amount of precipitation that enter the waste and to limit wind and water erosion and burrowing animal activity. This will not only prevent the odor of decaying waste from escaping from the landfill but also protect the site against intrusion of vermin and pests.

525. The top cover system consists of following arrangements.

- Thick top soil layer of 45 cm capable of supporting vegetation in order to protect the landfill surface from wind and water erosion.
- Drain Layer of 15 cm at bottom to maximize runoff of precipitation while minimizing infiltration and preventing ponding of water on the landfill.
- Compacted soil layer or barrier of 60 cm of low permeability to limit and control the amount of precipitation that enters the waste.
- Vent layer of 15 cm thickness comprised of sand and gravel
- Appropriate and regular housekeeping (i.e. cleaning) will be done in all areas
- Strict use of Personal Protective Equipment (PPE) by all personnel (e.g. inspectors at the Weigh Bridge, MRFs, material handler and waste compactor operators) must be ensured.
- All the incoming ingredients that are anaerobic will be converted to aerobic state through combining them with a coarse, dry bulking amendment to increase the porosity and allow oxygen penetration.
- Air shall be thoroughly dispersed throughout the organic waste. This is done by frequently turning and mixing the wastes.
- Oxidizing chemicals like hydrogen peroxide, potassium permanganate, and chlorine will be used by the wastewater treatment industry for odor control.
- Organic waste lot which is creating objectionable odor will be attended immediately and introduced in the composing system on priority basis.
- Controlled composting conditions will be maintained throughout the operation.
- Mandatory health and medical check-ups for all employees especially workers working at MRF as they may be exposed to general airborne dust above the level where it is considered a substance hazardous to health (10 mg/m<sup>3</sup> as an 8-hr TWA). This shall ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill;
- Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV) the appropriate use of respiratory protective equipment (RPE); where solid waste will be processed (i.e. weigh bridge area). This will prevent the reproduction of flies, generation of obnoxious odors, scattering of plastic and papers, etc.

#### 6.4.5 Attraction of Vermin and disease vector generation

##### ***Impacts***

526. The operation of the landfill may attract presence of pests such as rats, cockroaches, flies, ants and other pests in the immediate area along with various other vectors such as foxes, feral cats and dogs, birds and other animals. These pests can freely move around the area and may find their way to buildings and areas adjacent to the landfill. Since these pests are known to be carriers of diseases, they may trigger the sudden occurrence of illnesses and unacceptable conditions among people of weak resistance and children.
527. Each type of vector can live and multiply at a landfill and is potentially of concern to site operators, regulators, public health professionals and the general public. Fortunately, vectors are controllable and shall rarely, and even then only intermittently, be present on a well controlled landfill.

##### ***Mitigation measures***

528. The most important control measure used to minimise vector problems at landfills is the application of daily cover. Cover shall be present on all solid waste at all times, except the tipping face while it is being worked. Daily cover of at least 150mm of compacted soil or similar material or an effective layer of alternate daily cover (ADC) shall be applied on finished portions of the daily cell during operation and at the conclusion of daily operations, and not less frequently than once per day. Alternative daily cover materials such as tarpaulins, foams, granular waste, etc, can be effective as vector control after careful site-specific evaluation.
529. Intermediate cover of 300mm (minimum) compacted soil shall be used on all areas not at finished levels, but not to be further landfilled for a period of 30 days or more.
530. Final cover is typically applied as each area is brought to finished level through the operational life of the landfill.
531. There shall be no uncontrolled or uncovered (stockpiled) waste, including litter, tyres, brush, appliances, construction/demolition waste or even inert industrial waste on the landfill property. The only exception is compactable soil-like inert wastes, such as ash, but even this waste must be graded and compacted to avoid ponding water.
532. There shall be no ponding water on the landfill property except as designed for runoff storage or sedimentation. Sedimentation ponds can, however, aid vector reproduction if not designed and controlled properly so as to minimise stagnant water, nutrient build-up and plant growth.
533. Finally, the waste must be compacted and graded at reasonable maximum slopes (see the Working Face Guideline) to minimise voids within the waste that can harbour rodents in particular. Rodents and foxes can readily dig into cover soil, but have much more difficulty digging into compacted solid waste.
534. On-site landfill site personnel must be trained and must monitor the levels of key vectors on a daily basis as part of daily management. A simple monthly site walk-over can provide

a baseline of vector activity so changes can be noted and translated into action. Observations of various droppings, sightings, tracks, insect counts, etc are useful indicators of activity. Written reports from regular walk-over assessments shall be kept on file so changes that occur over time and in response to control measures can be assessed.

#### **6.4.6 Occupational Health and Safety**

##### ***Impacts***

535. There are considerable risks associated with the operation of the proposed landfill site from an occupational health and safety perspective, keeping in view the scope of work to be conducted on a daily basis and the use of heavy machinery to be involved in the daily operations. Moreover, Organic dust which may lead to exposure to airborne microorganisms and their toxic by-products exposure cause work-related symptoms and effects among waste recycling workers in Materials Recovery Facilities (MRFs) are also a concern.
536. The equipment in a MRF is likely to expose employees to excessive noise levels. Unless suitable precautionary protocols in accordance with international good practices are put in place, there is a high risk of injury and accidents taking place at the landfill site during its day-to-day operations. Draft Occupational Health and Safety Plan has been attached as Annexure E.

##### ***Mitigation Measures***

537. In order to ensure a safe and healthy working environment for the employees of the landfill and all its auxiliary facilities, the following measures have to be strictly enforced, implemented and monitored:
  - OHS management system will be prepared and implemented prior to commencement of operation of the SWMF.
  - Designation of an Environment, Health and Safety (EHS) officer dedicated to the site;
  - All employees must be able to reach their work stations safely. All path, walkways, staircases, ladders and platforms must be stable and suitable for the tasks to be undertaken;
  - Strict use of Personal Protective Equipment (PPE) by all personnel (e.g. inspectors at the Weigh Bridge, material handler and waste compactor operators) must be ensured.
  - Mandatory health and medical check-ups for all employees, especially workers working at MRF as they may be exposed to general airborne dust above the level where it is considered a substance hazardous to health ( $10 \text{ mg/m}^3$  as an 8-hr TWA). This shall ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill;
  - Develop a written program (i.e. health information, instruction and training) which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards of working in a landfill and

its auxiliary facilities;

- Mandatory monitoring of air quality and noise levels in the working stations i.e MRFs, compactors and bailer etc to maintain the same within local standards and whenever possible near ambient levels;
- Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV) the appropriate use of respiratory protective equipment (RPE);
- Accidental fires must be addressed immediately. Appropriate operational procedures involving the spreading and smothering of burning waste, rather than the use of water, must be implemented;
- Emergency plan (including fire management) must be developed and implemented;
- Availability of first-aid kits and vehicles that can be used to bring any injured employee to the nearest doctor in cases of accidents;
- Mandatory reporting of all accidents or incident of near misses of accidents and immediate adoption of corrective measures; and
- Management must provide all the necessary financial and manpower resources for the implementation and enforcement of all health and safety programs and activities of the project;
- Regular training and orientation on safety practices will be implemented to impart knowledge of safe and efficient working environment. Furthermore, regular health checkups of all employees including contract workers will be conducted. Effective and proper housekeeping is recommended to reduce dust exposures to its direct vicinity. Heat levels must be monitored as well. Spot checks shall be done to ensure that workers' welfare is addressed especially during summer months.

#### **6.4.7 Waste Collection and Hauling Impacts**

##### ***Impacts***

538. The operation of the proposed landfill will result in the movement of a higher volume of trucks and heavy vehicles in general, transporting solid waste between Kohat city and the proposed landfill site. The movement of these heavy vehicles could result in a higher risk of accidents along with the risk of increased congestion events taking place along the route of these vehicles, particularly during the times of peak traffic, such as during the morning and evening times of the day.
539. Increased traffic volume of waste carrying vehicles will result in increased noise levels and dust issues if such impacts are not managed properly. Waste hauling through mechanically unfit vehicles will result in increased noise levels in the project area. Waste transport without purpose built vehicles or waste transport on dirt roads will result in increased dust levels.

540. There is general practice by citizens to throw waste on streets instead of communal bins. WSSCK workers need to collect all scattered waste manually. There are multiple transactions of waste till disposal site resulting in poor waste management.
541. Communal storage constraints include shortage of containers, lack of financial resources leading to broken and ill maintained bins; Lack of planning for waste storage depots or temporary storage locations and Inaccessible areas and narrow lanes that do not allow sufficient space for container. If such constraints are not addressed it will result in poor waste management and environmental/public nuisance.
542. Currently WSSCK is under capacity with respect to daily manual sweeping and waste collection on Sunday and public holiday resulting in poor waste collection and environmental nuisance.
543. There is lack of public/civic sense with respect to waste management at source, segregation of recyclables and waste collection system. Public don't practice responsible behavior and throw litter outside their premises in open streets, along roads, canals and other places which is resulting in operational constraints for WSSCK towards solid waste management.

#### ***Mitigation measures***

544. The following measures will be implemented to ensure that no traffic related issues take place due to the landfill operation:
  - Capacity of WSSCK will be increased through increase in its collection fleet. It will be done through procurement of both solid waste and non-solid waste carrying machinery under this project.
  - Door to Door collection of waste will be enhanced through media campaigns. Communication programs would be developed to encourage better management of waste. Proper PPEs will be provided to waste handlers. Key performance indicators will be developed to monitor improvements in the system.
  - All type of waste hauling will be carried out in purpose built vehicles to avoid scattering of waste at hauling routes. Drivers of waste carrying vehicles will be trained with respect to environmental sensitization. Drivers are allowed to commute only on designated routes through purpose built vehicles for waste hauling.
  - Multiple transactions of waste will be avoided through use of main and mobile transfer stations. Improved segregation practices will be introduced once door to door collection desired efficiency achieved. Necessary legal bindings with respect to waste storage by Public will be introduced.
  - A comprehensive traffic management plan (TMP) must be developed and implemented;
  - As part of the TMP, it will be ensured that the movement of heavy vehicles related to landfill operations is minimized during the peak traffic hours of the day in order to prevent congestion and accidents as far as possible;

- Furthermore, the movement of heavy vehicles within Kohat city related to landfill operations must be restricted to specific routes containing least number of sensitive receptors and low traffic volumes.
- Waste hauling through dirt tracks will be strictly prohibited. Waste hauling through mechanically unfit vehicles or noisy vehicles will not be allowed.
- Waste transporters will be directed to use designated routes and follow recommended speed limit for waste hauling and such routes will be metalled roads instead of dirt tracks.

#### **6.4.8 Wind Blown Litter**

##### ***Impacts***

545. One of many operational concerns in the management of a landfill is the control and management of litter. Litter includes blowing papers and other solid materials that may become airborne and carried by the wind away from the working face where solid waste is being deposited.
546. The control of litter is an integral part of the daily operations of the facility. The goal of the facility operations is to implement best management practices and have all blowing litter contained at the working face. However, due to the type of facility operation and waste materials received, total containment of litter at the working face may be difficult to achieve. The secondary goal of the facility is to strive to pick up all blowing litter that has escaped the working face at the end of each operating day.

##### ***Mitigation measures***

547. The facility operator, as necessary, will implement the following procedures and techniques to control litter:
- All trucks must be tarped upon entering and exiting the facility. They shall only untarp and tarp at the active area. This policy will be strictly enforced.
  - Daily waste entering the landfill site will be subject to immediate compaction to minimize the area and debris subject to the impacts of wind.
  - If possible, on windy days, the daily fill face tipper locations shall be selected for its protection to minimize effects of wind.
  - Waste that is more susceptible to windblown distribution may, on windy days, be worked immediately into the fill face and covered with a layer of daily cover, as needed, or the waste may be excluded from the site.
  - Portable skid-mounted litter fences may be provided for deployment downwind as close as practical to the working area, as needed.
  - Semi-permanent fencing may be provided around the fill area as an additional barrier to the migration of litter off-site when litter has not been contained by the portable litter

fences. (Examples of additional barriers include but not limited to, a four-foot minimum temporary construction fence and/or a ten-foot or higher semi-permanent fence.) The utilization will be continually evaluated and the fence will be relocated or added as needed.

- Permanent fencing (ten-foot high with an additional three-foot kicker) may be constructed with possibility of placement on an eight-foot high berm.
- On very windy days, when all other procedures are not successful in controlling blowing litter, the operator may apply cover material more frequently or immediately to the incoming waste load.
- Buffer zones resulting from required facility setbacks along the site's perimeter shall provide some protection of adjacent properties.
- As a final control measure, personnel will be dispatched, as needed or daily if conditions require, collecting any litter that has escaped the above control measures.
- Portable litter vacuums may be used to collect litter that has accumulated on litter fences. If fences are positioned properly, this can be a very efficient method of collecting litter.
- The main highway leading to the site will be routinely inspected for litter. If the highway has litter associated with the trucks entering the facility, then the litter will be picked up on a routine basis. All necessary safety precautions must be followed.
- Before and after photos of any litter removal effort may be taken in the event anyone questions the level of effort spent on litter collection.
- Site management's cell phone numbers may be provided to community/neighbors.
- The management of litter at the landfill is a daily activity. In most instances the above procedures and techniques shall properly manage litter effectively. However, there will be occasions and situations when litter will be distributed by the wind in such a manner that the above procedures will not totally manage the litter and contain the litter on-site. In these situations, the facility operator may not be able to collect all litter within the day the litter problem occurred. However, the facility operator shall proceed with collecting the litter off site and complete the retrieval of wind-blown litter at the earliest practicable time.

#### **6.4.9 Impacts on Scavengers/Waste Pickers**

##### ***Impacts***

548. Most of the existing waste pickers are under age children. The waste is brought to the store by local waste pickers who work on small scale. They sell out the waste to the bigger scrap stores in the locality. Amount of income generated from waste collection is linked to the quantity of waste collected. Small waste pickers earn an amount of only PKR 300-500 daily and they collect recyclable waste upto 5-10 kg. Small scrap dealers who buy recyclable waste from waste pickers upto 25-30 kg usually earn PKR 6000- 7000/day.

Medium size scrap dealers with waste collection of 70-100 kg usually earn 10,000-15,000 on daily basis. After execution of ISWM project, scavenging business will be impacted, resulting in loss of income of small waste pickers.

549. Furthermore, existing scavenging practices are not formalized and/or regulated. Facilitation in the form of better streamlined movement of waste within this informal system is missing and is not well integrated within the ISWM system. There shall be some form of government formalization, management or oversight in order to better take care of the operation and all the operators involved, regardless of their position or significance in the system chain.

#### ***Mitigation measures***

- WSSCK will carry out assessment of scavenging business in their respective city to identify waste picker and scrap dealers which will be impacted.
- WSSCK will provide resources and tools to efficiently collect and sort out the waste onsite, as these waste pickers are the first one to deal with the waste.
- WSSCK will train these waste pickers to optimize their waste collection process.
- WSSCK will hire waste pickers at MRF facility that will be established at landfill site.
- WSSCK will hire services of scrap dealers for waste collection and transportation to landfill site on need basis.
- WSSCK will prepare communication strategy and will run community-based operation to integrated SWM operations including waste pickers and scrap dealers.
- PMU KPCIP will prepare guidelines to involve scavengers/waste pickers in IWMS through formalization and regulations of their business. These guidelines will be adopted by WSSCK to encourage involvement of scavengers and waste pickers working at all levels regardless of their position in present system chain.

#### **6.4.10 Inefficient management and disposal of septage from administration building toilets**

##### **Impacts**

550. The sewage generated from the toilets of the administration building at the SWMF, if not managed through proper collection and disposal, could lead to contamination of ground water along with a public health nuisance on the site.

##### **Mitigation measures**

551. The following measures will be implemented:

- Regular desludging and proper treatment of the septage will be conducted on a regular basis.

#### **6.4.11 Improved management of solid waste & health and sanitation**

##### ***Impacts***

- 552. The landfill development will greatly improve solid waste management system in Kohat city and the project area and improve overall aesthetic value and quality of urban area of Kohat city.
- 553. Community development programs that may be undertaken, including health and hygiene education, reduction, reuse and recycling of solid waste, skill training of low income people would be of great benefit to local community. The magnitude of the impact shall be high, local, long term and impact is very significant.

##### ***Mitigation measures***

No measures required.

#### **6.4.12 Improvements in Public Health**

##### ***Impacts***

- 554. The operation of the proposed landfill will result in solid waste management in integrated way resulting in fixing issues like odor, vector born diseases from open dumped waste, poor sanitation and ground water contamination in the area.
- 555. The operation of the proposed landfill will limit risk of vector spread, fire and explosion of dump site gas.
- 556. It will result in an overall positive impact on the public health by preventing issues such as infectious diseases, disease vector generation, groundwater aquifer contamination etc.
- 557. Successful operation of Kohat landfill site will limit the child scavenging activity who are directly at risk as they are not using any PPEs.
- 558. Further, it will provide promising opportunities to people involved in scavenging activity in terms of jobs and other economic incentives to accelerate recycling potential at the facility.

##### ***Mitigation measures***

No measures required.

#### **6.4.13 Improvements in Aesthetic Aspects**

##### ***Impacts***

- 559. Open dumping of solid waste creates poor aesthetics in the project area. However, landfill site shall be walled and the aesthetic impacts will be far less as compared to open dumping. However, due to the movement of the waste truck on the streets will create a little aesthetic nuisance.

***Mitigation measures***

- The boundary walls shall be constructed alongside the facility.
- The indigenous plants shall be planted alongside the access road and around the landfill site which will act as buffer zone.
- The waste transfer vehicles shall be covered.
- Reasonable area will be allocated for plantation within and at boundary of facility to improve aesthetic appeal of the area.
- Plantation will start as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds mobilized, plantation activity can be started in collaboration with Kohat Development Authority or WSSCK can outsource the activity separately.

## **6.5 Closure and Post Closure Impacts**

***Impacts***

560. Even after closure, landfills required long-term care, including maintenance of the cap system, collection and treatment of leachate, collection and flaring or utilization of landfill gas, and monitoring of groundwater so that the waste remains isolated.
561. Impacts associated with closure and post closure phase of the SWMF include poor aesthetics of the area, runoff issues, leachate/odors issues, uncontrolled gases and long term environmental nuisance. There is need of routine inspection of the facility infrastructure particularly landfill cells and gas/leachate collection system to avoid and monitor any contamination released to environment. The need to manage leachate and gas continues after landfill closure, which shall be an integral component of the total landfill management together with restoration and surveillance.
562. As moisture enters the landfill through an ineffectively maintained cover after the landfill has been closed, leachate will also again be generated. If the leachate collection and removal system is no longer functioning to collect and remove from the landfill all the leachate generated, and/or the landfill operator is no longer operating/maintaining the such system, the leachate will accumulate in the landfill, leading to increased potential for leachate to penetrate through the liner and potentially begin to pollute groundwaters.

***Mitigation measures***

563. The following measures will be implemented:
  - Appropriate selection of soil type for final cover will be ensured to prevent water infiltration and minimize infiltration of precipitation into the waste and the subsequent generation of leachate; control landfill gas migration; and minimize long term maintenance needs.

- Appropriate selection of soil type for final cover will be ensured to prevent direct or indirect contact of living organisms with the waste materials and their constituents;
- Application of final cover components that are consistent with post closure use and local climatic conditions.
- Necessary environmental objectives and controls (including technical specifications) will be defined and implemented.
- Necessary surveillance protocols for final capping, leachate and gas monitoring will be established and implemented.
- Future Land use of the site will be defined in consultation with local communities and government agencies.
- It will be ensured that financial resources, and monitoring arrangements are in place for closure and post closure activities.
- PMU KP LGE&RDD will ensure that financial instruments are in place to cover the costs of closure and post-closure care and monitoring.
- Long term integrity and security of the site will be maintained.

## **6.6 Cumulative Impacts**

564. Based on the scoping exercise of the site and based on discussions with the public sector agencies responsible for development in the project area, no other infrastructure works are planned to be conducted in the landfill project area while these project works shall be conducted. Thus, no cumulative impacts are expected.

## **6.7 Indirect and Induced Impacts**

565. The potential impact of development of the landfill in the project area has been examined, which indicated that the existing and planned infrastructure such as water supply, wastewater collection and treatment, municipal solid waste collection and disposal would be adequate to accommodate any potential population intake as a result of the proposed landfill development. Impacts on the environment from air emissions, traffic and community noise have also been assessed and have found to be acceptable and within the carrying capacities of the environmental media.
566. Thus, negative indirect and induced impacts from the proposed landfill works are not expected.

## 7 Environmental Management Plan & Institutional Requirements

### 7.1 Introduction

567. The IEE has identified potential impacts that are likely to arise during development of Kohat SWMF in detail, both negative and positive impacts at each stage of the project. To minimize the effects of adverse impacts the IEE has recommended mitigation measures in the EMP. The proposed mitigation measures have been based on the understanding of the sensitivity and behaviour of environmental receptors in the project area, the legislative controls that apply to the project and a review of good industry practices for projects of similar nature. For residual impacts (impacts remaining after applying the recommended mitigation measures) and for impacts in which there can be a level of uncertainty in prediction at the IEE stage, monitoring measures have been recommended to ascertain these impacts during the course of the project activities.
568. The Environmental Management Plan (EMP) is developed to eliminate and/or mitigate the impacts envisaged at the design, construction and operation stages.
569. The detailed EMP provided in this document as **Table 7.1** ensures that development of Kohat SWMF has no detrimental effect on the surrounding environment. The Plan shall act as a guideline for incorporating environmental measures to be carried out by the contractors engaged for the proposed project. It shall also be used for other parties concerned for mitigating possible impacts associated with each project and will form part of the Contract documents to be considered alongside the specifications. This Plan shall act as the Environmental Management and Monitoring Plan during the construction and operation phase of the project and will allow for prompt implementation of effective corrective measures.

### 7.2 Environmental Management Plan (EMP)

570. The EMP attached with this report ensures the following:
- Delivery of the prescribed environmental outcomes during all phases of this sub-project;
  - Formulating a system for compliance with applicable legislative requirements and obligations and commitments for this sub-project;
  - Ensure that project design process incorporates best practice environmental design and sustainability principles to minimize potential impacts of construction on the environment and community.
  - Ensure that the construction work procedures minimize potential impacts on the environment and community.
  - Develop, implement and monitor measures that minimize pollution and optimize resource use.

### 7.3 Objectives of EMP

571. The EMP provides a delivery mechanism to address potential impacts of the project activities, to enhance project benefits and to outline standardized good practice to be adopted for all project works. The EMP has been prepared with the objectives of:
- Defining the roles and responsibilities of the project proponent for the implementation of EMP and identifying areas where these roles and responsibilities can be shared with other parties involved in the execution and monitoring of the project;
  - Outlining mitigation measures required for avoiding or minimizing potential negative impacts assessed by environmental study;
  - Developing a monitoring mechanism and identifying requisite monitoring parameters to confirm effectiveness of the mitigation measures recommended in the study;
  - Defining the requirements for communication, documentation, training, monitoring, management and implementation of the mitigation measures.

### 7.4 Environmental Management/Monitoring and Reporting

572. During the construction phase, the overall responsibility for the implementation and monitoring of the EMP rests with the Project Director (PD), Project Management Unit (PMU), KP LGERDD. The PD at the PMU, using the Construction Supervision Consultant (CSC), will supervise the implementation of the proposed mitigation measures and monitor the implementation progress in the field.
573. During the operation phase, the overall responsibility for the implementation and monitoring of the EMP rests with CEO WSSCK. For initial two years of LFS operation, relevant Contractor will be responsible for running of relevant plant (e.g AD composting vendor, MRF Vendor, Lechate treatment plant vendor etc.) and also responsible for implementation of EMP. This requirement will be reflected in the bidding document of such Contractors/Suppliers. Furthermore, these Contractors will train designated staff of WSSCK with respect to technical matters as well as EMP requirements.
574. The specific roles and responsibilities for environmental management and monitoring are provided in **Table 7.1** below. The expected costs for implementing any required mitigation measures are provided in **Table 7.7** below.

#### 7.4.1 Inclusion of EMP in Contract documents

575. In order to make Contractors fully aware and responsible of the implications of the EMP and to ensure compliance, it is recommended that mitigation measures be treated separately in the tender documentation and that payment milestones shall be linked to performance, measured by execution of the prescribed mitigation measures. Such a procedure would help ensure adequate management of project impacts is carried out during the construction and operation phases, where a consistent approach will be expected on behalf of the Contractor and its sub-contractors so that data and information collected from monitoring programs is comparable with baseline monitoring data.

576. The Contractor shall be made accountable through contract documents and/or other agreements for fulfilling the environmental safeguard obligations and delivering on the environmental safeguard components of the Project. Contractors shall be prepared to co-operate with the executing agency and supervising consultants and local population for the mitigation of adverse impacts. After the EMP's inclusion in the contract documents, the Contractor will be bound to implement the EMP and will engage appropriately trained environmental and social management staff to ensure the implementation and effectiveness of the mitigation measures.
577. The Contractor is required to bid for executing the EMP, including the recommended mitigation measures and monitoring programs, as part of its Bill of Quantities (BoQ).

## **7.5 Institutional Arrangements**

578. The environmental management plan will require involvement of the following organizations for its implementation during construction and operation phases of the project:

### **7.5.1 Role of PMU, KP LGE & RDD**

579. The PMU will:
  - Provide support to ADB missions;
  - Coordinate activities with all stakeholders, review consultants, proposals, and provide overall guidance during various stages of project preparation;
  - Manage and ensure safeguard due diligence and disclosure requirements including resettlement and environmental safeguards in accordance with ADB's Safeguard Policy Statement (2009) and KP government requirements;
  - Manage and ensure effective implementation of the gender action plan;
  - Ensure submission of all IEE requirements as per law by responsible entities; and
  - Monitoring of activities of the entire project.

### **7.5.2 Role of the ADB**

580. The ADB will:
  - Support the coordination and administration of the project;
  - Provide guidance to PMU and WSSCK on implementation issues and project design;
  - Disclose all safeguards documents, and monitor safeguards implementation;
  - Monitor and report project performance;
  - Conduct periodic review of the project;

### **7.5.3 Role of Construction Supervision Consultant (CSC)**

581. The CSC will be responsible for the following items:

- Incorporates into the project design the environmental protection and mitigation measures identified in the EMP for the design stage;
- Assists PMU to ensure that all environmental requirements and mitigation measures from the IEE and EMP are incorporated in the bidding and contracts documents
- Prior to construction, reviews the updated SSEMPs prepared by the contractor.
- Undertakes environmental management capacity building activities for relevant project focal staff.

### **7.5.4 Role of KP EPA**

582. The KP EPA will have the following responsibilities with regards to this SWMF project:

- Provides regulatory compliance works for the project.
- Reviews and approves environmental assessment report of SWMF, submitted by PMU.
- Issues environmental clearance certification for the Project based on their mandate and regulations.
- Undertakes monitoring of the project's environmental performance based on their mandate.

### **7.5.5 Role of Project Contractor**

583. The project contractor will be responsible for following items:

- Implementation of, or adherence to, all provisions of the IEE and EMP;
- Preparation of site specific EMPs (SSEMPs) as required. SSEMPs will be prepared by Contractor's Environment Specialist, site incharge, HSE staff and project technical team before their mobilization and it will be submitted to Engineer of construction supervision consultant/PMU for review and approval.
- Contractor's environmental performance will rest with the person holding the highest management position within the contractor's organization. Reporting to their management, the contractor's site managers will be responsible for the effective implementation of the EMP.
- The Contractor will be required to have qualified Environmental Specialists in their team to ensure all mitigation measures are implemented during the different development phases of the project.

### 7.5.6 Role of WSSCK

584. The WSSCK will be responsible for following items:

- Implementation of, or adherence to, all provisions of the IEE and EMP
- Preparation of site specific EMPS for operations phase
- WSSCK would be responsible to ensure that contractors engaged during operation phase of landfill site are executing activities in compliance to IEE/EMP.
- WSSCK will be required to have qualified Environmental Specialist designated for LFS to ensure all mitigation measures are implemented in true letter and spirit.
- WSSCK will design and drive behavior change campaigns to increase public participation and cooperation. Public cooperation will be extended through incentives and penalties to the public.
- WSSCK will plan customer feedback surveys in order to ensure sustainable service delivery and to remove gaps in the system.

### 7.5.7 Role of Third Party Monitor

585. The Third party monitor will be responsible for following items:

- Monitoring and reporting of all provisions of the IEE and EMP.
- Periodic environmental monitoring during opration phase.
- Reporting of environmental non-complaices to project stakeholders including ADB, PMU, WSSCK and Supervision consultants.
- Suggest corrective actions for close out of EMP non compliances.
- Train the contractors and project stakeholder toward EMP implementation.

## 7.6 Monitoring Parameters

586. A monitoring plan for the construction phase of the project, indicating environmental parameters, frequency and applicable standards is provided below as **Table 7.3** below.
587. During the procurement/pre-construction period, the monitoring activities will focus on (i) checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and (ii) checking that the contract documents' references to environmental mitigation measures requirements have been incorporated as part of contractor's assignment and making sure that any advance works are carried out in good time.

588. During the construction period, the monitoring activities will focus on ensuring that any required environmental mitigation measures are implemented to address possible impacts.
589. In general, the construction impacts will be manageable, and no insurmountable impacts are predicted, provided that the EMP is implemented to its full extent as required in the Contract documents. However, experience suggests that some Contractors may not be familiar with this approach or may be reluctant to carry out some measures. For the proposed project, in order that the Contractor is fully aware of the implications of the EMP and to ensure compliance, environmental measures must be costed separately in the tender documentation and listed as BoQ items, and that payment milestones must be linked to environmental performance, vis a vis the carrying out of the EMP.
590. The effective implementation of the EMP will be audited as part of the loan conditions by ADB, and as part of regulatory/NOC compliance by KP EPA. In this regard, the PMU/PMC will guide the design engineers and Contractors on the environmental aspects and necessary EMP documentation. Monitoring during operation phase will be carried out by WSSCK throughwith support from PMU.

## 7.7 Environmental Training

### 7.7.1 Capacity Building and Training

591. Capacity building and training programs are necessary for the project staff in order to control the negative impacts resulting from the project construction and during its operation phase. They will also require trainings on monitoring and inspecting of such a project for environmental impacts and for implementation of mitigation measures.
592. The details of this capacity building and training program are presented in the **Table 7.10** below.

**Table 7.1: Environmental Management Plan**

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
<b>Design/Pre-Construction Phase</b>	1.1	Improper designing of landfill site leading to various impacts (leachate leakage causing groundwater contamination, landfill gas leakage etc.)	<ul style="list-style-type: none"> <li>▪ Landfill has been designed in accordance with international standards and guidelines for landfill development, including but not limited to the IFC Guidelines on Waste Management Facilities for Landfills.</li> <li>▪ Consideration shall be given to the stability of the sub-grade, the base liner system, the waste mass and the capping system. The sub-grade and the base liner will be sufficiently stable to prevent excessive settlement or slippage.</li> <li>▪ Bottom and cap lining system for each landfill cell must be designed for the protection of soil, groundwater and surface runoff.</li> </ul>	EDCM	PMU	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ An efficient leachate collection system must be provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum.</li> <li>▪ The accumulation and migration of gases from landfill facility must be controlled. Landfill gas will be collected through installation of perforated pipes within the cells.</li> <li>▪ Consideration will be given to the visual appearance of the landfill site during operation and at termination of landfill site and its impact on the surrounding landforms. Necessary plantation will be carried out which will act as buffer zone from surrounding environment. Reasonable</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>area has been allocated for plantation within and at boundary of facility to improve landscape of the area.</p> <ul style="list-style-type: none"> <li>▪ Daily cover will be provided at end of each day to avoid risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill.</li> <li>▪ One groundwater monitoring well will be maintained out of the drills made for geotechnical investigation. However, more wells may be constructed if required once the landfill starts operations.</li> <li>▪ To incorporate advancement in technology and changes, a periodic review of the design will be carried out, as the lifespan of a disposal site from commencement to</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			completion is long compared to other construction projects.			
1.2		Improper selection of landfill site due to non-compliance with IFC guidelines for Landfills	<ul style="list-style-type: none"> <li>▪ Site selection for the proposed landfill site must be conducted in accordance with international standards and guidelines for landfill development, including but not limited to the IFC Guidelines on Waste Management Facilities for Landfills.</li> <li>▪ Factors such as site capacity, accessibility, acceptability, stability, environmental sensitivity, landuse, socio-economic receptors and climate hazards shall be assessed and evaluated at the time of site selection</li> <li>▪ Proposed selection of landfill</li> </ul>	EDCM	PMU	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			site must take into account impacts from leachate, litter, dust, vector and odors on surrounding environment.			
1.3	Lack of Integration of IEE/EMP requirements into bidding documents		<ul style="list-style-type: none"> <li>▪ The proposed 'Safeguards unit' that will be developed at the PMU will be assigned the task to check that design and bid documents are responsive to key environmental, social and safety considerations, and that the proposed method of work reflects the boundaries defined in the EMP. The bid documents must include the EMP and its implementation cost must be reflected in the BoQ.</li> <li>▪ IEE/EMP implementation and monitoring requirements must be part of bidding documents and</li> </ul>	PMU	-	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>necessary contractual binding must be agreed by project contractors before award of contract.</p> <ul style="list-style-type: none"> <li>▪ Project contractors shall have qualified and experienced environmental staff to plan, arrange, implement, monitor and report IEE/EMP requirements.</li> </ul>			
1.4	Material Haul routes		<ul style="list-style-type: none"> <li>▪ The construction vehicles hauling materials along the Kohat city roads and anywhere where there are sensitive receptors such as hospitals, schools and/or roadside residences will be limited and the PMU in collaboration with the focal agencies will establish a route plan to minimize this disruption which shall be</li> </ul>	EDCM	PMU	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>appended to the EMP.</p> <ul style="list-style-type: none"> <li>▪ Vehicles to be used will be of good quality and well maintained and will meet the national emission standards for vehicles.</li> <li>▪ Idling of vehicles along the route will be limited to 3-5 minutes.</li> </ul>			
1.5		Improper location of worker camps and ancillary facilities	<ul style="list-style-type: none"> <li>▪ In order to prevent a nuisance, specific locations shall be designated for development of the labor camps. All necessary facilities and amenities shall be provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc.</li> <li>▪ The use of proper planning while identifying locations for the labor camps will</li> </ul>	EDCM	PMU	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labor camps being set up roadside next to the construction sites.			
	1.6	Inadequate Contractor's Environmental Safeguards Capacity	<ul style="list-style-type: none"> <li>▪ PMU KP LGERDD shall review the contractor capacity with respect to safeguard management and contracts shall be awarded accordingly.</li> <li>▪ The Contractor will be required to define an Occupational and Environmental Health and Safety procedure for all work, including work camp operation, management of cement dust, and use of Personal Safety Equipment. These procedures shall be developed and approved by</li> </ul>	PMU	-	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>the PMU in collaboration with the focal agencies before the Contractor commences any physical works on ground.</p> <ul style="list-style-type: none"> <li>▪ PMU KP LGERDD shall ensure the project contractors are selected on merit and necessary funds has been allocated in the contract documents for EMP implementation and monitoring.</li> </ul>			
	1.7	Land Acquisition and Resettlement	<p>The PMU KP LGERDD shall ensure the following:</p> <ul style="list-style-type: none"> <li>▪ Pending payment to all land owners must be paid before mobilization of construction contractors.</li> <li>▪ Social safeguard unit shall ensure that project affected people has been paid following appropriate</li> </ul>	PMU		BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>procedures and there are no grievances about land acquisition process.</p> <ul style="list-style-type: none"> <li>▪ Accelerating the pending resettlement process in collaborataiton with DC Kohat and WSSCK.</li> </ul>			
	1.8	Impacts due to Natural Hazards	<ul style="list-style-type: none"> <li>▪ Kohat SWMF infrastructure shall be designed keeping in view the seismic zone 2 B building considerations.</li> <li>▪ Surface water diversion shall be included in the design to protect landfill from urban/flash flooding.</li> <li>▪ Extreme precipitation events analysis shall be performed for landfill life i.e. 25 years to predict and manage impacts of flash flooding.</li> <li>▪ Infrastructure built by the project will be designed to</li> </ul>	EDCM	PMU	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>withstand high speed winds.</p> <ul style="list-style-type: none"> <li>▪ On site waste storage at loading bay shall be kept to minimum during high precipitation events.</li> <li>▪ Emergency response plan shall be prepared by construction and operation phase Contractors and will be submitted to PMU for approval to manage impacts of natural hazards such as earth quakes and floods.</li> </ul>			
<b>Construction Phase</b>	2.1	Construction of landfill not in accordance with finalized design	<ul style="list-style-type: none"> <li>▪ Method statements must be prepared by the Contractor and approved by the Construction Supervision Consultant (CSC) prior to commencement of construction works;</li> <li>▪ The CSC must closely monitor the construction works being conducted by the Contractor</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
<b>Construction Phase (Continued...)</b>			<p>to ensure the finalized design is implemented in full and the landfill design is developed completely in compliance of the approved finalized designs.</p> <ul style="list-style-type: none"> <li>▪ Any deviation by the Contractor from following the finalized design must be immediately highlighted and corrective measures must be implemented to ensure full compliance with the finalized design of the landfill.</li> <li>▪ PMU KP LGERDD shall ensure that construction activities are being carried out in compliance to project design following best international practices. It will closely review and monitor the activities of CSC and contractors involved in</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
Construction Phase (Continued...)			construction activities.			
	2.2	Degradation of air quality due to construction works	<ul style="list-style-type: none"> <li>▪ At the landfill site and the immediately adjoining areas, water will be sprinkled every three hours and at a higher frequency if felt necessary, at all construction sites to suppress dust emissions.</li> <li>▪ All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations.</li> <li>▪ Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions.</li> <li>▪ Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions.</li> <li>▪ Vehicles transporting soil, sand and other construction</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>materials shall be covered with tarpaulin.</p> <ul style="list-style-type: none"> <li>▪ Limitations to speeds of such vehicles as felt necessary. Transport through densely populated area shall be avoided.</li> <li>▪ Concrete plants to be controlled in line with statutory requirements and shall not be close to sensitive receptors.</li> <li>▪ Stack height of generators will be at least 3 meters above the ground.</li> <li>▪ Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed roads within project area.</li> <li>▪ A minimum distance of 300 meters will be ensured between batching plant(s) and the nearest community.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles shall not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (&gt;25m<sup>3</sup>) of crushed materials are necessary, they shall be enclosed with side barriers and also covered when not in use.</li> <li>▪ Dust emissions due to road travel shall be minimized through good construction practices (such as keeping stock piles down wind and away from communities) and</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>sprinkling water over the access road.</p> <ul style="list-style-type: none"> <li>▪ Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects. .</li> <li>▪ Developing and implementing work practices to minimize release of contaminants into the work environment including: <ul style="list-style-type: none"> <li>○ Direct piping of liquid and gaseous materials</li> <li>○ Minimized handling of dry powdered materials;</li> </ul> </li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>Enclosed operations</p> <ul style="list-style-type: none"> <li>○ Local exhaust ventilation at emission/release points</li> <li>○ Vacuum transfer of dry material rather than mechanical or pneumatic conveyance</li> <li>○ Indoor secure storage, and sealed containers rather than loose storage</li> <li>▪ Where ambient air contains several materials that have similar effects on the same body organs (additive effects).</li> </ul> <p><b>Vehicular &amp; Equipment Emissions</b></p> <p>It shall be ensured that the following measures are taken to control emissions from vehicles being used in the construction activity:</p> <ul style="list-style-type: none"> <li>▪ Periodically check and conduct maintenance of the construction machinery and haul vehicles. Generators,</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>compressors and vehicles used during construction works will be maintained in a good condition to ensure that emissions are kept to a minimum level.</p> <ul style="list-style-type: none"> <li>▪ Regularly change the engine oil and use new engines/machinery/equipment having good efficiency and fuel burning characteristics.</li> <li>▪ Controlled technology generator and batching plants will be used to avoid excessive emissions.</li> <li>▪ Burning of wastes at any site will not be allowed.</li> <li>▪ The stack height of generators will be at least 3 meters above the ground.</li> <li>▪ Training of the technicians and operators of the</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>construction machinery and drivers of the vehicles.</p> <ul style="list-style-type: none"> <li>▪ Idling of vehicles on the site will be limited to 3-5 minutes.</li> <li>▪ All type of machinery and generator must comply with the NEQS. Vehicles, which are not in compliance with NEQS are not allowed to use.</li> <li>▪ Periodic emission monitoring of vehicles, generator and batching plants is proposed.</li> <li>▪ Project activities shall be planned to avoid harsh weather conditions.</li> </ul>			
	2.3	Potential accidents and injuries to communities in project area during construction works	<ul style="list-style-type: none"> <li>▪ Work areas outside the project site, especially where machinery is involved, will be barricaded and will be constantly monitored to ensure that local residents, particularly children stay away</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>while excavated areas being prepared for landfill related infrastructure will also be cordoned off. Also, no machinery will be left unattended, particularly in running condition.</p> <ul style="list-style-type: none"> <li>▪ Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children.</li> <li>▪ Speed limit of 20 km/hr will be maintained by all project related vehicles and nighttime driving of project vehicles will be limited where possible.</li> <li>▪ Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Contractor must take proper safety measures (placing warning tapes around excavations) to avoid people, especially children, accidentally falling into excavations.</li> <li>▪ All the working platforms must be cordon off with special care by well-trained skilled workers.</li> <li>▪ Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area.</li> <li>▪ PMU KP LGERDD shall ensure the contractor staff working in the the project are well trained and educated in the Health, Safety and Environment (HSE) hazards</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			associated with their duties, and that of the public, in the project area.			
2.4	Injuries to workers from lack of necessary training and/or not using PPEs etc.	<b>General</b>  The Contractor will be required to prepare and implement an effective OHS Plan that is supported by trained first aid personnel and emergency response facilities. Construction contracts will include standard OHS measures and contractors will be bound to implement these fully.  Monitoring will be required to ensure that the OHS plan based on contract specifications is followed. <ul style="list-style-type: none"><li>▪ Cement feed hopper areas will be inspected daily to ensure compliance with the requirement of dust masks.</li><li>▪ Surfaces (including flooring and work surfaces) in camps, kitchens, dining areas and workshops shall be solid and easy to clean. Flooring for</li></ul>	Contractors	CSC, PMU	DC	

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>work camps must be float finished concrete or better.</p> <ul style="list-style-type: none"> <li>▪ All drivers engaged by Contractors must hold a valid license for the vehicle they are operating.</li> <li>▪ Work in confined space shall be executed with available safety standards. Adequate monitoring and equipment shall be available to detect deficient oxygen levels.</li> <li>▪ The Contractor shall submit to the Engineer of CSC for approval an emergency evacuation plan and practice the procedure annually.</li> <li>▪ The Contractor shall submit to the Engineer of CSC for approval a site layout plan, identifying work areas, accommodation, kitchen, dining area, sanitary facilities,</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>location of generators, plant and vehicle parking, transport routes through the camp, pedestrian routes through the camp, evacuation routes, emergency exits, batching plants, storage areas, waste facilities etc.</p> <ul style="list-style-type: none"> <li>▪ Fire extinguishers shall be provided throughout camps and work sites. Fire extinguishers shall be inspected monthly and maintained as necessary.</li> <li>▪ An adequate and reliable supply of safe drinking water shall be made available at readily accessible and suitable places including at all camps.</li> <li>▪ The Contractor shall take samples from each supply of drinking water and arrange for analysis of these samples at</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>EPA certified laboratory prior to its use by the Contractor's staff. The results of these tests for each supply must be submitted to the Engineer of CSC and must demonstrate that each water supply meets national and World Health Organisation standards for drinking water.</p> <ul style="list-style-type: none"> <li>▪ The Contractor shall provide and maintain adequate hygienic kitchens which are sheltered and separated from the living quarters. Kitchens shall include raised and washable surfaces suitable for food preparation.</li> <li>▪ The Contractor shall provide and maintain adequate hygienic dining areas for staff. Work places and camps shall be provided with both natural &amp;</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>artificial light. Artificial lighting shall be powered by generator in the event of power cuts.</p> <ul style="list-style-type: none"> <li>▪ Public sensitization training shall be provided to workers to avoid social conflicts between residents and the construction contractor, Occurrence of any such impacts can be avoided by community sensitive project planning and implementation and through effective involvement of local administration.</li> <li>▪ All HSE protocols shall be implemented in true letter and spirit.</li> <li>▪ Contractor must appoint an HSE resource to implement, monitor and report the HSE management plan to concerned authorities.</li> <li>▪ Contractor must ensure the</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>provision of first aid facility at construction site and camps through hiring medics and establishing a dispensary at the campsite.</p> <ul style="list-style-type: none"> <li>▪ Reasonable number of first aid kits shall be available on construction sites and within contractor camps.</li> </ul> <p>Based on the type of hazard applicable during the proposed works at site, the following mitigation measures as per IFC guidelines for Occupational Health and Safety (OH&amp;S) must be implemented:<sup>20</sup></p> <p><b><u>Mitigation Measures for Physical Hazards</u></b></p> <p><b><i>Rotating and Moving Equipment</i></b></p> <ul style="list-style-type: none"> <li>▪ Designing machines to eliminate trap hazards and ensuring that extremities are</li> </ul>			

<sup>20</sup> <https://www.ifc.org/wps/wcm/connect/1d19c1ab-3ef8-42d4-bd6b-cb79648af3fe/2%2BOccational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES&CVID=ls62x8l>

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>kept out of harm's way under normal operating conditions.</p> <ul style="list-style-type: none"> <li>▪ Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment shall be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards shall be designed and installed in conformance with appropriate machine safety standards.</li> <li>▪ Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>components) during servicing or maintenance.</p> <ul style="list-style-type: none"> <li>▪ Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms.</li> </ul> <p><b><i>Vibration</i></b></p> <p>Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, shall be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and action values. Exposure levels shall be checked on the basis of daily exposure time and data provided by equipment manufacturers.</p> <p><b><i>Electrical</i></b></p> <ul style="list-style-type: none"> <li>▪ Marking all energized</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>electrical devices and lines with warning signs;</p> <ul style="list-style-type: none"> <li>▪ Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance;</li> <li>▪ Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools; .</li> <li>▪ Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits; .</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas; ·</li> <li>▪ Conducting detailed examination and marking of all buried electrical wiring prior to any excavation work.</li> <li>▪ Appropriate labeling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited; ·</li> </ul> <p><b><i>Eye Hazards</i></b></p> <ul style="list-style-type: none"> <li>▪ Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full-face shield. Specific Safe Operating Procedures</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>(SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals.</p> <p>Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding shall conform to standards published by organizations such as CSA, ANSI and ISO.</p> <p><b><i>Welding/Hot Work</i></b></p> <ul style="list-style-type: none"> <li>▪ Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations.</li> <li>Additional methods may include the use of welding barrier screens around the</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required.</p> <ul style="list-style-type: none"> <li>▪ Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) shall be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>that have contained flammable materials.</p> <p><b><i>Industrial Vehicle Driving and Site Traffic</i></b></p> <ul style="list-style-type: none"> <li>▪ Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits.</li> <li>▪ Ensuring drivers undergo medical surveillance.</li> <li>▪ Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms.</li> <li>▪ Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks)</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>in down position), and control of traffic patterns or direction.</p> <ul style="list-style-type: none"> <li>▪ Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate.</li> </ul> <p><b><i>Ergonomics, Repetitive Motion, Manual Handling</i></b></p> <ul style="list-style-type: none"> <li>▪ Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind.</li> <li>▪ Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds.</li> <li>▪ Selecting and designing tools that reduce force requirements and holding</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>times and improve postures.</p> <ul style="list-style-type: none"> <li>▪ Providing user adjustable workstations.</li> <li>▪ Incorporating rest and stretch breaks into work processes and conducting job rotation.</li> <li>▪ Implementing quality control and maintenance programs that reduce unnecessary forces and exertions.</li> <li>▪ Taking into consideration additional special conditions such as left-handed persons.</li> </ul> <p><b>Working at Heights</b></p> <ul style="list-style-type: none"> <li>▪ Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area.</li> <li>▪ Proper use of ladders and scaffolds by trained employees.</li> <li>▪ Use of fall prevention devices, including safety belt and</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines. .</p> <ul style="list-style-type: none"> <li>▪ Appropriate training in use, serviceability, and integrity of the necessary PPE. .</li> <li>▪ Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall.</li> </ul> <p><b><i>Fire and Explosions</i></b></p> <ul style="list-style-type: none"> <li>▪ Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area shall be:</li> <li>▪ Remote from entry and</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>exit points into camps</p> <ul style="list-style-type: none"> <li>▪ Away from facility ventilation intakes or vents</li> <li>▪ Have natural or passive floor and ceiling level ventilation and explosion venting</li> <li>▪ Use spark-proof fixtures</li> <li>▪ Be equipped with fire extinguishing devices and self closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time.</li> <li>▪ Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment). .</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Providing specific worker training in handling of flammable materials, and in fire prevention or suppression.</li> </ul> <p><b><i>Corrosive, oxidizing, and reactive chemicals</i></b></p> <ul style="list-style-type: none"> <li>▪ Corrosive, oxidizing and reactive chemicals shall be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills. .</li> <li>▪ Workers who are required to handle corrosive, oxidizing, or reactive chemicals shall be provided with specialized</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc). .</p> <ul style="list-style-type: none"> <li>▪ Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid shall be ensured at all times. Appropriately equipped first-aid stations shall be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers shall be provided close to all workstations where the recommended first-aid response is immediate flushing with water.</li> </ul> <p><b><u>Mitigations for Biological Hazards</u></b></p> <ul style="list-style-type: none"> <li>▪ The Contractor shall review and assess known and suspected presence of biological agents at the place</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>of work and implement appropriate safety measures, monitoring, training, and training verification programs.</p> <ul style="list-style-type: none"> <li>▪ Project contractor must provide good working and sanitation conditions at camp and work sites. Disease surveillance shall be carried out to identify any exposure to parasites, such as hookworm, ascaris, and various mites, chiggers, ticks and dengue.</li> <li>▪ Measures to eliminate and control hazards from known and suspected biological agents at the place of work shall be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
	2.5	High noise levels from construction activities	<ul style="list-style-type: none"> <li>▪ Equipment noise will be reduced at source by proper design, maintenance and repair of construction machinery and equipment.</li> <li>▪ Noise from vehicles and power generators will be minimized by use of proper silencers and mufflers.</li> <li>▪ Excessive noise emitting equipment will not be allowed to operate and will be replaced.</li> <li>▪ Blowing of horns will be prohibited on access roads to work sites.</li> <li>▪ As a rule, the operation of heavy equipment shall be conducted in daylight hours.</li> <li>▪ Construction equipment, which generates excessive noise, shall be enclosed or</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>fitted with effective silencing apparatus to minimize noise.</p> <ul style="list-style-type: none"> <li>▪ Well-maintained haulage trucks will be used with speed controls.</li> <li>▪ Use of ear plug and ear muffs must be ensured during construction. No employee shall be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear shall be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).</li> <li>▪ Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
2.6	Improper handling and/or disposal of hazardous and non-hazardous waste		engineering controls shall be investigated and implemented, where feasible.	Contractors	CSC, PMU	DC
			<ul style="list-style-type: none"> <li>▪ Periodic medical hearing checks shall be performed on workers exposed to high noise levels.</li> <li>▪ All the equipment and machinery used during construction phase shall be well maintained and in compliance with NEQS.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>area with secondary containment.</p> <ul style="list-style-type: none"> <li>▪ Licensed waste contractors will be engaged to dispose off all non-hazardous waste material that cannot be recycled or reused.</li> <li>▪ Excavated material from landfill cells will be stored at site and it will be used as daily cover within landfill cells.</li> <li>▪ All types of combustible and non-combustible waste including plastic or glass bottles and cans will be temporarily stored on site and later sold/handed over to a waste/recycling contractor who will utilize these wastes for recycling purposes.</li> <li>▪ Waste management training for all site staff to be included in Contractor's training plan.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The volume of the containment area shall be equal to 120% of the total volume of fuel stored.</li> <li>▪ Fuel and hazardous material storage points must be included in camp layout plan to be submitted for approval. Hazardous material storage areas shall include a concrete floor to prevent soil contamination in case of leaks or spills. Fuel tanks will be checked daily for leaks and all such leaks will be plugged immediately.</li> <li>▪ Designated vehicles/plant wash down and refuelling points must be included in</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>camp layout plan to be submitted for approval.</p> <ul style="list-style-type: none"> <li>▪ Hazardous waste will be initially stored on site at designated area and then handed over to EPA certified contractor to final disposal.</li> <li>▪ Record of waste generation and transfer shall be maintained by project contractors.</li> <li>▪ Spill kits, including sand buckets (or other absorbent material) and shovels must be provided at each designated location.</li> <li>▪ At the time of restoration, septic tanks will be dismantled and backfilled with at least 1m of soil cover keeping in view landscape of surrounding natural surface.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ It will be ensured that after restoration activities, the campsite is clean and that no refuse has been left behind.</li> <li>▪ Clinical wastes will be temporarily stored onsite separately and will be handed over to approve waste contractor for final disposal.</li> <li>▪ Training will be provided to personnel for identification, segregation and management of waste.</li> </ul>			
	2.7	Untreated disposal of effluent from worker camps and batching plant(s) and construction sites	<ul style="list-style-type: none"> <li>▪ It will be ensured that no untreated effluent is released to the environment.</li> <li>▪ A closed sewage treatment system including soak pits and septic tank will be constructed to treat the effluent from the construction/labor camps.</li> <li>▪ Sewage treatment system will</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>be installed at each respective labor camp based on the number of laborers residing at the respective camp.</p> <ul style="list-style-type: none"> <li>▪ Wastewater from laundry, kitchen washings and showers will be disposed-off into soak pits or septic tank (where soak pit cannot be constructed) and after treatment it will disposed of in TMA provided drains in the project area.</li> <li>▪ Soak pits will be built in absorbent soil and shall be located 300 m away from a water well, hand pump or surface water body. Soak pits in non-absorbent soil will not be constructed.</li> <li>▪ Ensure that the soak pits remain covered all the time and measures are taken to</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
	2.8	Soil Erosion and	<p>prevent entry of rainwater into them.</p> <ul style="list-style-type: none"> <li>▪ Sprinkling of grey water or sewage will not be allowed; in case the septic tank gets filled with sludge, septic tank shall be emptied through vacuum truck and material shall be transferred to treatment facility or approved municipal drain.</li> <li>▪ Water being released from any batching plant(s) must be treated as per requirements of NEQS prior to release to sewerage system/any other water body.</li> <li>▪ Sewage at the end of construction period to be disposed of in nearest municipal drains after getting approval from concerned municipal authorities.</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
2.9		Sedimentation	culverts or pipes crossing the project site may need to be modified or protected and the detailed designs must make provisions to protect or re-provision all infrastructure that may be affected by the construction works.			
		Soil Contamination	<ul style="list-style-type: none"> <li>▪ It will be ensured that spill prevention trays are provided and used during refueling. Also, on-site maintenance of construction vehicles and equipment will be avoided as far as possible. In case on-site maintenance is unavoidable, tarpaulin or other impermeable material will be spread on the ground to prevent contamination of soil.</li> <li>▪ Regular inspections will be carried out to detect leakages in construction vehicles and</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>equipment and all vehicles will be washed in external commercial facilities.</p> <ul style="list-style-type: none"> <li>▪ Fuels, lubricants and chemicals will be stored in covered bounded areas, underlain with impervious lining. Appropriate arrangements, including shovels, plastic bags and absorbent materials will be available near fuel and oil storage areas.</li> </ul>			
	2.10	Employment Conflicts	<ul style="list-style-type: none"> <li>▪ The Construction Contractor will adopt a transparent hiring policy. Prior to the commencement of the construction activity, the local communities in the project area will be informed of the employment policy in place and number of people that can be employed for this</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>project.</p> <ul style="list-style-type: none"> <li>▪ It will be ensured that maximum number of unskilled and semi-skilled jobs will be provided to the residents of the project area.</li> <li>▪ The PMU will ensure a balanced process of employment of the communities in the project area with preference given to those most directly affected by the project.</li> </ul>			
2.11		Communicable diseases incl. COVID-19	<p><b>COVID-19 specific measures</b></p> <ul style="list-style-type: none"> <li>▪ All workers must perform complete sanitization at the site as per SOPs/guidelines issued by WHO.</li> <li>▪ All workers must wear a mask as soon as they arrive at site and must keep</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>wearing it at all times while present at the work site/hospital premises.</p> <ul style="list-style-type: none"> <li>▪ As soon as workers arrive at work site, their body temperature must be checked and in case any worker is assessed to be running a fever or suffering from a flu or cough, he must be informed to leave immediately and self-isolate for a two-week period and not report for work until this two-week mandatory period has been completed.</li> <li>▪ At the work site(s), social distancing measures must be strictly implemented and gathering of workers at any location at the work site(s) must be strictly forbidden. In</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>case of workers not taking this measure seriously, strict penalties must be imposed to ensure implementation.</p> <ul style="list-style-type: none"> <li>▪ The work tasks must be divided into shifts, as far as possible, to reduce the workforce present at the work site(s) at any one moment and improve the working speed/efficiency.</li> <li>▪ All workers will be strictly advised to wash their hands as frequently as practicable and not to touch their face during work.</li> <li>▪ A supply of safe drinking water will be made available and maintained at the project site(s).</li> <li>▪ COVID awareness sign boards must be</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>installed at the clinic premises and at the work site(s).</p> <ul style="list-style-type: none"> <li>▪ Contact details of all workers will be kept in a register on site in order to efficiently trace and manage any possible workers that might experience symptoms of COVID-19.</li> <li>▪ Prohibition of entry for local community/any unauthorized persons at work sites.</li> <li>▪ Proper hygiene practices in the toilets and washrooms will be implemented with proper and adequate use of soaps and disinfectant spray.</li> <li>▪ Social distancing must be maintained</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>during the pick-up and dropping off of workers from their residences to and from the work site(s).</p> <p><b>COVID-19 specific measures GOP</b></p> <p><b>Advice for Site Managers:</b></p> <ul style="list-style-type: none"> <li>▪ Every construction project shall make proper arrangements for uninterrupted building services including but not restricted to, electricity, fuel, water supply, water disposal and sanitation, communication links, washrooms with hand hygiene and shower facility and with proper and adequate supply of soaps and disinfectants.</li> <li>▪ Workers shall not</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>use biometric attendance machines or crowd during attendance, entry or exit to the premises of the construction site.</p> <ul style="list-style-type: none"> <li>▪ Ensure the availability of the thermal gun at the entry and exit of the construction site and no worker shall be allowed without getting his/her temperature checked.</li> <li>▪ Site manager must maintain a register of all contact details with NID number and addresses of all present at the site in case a follow up or tracing and tracking of contacts is required at a later stage.</li> <li>▪ Develop the employee roster to</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>decrease the number of people on the site very day. Split the shifts of the workers in morning and evening with limit of each shift to 8 working hours.</p> <ul style="list-style-type: none"> <li>▪ Every worker must change into standard working attire at the time of commencement of duty and change back to their regular dress after taking shower when their duty hours' end.</li> <li>▪ In addition to all other internationally recognized safety precaution for construction workers and other staff, every individual must be provided with a face mask. It must be ensured that everyone during his or her presence at the site continues to</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>wear the mask. Face mask shall be replaced as and when soiled or otherwise removed. Outer surface of face mask must not be touched with hands.</p> <ul style="list-style-type: none"> <li>▪ Non-essential work trainings must be postponed avoiding gathering of people.</li> <li>▪ Ensure the physical distance by creating more than one route of entry and exit to the site.</li> <li>▪ Instruct the workers to inform the construction manager (or authorities) if</li> <li>▪ They develop any symptoms of cough, flu or fever.</li> <li>▪ They have been exposed to someone suspected or</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>confirmed with COVID 19.</p> <ul style="list-style-type: none"> <li>▪ They have met someone who has a travel history of COVID 19 endemic country. They have travelled in last couple of days or plan to travel soon.</li> <li>▪ All incidences of appearance of the symptoms of COVID-19 shall be immediately documented and maintained at the site and information regarding which shall be immediately communicated through e-mail or else, to the designated health facility, and the sick worker shall be transported to the health facility for further advice and action. The site manager must</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>establish a link with a nearby healthcare facility with arrangements for quick transportation of workers in case of an emergency.</p> <ul style="list-style-type: none"> <li>▪ Persuade the workers to inform the authorities for their safety and of other if they observe any signs and symptoms in a colleague.</li> <li>▪ Do not allow any worker at the construction site who has the symptoms</li> <li>▪ Display the awareness banners about hand hygiene and physical distancing, where you can, around the work site.</li> <li>▪ Everyone on the construction site must observe sneezing and</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>coughing etiquettes. Workers shall be requested and required to wash their hands as frequently as practicable and shall also be advised not to touch their face with their hands during work.</p> <ul style="list-style-type: none"> <li>▪ Workers must maintain no less than two arm lengths between them before, during after work at all the times. They shall not make physical contact and shall be required to maintain separate personal gears and assets which must be clearly labelled and stored without intermixing.</li> <li>▪ Only sanitizable dinning surfaces shall be used, which must be cleaned</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>before each service.</p> <ul style="list-style-type: none"> <li>▪ The lunch breaks and stretch breaks of the workers must be staggered to avoid the clustering of workers. Workers must not sit at less than 2 meters' distance while having meals and while any other activity requiring interpersonal communications.</li> <li>▪ Adequate ventilation shall be provided in dining areas, resting places and sleeping areas.</li> <li>▪ In the wake of current restrictions on transportations site mangers will ensure safe transport arrangements for worker which shall not be crowded and shall have social</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>distancing in place during the entire process from pickups till drops at destination.</p> <ul style="list-style-type: none"> <li>▪ In case of workers sleeping in at the site of construction, a safe distance of 2 meters must be ensured in the sleeping rooms in a well ventilated area.</li> <li>▪ A supply of safe drinking water must be made available at the project site and maintained.</li> </ul> <p><b>Advice for Construction Workers:</b></p> <ul style="list-style-type: none"> <li>▪ All possible and prescribed measures shall be taken to ensure your and others health. Enter your contact details in the register maintained at the site, in case a follow</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>up or tracing and tracking of contacts is required at a later stage.</p> <ul style="list-style-type: none"> <li>▪ Follow hygiene practices at washrooms and shower facility with proper and adequate use of soaps and disinfectants.</li> <li>▪ Every worker must change into standard working attire at the time of commencement of duty and change back to their regular dress after taking shower when their duty hours' end.</li> <li>▪ In addition to all other internationally recognized safety precaution for construction workers and other staff, every individual must use face mask. Face mask shall be</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>replaced as and when soiled or otherwise removed. Outer surface of face mask must not be touched with hands.</p> <ul style="list-style-type: none"> <li>▪ Workers shall wash their hands as frequently as practicable and shall not touch their face with their hands during work.</li> <li>▪ Everyone on the construction site must observe sneezing and coughing etiquettes.</li> <li>▪ Workers must maintain no less than two arm lengths between them before, during after work at all the times. They shall not make physical contact and shall be required to maintain separate personal gears and assets which must</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>be clearly labelled and stored without intermix.</p> <ul style="list-style-type: none"> <li>▪ Sick worker shall immediately inform the site manager and must get medical advice from nearby health Centre.</li> <li>▪ Only sanitizable dining surfaces shall be used.</li> <li>▪ Do not sit at less than 2 meters' distance while having meals and while any other activity requiring interpersonal communications.</li> <li>▪ Do not use biometric attendance machines or crowd during attendance, entry or exit to the premises of the construction site.</li> <li>▪ Use safe transport</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>arrangements which shall not be crowded and shall have social distancing in place during the entire process from pickups till drops at destination.</p> <ul style="list-style-type: none"> <li>▪ In case sleeping in at the site of construction, a safe distance of 2 meters must be ensured in the sleeping rooms in a well ventilated area</li> </ul> <p><b>Deliveries or Other Contractors Visiting the Site:</b></p> <ul style="list-style-type: none"> <li>▪ Non-essential visits to the construction sites shall be cancelled or postponed.</li> <li>▪ Delivery workers or other contractors who need to visit the construction site must go through</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>temperature check before entering and shall be given clear instructions for precautions to be taken while on site.</p> <ul style="list-style-type: none"> <li>▪ Designate the workers, with protective gears or at least gloved and mask, to attend to the deliveries and contractors.</li> <li>▪ Make alcohol-based hand sanitizer (at least 70%) available for the workers handling deliveries.</li> <li>▪ Instruct the visiting truck drivers to remain in their vehicles and whenever possible make use of contactless methods, such as mobile phones, to communicate with your workers</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
	2.12	Vegetation and Wildlife Loss	<ul style="list-style-type: none"> <li>▪ Necessary plantation will be carried out, which will act as buffer zone from surrounding environment. Reasonable area has been allocated for plantation within and at boundary of facility to improve landscape of the area.</li> <li>▪ Indigenous tree plantation will be carried out, which will serve as the buffer zone. Green belt provided in project key plan. For the landfill, to present a clean and aesthetically pleasing view, buffer zone with tree plantation and landscaped berms will be done. Plantation will start as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds mobilized, plantation activity</li> </ul>	Contractors	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>can be started in collaboration with WSSCK can outsource the activity separately.</p> <ul style="list-style-type: none"> <li>▪ Camp/s will be located in existing clearings; as much as possible.</li> <li>▪ Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project</li> <li>▪ Vehicles speed will be regulated and monitored to avoid excessive dust emissions.</li> <li>▪ No hunting or killing of animals will be permitted.</li> <li>▪ No cutting down of vegetation or using vegetation or trees as firewood will be permitted.</li> </ul>			
	2.13	Historical/Archaeological Sites	If evidence of any archaeological remains is found during the construction activities, the excavation work will be stopped immediately	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			and necessary next steps taken to identify the archaeological discovery based on the 'Chance Find' procedures.			
2.14		Construction of Administration Building and Other Infrastructure	<ul style="list-style-type: none"> <li>▪ Water will be sprinkled regularly to suppress dust emissions. Off road travelling of vehicles will be prohibited.</li> <li>▪ Stock piles will be appropriately located and out of wind to avoid dust emissions. Dry dusty materials will be sprinkled with water and properly covered to avoid dust emissions.</li> <li>▪ No cement and concrete waste will be left unattended. Construction debris will not be thrown from height to avoid dust emissions. Return unpaved areas to original or</li> </ul>	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>improved contours following construction.</p> <ul style="list-style-type: none"> <li>▪ Solid waste generated during construction of admin building will be managed through SEMMP.</li> <li>▪ Set protocols for proper and regular maintenance of construction machinery, vehicles and generators. Generators that will be used will be placed at suitable locations.</li> <li>▪ Contractor will not be allowed to store bulk quantities of fuel or hazardous material at site.</li> <li>▪ Any fuel or chemicals stored at site (in small quantities) will be stored at designated site and containers/storage vessels be properly marked for their contents. Storage</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>area will be provided with hard impervious surface and secondary containment.</p> <ul style="list-style-type: none"> <li>▪ Equipment and machinery with loose vibratory parts will not be allowed to use.</li> <li>Used equipment and machinery will be in compliance to NEQS.</li> <li>▪ Waste bins will be provided at appropriate places to mange waste. Daily housekeeping of the construction area will be carried out.</li> </ul>			
2.15		Construction of Access Road	<ul style="list-style-type: none"> <li>▪ The road widening will be to a standard that is suitable for movement of high-capacity waste carrying vehicles.</li> <li>▪ WSSC/PMU will maintain close coordination with the residents falling close to road widening works, project</li> </ul>	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>information leaflet will be distributed to them and awareness with respect to impacts (noise, dust and vibrations) associated with construction will be provided. If people are notified, their acceptance of the disturbance is usually higher.</p> <ul style="list-style-type: none"> <li>▪ WSSC/PMU will arrange community consultation session before commencement of construction works to make public sensitization which will facilitate smooth execution of project activities.</li> <li>▪ Compaction with heavy vibration rollers shall be avoided or minimized in built-up areas.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Work areas outside the project site, especially where machinery is involved, will be barricaded and will be constantly monitored to ensure that local residents, particularly children stay away.</li> <li>▪ Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children.</li> <li>▪ Traffic diversions will be planned in such way that it does not create traffic congestion during road widening works. Road closure for the works will be avoided.</li> <li>▪ PMU KPCIP through CSC will ensure that road widening structure shall be</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>as similar as existing part.</p> <ul style="list-style-type: none"> <li>▪ Proper drainage system will be provided in order to achieve sustainability.</li> <li>▪ Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project.</li> <li>▪ Vehicle speed will be regulated and monitored to avoid excessive dust emissions.</li> <li>▪ Blowing of horns will be prohibited on access roads to work sites.</li> <li>▪ Periodic sprinkling on access road at least twice per day during construction phase and restrict vehicle speed to 20 kmph.</li> <li>▪ Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed part within project area.</li> <li>▪ Traffic is not disrupted by labor camps being set up</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>roadside next to the construction sites.</p> <ul style="list-style-type: none"> <li>▪ Contractor will prepare construction management plan which will include the hazard prevention and safety plan, which will address health and safety of the people in the project area.</li> <li>▪ PMU KP LGE&amp;RDD shall ensure the contractor staff working in the project are well trained and educated in the Health, Safety and Environment (HSE) hazards associated with their duties, and that of the public, in the project area.</li> <li>▪ Record of waste generation and transfer shall be maintained by project contractor.</li> <li>▪ Periodic water sprinkling will be carried out during widening works to suppress dust.</li> <li>▪ Fuel-efficient and well-</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>maintained equipment and machinery shall be employed to minimize exhaust emissions.</p> <ul style="list-style-type: none"> <li>▪ The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles shall not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (&gt;25m<sup>3</sup>) of crushed materials are necessary, they shall be enclosed with side barriers and also covered when not in use.</li> <li>▪ Prior to starting of work, the contractor shall prepare a method statement for water supply pipeline works. This shall be simple and explain the contractor's work process that is actually conducted on site, with safety and</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>safeguard concerns.</p> <ul style="list-style-type: none"> <li>▪ Method Statement is very important, particularly for the road widening works.</li> <li>▪ Method Statement can be prepared for each stretch (say 1 km) /specific site based on the project area.</li> <li>▪ Method Statement shall be in a Table format with appended site layout map and cover the following:</li> <li>▪ Work description</li> <li>▪ No. of workers (skilled &amp; unskilled)</li> <li>▪ Details of Plant, equipment &amp; machinery, vehicles</li> <li>▪ Work duration (total, and activity-wise, for example for preparation of sub grade, sub-base, base and wearing coarse</li> <li>▪ PPE (helmet, gloves, boots, etc.) details for</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>each type of work</p> <ul style="list-style-type: none"> <li>▪ Details of materials at each site (type &amp; quantity)</li> <li>▪ Risks/hazards associated with the work</li> <li>▪ Construction waste/debris generated (details &amp; quantity)</li> <li>▪ Detail the sequence of work process (step-by-step) including specific details of each work</li> <li>▪ Contractor's supervision &amp; management arrangements for the work</li> <li>▪ Emergency: Designate (i) responsible person on site, and (ii) first aider</li> <li>▪ Typical site layout plan including placement of material, excavated earth, barricading etc.</li> <li>▪ The following shall be included in the site layout</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>plan:</p> <ul style="list-style-type: none"> <li>▪ Provide barricading/security personnel at the site to prevent entry/trespassing of pedestrian/vehicles into the work zone.</li> <li>▪ Location of temporary stockpiles and provision of bunds</li> <li>▪ Separation of stockpiles areas with workers/vehicle movement paths to avoid disturbing the stockpiled soil</li> <li>▪ Wetting of soil to arrest dust generation by sprinkling water</li> <li>▪ Waste/surplus soil utilization and disposal plan – indicate expected duration of temporary stockpiling along the road and identify final surplus soil utilization/disposal site in consultation with CSC/PMU.</li> <li>▪ PMU KPCIP will ensure the</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>identification of disposal sites for unsuitable excavated material in consultation with WSSP.</p> <ul style="list-style-type: none"> <li>▪ CSC will inspect and monitor the borrow material areas prior to procurement to ensure that it is being used in sustainable way and no significant disfiguration of landscape is going on at quarry site.</li> <li>▪ Stock piling of excavated material at places that are congested will be avoided as these piles can create traffic issues and public nuisance.</li> <li>▪ Already available quarry sites for additional backfill material will be utilized. Development of new quarry site will be discouraged.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Record of borrow materials will be maintained including details of quarry site, agreement and necessary approvals from concerned government authorities.</li> </ul>			
2.16		Sexual Abuse, Exploitation and Harassment (SEAH)	<ul style="list-style-type: none"> <li>▪ The contractor's COC shall cover a program to promote awareness of the construction workers on avoiding any gender-based violence;</li> <li>▪ The contractor's monthly training program will cover topics related to COC such as sexual harassment particularly towards women and children, violence, including sexual and/or gender-based violence;</li> <li>▪ Measures to protect the privacy of women and girls by the contractor, sub-contractors and service providers;</li> </ul>	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ The contractor will make sure that no discrimination is made on the basis of gender while hiring of workers;</li> <li>▪ The contractor will set the employment relationship on the code of equal opportunity and fair treatment and develop COC for workers to address these issues;</li> <li>▪ The employment decisions will not be made on the basis of personal characteristics unrelated to inherent job requirements, including race, gender, nationality, religion or belief, disability, age, sexual orientation, or ethnic, social and indigenous origin;</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Special measures will be taken to address harassment, intimidation, and/or exploitation, especially in relation to women;</li> <li>▪ No Sexual Harassment Policy will be established and strictly endorsed in accordance with provincial law;</li> </ul> <p>World Bank Good Practice Note on Addressing GBV will be used as guidance.</p>			
Operation Phase	3.1	Generation of Leachate	<ul style="list-style-type: none"> <li>▪ Operate the landfill in accordance with applicable internationally recognized standards to minimize leachate generation, including the use of low-permeability landfill liners to prevent migration of leachate as well as landfill gas, a leachate drainage and collection system, and landfill cover (daily,</li> </ul>	O&M Contractor/WSSCK	WSSCK, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>intermediate, and final) to minimize infiltration;</p> <ul style="list-style-type: none"> <li>▪ A leachate holding tank of 500 m<sup>3</sup> will collect the leachate before it enters the treatment plant. Leachate treatment will be based on DTRO, which is potable arrangement for treatment of leachate and can be operationalized during monsoons for 24/7 basis.</li> <li>▪ During monsoons, recirculation of leachate will be increased to avoid operational constraints of leachate collection, storage and treatment system at landfill site.</li> <li>▪ Minimize the daily exposed working face and use perimeter drains and landfill cell compaction, slopes and</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>daily cover materials to reduce infiltration of rainfall into the deposited waste;</p> <ul style="list-style-type: none"> <li>▪ Leachate collection will be augmented by a leachate recirculation system in the landfill design.</li> <li>▪ The operators of the landfill must ensure that an effective and efficient leachate control and monitoring system is maintained. This may be complimented by establishment of groundwater monitoring wells and regularly collecting samples for laboratory analysis. Results of the analysis could aid the operators to determine the final fate of the collected leachate and/detect any</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>potential leakages. Final decision rests with the landfill operator on the final number of wells as well as the frequency of sampling for groundwater quality.</p> <ul style="list-style-type: none"> <li>▪ The final vegetative cover plays an integral part in leachate production control. Its basic functions are to limit infiltration by intercepting precipitation directly, thereby improving evaporation from the surface, and to reduce percolation through the cover material by taking up soil moisture and transpiring it back to the atmosphere. Preferred plant species shall be of those that do not have deep roots in order to protect the surface sealing. Further, these species shall</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>require minimal maintenance and human intervention.</p> <ul style="list-style-type: none"> <li>▪ Landfill operators must be properly and adequately trained to operate and maintain the installed control system.</li> <li>▪ A procedure for the rapid repair of leaks in the pipes, pumps and other equipment must be part of landfill operations.</li> <li>▪ An inventory of spare parts and repair equipment must be continuously in place to ensure immediate remedial action against breakdowns.</li> <li>▪ Strict quality assurance and construction guidelines during the installation of the HDPE liner shall be strictly implemented.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ In worst case, if leachate contamination is detected during ground water monitoring after few years of landfill operation, Ground water modelling to determine possible contamination of leachate will be carried out and necessary design changes will be done.</li> <li>▪ Detailed ground water quality baseline will be developed during operation phase of the project to trace any ground water contamination from landfill operations.</li> </ul>			
	3.2	Possible Contamination of Soil and Groundwater	<ul style="list-style-type: none"> <li>▪ Appropriate liner and collection systems in compliance with international guidelines/criteria are part of</li> </ul>	O&M Contractor/WSSCK	WSSCK, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>the design will be installed.</p> <ul style="list-style-type: none"> <li>▪ An efficient leachate collection and treatment system has been provided to ensure leachate accumulation at the base of the landfill and keep it to a minimum.</li> <li>▪ The leachate system will consist of a leachate collection layer of either natural granular (sand, gravel) or synthetic drainage material (e.g. geonet or geo-composite) with pipe network to convey the leachate to treatment facility.</li> <li>▪ A total of 600 mm clay liner of permeability of <math>1 \times 10^{-6}</math> cm/sec will be compacted at the bottom in series of</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>150mm layers each compacted to 95% of compaction, followed by 150 mm base layer for drainage and monitoring. This layer will be topped by 1.5 mm HDPE geomembrane.</p> <ul style="list-style-type: none"> <li>▪ As soon as HDPE is placed, 200 mm silty sand will be covered on top of HDPE for the protection of the HDPE on the side slopes. The main purpose of this sand layer on top of HDPE geomembrane serves as leakage detection layer.</li> <li>▪ Above this 300 mm PEA gravel layer will be placed followed by 150 mm compacted (85-90%) sand layer.</li> <li>▪ Leachate collection pond shall be in opposite direction</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>from nearest surface water body.</p> <ul style="list-style-type: none"> <li>▪ A leachate treatment facility with a design capacity of 50 m<sup>3</sup> /d will be constructed. Leachate treatment is designed on activated sludge treatment with advance level treatments (Disc Tube Reverse Osmosis-DTRO) for heavy metals and other pollutants potentially present in leachate.</li> <li>▪ Slope of the landfill site shall be away from nearest surface water body.</li> <li>▪ Cut-off drains around active landfill site and peripheral drains around landfill site shall be provided</li> <li>▪ Ground water monitoring wells shall be dug keeping</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>in view of the flow of ground water on both upstream and downstream of the disposal site and monitor the ground water quality of the upper strata for any contamination for disposal site every month.</p> <ul style="list-style-type: none"> <li>▪ Waste hauling vehicles shall be covered during transport of waste to landfill site</li> <li>▪ Hauling vehicles shall not wash at the surface water bodies along the route as the wash water shall drain into the canal and will pollute the surface water source which is used by the animals of the nearby communities and for agriculture purpose.</li> <li>▪ Domestic sewerage of Kohat facility shall not be</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>discharged untreated in open area and drains,</p> <ul style="list-style-type: none"> <li>▪ Waste water generated from vehicle wash area shall be contained and treated before final discharge</li> <li>▪ In order to augment this system, regular quality control checks on the equipment /accessories will be implemented and incorporated during construction and operations.</li> </ul>			
	3.3	Generation of Landfill Gas	<ul style="list-style-type: none"> <li>▪ Landfill gas capture and flaring systems will be in place as part of the landfill design and thus no significant impacts on occupational or community health and safety are envisaged from landfill gas exposure.</li> <li>▪ Landfill gas will be collected</li> </ul>	O&M Contractor/WSSCK	WSSCK, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>through installation of perforated pipes within the cells. This gas transferred to gas recovery unit where it receives subsequent treatment and utilization, or disposal in a safe manner through flaring or venting.</p> <ul style="list-style-type: none"> <li>▪ The vertical gas recovery wells will be designed keeping in view the capacity of the landfill.</li> <li>▪ For KPCIP landfills, Open flame flare technology, consisting of a pipe through which the gas is pumped, a pilot light to spark the gas, and a means to regulate the gas flow is proposed.</li> <li>▪ For Kohat, flaring is proposed for landfill gas management. Keeping in view the amount of gas</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>production after few years of landfill operation, feasibility for gas reuse will be carried out and accordingly design changes will be executed.</p> <ul style="list-style-type: none"> <li>▪ PMU KP LGERDD shall ensure that during operation phase of the project, if there are changes in the baseline ambient air quality, then a quantitative assessment will be carried out for flaring and necessary design changes will be incorporated to avoid air quality impacts from flaring.</li> <li>▪ As part of closure plan of existing dumping site, GHG monitoring will be carried out and necessary gas venting system will be done.</li> <li>▪ Periodic GHG monitoring will be carried out during</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			operation phase of the project.			
3.4		Generation of objectionable Odor and impact on air quality	<p>Best management practices and good housekeeping measures will be implemented to minimize the release of objectionable odours. Potential odours impacts can be minimized or eliminated by adopting the following measures:</p> <ul style="list-style-type: none"> <li>▪ Daily cover will be placed on working surface of waste in order to reduce the risk of fire, wind littering, odor, vector breeding and dust hazards in the landfill.</li> <li>▪ Suitable amount of daily cover will be stocked at the landfill site.</li> <li>▪ Final capping of landfill cells will be carried out in order to limit and control the amount of precipitation that enter the waste and to limit wind and water erosion and</li> </ul>	O&M Contractor/WSSCK	WSSCK/PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>burrowing animal activity. This will not only prevent the odor of decaying waste from escaping from the landfill but also protect the site against intrusion of vermin and pests.</p> <p>The top cover system consists of following arrangements.</p> <ul style="list-style-type: none"> <li>▪ Thick top soil layer of 45 cm capable of supporting vegetation in order to protect the landfill surface from wind and water erosion.</li> <li>▪ Drain Layer of 15 cm at bottom to maximize runoff of precipitation while minimizing infiltration and preventing ponding of water on the landfill.</li> <li>▪ Compacted soil layer or barrier of 60 cm of low</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>permeability to limit and control the amount of precipitation that enters the waste.</p> <ul style="list-style-type: none"> <li>▪ Vent layer of 15 cm thickness comprised of sand and gravel</li> <li>▪ Appropriate and regular housekeeping (i.e. cleaning) will be done in all areas where solid waste will be processed (i.e. weigh bridge area). This will prevent the reproduction of flies, generation of obnoxious odors, scattering of plastic and papers, etc.</li> <li>▪ Strict use of Personal Protective Equipment (PPE) by all personnel (e.g. inspectors at the Weigh Bridge, MRFs, material handler and waste</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>compactor operators) must be ensured.</p> <ul style="list-style-type: none"> <li>▪ All the incoming ingredients that are anaerobic will be converted to aerobic state through combining them with a coarse, dry bulking amendment to increase the porosity and allow oxygen penetration.</li> <li>▪ Air shall be thoroughly dispersed throughout the organic waste. This is done by frequently turning and mixing the wastes.</li> <li>▪ Oxidizing chemicals like hydrogen peroxide, potassium permanganate, and chlorine will be used by the wastewater treatment industry for odor control.</li> <li>▪ Organic waste lot which is creating objectionable odor</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>will be attended immediately introduced in the composing system on priority basis.</p> <ul style="list-style-type: none"> <li>▪ Controlled composting conditions will be maintained throughout the operation.</li> <li>▪ Mandatory health and medical check-ups for all employees especially workers working at MRF as they may be exposed to general airborne dust above the level where it is considered a substance hazardous to health (10 mg/m<sup>3</sup> as an 8-hr TWA). This shall ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill;</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV)</li> <li>the appropriate use of respiratory protective equipment (RPE);</li> </ul>			
	3.5	Attraction of Vermin and disease vector generation	<ul style="list-style-type: none"> <li>▪ The most important control measure used to minimise vector problems at landfills is the application of daily cover. Cover shall be present on all solid waste at all times, except the tipping face while it is being worked. Daily cover of at least 150mm of compacted soil or similar material or an effective layer of alternate daily cover (ADC) shall be applied on finished portions</li> </ul>	O&M Contractor/WSSCK	WSSCK, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>of the daily cell during operation and at the conclusion of daily operations, and not less frequently than once per day. Alternative daily cover materials such as tarpaulins, foams, granular waste, etc, can be effective as vector control after careful site-specific evaluation.</p> <ul style="list-style-type: none"> <li>▪ Intermediate cover of 300mm (minimum) compacted soil shall be used on all areas not at finished levels, but not to be further landfilled for a period of 30 days or more.</li> <li>▪ Final cover is typically applied as each area is brought to finished level through the operational life</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>of the landfill.</p> <ul style="list-style-type: none"> <li>▪ There shall be no uncontrolled or uncovered (stockpiled) waste, including litter, tyres, brush, appliances, construction/demolition waste or even inert industrial waste on the landfill property. The only exception is compactable soil-like inert wastes, such as ash, but even this waste must be graded and compacted to avoid ponding water.</li> <li>▪ There shall be no ponding water on the landfill property except as designed for runoff storage or sedimentation. Sedimentation ponds can, however, aid vector</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>reproduction if not designed and controlled properly so as to minimise stagnant water, nutrient build-up and plant growth.</p> <ul style="list-style-type: none"> <li>▪ Finally, the waste must be compacted and graded at reasonable maximum slopes (see the Working Face Guideline) to minimise voids within the waste that can harbour rodents in particular. Rodents and foxes can readily dig into cover soil, but have much more difficulty digging into compacted solid waste.</li> <li>▪ On-site landfill site personnel must be trained and must monitor the levels of key vectors on a daily basis as part of daily management. A simple</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			monthly site walk-over can provide a baseline of vector activity so changes can be noted and translated into action. Observations of various droppings, sightings, tracks, insect counts, etc are useful indicators of activity. Written reports from regular walk-over assessments shall be kept on file so changes that occur over time and in response to control measures can be assessed.			
3.6	Occupational Health and Safety		<ul style="list-style-type: none"> <li>▪ OHS management system will be prepared and implemented.</li> <li>▪ Designation of an Environment, Health and Safety (EHS) officer dedicated to the site;</li> <li>▪ All employees must be able</li> </ul>	O&M Contractor/WSSCK	WSSCK, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>to reach their work stations safely. All path, walkways, staircases, ladders and platforms must be stable and suitable for the tasks to be undertaken;</p> <ul style="list-style-type: none"> <li>▪ Strict use of Personal Protective Equipment (PPE) by all personnel (e.g. inspectors at the Weigh Bridge, material handler and waste compactor operators) must be ensured.</li> <li>▪ Mandatory health and medical check-ups for all employees especially workers working at MRF as they may be exposed to general airborne dust above the level where it is considered a substance hazardous to health (10 mg/m<sup>3</sup> as an 8-hr TWA).</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>This shall ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill;</p> <ul style="list-style-type: none"> <li>▪ Mandatory training of all employees, including sub-contractors, on Health and Safety Practices for Landfill and its auxiliary facilities. Tool Box talks are also recommended;</li> <li>▪ Mandatory health and medical check-ups for all employees. This shall ideally be complimented by obtaining an Insurance Policy for Workmen's especially engaged in the daily activities of the landfill;</li> <li>▪ Develop a written program (i.e. health information,</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>instruction and training) which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards of working in a landfill and its auxiliary facilities;</p> <ul style="list-style-type: none"> <li>▪ Mandatory monitoring of air quality and noise levels in the working stations to maintain the same within local standards and whenever possible near ambient levels;</li> <li>▪ Control of inhalation exposure to hazardous substances by the effective use of general ventilation within MRF and Local Exhaust Ventilation (LEV)</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>the appropriate use of respiratory protective equipment (RPE);</p> <ul style="list-style-type: none"> <li>▪ Accidental fires must be addressed immediately. Appropriate operational procedures involving the spreading and smothering of burning waste, rather than the use of water, must be implemented;</li> <li>▪ Emergency plan (including fire management) must be developed and implemented;</li> <li>▪ Availability of first-aid kits and vehicles that can be used to bring any injured employee to the nearest doctor in cases of accidents;</li> <li>▪ Mandatory reporting of all accidents or incident of near misses of accidents and</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>immediate adoption of corrective measures; and</p> <ul style="list-style-type: none"> <li>▪ Management must provide all the necessary financial and manpower resources for the implementation and enforcement of all health and safety programs and activities of the project;</li> <li>▪ Regular training and orientation on safety practices will be implemented to impart knowledge of safe and efficient working environment. Furthermore, regular health checkups of all employees including contract workers will be conducted. Effective and proper housekeeping is recommended to reduce dust exposures to its direct</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			vicinity. Heat levels must be monitored as well. Spot checks shall be done to ensure that workers' welfare is addressed especially during summer months.			
3.7		Waste Collection and Hauling Impacts	<ul style="list-style-type: none"> <li>▪ Capacity of WSSCK will be increased through increase in its collection fleet. It will be done through procurement of both solid waste and non-solid waste carrying machinery under this project.</li> <li>▪ Door to Door collection of waste will be enhanced through media campaigns. Communication programs would be developed to encourage better management of waste. Proper PPEs will be provided to waste handlers.</li> </ul>	O&M Contractor/WSSCK	WSSCK, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>Key performance indicators will be developed to monitor improvements in the system.</p> <ul style="list-style-type: none"> <li>▪ All type of waste hauling will be carried out in purpose built vehicles to avoid scattering of waste at hauling routes. Drivers of waste carrying vehicles will be trained with respect to environmental sensitization. Drivers are allowed to commute only on designated routes through purpose built vehicles for waste hauling.</li> <li>▪ Multiple transactions of waste will be avoided through use of main and mobile transfer stations. Improved segregation practices will be introduced</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>once door to door collection desired efficiency achieved. Necessary legal bindings with respect to waste storage by Public will be introduced.</p> <ul style="list-style-type: none"> <li>▪ A comprehensive traffic management plan (TMP) must be developed and implemented;</li> <li>▪ As part of the TMP, it will be ensured that the movement of heavy vehicles related to landfill operations is minimized during the peak traffic hours of the day in order to prevent congestion and accidents as far as possible;</li> <li>▪ Furthermore, the movement of heavy vehicles within Kohat city related to landfill operations must be</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>restricted to specific routes containing least number of sensitive receptors and low traffic volumes.</p> <ul style="list-style-type: none"> <li>▪ Waste hauling through dirt tracks will be strictly prohibited. Waste hauling through mechanically unfit vehicles or noisy vehicles will not be allowed.</li> <li>▪ Waste transporters will be directed to use designated routes and follow recommended speed limit for waste hauling and such routes will be metaled roads instead of dirt tracks.</li> </ul>			
	3.8	Wind Blown Litter	<p>The facility operator, as necessary, will implement the following procedures and techniques to control litter:</p> <ul style="list-style-type: none"> <li>▪ All trucks must be tarped upon entering and exiting the facility. They shall only</li> </ul>	O&M Contractor/WSSCK	WSSCK, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>untarp and tarp at the active area. This policy will be strictly enforced. Daily waste entering the landfill site will be subject to immediate compaction to minimize the area and debris subject to the impacts of wind.</p> <ul style="list-style-type: none"> <li>▪ If possible, on windy days, the daily fill face tipper locations shall be selected for its protection to minimize effects of wind.</li> <li>▪ Waste that is more susceptible to windblown distribution may, on windy days, be worked immediately into the fill face and covered with a layer of daily cover, as needed, or the waste may be excluded from the site.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Portable skid-mounted litter fences may be provided for deployment downwind as close as practical to the working area, as needed.</li> <li>▪ Semi-permanent fencing may be provided around the fill area as an additional barrier to the migration of litter off-site when litter has not been contained by the portable litter fences. (Examples of additional barriers include but not limited to, a four-foot minimum temporary construction fence and/or a ten-foot or higher semi-permanent fence.) The utilization will be continually evaluated and the fence will be relocated or added as needed.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ Permanent fencing (ten-foot high with an additional three-foot kicker) may be constructed with possibility of placement on an eight-foot high berm.</li> <li>▪ On very windy days, when all other procedures are not successful in controlling blowing litter, the operator may apply cover material more frequently or immediately to the incoming waste load.</li> <li>▪ Buffer zones resulting from required facility setbacks along the site's perimeter shall provide some protection of adjacent properties.</li> <li>▪ As a final control measure, personnel will be dispatched, as needed or</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>daily if conditions require, to collect any litter that has escaped the above control measures</p> <ul style="list-style-type: none"> <li>▪ Portable litter vacuums may be used to collect litter that has accumulated on litter fences. If fences are positioned properly, this can be a very efficient method of collecting litter.</li> <li>▪ The main highway leading to the site will be routinely inspected for litter. If the highway has litter associated with the trucks entering the facility, then the litter will be picked up on a routine basis. All necessary safety precautions must be followed.</li> <li>▪ Before and after photos of any litter removal effort may</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>be taken in the event anyone questions the level of effort spent on litter collection.</p> <ul style="list-style-type: none"> <li>▪ Site management's cell phone numbers may be provided to community/neighbors.</li> <li>▪ The management of litter at the landfill is a daily activity. In most instances the above procedures and techniques shall properly manage litter effectively. However, there will be occasions and situations when litter will be distributed by the wind in such a manner that the above procedures will not totally manage the litter and contain the litter on-site. In these situations, the facility operator may not be able to</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			collect all litter within the day the litter problem occurred. However, the facility operator shall proceed with collecting the litter off site and complete the retrieval of wind-blown litter at the earliest practicable time.			
3.9	Impacts on Scavengers and Waste Pickers		<ul style="list-style-type: none"> <li>▪ WSSC Kohat will carry out detailed assessment of scavenging business in their respective jurisdiction to identify waste picker and scrap dealers which will be impacted.</li> <li>▪ WSSC Kohat will provide resources and tools to efficiently collect and sort out the waste onsite, as these waste pickers are the first one to deal with the waste.</li> <li>▪ WSSC Kohat will train these waste pickers to optimize their waste collection process.</li> <li>▪ WSSC Kohat will hire waste pickers at MRF facility that will be established at landfill</li> </ul>	O&M Contractor/WSSCK	WSSCK, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>site.</p> <ul style="list-style-type: none"> <li>▪ WSSC Kohat will hire services of scrap dealers for waste collection and transportation to landfill site on need basis.</li> <li>▪ WSSC Kohat will prepare communication strategy and will run community-based operation to integrated SWM operations including waste pickers and scrap dealers.</li> <li>▪ PMU KPCIP will preapre guidelines to involve scavengers/waste pickers in IWMS through formalization and regulations of their business. These guidelines will be adopted by WSSC Kohat to encourage involvement of scavengers and waste pickers working at all levels regardless of their position in present system chain.</li> </ul>			
	3.10	Improvement in Aesthetic Aspects	<ul style="list-style-type: none"> <li>▪ The boundary walls shall be constructed alongside the facility.</li> <li>▪ The indigenous plants shall be planted alongside the</li> </ul>	O&M Contractor/WSSCK	WSSCK/PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>access road and around the landfill site which will act as buffer zone.</p> <ul style="list-style-type: none"> <li>▪ The waste transfer vehicles shall be covered.</li> <li>▪ Reasonable area will be allocated for plantation within and at boundary of facility to improve aesthetic appeal of the area.</li> <li>▪ Plantation will start as one of the earliest activities of site development. Once the design of landfill is approved and necessary funds mobilized, plantation activity can be started in collaboration with Kohat Development Authority or WSSCK can outsource the activity separately.</li> </ul>			
	3.11	Management and disposal of septage from administration building	Regular desludging and proper treatment of the septage will	O&M Contractor/WSSCK	WSSCK/PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
		toilets	be conducted on a regular basis.			
Closure & Post Closure Phase	4.1	Closure and Post Closure Impacts	<ul style="list-style-type: none"> <li>▪ Appropriate selection of soil type for final cover will be ensured to prevent water infiltration and minimize infiltration of precipitation into the waste and the subsequent generation of leachate; control landfill gas migration; and minimize long term maintenance needs.</li> <li>▪ Appropriate selection of soil type for final cover will be ensured to prevent direct or indirect contact of living organisms with the waste materials and their constituents;</li> <li>▪ Application of final cover components that are consistent with post closure</li> </ul>	WSSCK	WSSCK	During Closure & Post Closure

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<p>use and local climatic conditions.</p> <ul style="list-style-type: none"> <li>▪ Necessary environmental objectives and controls (including technical specifications) will be defined and implemented.</li> <li>▪ Necessary surveillance protocols for final capping, leachate and gas monitoring will be established and implemented.</li> <li>▪ Future Land use of the site will be defined in consultation with local communities and government agencies.</li> <li>▪ It will be ensured that financial resources, and monitoring arrangements are in place for closure and post closure activities.</li> </ul>			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			<ul style="list-style-type: none"> <li>▪ PMU KP LGE&amp;RDD will ensure that financial instruments are in place to cover the costs of closure and post-closure care and monitoring.</li> <li>▪ Long term integrity and security of the site will be maintained.</li> </ul>			

**CSC** : Construction Supervision Consultant  
**BC** : Before Construction  
**DC** : During Construction  
**PMU** : Project Management Unit  
**DO** : During Operation  
**WSSCK** : Water and Sanitation Services, Kohat

**Table 7.2: ‘Pre-Construction’ Environmental Monitoring Plan for Baseline Development**

<b>Parameter to be measured</b>	<b>Objective of Monitoring</b>	<b>Parameters to be Monitored</b>	<b>Measurements</b>	<b>Location</b>	<b>Frequency</b>	<b>Responsibility</b>
<b>Ambient Air Quality</b>	To establish baseline air quality levels	CO, NO <sub>2</sub> , SO <sub>2</sub> , O <sub>3</sub> & PM <sub>10</sub> (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At four random receptor locations in the project area, both upwind and downwind	Once	CSC
<b>Ambient Noise</b>	To establish baseline noise levels	Ambient noise level near receptors in project area	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour, and then averaged	At four random receptor locations in the project area	Once	CSC
<b>Groundwater Quality in vicinity of landfill site</b>	To establish groundwater quality in project area	Groundwater quality in project area	Water samples for comparison against NEQS parameters	At two locations around the landfill site in the project area	Once	CSC

**Table 7.3: Construction Phase Monitoring Requirements**

<b>Project Activity and Potential Impact</b>	<b>Objective of Monitoring</b>	<b>Parameters to be Monitored</b>	<b>Measurements</b>	<b>Location</b>	<b>Frequency</b>	<b>Responsibility</b>
<b>Noise</b> Disturbance due to noise from construction activity	To determine the effectiveness of noise abatement measures on sound pressure levels	Ambient noise level at different locations in project area	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour at 15 m from receptors, and then averaged	At four random receptor locations in project area	Quarterly basis on a typical working day	Contractor's Environmental officer, CSC
<b>Air Quality</b> Dust emissions from construction vehicles and equipment	To determine the effectiveness of dust control program on dust at receptor level	CO, NO <sub>2</sub> , SO <sub>2</sub> , O <sub>3</sub> & PM <sub>10</sub> (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At four random receptor locations in project area	Quarterly basis on a typical working day	Contractor's Environmental officer, CSC
		Visible dust	Visual observation of size of dust clouds, their dispersion and the direction of dispersion	Construction site	Once daily during peak construction period	Contractor's Environmental officer, CSC
<b>Safety precautions by Safety workers</b>	To prevent accidents for workers and general public	Number of near miss events and accidents taking place	Visual inspections	Construction site	Once Daily	Contractor's Environmental officer, CSC

<b>Project Activity and Potential Impact</b>	<b>Objective of Monitoring</b>	<b>Parameters to be Monitored</b>	<b>Measurements</b>	<b>Location</b>	<b>Frequency</b>	<b>Responsibility</b>
<b>Soil Contamination</b>	To prevent contamination of soil from oil and toxic chemical spills and leakages	Incidents of oil and toxic chemical spills	Visual inspections	At construction site and at vehicle and machinery refuelling & maintenance areas	Once a month	Contractor's Environmental officer, CSC
<b>Solid Waste &amp; Effluent disposal</b>  Insufficient procedures for waste collection, storage, transportation and disposal	To check the availability of waste management system and implementation	Inspection of solid and liquid effluent generation, collection, segregation, storage, recycling and disposal will be undertaken at all work sites in project area	Visual inspections	At work sites in project area	Once daily.	Contractor's Environmental officer, CSC

**Table 7.4: 'Operation Phase' Environmental Monitoring Plan**

<b>Parameter to be measured</b>	<b>Objective of Monitoring</b>	<b>Parameters to be Monitored</b>	<b>Measurements</b>	<b>Location</b>	<b>Frequency</b>	<b>Responsibility</b>
<b>Groundwater Quality in vicinity of landfill site</b>	To assess whether landfill operation is causing any seepage into the groundwater aquifers in project area and contaminating it.	Groundwater quality in project area	Water samples for comparison against PEQS parameters	At two locations around the landfill site in the project area	Quarterly	WSSCK
<b>Waste Management Monitoring</b>	To ensure Waste Management Plan is being implemented	Management and disposal of waste at SWMF	Implementation of Clauses and conditions of Waste Management Plan	Entire project corridor from waste collection points upto disposal at SWMF	Quarterly	WSSCK

**Table 7.5: Capacity Development and Training Programme**

<b>Provided by</b>	<b>Organized by</b>	<b>Contents</b>	<b>No. of training events</b>	<b>Duration</b>	<b>Cost (PKR)</b>
<b>Pre-construction Phase</b>  Monitoring Consultants/Organizations offering specialized services in environmental management and monitoring	CSC & PMU	Short seminars and courses on:  Environmental Management Plan and Environmental Monitoring Plan	Two seminars for Contractor management staff and project staff	1 day	200,000/Training
<b>Construction Phase</b>  Monitoring Consultants/Organizations offering specialized services in environmental management and monitoring	CSC & PMU	Short seminars on Environmental risks associated with construction phase.  Development of Environmental Performance Indicators  Occupational Health and Safety (OHS) issues	Two seminars for Contractor management staff and project staff dealing in environment and social issues	1 day	200,000/Training
<b>Operation Phase</b>  <b>Landfill Facility Operator authorized representative or 3<sup>rd</sup> party trainer</b>	Landfill Facility Operator	Short seminars on Environmental risks associated with operation phase.  Development of Environmental Performance Indicators/ Occupational Health and Safety (OHS) issues	Bi-annual seminars	1-2 Day	600,000/Year
<b>Total</b>			<b>10,00,000 (PKR 1 million)</b>		

## 7.8 Environmental Management Costs

1. The **Table 7.6** below provides cost estimates for 'Pre-Construction phase' monitoring while **Tables 7.7** and **7.8** provides cost estimates for 'Construction phase' and 'Operation phase' monitoring of key environmental parameters.
2. The costs associated with implementation of the EMP and the necessary mitigation measures are provided as **Table 7.9** below. The **Table 7.10** below provides the 'Capacity development and training programme' for project contractors for the proposed landfill development.

**Table 7.6: Annual Cost Estimates for 'Pre-Construction Phase' Environmental Monitoring<sup>21</sup>**

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NO <sub>2</sub> , SO <sub>2</sub> , O <sub>3</sub> , PM <sub>10</sub>	4 (Once only at 4 locations)	120,000	4 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	4 (Once only at 4 locations)	120,000	4 readings @ PKR 30,000 per reading
Ground Water Quality	NEQS	2 (Once only at 2 locations)	60,000	2 readings @ PKR 30,000 per sample
Contingencies			15,000	5% of monitoring cost
<b>Total (PKR)</b>			<b>315,000</b>	

**Table 7.7: Annual Cost Estimates for 'Construction Phase' Environmental Monitoring<sup>22</sup>**

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NO <sub>x</sub> , PM <sub>10</sub>	12 (Quarterly basis at 4 locations)	480,000	12 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	12 (Quarterly basis at 4 locations)	480,000	12 readings @ PKR 30,000 per reading
Contingencies			48,000	5% of monitoring cost
<b>Total (PKR)</b>			<b>1,008,000</b>	

<sup>21</sup> For air quality monitoring: 'Passive samplers' such as test tubes can be used or 'Active samplers' with sorbent tubes can also be used.

<sup>22</sup>For noise monitoring: sampling equipment with duration greater than 1 hour can be used.

**Table 7.8: Annual Cost Estimates for 'Operation Phase' Environmental Monitoring<sup>23</sup>**

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Surface Water Quality	NEQS	2 (bi-annual basis)	60,000	2 readings @ PKR 30,000 per sample
Groundwater Quality in vicinity of landfill site	NEQS	20 (Quarterly basis @ 5 locations)	600,000	20 readings @ PKR 30,000 per reading
Contingencies			33,000	5% of monitoring cost
<b>Total (PKR)</b>			<b>693,000</b>	

**Table 7.9: Estimated Costs for EMP Implementation**

Item	Sub-Item	Estimated Total Cost (PKR)
Staff, audit and monitoring cost <sup>24</sup>	1 person for 24 months (@ 100,000 per month)	2,400,000
Monitoring Activities	Provided separately in Tables 7.7 and 7.8.	-
Mitigation Measures	As prescribed under EMP and IEE.	40,00,000
(i) Water sprinkling	To suppress dust emissions	800,000
(ii) Solid waste collection & disposal	From construction sites (based on initial estimates)	700,000
(iii) Plantation around project boundary to control odor levels	To plant vegetation all along the landfill boundary to limit odor emissions	15,00,000
(iv) Chemicals/pesticides to prevent/minimize disease vector generation	Chemicals to be injected into the influent streams in order to minimize/prevent disease vector generation	10,00,000
Contingencies	5% of EMP implementation cost	320,000
<b>Total Estimated Cost (PKR)</b>		<b>6,720,000</b>

<sup>24</sup> To cover staff cost and expenses of Environmental Specialist for Contractor

**Table 7.10: Capacity Development and Training Programme for Project Contractor(s)**

<b>Provided by</b>	<b>Organized by</b>	<b>Contents and Methodology</b>	<b>Target Audience</b>	<b>Venue</b>	<b>Duration</b>
<b>Pre-construction Phase</b>  PMC offering specialized services in environmental management and monitoring	CSC & PMU	Short seminars and courses on:  Environmental Management Plan and Environmental Monitoring Plan  Methodology: Participatory approach with a before and after quiz or survey to measure the effectiveness of the program	Contractor staff	PMU Office, Kohat	One day long training seminar including group exercise/workshop
<b>Construction Phase</b>  PMC offering specialized services in social management and monitoring	CSC & PMU	Short seminar on Environmental risks associated with construction phase.  Development of Environmental Performance Indicators  Occupational Health and Safety (OHS) issues  Methodology: Participatory approach with a before and after quiz or survey to measure the effectiveness of the program	Contractor staff	PMU Office, Kohat	One day long training seminar including group exercise/workshop

## 8 Public Consultation and Information Disclosure

3. This section describes the process and outcomes of the consultations carried out with various groups of stakeholders as part of the environmental and social assessment. It includes a brief discussion on the concerns expressed by the stakeholders during the consultation meetings and responses provided in order to address the concerns through necessary mitigation measures.
4. The specific objectives of the consultation were: (i) obtaining local and indigenous knowledge about the environment and people living in the project area; (ii) interaction with the project affected population and other stakeholders for the collection of primary and secondary data on environment and people; and (iii) engaging stakeholders for maximization of the project benefits.
5. A total of five comprehensive focus group discussions with stakeholders were organized with a total of over 40 different stakeholders consulted. The first round of public consultations was conducted in the month of May, 2020, while the second round of public consultation was completed in the month of June, 2020. Information on positive and negative impacts associated with constructional and operational stage and proper mitigation of adverse impacts were shared at these consultations.
6. Details on the public consultations conducted are provided below with the pictorial evidences and list of persons consulted provided as **Annexure C**.

### 8.1 Identification of Stakeholders

7. There are three types of stakeholders for the proposed landfill site development as described below.

#### 8.1.1 Primary Stakeholders

8. The primary stakeholders are primarily the Project Affected Persons (PAPs) and general public including women residing in the project area - for example, people living in the project area particularly those affected by the footprint of the Muhammadzai Landfill site, Kohat. These are the people who are directly exposed to the project's impacts, though in most cases they may not be receiving any direct benefit from the project.

#### 8.1.2 Secondary Stakeholders

9. The secondary stakeholders are typically institutional stakeholders – for instance, related government department/agencies, local government, and organizations that may not be directly affected by the project; however, they may influence the project and its design. In the case of the proposed landfill site development, the secondary stakeholders are as follows:
  - Irrigation, Agriculture and EPA Department
  - The ADB (The Financing Agency)
  - Forest and Wildlife Departments, Government of KP

- P&D Department, Government of KP
- Representatives of local communities
- Tehsil Municipal Authority, Kohat
- Irrigation Department, Government of KP
- Revenue Department, Government of KP
- Al-Khidmat Foundation, Government of KP
- Public at large

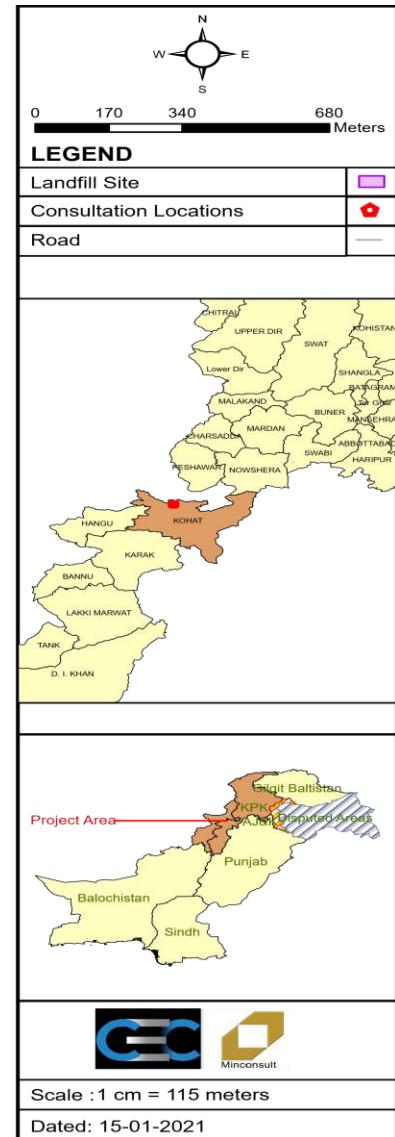
### **8.1.3 Key stakeholders**

10. The stakeholders considered possessing the ability to significantly influence a project, or who are critical to the success of a project are considered key stakeholders. Key stakeholders may be from the primary and/or secondary stakeholder groups. In this context of the proposed landfill site development, these are considered to be local leaders, influential community members and other local representatives including Imams of mosques and teachers of local schools.

## **8.2 Information Disclosure and Consultation**

### **8.2.1 Scope of Consultations**

11. The consultations were conducted and recorded by Mr. Musaddiq Shah (Sociologist), Mr Zeeshan (Sociologist), Mr Waji Ul Hasan (Sociologist) and Mr.Ibrahim Atiq (Environmentalist). The stakeholders were also briefed by PMU Project associate Mr Asad Jan and Senior Sociologist PMU Hashmat Khan. During these consultations, the primary and secondary stakeholders were briefed on the project components in detail and all their concerns and feedback was recorded.
12. All consultations were carried out in accordance with the ‘meaningful consultation’ guidelines of ADB’s SPS 2009 and their outcome is discussed in the proceeding sections. Consultations were also held with the PMU, Local Government Board and the design consultants.
13. As part of the present environmental and social assessment, detailed consultations with over 40 different stakeholders were conducted through village meetings and focus group discussions (FGDs) with the communities, including women in the project area. Separate meetings were held with the institutional stakeholders in the form of one-to one meetings i.e. with EPA, WSSCK, etc. Specially, prepared consultation performa was used during the data collection. Details of this consultation process are described in the **Table 8.1** below and the locations of the Public consultations are provided in **Figure 8.1** below. Photographs of institutional stakeholders are provided in **Figure 8.2**. Photographs of FGDs are provided in **Figure 8.3**. Photogrpahs of scavangers consultations are provided as **Figure 8.4**.

**Figure 8-1: Map of Public Consultation Locations****Map Showing Locations of Consultation Around Kohat Landfill Site**

**Table 8.1: List of Stakeholder Consultation and Concerns**

<b>Sr. No.</b>	<b>Date</b>	<b>Location of Consultation</b>	<b>Total No. of Participants</b>	<b>Comments/Concerns</b>	<b>Consultant Response</b>
i	06/05/20	Oblan Camp	05	Dumping sites for municipal/sanitary waste has also been located before the proposed site. But due to open dumping, the spread of diseases and odor problems became a major problem for the surrounding area residents.	Waste Management and transportation plan shall be properly implemented.  Educating about the technologies that go into sanitary landfills which will alleviate disease and odor problem
ii	06/05/20	Recycling Plant Kohat	07	The local people appreciated the initiative taken for managing the solid waste problem.  These people were only concerned that adequate and efficient transportation of solid waste to the targeted proposed landfill shall be followed	Preparation and implementation of community EHS plan.  Preparation of waste transport management plan.  Selection of proper vehicle parking areas.
iii	07/05/20	Laal Mela	12	The locals demanded for new road infrastructure to be provided to their village.  The new landfill technology shall control the odor problem and prevent the spread of disease.	Educating about the technologies that go into landfills which will eliminate disease and odor problem.  Preparation of green belt along the boundary limits of the landfill site.

Sr. No.	Date	Location of Consultation	Total No. of Participants	Comments/Concerns	Consultant Response
iv	01/06/20	Muhammad Zai	05	<p>Land acquisition for the proposed landfill site is a major concern for the people of Muhammad Zai village.</p> <p>The locals demanded road access shall be improved. They were also concerned for educational awareness of their community as literacy rate was below in their neighborhood.</p> <p>Provision of health facilities for residents was one of their basic concerns.</p> <p>They also advised that proper mitigation plans shall be followed after construction/installation of the proposed sanitary landfill</p>	<p>Timely compensation against the resettlement issues shall be made sure.</p> <p>Educating about the technologies that go into landfills which will eliminate disease and odor problem.</p> <p>Implementation of EMP i.e. spraying of flees and mosquito killer reagents at site</p>
v	03/06/20	Muhammad Zai	11	<p>The idea of installation of sanitary landfill technology was praised by the local community of Muhammad Zai, Kohat.</p> <p>They however demanded for better health facilities to be provided for the residents as no respectable BHU was situated In the nearby area.</p>	<p>Project design and implementation will be socially and environmentally sustainable.</p> <p>The betterment of health infrastructure issue shall be communicated to the respective department of the government.</p>

**Table 8.2: Consultations with Government Stakeholders**

<b>Sr. No.</b>	<b>Date</b>	<b>Department of Consultation</b>	<b>Designation of Person</b>	<b>Comments/Concerns</b>	<b>Consultant Response</b>
1	4-2-20	EPA Head Office Peshawar	DD-EPA	The design and project implementation shall be in compliance with the KPEPA 2014 and NEQS. Project proponent shall obtain the approval before to start any activity at site.	After the detail design and all mandatory financial arrangement project proponents will make a liaison with EPA for necessary applicable approval.
2	4-2-20	PkHA	DD-Env.& reset	The designer shall also assess the carrying capacity of road network of the area before selection of the final site	All physical structures and road network assessment is also part of the feasibility and will be considered during the detail design.
3	19-10-20	PkHA	Director-1 (Maintenance)	He emphasized the importance of ensuring environmental safeguards through conducting thorough and comprehensive Environmental Impact Assessments. If any roads providing access to various landfill or treatment plant sites require rehabilitation or expansion and fall under PKHA jurisdiction, he advised and assured that all relevant protocols will be followed.	All necessary protocols will be followed and comprehensive IEE report will be prepared.

<b>Sr. No.</b>	<b>Date</b>	<b>Department of Consultation</b>	<b>Designation of Person</b>	<b>Comments/Concerns</b>	<b>Consultant Response</b>
4	17-3-20	Alkhidmat Foundation Peshawar Bazar	Office Manager	He appreciated the project and government initiations.	Project design and implementation will be socially and environmentally sustainable.
5	17-3-20	Environment Practitioner	Environment Practitioner	He appreciated the project and government initiations and emphasizes the project implementation in accordance to environmental laws.	Project design and implementation will be socially and environmentally sustainable.
6	19-10-20	P& D Department	Director Sustainable Development Unit (SDU)	He expressed an interest in facilitating the necessary fulfillment of the environmental and social safeguard criteria.	All necessary protocols will be followed as per environmental and social safeguard criteria
7	19-10-20	KP Wildlife Department	District Forest Officer-Wildlife	She stressed the need to conserve the natural environment as best possible. She suggested that GIS database of project sites' surrounding areas may be prepared as it will help track the natural environmental and any changes to it caused by the projects.	Consultation response of KP wildlife department has been noted and it will be made part of IEE report.
8	20-10-20	Irrigation Department	SE Headquarter	He explained that it is not just the solid waste being dumped in canals and streams which are a major	Consultation response of KP irrigation department has been noted and it

Sr. No.	Date	Department of Consultation	Designation of Person	Comments/Concerns	Consultant Response
				<p>concern for the department as far as sources of irrigation are concerned. An even more potent negative impact is caused by the effluent that is directly disposed of into these water bodies. He expressed optimism over the various different subprojects of KPCIP, anticipating a synchronized effect of the different waste management, sewerage treatment, water supply and green urban spaces subprojects that will ultimately influence a positive change in the different cities' natural environments and the lives of their many residents.</p>	will be made part of IEE report.
9	09-11-20	KP Forestry Department	Conservator, Forestry	<p>The conservator suggested that indigenous species of flora may be planted across the boundaries of the proposed project site. He also suggested assigning some project area to a small nursery from where the plants shall be provided to the</p>	Consultation response of KP Forestry department has been noted and it will be made part of IEE report.

<b>Sr. No.</b>	<b>Date</b>	<b>Department of Consultation</b>	<b>Designation of Person</b>	<b>Comments/Concerns</b>	<b>Consultant Response</b>
				locals for plantation as to mitigate the effect of poor air quality due to brick kilns present in the vicinity.	

**Figure 8-2: Consultations with Institutional Stakeholders**

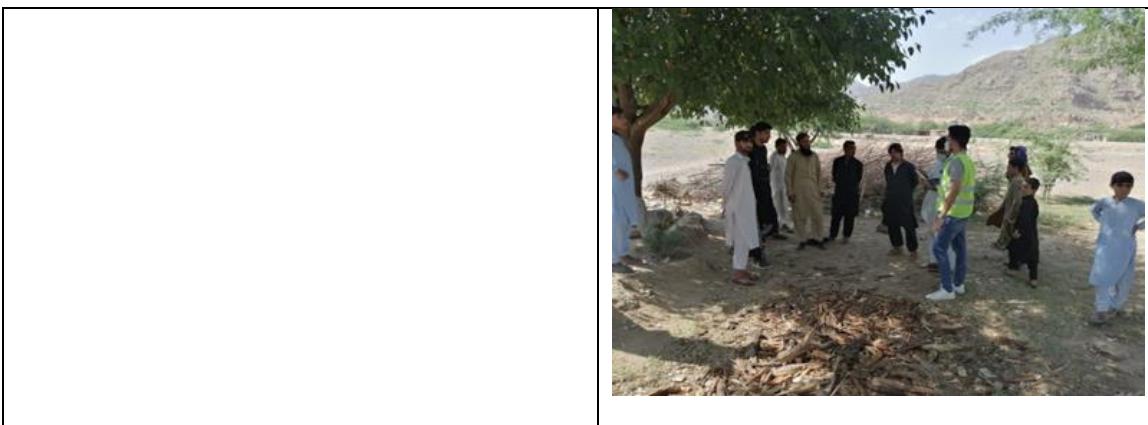
	
Meeting with Conservator, Forestry (KP Forestry Department, Headoffice)	Consultation with DD-EIA, KP-EPA
	
Meeting with DFO, Wildlife (KP Wildlife Department, Headoffice)	Consultation with Irrigation Department
	
Meeting with Director-I PKHA (Pakhtunkhwa Highways Authority)	Meeting with Director SDU (Sustainable Development Unit) P&D Department

	
PMU & EDCM Environmental and Social Safeguards experts meeting with WSSC-Kohat	Meeting on KPCIP with ADC (Revenue) and DC Kohat.

### 8.2.2 Social Safeguard Focus Group Discussions

14. After initial survey by Social Safeguard team, the overall number of directly affected people from the proposed landfill site was known. Every affected person was reached out and interviewed by social safeguard team as per ADB requirements. These people were interviewed about the land area they share in the project area and their entire social status including details of their income, food expenditure, basic life amenities, living background etc. Till date, most of those people including both men and women have been interviewed and their observations have been noted down while the rest is in progress. The process was started in first week of May'20, but due to COVID-19 pandemic and lockdown in the entire country and due to migration of some affectees to foreign countries, the data collection and interviewing process got slowed down.
15. Consultation with the affectees was conducted within their settlements to encourage and facilitate their participation. Separate sessions are being arranged for the women. During the consultation process, a verbal detailed description of the Project activities was provided to those interviewed.

**Figure 8-3: Focus Group Discussions (FGDs) for Kohat SWMF**



Consultation with secondary stakeholders in KDA Phase 02, Kohat	Consultation with secondary stakeholders in Laal Maila, Kohat
Consultation with secondary stakeholders in Oblan Camp, Kohat	Consultation with secondary stakeholders in Recycling plant, Kohat
Consultation with secondary stakeholders in Muhamad Zai, Kohat	Consultation with secondary stakeholders in LaalMaila, Kohat

### **8.2.3 Findings of the Public Consultations/Focal Group Discussions**

16. All the directly affected people were the owners of proposed landfill property so majority of those affected people had observation regarding land settlement process as they stated that the government always pays less for any land acquitted from the public. Those people demanded that they shall be paid a handsome amount for their acquitted land. Some of those affected households demanded for alternate land as a payment method, while the rest demanded cash in return for their acquitted land.
17. All the indirectly affected people included the population living in the vicinity of the project area. Those people complained about the smell issues and spreading of different diseases in the project area due to open dumping of untreated solid waste in the proposed landfill site. Due to variation in direction and flow of wind in summers, the odor problem was observed to be increased and hence causing the spread of fever and skin diseases.
18. Power load shedding is adversely affecting the daily lives of residents as the only source of power in the vicinity of the project area is through solar panels which the locals have installed on their own finances.
19. Health, education, and drinking water facilities shall be provided, following the Project development.
20. There are no public tube wells and pipeline structure to facilitate water source for the people in the vicinity of the project area. The locals have installed private tube wells to keep up with the water resources.

### **8.2.4 Response from Social Safeguards Team**

21. Our team made sure that the affected people were given full surety regarding their demands.
22. The people directly affected from the project were told on spot that they would be given payment of their acquitted land after completion of the entire process and that they would be called to DC office and the cheques would be issued in the name of each landowner of the proposed landfill site to make sure no one misses out on their right.
23. The people indirectly affected from the project were told about the new technological installation in the project area as installation of new engineered landfill would reduce the odor issue and hence reduction in spreading of different diseases.
24. The people were made sure that their demands reach to the higher authorities and that the basic life amenities be provided to them once work on project gets initiated.

### **8.2.5 Consultations with Scavengers and Scrap Dealers**

25. During the scoping of environmental and socioeconomic studies of the project area, these groups were identified as important stakeholders which will be influenced in some form or another. To gather more information on the nature and extent of this influence, a data collection and analysis strategy was devised by the environmental experts, relevant literature consulted and compiled (included previously our project data), questionnaires drafted and site visits conducted. All these activities are described below.

26. The process of consultation was planned to begin with contacting the workers collecting waste door-to-door every morning, and progressing step by step through scrap collection and sorting facilities of various capacities, possibly including the transporters associated along the way, up till the larger scrap recycling or management facilities.
27. The initial few visits conducted by the environmental team, covering most of the aforementioned groups, yielded some useful data which projects a picture of the current operations within the informal waste management system structure. Details of their operations, income levels and their opinions, particularly concerns, are given in at the end of this section. The summary of the consultation data is provided in the **Table 8.3** below. Photographs of scavenger's consultations are provided in **Figure 8.4**.
28. Based on these consultations, some general conclusions can be derived regarding the prevailing scavenging and informal waste recycling system in operation, as well as its scope of potential involvement in the proposed ISWM system, which are summarized below:
  - Majority of stakeholders consulted expressed the need for some form of government formalization, management or oversight is needed in order to better manage the operation of the landfill site, once developed, regardless of their position or significance in the system's chain.
  - Improvements in physical equipment and facilities made available to the operators will serve to improve their working conditions and income levels.
  - The reason that most scavengers and waste-pickers adopt this line of work is due to necessity born out of a lack of employment opportunities of any other kind.
  - Those stakeholders in the waste management business doing well financially appear to have been involved in this line of work for a longer period, pointing to the benefits of persistence and experience in this business. In their position, they are no longer limited by work options and do this type of business more by choice and in anticipation of significant profits.

**Table 8.3: Consultations with Scavengers and Scrap Dealers**

<b>Sr. No.</b>	<b>Date</b>	<b>Location of Consultation</b>	<b>Total No. of Participants</b>	<b>Comments/Concerns</b>	<b>Consultant Response</b>
1	22/7/20	Peshawar Road, Kohat	1	<b>(Scrap dealer)</b> The reason for adopting this line of work is a lack of other employment opportunities. They would like to see government supervision to the extent that it results in an improvement in their working conditions and secure income.	The new system will carefully consider some level of formalization of the informal network, in order to facilitate improvement in working conditions and creating secure employment.
2	22/7/20	Peshawar Road, Kohat	1	<b>(Scrap dealer)</b> Government supervision and support in order to improve working condition and formalize their employment.	The new system will carefully consider some level of formalization of the informal network.
3	22/7/20	Peshawar Road, Kohat	1	<b>(Scrap dealer)</b> Highly informal income source, necessitated due to lack of education, employment options and government support or supervision of any kind.	The new system will carefully consider some level of formalization of the informal network.
4	22/7/20	Peshawar Road, Kohat	1	<b>(Large scrap dealer)</b> Not many income related concerns at this large level of operation. Employees' working conditions are tough but monetary compensation is comparatively better. Cooperation with government possible and	Proper consideration will be given to develop measures that do not disrupt the existing profitable and efficiently running operations, as is the risk when government involvement usually takes place.

Sr. No.	Date	Location of Consultation	Total No. of Participants	Comments/Concerns	Consultant Response
				beneficial to the extent that it does not restrict their existing operations.	

**Table 8.4: Responses from Scavengers based on Survey Questions**

Name, Details	Responses
• Rehmat Gul 30, scrap dealer, Peshawar Road, Kohat	<p><b>Amount of waste collected/day:</b> 20 to 30 kg per day.</p> <p><b>Usefulness of that waste:</b> The waste consists on mostly food (dried bread) and some amount of other scrap cardboard or plastic.</p> <p><b>Procedure for collection:</b> There are 3 to 4 employees who drop the scrap that they have collected.</p> <p><b>Usual cost and time spent:</b> Regular working hours. Cost include wages and rent.</p> <p><b>Amount of income generated:</b> Income ranges between Rs6000 to 10000.</p> <p><b>Source of income:</b> This is his only occupation. Since 12 years.</p> <p><b>End use of waste:</b> The salvaged food is used to prepared livestock feed, either directly or after being sold to bigger scrap dealers.</p>

<b>Name, Details</b>	<b>Responses</b>
	<p><b>Motivation/reason for this job:</b> Lack of job opportunities, financial responsibilities.</p> <p><b>Working relationship with any government authority:</b> No relationship. Private business.</p> <p><b>Expected improvements in the system/Comments:</b> Working conditions are difficult. Government departments' supervision or endorsement will help.</p> <p>On this stretch of Peshawar Road, there would be an estimated 20-25 similarly sized scrap dealers, some focusing on particular types of recyclables. Most of them sell to bigger scrap dealers in the area, while some hire transport and sell to large markets in Lahore etc.</p>
<ul style="list-style-type: none"> <li>• Habib 20, scrap dealer, Peshawar Road, Kohat</li> </ul>	<p><b>Amount of waste collected:</b> Around 20-30kg of useful recyclable waste is received in a day.</p> <p><b>Usefulness of that waste:</b> The waste includes food, cardboard and plastic.</p> <p><b>Procedure for collection:</b> One employee hired to collect and bring scrap.</p> <p><b>Usual cost and time spent:</b> The space is owned so he does not pay rent. Costs include purchasing of recyclable waste and employees' wages.</p> <p><b>Amount of income generated:</b> Not disclosed.</p> <p><b>Source of income:</b> This is the only source of income.</p>

Name, Details	Responses
	<p><b>End use of waste:</b> The waste is sold to bigger scrap dealers.</p> <p><b>Motivation/reason for this job:</b> Financial responsibility, lack of other job prospects.</p> <p><b>Working relationship with any government authority:</b> Private venture, no working relationship.</p> <p><b>Expected improvements in the system:</b> Government oversight would be beneficial.</p>
<ul style="list-style-type: none"> <li>• Rehmat 24, scrap dealer, Peshawar Road, Kohat</li> </ul>	<p><b>Amount of waste collected:</b> 50 to 60 kg daily.</p> <p><b>Usefulness of that waste:</b> The waste arrives mostly sorted and ready to be sold onwards.</p> <p><b>Procedure for collection:</b> There are 10 employees, who transport the waste with the assistance of KDA, through provision of vehicles or designated pick up spots.</p> <p><b>Usual cost and time spent:</b> Mostly employees' wages.</p> <p><b>Amount of income generated:</b> Not disclosed.</p> <p><b>Source of income:</b> This is the only occupation.</p> <p><b>End use of waste:</b> The waste goes to large scrap facilities in Lahore and Gujranwala through external transporters.</p>

Name, Details	Responses
	<p><b>Motivation/reason for this job:</b> Lack of other job opportunities.</p> <p><b>Working relationship with any government authority:</b> Although his operations are private, he does have a working relationship with KDA that effectively authorizes him to collect useful recyclable in order to assist municipal waste management to some extent. (This informal authorization is not exclusive to him and his business, meaning there is potential for other such operators to enter this market.)</p> <p><b>Expected improvements in the system:</b> Incentives or subsidies from government departments or authorities can make this activity more streamlined and lucrative.</p>
<ul style="list-style-type: none"> <li>• Shafi</li> </ul> <p>39, manager at a large scrap yard, Peshawar Road, Kohat</p>	<p><b>Amount of waste collected:</b> Several loads of carts, Qingqis and even larger carry vehicles. These are bought by the yard. Around 400-500kg in a delivery, and 2 to 3 such deliveries in a day.</p> <p><b>Usefulness of that waste:</b> The waste comprises of plastic, metal, paper, cardboard, food, electronics and appliances, animal skin and hoofs, and other different types of material which has the potential for reuse or recycling.</p> <p><b>Procedure for collection:</b> Waste requires some sorting but overall is in a state where it can be readily hauled into large trucks to be sold to market onwards. 12-15 workers are present at any time to perform these tasks.</p> <p><b>Usual cost and time spent:</b> Full time operation involving several employees. Costs include waste procurement and employees' wages.</p> <p><b>Amount of income generated:</b></p>

<b>Name, Details</b>	<b>Responses</b>
	<p>Not disclosed.</p> <p><b>Source of income:</b> This is his full time occupation. He has been in the position for 4 years.</p> <p><b>End use of waste:</b> The waste is transported in large trucks to markets in Peshawar, Lahore and Gujranwala around 3 to 5 times a week.</p> <p><b>Motivation/reason for this job:</b> This business provides steady income source.</p> <p><b>Working relationship with any government authority:</b> This is a private operation, no working relationship.</p> <p><b>Expected improvements in the system:</b> No significant comments or insight regarding operations or working conditions.</p>
<ul style="list-style-type: none"> <li>• Miskeen Khan, WSSC Kohat employee, DHQ Hospital Kohat</li> </ul>	<p>As an observational visit, the WSSC-Kohat representative assisting in the consultations remarked that the DHQ Hospital is one of the major scavenging hotspots, posing a serious Health and Safety risk to patients, passers-by, residents, as well as the scavengers and occasional squatters themselves. Scavengers regularly attempt to sort through hazardous hospital, which instead of being incinerated at the premises, is dumped over the boundary wall onto the road, thereby providing easy access to the scavengers. Metals, syringes, cannulas, tubes, bottles, bandages are perceived as items which will generate some monetary value if sold on to places which deal in their reuse.</p>

**Figure 8-4: Consultations with Scavengers/Waste Handlers**

### 8.3 Consultation Plan for Construction and Operation Phase

29. Consultation plan for construction and operation phase of Kohat SWMF will be prepared in order to take response of project stakeholders and general public about the project. Periodic consultations and community feed back surveys will be carried out to develop positive perception about the project. Intended stakeholders for such consultations will be

all stakeholders that are consulted at the time of IEE preparation and KPCIP PRF processing. Record of such consultations will be maintained at PMU/WSSCK offices and necessary changes in operational modalities will be introduced in the system in light of the response provided by the consultees.

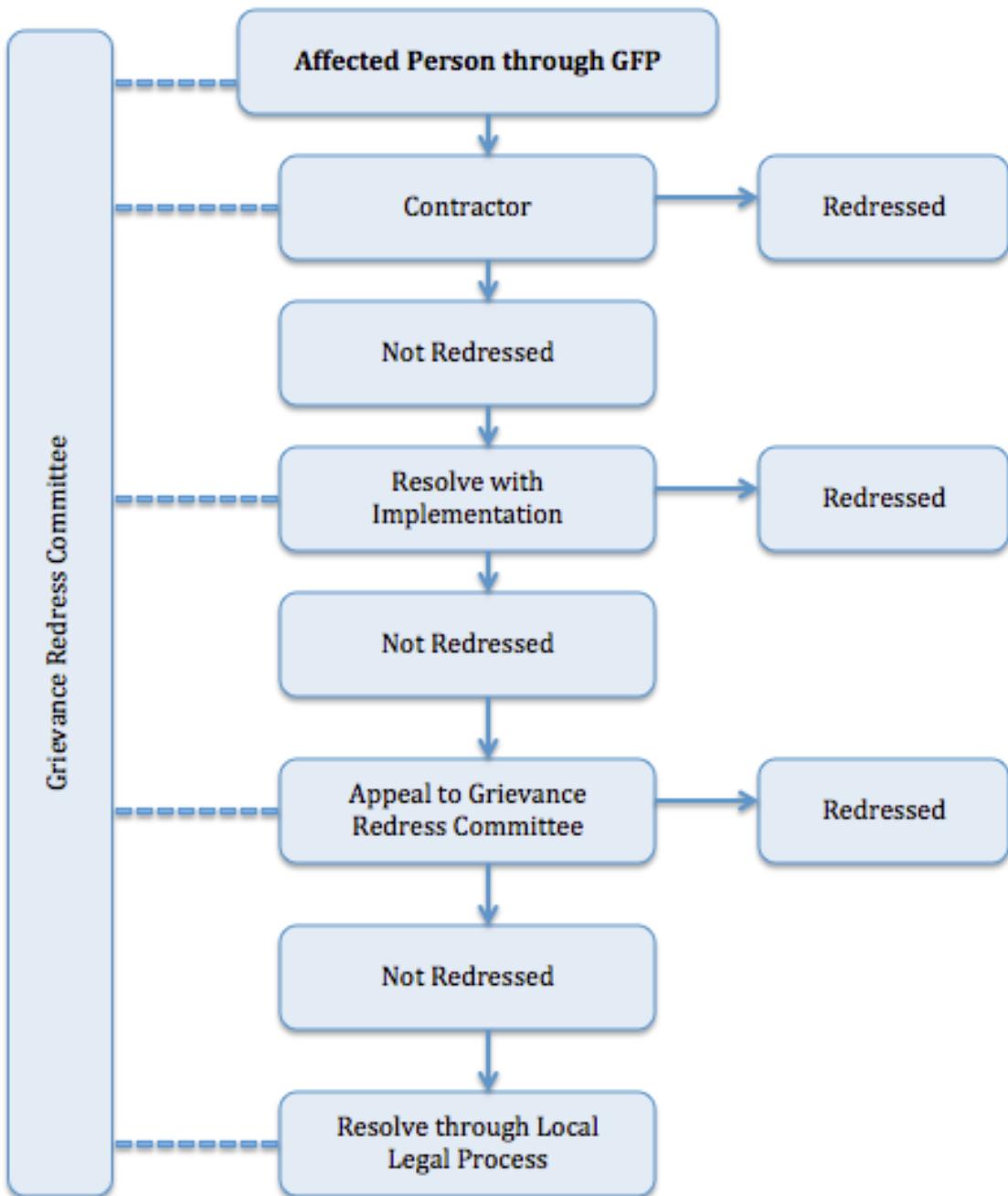
30. The IEE study including the EMP will be disclosed locally at PMU KPCIP website at least two weeks prior to the next consultation to allow the public time to read, look for information or consult experts, and form opinions.

## 9 Grievance Redressal Mechanism

### 9.1 General

31. The ADB Policy (SPS 2009) requires establishment of a local grievance redress mechanism to receive and facilitate resolution of the Displaced/Affected Persons concerns and grievances regarding the project's social and environment performance. The measures have been identified to mitigate any potential environmental and social impacts to be caused due to implementation of the landfill works.
32. However, in spite of best efforts, there is chance that the individuals / households affected by the project or other stakeholders are dissatisfied with measures adopted to address adverse social impacts of the project. To address, such situation an effective Grievance Redress Mechanism (GRM) will be established to ensure timely and successful implementation of the project. It will also provide a public forum to the aggrieved to raise their objections and the GRM would address such issues adequately. It will receive, evaluate and facilitate the resolution of displaced persons' concerns, complaints and grievances about the social and environmental performance at the level of the project.
33. The GRM will aim to investigate charges of irregularities and complaints receive from any displaced persons and provide a time-bound early, transparent and fair resolution to voice and resolve social and environmental concerns link to the project.
34. The PMU shall make the public aware of the GRM through public awareness campaigns. The name of contact person(s) and his/her phone number, PMU contact numbers will serve as a hotline for complaints and shall be publicized through the media and placed on notice boards outside their offices, construction camps of contractors, and at accessible and visible locations in the project area. The project information brochure will include information on the GRM and shall be widely disseminated throughout the project area. Grievances can be filed in writing, via web-based provision or by phone with any member of the PMU.
35. **First tier of GRM.** The PMU is the first tier of GRM which offers the fastest and most accessible mechanism for resolution of grievances. The PMU staff for environment and social safeguards will be designated as the key officers for grievance redressal. Resolution of complaints will be completed within seven (7) working days. Investigation of grievances will involve site visits and consultations with relevant parties (e.g., affected persons, contractors, traffic police, etc.). Grievances will be documented and personal details (name, address, date of complaint, etc.) will be included, unless anonymity is requested. A tracking number will be assigned for each grievance, including the following elements:
  - Initial grievance sheet (including the description of the grievance), with an acknowledgement of receipt handed back to the complainant when the complaint is registered;
  - Grievance monitoring sheet, mentioning actions taken (investigation, corrective measures);
  - Closure sheet, one copy of which will be handed to the complainant after he/she has agreed to the resolution and signed-off.

- The updated register of grievances and complaints will be available to the public at the PMU office, construction sites and other key public offices in the project area. Should the grievance remain unresolved, it will be escalated to the second tier.
36. **Second Tier of GRM.** The PMU will activate the second tier of GRM by referring the unresolved issue (with written documentation) to the Water Sanitation and Services Company (WSSCK), Kohat who will pass unresolved complaints upward to the Grievance Redress Committee (GRC). The GRC will be established by WSSCK before start of site works. The GRC will consist of the following persons: (i) Project Director; (ii) representative of District government; (iii) representative of the affected person(s); (iv) representative of the local Deputy Commissioners office (land); and (v) representative of the KP EPA (for environmental-related grievances). A hearing will be called with the GRC, if necessary, where the affected person can present his/her concerns/issues. The process will facilitate resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within fifteen (15) working days. The contractor will have observer status on the committee. If unsatisfied with the decision, the existence of the GRC will not impede the complainant's access to the Government's judicial or administrative remedies.
37. The functions of the local GRC are as follows: (i) resolve problems and provide support to affected persons arising from various environmental issues and including dust, noise, utilities, power and water supply, waste disposal, traffic interference and public safety as well as social issues and land acquisition (temporary or permanent); asset acquisition; and eligibility for entitlements, compensation and assistance; (ii) reconfirm grievances of displaced persons, categorize and prioritize them and aim to provide solutions within a month; and (iii) report to the aggrieved parties about developments regarding their grievances and decisions of the GRC.
38. The WSSCK officers will be responsible for processing and placing all papers before the GRC, maintaining a database of complaints, recording decisions, issuing minutes of the meetings and monitoring to see that formal orders are issued and the decisions carried out.
39. **Third tier of GRM.** In the event that a grievance cannot be resolved directly by the PMU (first tier) or GRC (second tier), the affected person can seek alternative redressal through the district or sub-district committees as appropriate. The PMU or GRC will be kept informed by the district, municipal or national authority. The grievance redress mechanism and procedure are depicted in the **Figure 9.1** below. The monitoring reports of the EMP and RP implementation will include the following aspects pertaining to progress on grievances: (i) Number of cases registered with the GRC, level of jurisdiction (first, second and third tiers), number of hearings held, decisions made, and the status of pending cases; and (ii) lists of cases in process and already decided upon may be prepared with details such as Name, ID with unique serial number, date of notice, date of application, date of hearing, decisions, remarks, actions taken to resolve issues, and status of grievance (i.e., open, closed, pending).
40. In order to provide greater clarity, the pictorial description of the GRM is provided in **Figure 9.1** below.

**Figure 9-1: Grievance Redressal Mechanism**

## 10 Conclusion and Recommendations

41. The development of the proposed SWMF project in Kohat is of high significance considering the urgent need for improving the SWM system of Kohat city.
42. Primary and secondary data has been collected and used to assess the environmental impacts of the Project. This IEE report highlights all potential environmental impacts associated with the Project and recommends mitigation measures. Any environmental impacts associated with the project need to be properly mitigated, through the existing institutional arrangements described in this report.
43. The majority of the environmental impacts are associated with the operation phase of the project since these will be long term, such as Generation of objectionable Odor and impact on air quality, Attraction of Vermin and disease vector generation, Leachate generation, Possible contamination of Soil and Groundwater, Generation of Landfill Gas etc., to name a few.
44. The implementation of mitigation measures during this period will be the responsibility of the Contractor. Therefore, the required environmental mitigation measures will have to be clearly defined in the bidding and contract documents, and appropriately qualified environmental staff retained by the Consultant to supervise the implementation process. The EMP includes measures to minimize project impacts due to noise and air pollution, waste generation etc.
45. The EMP contained within this IEE document is considered sufficient for issuance as part of the Contracts to the successful bidder(s) and for subsequent use during the project works. It should be mentioned that prior to the commencement of works, this EMP must be further updated by the Contractor into site specific EMPs (SSEMPs) for review and approval of ADB. In these SSEMPs, aspects such as a detailed traffic management plan, identification of locations for disposal of debris and spoil and any other details which shall become available later must be included for efficient implementation of all proposed mitigation measures and the subsequent monitoring of these measures.
46. This project has been assigned environmental category 'B' in accordance with the ADB's Safeguard Policy Statement (SPS) 2009 and Schedule II as per EPA, IEE and EIA Gazette Notification, 2000. Thus, a comprehensive IEE report has been prepared for the proposed project.

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# **ANNEXURES**

## **Annexure A**

## **REA Checklist**

## Rapid Environmental Assessment (REA) Checklist

### Instructions:

- (i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES) for endorsement by the Director, RSES and for approval by the Chief Compliance Officer.
- (ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.
- (iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title:

Pakistan/Kohat SWMS Development

Sector Division:

Solid Waste Management in Urban Environment

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area...			
▪ Densely populated?		✓	
▪ Heavy with development activities?		✓	
▪ Adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site		✓	
• Protected Area		✓	
• Wetland		✓	
• Mangrove		✓	
• Estuarine		✓	
• Buffer zone of protected area		✓	

Screening Questions	Yes	No	Remarks
• Special area for protecting biodiversity		✓	
• Bay		✓	
B. Potential Environmental Impacts Will the Project cause...			
▪ impacts associated with transport of wastes to the disposal site or treatment facility	✓		
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		✓	
▪ degradation of aesthetic and property value loss?	✓		However, best management practices will be adopted as a part of EMP to improve the aesthetic quality of the site.
▪ nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc.?	✓		The design of the facilities will ensure that odor nuisances, infestations and other contaminations are minimized by providing a buffer zone.
▪ dislocation or involuntary resettlement of people?		✓	Though the land is not acquired yet
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?	✓		However, there are no indigenous people.
▪ risks and vulnerabilities related occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?	✓		However, these impacts would be mitigated by applying best management practices and engineering solutions.
▪ public health hazards from odor, smoke from fire, and diseases transmitted by flies, insects, birds and rats?	✓		However, these impacts would be mitigated by applying best management practices and engineering solutions.
▪ deterioration of water quality as a result of contamination of receiving waters by leachate from land disposal system?	✓		Protective measures to control water contamination from leachate will be adopted during the design of sanitary landfill site.
▪ contamination of ground and/or surface water by leachate from land disposal system?	✓		Leachate collection and treatment system would be given in the design.
▪ land use conflicts?		✓	
▪ pollution of surface and ground water from leachate coming from sanitary landfill sites or methane gas produced from decomposition of solid wastes in the absence of air, which could enter the aquifer or escape through soil fissures at places far from the landfill site?	✓		Mitigation measure would be adopted to control the leakage and collection of leachate and methane gas.

Screening Questions	Yes	No	Remarks
▪ inadequate buffer zone around landfill site to alleviate nuisances?		✓	Inside the boundary wall, tree plantation will be done to create environmental barrier between the external and internal environment.
▪ road blocking and/or increased traffic during construction of facilities?	✓		Traffic management plan would be developed and implemented by contractor.
▪ noise and dust from construction activities?	✓		Mitigation measures will be adopted to control dust and noise pollution during construction.
▪ temporary silt runoff due to construction?	✓		Appropriate mitigation measures will be adopted to control the silt runoff (such as silt fences or sedimentation basins).
▪ hazards to public health due to inadequate management of landfill site caused by inadequate institutional and financial capabilities for the management of the landfill operation?	✓		Capacity building will be carried out for the WSSC-Kohat employees for the management of landfill operations.
▪ emission of potentially toxic volatile organics from land disposal site?		✓	Toxic emissions such as landfill gas from the site are possible
▪ surface and ground water pollution from leachate and methane gas migration?	✓		Mitigation measures will be adopted to control surface and water pollution from leachate and methane migration.
▪ loss of deep-rooted vegetation (e.g. trees) from landfill gas?	✓		Mitigation measures will be adopted to collect landfill gas.
▪ explosion of toxic response from accumulated landfill gas in buildings?	✓		This potential risk exists and will be mitigated through required mitigation measures.
▪ contamination of air quality from incineration?		✓	
▪ public health hazards from odor, smoke from fire, and diseases transmitted by flies, rodents, insects and birds, etc.?	✓		Proper mitigation measures will be adopted to control the spread of infectious diseases.
▪ health and safety hazards to workers from toxic gases and hazardous materials in the site?	✓		Safety mitigation measures will be adopted to protect workers (as per IFC/EHS guidelines).
▪ large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?	✓		Contractor will give preference to hiring local labor.
▪ social conflicts if workers from other regions or countries are hired?		✓	Not expected

Screening Questions	Yes	No	Remarks
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	✓		Mitigation will be adopted for the proper transportation and storage of hazardous materials.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components (e.g., landfill or incinerator) of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	✓		Design engineers will consider the hydrology and seismicity of the selected area to incorporate appropriate features in the designs. ERP would be the part of EMP

Climate Change and Disaster Risk Questions	Yes	No	Remarks
The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.			
▪ Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes (see Appendix I)?	✓		Yes, it is subject to earthquakes, landslides and storm surges (that could be aggravated by climate change).
▪ Could changes in precipitation, temperature, salinity, or extreme events over the Project lifespan affect its sustainability or cost?	✓		In case of higher precipitation events, handling costs could go up.
▪ Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		✓	
▪ Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., increasing traffic or housing in areas that will be more prone to flooding, by encouraging settlement in earthquake zones)?	✓		Methane and carbon dioxide emissions from the landfill will contribute to higher atmospheric temperatures and precipitation.

## **Annexure B**

# **Questionnaires for Conducting FGDs & Surveys**

Focal Group Discussion (FGDs)

Project Name:

Venue:

Sr no \_\_\_\_\_

Date:

Sr no	Name	Profession	CNIC	Moza/Village UC, Tehsil & District	Signature/Thumb
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

**SOCIO-ECONOMIC AND MIGRATION SURVEY FOR KUCHIUM PROJECT**

Date: \_\_\_\_\_

Sl No. \_\_\_\_\_

**1. Identification**

1.1 Name of Respondent

1.2 Father's Name

1.3 Respondent CNIC No:

1.4 Tribe

1.5 Address: Village:

Town:

Tehsil:

District:

Province:

1.6 Demographic Profile of Respondent (Children up to 10 yrs (#): M

FM      =T      )

Sr. No.	Relationship with Respondent (See codes)	Sex Male=1 Female=2	Age (Yrs.)	Education (See Codes)	Name of Business/ Occupation (See Codes)		Income From Business/ Occupation (Rs./ Annum)		Diseases During Last Year (See codes)
					Main	Secondary	Main	Secondary	
1	SELF								
2									
3									
4									
5									
6									
7									
8									
9									
10									

\*Other: Rent from property, remittances, net sale of items during a year, net income from agriculture etc.

Demographic Codes:

Relationship: 1=Self, 2=Wife, 3=Son, 4=Daughter, 5=Father, 6=Mother, 7=Brother, 8=Sister, 9=Grand Father, 10=Grand Mother, 11=Bhabhi, 12=Nephew, 13=Father-in-Law, 14=Mother-in-Law, 15=Others

Sex: 1=Male, 2=Female

Education: 1= Primary 2= Middle 3= Matric, 4= Intermediate, 5= BA/BSc, 6= MA/MSc, 7=LLB, 8=Engineer, 9=MBBS, 10=Technical Diploma, 11=Dars-e-Nizami, 12=CanRead Quran, 13= Can Insert Signatures, 14= Illiterate,

Occupations: 1=Agriculturist, 2=Shopkeeper, 3= Trader, 4= Govt. Servant, 5=Private Servant, 6=Timber Labour, 7=General Labour, 8=Livestock, 9=Fishing, 10=8=Driver, 11=Health Related, 12=Educator/Teacher, 13=House-Maid, 14= House Wife, 15=Gone Abroad, 16=Gone out City within Pakistan

Diseases: 1=Diarrhea, 2=Measles, 3=Hepatitis, 4=Typhoid, 5=HIV/AIDS, 6=Polio, 7=Cholera, 8=Tuberculosis, 9=Heart Disease, 10>No Disease,

- 1.7 Are you member of any village Community organization \_\_\_\_ 1. Yes  2. No   
 1.8 If yes, which of the following organizations?

- i. Religious      ii. Political      iii. Law & Order  
 iv. Educational (formal/informal)  
 v. Community Organization      vi. Local Jirga  
 vii. Youth Organization      viii. Any other
2. Land Utilization

Land	Acre	Kanal	Maria
Total Area owned			
Total Cultivated Area			
Area Under Rabi (winter) Crops			
Area Under Kharif (summer) Crops			
Uncultivated Area			
Waste land			
Area Under Farm Houses			
Barren Land			

2.1 Cropping Pattern, Yield and Cost

Sr. No.	Major Crops	Area Sown		Average Production (Kgs)	Price/40 kgs (Rs.)	Total Cost Incurred (Rs.)
		Acre	Kanal			
1.	Wheat					
2	Maize					
3	Cotton					
4	Rice					
5	Sugarcane					
6	Orchards					
7	Other (_____)					
8	Grand Total:					

2.2 Land Tenure Status:  Owner       Tenant       Share Cropper     

2.3 Land Rent (Rs. / acre) \_\_\_\_\_

3. Possession of Household Goods

Item	No.	Value (Rs.)	Item	No.	Value (Rs.)
Television			Car		
Washing machine			Van/Pickup		
Geyser			Gas Cylinder		
Electric fan			VCR/DVD Player		
Electric iron			Dish Antenna/Cable Connection		

Item	No.	Value (Rs.)	Item	No.	Value (Rs.)
Sewing machine			Telephone/Mobile		
Radio/tape recorder			Electric Water Pump		
Motor cycle/ scooter			Computer		
Other			Other		
Total:			Total:		

**4. Average Monthly Expenditure on Food and Non-Food Items**

**4.1 Monthly Expenditure on Food & Non-Food Items (Rs.)**

a) Expenditures on Food Items

Sr. No.	Item	Qty. / Month	Expenditure (Rs.)
1.	Wheat / Atta (Flour)		
2.	Maize Flour		
3.	Ghee		
4.	Sugar		
5.	Legumes		
6.	Vegetables		
7.	Tea Leaves		
8.	Milk		
9.	Other Specify		
10.	Total:		

b) Exp. On Non-Food Items:

1.	Fire wood		
2.	Gas Cylinder		
3.	Kerosene Oil		
4.	Washing Material		
5.	Other Specify		
6.	Total:		

4.2 Expenditure on clothes and shoes during last year: Rs.

4.3 Occasional expenses during last year  
(such as meeting social obligation expenditure) Rs.

4.4 Av. Monthly utility bills for: Electricity (Rs.)

Communication (Rs.) Water (Rs.)

4.5 Annual Expenditure on Health Care (Rs.):

**5. Social Organizations**



| . Other |

**8.3 Other Assets**

Area (ft.)

Shop(Sq. ft): L W

Khokha:

Electric Pump / Hand Pump (No.):

Hydropower Generator:

Other ( ) (No.):

**8.4 Trees**

- Mature Fruit Trees (No.):
- Mature Shade Trees (No.):

**9. Access to Social Amenities (Tick)**

Social Amenities	Available	Satisfactory	Non-Satisfactory	No Access
Electricity				
Sui Gas				
Water Supply				
Telephone				
Sewerage/Drainage				
BHU				
School				
Others				

**10. Livestock Inventory**

Livestock	No.	Present Value (Rs.)
Buffaloes	[ ]	[ ]
Cows	[ ]	[ ]
Horse	[ ]	[ ]
Donkey	[ ]	[ ]
Mule	[ ]	[ ]
Sheep	[ ]	[ ]
Goat	[ ]	[ ]
Poultry	[ ]	[ ]
Other	[ ]	[ ]

**11. Women's Participation and Decision Making in Different Activities**

**11.1 Women participation in different household activities:**

Activities	Participation (%)	Decision Making (%)
Household activities	[ ]	[ ]

Child caring	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Farm/Crop activities	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Livestock rearing	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sale & Purchase of properties	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Social obligations (marriage, birthday & other functions)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Local representation (councilor/political gathering)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Others	<input type="checkbox"/>	<input type="checkbox"/>

**11.2 Women issues in the project area**

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**11.3 Women views about the project**

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**12. Perceptions of Respondents for Action Associated with the Project**

	Increase	Decrease
Employment opportunities	<input type="checkbox"/>	<input type="checkbox"/>
Marketing facilities opportunities	<input type="checkbox"/>	<input type="checkbox"/>
Living standard	<input type="checkbox"/>	<input type="checkbox"/>
Unemployment	<input type="checkbox"/>	<input type="checkbox"/>
Income generating activities	<input type="checkbox"/>	<input type="checkbox"/>
Mobility (Access to Resources)	<input type="checkbox"/>	<input type="checkbox"/>
Quality of drinking water	<input type="checkbox"/>	<input type="checkbox"/>
Agriculture water	<input type="checkbox"/>	<input type="checkbox"/>
Trend of fish farm	<input type="checkbox"/>	<input type="checkbox"/>
Other specify _____		

**13. General Remarks of the Respondents**

**14. Resettlement Part**

14.1 Do you feel any establishment impact? Yes \_\_\_\_\_ No \_\_\_\_\_

If yes then

Category	Area Acre	Kanal	Value of Land (Rs.)	Remarks
Cultivated				
Uncultivated				
Grazing				
Barren Land				
Waste Land				
Other				
Total				

14.2 Affected Cropping Area

Yes \_\_\_\_\_ No \_\_\_\_\_  
If yes then

Name of Crop	Acre	Kanal	Value (Rs.)
Rabi			
Kharif			
Total:			

14.3 Affected residential structures

Name of Structure	Types of Structures			Area		Value of Structure
	Kacha	Pacca	Semi Pacca	Sq. ft.	Rft.	
Houses						
Boundary Wall						
Other						

14.4 Impact on Farm House

Yes \_\_\_\_\_ No \_\_\_\_\_  
If yes then

Name	Type of Farm House			Area		Value (Rs.)
	Kacha	Pacca	Semi Pacca	Sq. ft	Rft.	
Rooms						
Cattle Shed						
Boundary Wall						
Other						

14.5 Impact of Tube wells

Yes \_\_\_\_\_ No \_\_\_\_\_

If yes then

Types of Tube wells	No.	Value (Rs.)
Electric		
Diesel		
Turbine		
Other		
Total:		

**14.6 Impact on Utility**

Yes \_\_\_\_\_ No \_\_\_\_\_

If yes then

Types	Nos. / Area
Electric poles	
Transformer	
Transmission line	
Telephone	
Other	
Total:	

**14.7 Impact on Community Structure**

Name	Yes	No	Value (Rs.)
Schools			
Mosque			
Graveyard			
Health Centre			
Shrine			
Others			
Total:			

**14.8 How to shift shrines / graveyards?**

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**14.9 Miscellaneous Impacts of the Project**

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14.10 Do you have any alternate residence place?

Yes  No

If yes then (tick relevant)

Own Land / House	Yes/No	Location-	Distance from current residence (km)
Tenancy			
Relative			
Other			

14.11 Mode of Payment

Land for land \_\_\_\_\_  
Cash compensation \_\_\_\_\_  
Kind \_\_\_\_\_  
Other \_\_\_\_\_

15. Project

\_\_\_\_\_

16. Views / Comments of Interviewers

\_\_\_\_\_

Name & Signature of Interviewer: \_\_\_\_\_ Date: \_\_\_\_\_

### **Scavenging Activity Questionnaire**

- 1) Name:
- 2) Occupation:
- 3) Age:
- 4) Residence City:  
■ \_\_\_\_\_
- 5) How much waste do you normally collect in a day?
- 6) Is all of the waste you collect useful, or do you have to sort it after collection as well?
- 7) What is the procedure you normally follow in your waste collection activity?
- 8) What is the usual cost (money) and time (man-hours) you put in the waste collection activity every day or every month?
- 9) What is the amount of (daily or monthly) income you generate from your activity?
- 10) Is this your only income source?
- 11) If no to Q10, what is your other occupation?
- 12) If no to Q10, what is your total income, and what percentage income is from waste collection?
- 13) Where does the waste go after you have processed it?
- 14) What is your motivation (reason) to do this activity?
- 15) Do you feel a sense of satisfaction that your work makes a positive difference to the cleanliness of the area?
- 16) What is your working relationship, if any, with any government department or authority (WSSC / PDA etc.) of your city?
- 17) What kind of improvements would you like to see in your work? Any kind of assistance from government?

## **Annexure C**

### **Details of public consultations**

# Kohat Landfill

Focal Group Discussion (FGDs)

Project Name: KPCIP

Venue: Kohat (Land fill)

Sr no 02

Date: 3/06/2020

Sr no	Name	Profession	CNIC	Mozza/Village UC, Tehsil & District	Signature/Thumb
1	Arif Shah	Police / Retired	14301-2029 882-3	Muhammadzai	Arif
2	Gazi Iazim muhamad	Nazim	14301-2056 813 -3	Muhammadzai	Iazim
3	Arshad khan	Driver	14301-355 8468 -7	Muhammadzai	Arshad
4	Asif Khan	farmer	14301-8420 325-3	Muhammadzai	Asif
5	Adil Mehmood	Shopkiper	14301-8004 251 -9	Muhammadzai	Adil
6	Sheri aram khan	Retired	14301-20215 70 -1	Muhammadzai	Sheri
7	Dun Badshah	Shopkiper	14301-2023 989 -7	Muhammadzai	Dun
8	Shoaib zai	farmer	14301-9298 417-9	Muhammadzai	Shoaib
9	Shahfi khan	Business man	14301-19796 83-3	Muhammadzai	Shahfi
10	Kamran	labal	14301-7877 384 -9	Muhammadzai	Kamran
11	Zahid khan	labal	14301-7879 427 -7	Muhammadzai	Zahid
12					

*Kohat (Landfill, Muhammad Zai)*

Focal Group Discussion (FGDs)

Project Name: KPCIP

Venue: Kohat (land fill)

Sr no 01

Date: 01/06/2020

Sr no	Name	Profession	CNIC	Moza/Village UC, Tehsil & District	Signature/Thumb
1	Khan Badshah	Retired government servant	14301-1950 427-7	Muhammad Zai	<u>Khans</u>
2	Gull Mir Khan	Community elder	14301-1093 266-1	Muhammad Zai	<u>Gull</u>
3	Safim Mohsin	PAF-Retired	14301-0488 817-5	Muhammad Zai	<u>Safim</u>
4	Noor Badshah	Retired/PAF Army	90402-010 9344-9	Muhammad Zai	<u>Noor</u>
5	Muhammad Aslam Khan	Nazim/Retired	14301-5031 654-3	Muhammad Zai	<u>Aslam</u>
6					
7					
8					
9					
10					
11					
12					

## **Annexure D**

# **Environmental Baseline Monitoring**

## Air Quality



Integrated Environment Laboratory



## AMBIENT PARTICULATE MATTERS MONITORING REPORT

Reference Number	KPCIP/ENV/99-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	Site Address:	Near Muhammad Zai Fort, Obian Camp, Kohat
Monitoring Date:	25-05-2020	Reporting Date:	04-06-2020
Source:	Ambient Air	Monitoring Instrument:	AQMS65, Serial # 13101
Location:	Land fill Site		
GPS Coordinates:	71.39312 33.62340		

Sr. No	Time	Parameters		Results (Average 24 Hrs)		Integrated Environment	
		PM <sub>2.5</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>		
		Units					
Hours	( $\mu\text{g}/\text{m}^3$ )	( $\mu\text{g}/\text{m}^3$ )					
1.	08:00 AM	20.3	63.9			Integrated Environment	
2.	09:00 AM	12.7	66.2			Integrated Environment	
3.	10:00 AM	18.5	61.4			Integrated Environment	
4.	11:00 AM	18.9	62.7			Integrated Environment	
5.	12:00 PM	18.3	62.5			Integrated Environment	
6.	01:00 PM	16.4	73			Integrated Environment	
7.	02:00 PM	19.2	70.5			Integrated Environment	
8.	03:00 PM	19.9	64.7			Integrated Environment	
9.	04:00 PM	18.8	64.9			Integrated Environment	
10.	05:00 PM	16.6	61.5			Integrated Environment	
11.	06:00 PM	16.4	59.4			Integrated Environment	
12.	07:00 PM	13.8	56.7			Integrated Environment	
13.	08:00 PM	8.6	51.6	15.23 ( $\mu\text{g}/\text{m}^3$ )	51.73 ( $\mu\text{g}/\text{m}^3$ )	Integrated Environment	
14.	09:00 PM	5.7	48.7			Integrated Environment	
15.	10:00 PM	13.6	45.9			Integrated Environment	
16.	11:00 PM	11.9	43.4			Integrated Environment	
17.	12:00 AM	12.3	41.7			Integrated Environment	
18.	01:00 AM	16.8	38.6			Integrated Environment	
19.	02:00 AM	17.3	37.9			Integrated Environment	
20.	03:00 AM	17.8	31.6			Integrated Environment	
21.	04:00 AM	17.9	30.7			Integrated Environment	
22.	05:00 AM	15.7	33.4			Integrated Environment	
23.	06:00 AM	9.5	35.7			Integrated Environment	
24.	07:00 AM	8.7	34.8			Integrated Environment	
NEQSAA				35 ( $\mu\text{g}/\text{m}^3$ )	150 ( $\mu\text{g}/\text{m}^3$ )		
WHO				25 ( $\mu\text{g}/\text{m}^3$ )	50 ( $\mu\text{g}/\text{m}^3$ )	Environment	

NEQSAA: National Environmental Quality Standards for Ambient Air

**Note:**

- Selected measurement units were  $\mu\text{g}/\text{m}^3$  otherwise stated.
  - Quality was assured through self calibration of the instrument.
  - The values were representing of monitoring conditions prevailing during the monitoring period.
  - The measurements were carried out on client request.
  - The client is responsible lawful usage of reported data in future.
  - The report is not valid for court.

*[Signature]*

*[Signature]*  
Signature of Chief Chemist

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*Environmental Protection Agency (EPA-KPK) Certified*



## AMBIENT PARTICULATE MATTERS MONITORING REPORT

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai Fort, Obilan Camp, Kohat
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project		
Monitoring Date:	26-05-2020	Reporting Date:	04-06-2020
Source:	Ambient Air	Monitoring Instrument:	AQMS65, Serial # 1310
Location:	Near Recycling plant		
GPS Coordinates:	71.39960 33.61404		

Sr. No	Time	Parameters		Results (Average 24 Hrs)	
		PM <sub>2.5</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>
		Hours	Units ( $\mu\text{g}/\text{m}^3$ )		
1	09:00 AM	22.16	66.69		
2	10:00 AM	14.56	68.99		
3	11:00 AM	20.36	64.19		
4	12:00 PM	20.76	65.49		
5	01:00 PM	20.16	65.29		
6	02:00 PM	18.26	75.79		
7	03:00 PM	21.06	73.29		
8	04:00 PM	21.76	67.49		
9	05:00 PM	20.66	67.69		
10	06:00 PM	18.46	64.29		
11	07:00 PM	18.26	62.19		
12	08:00 PM	15.66	59.49		
13	09:00 PM	10.46	54.39	17.1 ( $\mu\text{g}/\text{m}^3$ )	54.5 ( $\mu\text{g}/\text{m}^3$ )
14	10:00 PM	7.56	51.49		
15	11:00 PM	15.46	48.69		
16	12:00 AM	13.76	46.19		
17	01:00 AM	14.16	44.49		
18	02:00 AM	18.66	41.39		
19	03:00 AM	19.16	40.69		
20	04:00 AM	19.66	34.39		
21	05:00 AM	19.76	33.49		
22	06:00 AM	17.56	36.19		
23	07:00 AM	11.36	38.49		
24	08:00 AM	10.56	37.59		
NEQSAA				35 ( $\mu\text{g}/\text{m}^3$ )	150 ( $\mu\text{g}/\text{m}^3$ )
WHO				25 ( $\mu\text{g}/\text{m}^3$ )	50 ( $\mu\text{g}/\text{m}^3$ )

NEQSAA: National Environmental Quality Standards for Ambient Air

Note:

- Selected measurement units were  $\mu\text{g}/\text{m}^3$  otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

*[Signature]*  
Signature of Analyst:*[Signature]*  
Signature of Chief Chemist

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Integrated Environment Laboratory

Integrated Environment Laboratory

ENVIRONMENTAL PROTECTION AGENCY

laboratory

IEE laboratory

Khyber Pakhtunkhwa

EPA Accredited

Integrated Environment Laboratory

## AMBIENT PARTICULATE MATTERS MONITORING REPORT

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai Fort, Obian Camp, Kohat
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	Reporting Date:	04-06-2020
Monitoring Date:	27-05-2020	Monitoring Instrument:	AQMS65, Serial # 1310
Source:	Ambient Air		
Location:	Lal Maila		
GPS Coordinates:	71.40080 33.60784		

Sr. No	Time	Parameters		Results (Average 24 Hrs)	
		PM <sub>2.5</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>
		Hours	( $\mu\text{g}/\text{m}^3$ )		
1	09:30 AM	23.08	68.83		
2	10:30 AM	15.48	71.13		
3	11:30 AM	21.28	66.33		
4	12:30 PM	21.68	67.63		
5	01:30 PM	21.08	67.43		
6	02:30 PM	19.18	77.93		
7	03:30 PM	21.98	75.43		
8	04:30 PM	22.68	69.63		
9	05:30 PM	21.58	69.83		
10	06:30 PM	19.38	66.43		
11	07:30 PM	19.18	64.33		
12	08:30 PM	16.58	61.63		
13	09:30 PM	11.38	56.53		
14	10:30 PM	8.48	53.63		
15	11:30 PM	16.38	50.83		
16	12:30 AM	14.68	48.33		
17	01:30 AM	15.08	46.63		
18	02:30 AM	19.58	43.53		
19	03:30 AM	20.08	42.83		
20	04:30 AM	20.58	36.53		
21	05:30 AM	20.68	35.63		
22	06:30 AM	18.48	38.33		
23	07:30 AM	12.28	40.63		
24	08:30 AM	11.48	39.73		
NEQSAA			35 ( $\mu\text{g}/\text{m}^3$ )	150 ( $\mu\text{g}/\text{m}^3$ )	
WHO			25 ( $\mu\text{g}/\text{m}^3$ )	50 ( $\mu\text{g}/\text{m}^3$ )	

NEQSAA: National Environmental Quality Standards for Ambient Air

Note:

- Selected measurement units were  $\mu\text{g}/\text{m}^3$  otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

Signature of Analyst:

Signature of Chief Chemist

## FOR ENVIRONMENTAL MONITORING, ANALYSIS &amp; SURVEYS

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## AMBIENT PARTICULATE MATTERS MONITORING REPORT

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai Fort, Obian Camp, Kohat
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project		
Monitoring Date:	28-05-2020	Reporting Date:	04-06-2020
Source:	Ambient Air	Monitoring Instrument:	AQMS 65, Serial # 1310
Location	Obian Camp		
GPS Coordinates:	71.404228 33.613453		

Sr. No	Time	Parameters		Results	
		PM <sub>2.5</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>
		Hours	( $\mu\text{g}/\text{m}^3$ )		
1	10:00 AM	22.62	67.76		
2	11:00 AM	15.02	70.06		
3	12:00 PM	20.82	65.26		
4	01:00 PM	21.22	66.56		
5	02:00 PM	20.62	66.36		
6	03:00 PM	18.72	76.86		
7	04:00 PM	21.52	74.36		
8	05:00 PM	22.22	68.56		
9	06:00 PM	21.12	68.76		
10	07:00 PM	18.92	65.36		
11	08:00 PM	18.72	63.26		
12	09:00 PM	16.12	60.56		
13	10:00 PM	10.92	55.46		
14	11:00 PM	8.02	52.56		
15	12:00 AM	15.92	49.76		
16	01:00 AM	14.22	47.26		
17	02:00 AM	14.62	45.56		
18	03:00 AM	19.12	42.46		
19	04:00 AM	19.62	41.76		
20	05:00 AM	20.12	35.46		
21	06:00 AM	20.22	34.56		
22	07:00 AM	18.02	37.26		
23	08:00 AM	11.82	39.56		
24	09:00 AM	11.02	38.66		
NEQSAA			35 ( $\mu\text{g}/\text{m}^3$ )	17.6 ( $\mu\text{g}/\text{m}^3$ )	55.6 ( $\mu\text{g}/\text{m}^3$ )
WHO			25 ( $\mu\text{g}/\text{m}^3$ )		150 ( $\mu\text{g}/\text{m}^3$ )
NEQSAA: National Environmental Quality Standards for Ambient Air					

Note:

- Selected measurement units were  $\mu\text{g}/\text{m}^3$  otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring period.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

Signature of Analyst:

Signature of Chief Chemist

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## AMBIENT GASEOUS MONITORING REPORT

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai Fort, Obian Camp, Kohat
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project		
Monitoring Date:	25-05-2020	Reporting Date:	04-06-2020
Source:	Ambient Air (Gaseous)	Monitoring Instrument:	AQMS 65, Serial # 1310
Location:	Kohat Landfill		
GPS Coordinates:	71.39312 33.62340		

Sr. No	Time	Parameters			
		CO	NO	NO <sub>2</sub>	SO <sub>2</sub>
		Hours	(mg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )
1.	08:00 AM	0.85	12.14	10.68	10.64
2.	09:00 AM	0.87	12.16	12.45	11.01
3.	10:00 AM	0.83	12.01	13.12	12.27
4.	11:00 AM	0.98	12.10	13.77	13.57
5.	12:00 PM	0.97	12.08	14.05	13.81
6.	01:00 PM	0.99	12.81	15.29	14.43
7.	02:00 PM	1.01	11.92	16.39	14.87
8.	03:00 PM	1.05	12.05	16.47	14.99
9.	04:00 PM	0.94	12.09	17.89	16.40
10.	05:00 PM	0.92	11.68	14.81	14.90
11.	06:00 PM	0.82	11.31	12.66	14.21
12.	07:00 PM	0.79	11.10	11.57	10.45
13.	08:00 PM	0.74	11.02	11.71	11.10
14.	09:00 PM	0.72	11.01	10.82	10.50
15.	10:00 PM	0.75	10.62	10.37	11.04
16.	11:00 PM	0.69	10.21	9.88	11.34
17.	12:00 AM	0.65	9.77	9.85	10.97
18.	01:00 AM	0.64	10.29	9.68	10.73
19.	02:00 AM	0.68	10.59	9.54	10.59
20.	03:00 AM	0.69	11.09	9.79	9.46
21.	04:00 AM	0.70	11.46	9.37	9.20
22.	05:00 AM	0.74	11.41	9.28	9.95
23.	06:00 AM	0.76	11.83	9.12	9.31
24.	07:00 AM	0.82	11.76	9.05	3.67
Average Concentration		0.82	11.44	11.98	11.64
NEQSAA		05 (24 hr)	40 (24 hr)	80 (24 hr)	120 (24 hr)
WHO		---	---	200 (24 hrs)	20 (24 hrs)

NEQSAA: National Environmental Quality Standards for Ambient Air

Note:

- Selected measurement units were mg/m<sup>3</sup> and µg/m<sup>3</sup> otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

*[Signature]*  
Signature of Analyst:*[Signature]*  
Signature of Chief Chemist

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## AMBIENT GASEOUS MONITORING REPORT

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai Fort, Oblan Camp, Kohat
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project		
Monitoring Date:	26-05-2020	Reporting Date:	04-06-2020
Source:	Ambient Air (Gaseous)	Monitoring Instrument:	AQMS 65
Location:	Recycling Plant		
GPS Coordinates:	71.39960 33.61404		

Sr. No	Time	Parameters			
		CO	NO	NO <sub>2</sub>	SO <sub>2</sub>
		Hours	(mg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )
1	09:00 AM	0.79	10.99	9.72	9.91
2	10:00 AM	0.81	11.01	11.49	10.28
3	11:00 AM	0.77	10.86	12.16	11.54
4	12:00 PM	0.92	10.95	12.81	12.84
5	01:00 PM	0.91	10.93	13.09	13.08
6	02:00 PM	0.93	11.66	14.33	13.7
7	03:00 PM	0.95	10.77	15.43	14.14
8	04:00 PM	0.99	10.9	15.51	14.26
9	05:00 PM	0.88	10.94	16.93	15.67
10	06:00 PM	0.86	10.53	13.85	14.17
11	07:00 PM	0.76	10.16	11.7	13.48
12	08:00 PM	0.73	9.95	10.61	9.72
13	09:00 PM	0.68	9.87	10.75	10.37
14	10:00 PM	0.66	9.86	9.86	9.77
15	11:00 PM	0.69	9.47	9.41	10.31
16	12:00 AM	0.63	9.06	8.92	10.61
17	01:00 AM	0.59	8.62	8.89	10.24
18	02:00 AM	0.58	9.14	8.72	10
19	03:00 AM	0.62	9.44	8.58	9.86
20	04:00 AM	0.63	9.94	8.83	8.73
21	05:00 AM	0.64	10.31	8.41	8.47
22	06:00 AM	0.68	10.26	8.32	9.22
23	07:00 AM	0.70	10.68	8.16	8.58
24	08:00 AM	0.76	10.61	8.09	2.94
Average Concentration		0.8	10.3	11.0	10.9
NEQSAA		05 (24 hr)	40 (24 hr)	80 (24 hr)	120 (24 hr)
WHO		---	---	200 (24 hrs)	20 (24 hrs)

NEQSAA: National Environmental Quality Standards for Ambient Air

## Note:

- Selected measurement units were mg/m<sup>3</sup> and µg/m<sup>3</sup> otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

*[Signature]*  
Signature of Analyst*[Signature]*  
Signature of Chief Chemist

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## AMBIENT GASEOUS MONITORING REPORT

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai Fort, Obian Camp, Kohat
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project		
Monitoring Date:	27-05-2020	Reporting Date:	04-06-2020
Source:	Ambient Air (Gaseous)	Monitoring Instrument:	AQMS 65, Serial # 1310
Location:	Lal Maila		
GPS Coordinates:	71.40080 33.60784		

Sr. No	Time	Parameters			
		CO	NO	NO <sub>2</sub>	SO <sub>2</sub>
		Hours	(mg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )
1	09:30 AM	0.83	11.57	9.24	9.25
2	10:30 AM	0.85	11.59	11.01	9.62
3	11:30 AM	0.81	11.44	11.68	10.88
4	12:30 PM	0.96	11.53	12.33	12.18
5	01:30 PM	0.95	11.51	12.61	12.42
6	02:30 PM	0.97	12.24	13.85	13.04
7	03:30 PM	0.99	11.35	14.95	13.48
8	04:30 PM	1.03	11.48	15.03	13.60
9	05:30 PM	0.92	11.52	16.45	15.01
10	06:30 PM	0.90	11.11	13.37	13.51
11	07:30 PM	0.80	10.74	11.22	12.82
12	08:30 PM	0.77	10.53	10.13	9.06
13	09:30 PM	0.72	10.45	10.27	9.71
14	10:30 PM	0.70	10.44	9.38	9.11
15	11:30 PM	0.73	10.05	8.93	9.65
16	12:30 AM	0.67	9.64	8.44	9.95
17	01:30 AM	0.63	9.20	8.41	9.58
18	02:30 AM	0.62	9.72	8.24	9.34
19	03:30 AM	0.66	10.02	8.1	9.20
20	04:30 AM	0.67	10.52	8.35	8.07
21	05:30 AM	0.68	10.89	7.93	7.81
22	06:30 AM	0.72	10.84	7.84	8.56
23	07:30 AM	0.74	11.26	7.68	7.92
24	08:30 AM	0.80	11.19	7.61	2.28
Average Concentration		0.8	10.9	10.5	10.2
NEQSAA		05 (24 hr)	40 (24 hr)	80 (24 hr)	120 (24 hr)
WHO		---	---	200 (24 hrs)	20 (24 hrs)

NEQSAA: National Environmental Quality Standards for Ambient Air

## Note:

- Selected measurement units were mg/m<sup>3</sup> and µg/m<sup>3</sup> otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

*[Signature]* Signature of Analyst*[Signature]* Signature of Chief Chemist

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## AMBIENT GASEOUS MONITORING REPORT

<b>Reference Number</b>	KPCIP/ENV/99-2020	<b>Site Address:</b>	Near Muhammad Zai Fort, Obilan Camp, Kohat
<b>Project Name:</b>	Khyber Pakhtunkhwa Cities Improvement Project		
<b>Monitoring Date:</b>	28-05-2020	<b>Reporting Date:</b>	04-06-2020
<b>Source:</b>	Ambient Air	<b>Monitoring Instrument:</b>	AQMS 65, Serial # 1310
<b>Location:</b>	Obilan Camp		
<b>GPS Coordinates:</b>	71.404228 33.613453		

Sr. No	Time	Parameters			
		CO	NO	NO <sub>2</sub>	SO <sub>2</sub>
		Hours	(mg/m <sup>3</sup> )	(µg/m <sup>3</sup> )	(µg/m <sup>3</sup> )
1	10:00 AM		0.79	10.70	9.96
2	11:00 AM		0.81	10.72	11.73
3	12:00 PM		0.77	10.57	12.4
4	01:00 PM		0.92	10.66	13.05
5	02:00 PM		0.91	10.64	13.33
6	03:00 PM		0.93	11.37	14.57
7	04:00 PM		0.95	10.48	15.67
8	05:00 PM		0.99	10.61	15.75
9	06:00 PM		0.88	10.65	17.17
10	07:00 PM		0.86	10.24	14.09
11	08:00 PM		0.76	9.87	11.94
12	09:00 PM		0.73	9.66	10.85
13	10:00 PM		0.68	9.58	10.99
14	11:00 PM		0.66	9.57	10.1
15	12:00 AM		0.69	9.18	9.65
16	01:00 AM		0.63	8.77	9.16
17	02:00 AM		0.59	8.33	9.13
18	03:00 AM		0.58	8.85	8.96
19	04:00 AM		0.62	9.15	8.82
20	05:00 AM		0.63	9.65	9.07
21	06:00 AM		0.64	10.02	8.65
22	07:00 AM		0.68	9.97	8.56
23	08:00 AM		0.70	10.39	8.4
24	09:00 AM		0.76	10.32	8.33
Average Concentration			0.8	10.0	11.3
NEQSAA			05	40	10.7
			(24 hr)	(24 hr)	(24 hr)
WHO			---	---	20
				200 (24 hrs)	20 (24 hrs)

NEQSAA: National Environmental Quality Standards for Ambient Air

- Selected measurement units were mg/m<sup>3</sup> and µg/m<sup>3</sup> otherwise stated.
  - Quality was assured through self calibration of the instrument.
  - The values were representing of monitoring conditions prevailing during the measurements.
  - The measurements were carried out on client request.
  - The client is responsible lawful usage of reported data in future.
  - The report is not valid for court.

Signature of Analyst FOR ENVIRONMENTAL MONITORING AND SURVEYS

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## Water Quality Analysis



Integrated Environment Laboratory



### WATER ANALYSIS REPORT

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai Fort, Environment Laboratory
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project.		Integrated Environment Laboratory
Sampling Date:	27-05-2020	Reporting Date:	04-06-2020
Source:	Ground Water	Sampling Done by:	Analyst
Location:	Lal Maila	Analysis Method:	APHA/USEPA Standard Methods

Sr. No.	Parameters	Standard Methods	Unit	NDWQS	Results
1	pH	APHA-4500H+ B	--	6.5-8.5	7.2
2	Taste & Odor	In-house	--	Non Objectionable	Non Objectionable
3	Color	APHA-2120 B/C	TCU	<15	3
4	Turbidity	APHA-2130 B	NTU	<5	2
5	Total Coliform	APHA-9222 B	mg/L	<1000	178
6	E-Coli	APHA-9222 D	mg/L	<500	229
7	Total Dissolved Solids (TDS)	APHA-2540 C	mg/L	≤50	3.8
8	Total Hardness	APHA-2340 C	mg/L	≤3	0.03
9	Nitrate	APHA-4500 NO3 B	mg/L	≤0.05	N.D.
10	Nitrite	APHA-4500 NO2 B	mg/L	≤0.02	0.01
11	Ammonia	APHA-4500-NH3-B	mg/L	<0.005	N.D.
12	Arsenic	APHA-3500 As B	mg/L	<250	87
13	Antimony	APHA-3500 Sb B	mg/L	0.5-1.5	0.3
14	Barium	APHA-3500 Ba B	mg/L	≤0.05	0.01
15	Chloride	APHA-4500 Cl- B	mg/L	≤1.5	0.82
16	Fluoride	APHA-4500 F-C	mg/L	≤0.2	N.D.
17	Aluminum	APHA-3500 Al B	mg/L	≤0.5	N.D.
18	Manganese	APHA-3500-Mn B	mg/L	0.01	N.D.
19	Mercury	APHA-3500-Hg B	mg/L	0.7	0.07
20	Iodine	-	mg/L	≤0.001	N.D.
21	Zinc	APHA-3500-Zn B	mg/L	2	0.12
22	Boron	APHA-4500 B-C	mg/L	5.0	0.76
23	Chromium	APHA-3500 Cr B	mg/L	0.3	N.D.
24	Selenium	APHA-3500 Se C	mg/L	≤0.05	N.D.

NDWQS: National Drinking Water Quality Standards

Signature of Analyst:

Signature of Chief Chemist



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## WATER ANALYSIS REPORT

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai Fort, Environment Laboratory
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project.		
Sampling Date:	28-05-2020	Reporting Date:	04-06-2020
Source:	Ground Water	Sampling Done by:	Analyst
Location:	Oblan Camp	Analysis Method:	APHA/USEPA Standard Methods

Sr. No.	Parameters	Standard Methods	Units	NDWQS	Results
1	pH	APHA-4500H+ B	--	6.5-8.5	7.4
2	Taste & Odor	In-house	--	Non Objectionable	Non Objectionable
3	Color	APHA-2120 B/C	TCU	<15	5
4	Turbidity	APHA-2130 B	NTU	<5	3
5	Total Coliform	APHA-9222 B	mg/L	<1000	172
6	E-Coli	APHA-9222 D	mg/L	<500	269
7	Total Dissolved Solids (TDS)	APHA-2540 C	mg/L	≤50	3.4
8	Total Hardness	APHA-2340 C	mg/L	≤3	0.03
9	Nitrate	APHA-4500 NO3 B	mg/L	≤0.05	N.D.
10	Nitrite	APHA-4500 NO2 B	mg/L	≤0.02	0.0089
11	Ammonia	APHA-4500-NH3-B	mg/L	<0.005	N.D.
12	Arsenic	APHA-3500 As B	mg/L	<250	83
13	Antimony	APHA-3500 Sb B	mg/L	0.5-1.5	0.40
14	Barium	APHA-3500 Ba B	mg/L	≤0.05	0.019
15	Chloride	APHA-4500 Cl- B	mg/L	≤1.5	0.82
16	Fluoride	APHA-4500 F-C	mg/L	≤0.2	N.D.
17	Aluminum	APHA-3500 Al B	mg/L	≤0.5	N.D.
18	Manganese	APHA-3500-Mn B	mg/L	0.01	N.D.
19	Mercury	APHA-3500-Hg B	mg/L	0.7	0.38
20	Iodine	-	mg/L	≤0.001	N.D.
21	Zinc	APHA-3500-Zn B	mg/L	2	0.039
22	Boron	APHA-4500 B-C	mg/L	5.0	1.5
23	Chromium	APHA-3500 Cr B	mg/L	0.3	N.D.
24	Selenium	APHA-3500 Se C	mg/L	≤0.05	N.D.

NDWQS: National Drinking Water Quality Standards

Signature of Analyst:

Signature of Chief Chemist



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## Noise



Integrated Environment Laboratory



### NOISE LEVEL MONITORING REPORT

Reference Number Project Name:	KPCIP/ENV/99-2020 Khyber Pakhtunkhwa Cities Improvement Project	Site Address:	Near Muhammad Zai Fort, Obian Camp, Kohat	Environment Laboratory			
Monitoring Date:	25-05-2020	Reporting Date:	04-06-2020	Integrated Environment Laboratory			
Source:	Ambient Condition	Monitoring Instrument:	Noise Meter-IEC651-Type-2	Integrated Environment Laboratory			
Location:	Landfill Site			Integrated Environment Laboratory			
Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq	Integrated Environment Laboratory	
1.	08:00 AM		50.4	53.3	51.9	Integrated Environment Laboratory	
2.	09:00 AM		50.2	53.1	51.6	Integrated Environment Laboratory	
3.	10:00 AM		50.0	52.9	51.4	Integrated Environment Laboratory	
4.	11:00 AM		49.8	52.7	51.2	Integrated Environment Laboratory	
5.	12:00 PM		49.6	52.4	51.0	Integrated Environment Laboratory	
6.	01:00 PM		49.3	52.2	50.8	Integrated Environment Laboratory	
7.	02:00 PM		49.1	52.0	50.6	Integrated Environment Laboratory	
8.	03:00 PM		48.9	51.8	50.4	Integrated Environment Laboratory	
9.	04:00 PM		48.7	51.6	50.1	Integrated Environment Laboratory	
10.	05:00 PM		48.5	51.4	49.9	Integrated Environment Laboratory	
11.	06:00 PM		48.3	51.1	49.7	Integrated Environment Laboratory	
12.	07:00 PM		48.0	50.9	49.5	Integrated Environment Laboratory	
13.	08:00 PM		47.8	50.7	49.3	Integrated Environment Laboratory	
14.	09:00 PM		47.6	50.5	49.1	Integrated Environment Laboratory	
15.	10:00 PM		47.4	50.3	48.8	Integrated Environment Laboratory	
16.	11:00 PM		47.2	50.1	48.6	Integrated Environment Laboratory	
17.	12:00 AM		47.0	49.9	48.4	Integrated Environment Laboratory	
18.	01:00 AM		46.8	49.7	48.2	Integrated Environment Laboratory	
19.	02:00 AM		46.6	49.5	48.0	Integrated Environment Laboratory	
20.	03:00 AM		46.4	49.2	47.8	Integrated Environment Laboratory	
21.	04:00 AM		46.1	49.0	47.5	Integrated Environment Laboratory	
22.	05:00 AM		45.9	48.8	47.3	Integrated Environment Laboratory	
23.	06:00 AM		45.7	48.6	47.1	Integrated Environment Laboratory	
24.	07:00 AM		45.5	48.4	46.9	Integrated Environment Laboratory	
NEQS limit : 65 dB(A)		Day Time		WHO Limit : 70 dB(A)		Night Time	

NEQS: National Environmental Quality Standards

WHO: World Health Organization

Leq: Log Equivalent Continuous Sound Level

Note:

- Selected measurement units were dB (A) otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
- The report is not valid for court.

Signature of Analyst:

Signature of Chief Chemist



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Khyber Pakhtunkhwa Laboratory

Khyber Pakhtunkhwa Laboratory

EPA Accredited

Integrated Environment Laboratory

NOISE LEVEL MONITORING REPORT						
Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai			
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project		Fort, Oblas Camp, Kohat			
Monitoring Date:	26-05-2020	Reporting Date:	04-06-2020			
Source:	Ambient Condition	Monitoring Instrument:	Noise Meter-IEC651-Type-2			
Location:	Near Recycling Plant					
Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq	
1	09:00 AM	dB(A)	50.7	53.6	52.2	Integrated Environment Laboratory
2	10:00 AM		50.5	53.4	51.9	Integrated Environment Laboratory
3	11:00 AM		50.3	51.6	50.9	Integrated Environment Laboratory
4	12:00 PM		50.1	53.0	51.5	Integrated Environment Laboratory
5	01:00 PM		49.8	52.7	51.3	Integrated Environment Laboratory
6	02:00 PM		49.6	52.5	51.1	Integrated Environment Laboratory
7	03:00 PM		49.4	52.3	50.9	Integrated Environment Laboratory
8	04:00 PM		49.2	52.1	50.6	Integrated Environment Laboratory
9	05:00 PM		49.0	51.9	50.4	Integrated Environment Laboratory
10	06:00 PM		48.8	51.7	50.2	Integrated Environment Laboratory
11	07:00 PM		48.5	51.4	50.0	Integrated Environment Laboratory
12	08:00 PM		48.3	51.2	49.8	Integrated Environment Laboratory
13	09:00 PM		48.1	51.0	49.6	Integrated Environment Laboratory
14	10:00 PM		47.9	50.8	49.3	Integrated Environment Laboratory
15	11:00 PM		47.7	50.6	49.1	Integrated Environment Laboratory
16	12:00 AM		47.4	50.3	48.9	Integrated Environment Laboratory
17	01:00 AM		47.2	50.1	48.7	Integrated Environment Laboratory
18	02:00 AM		47.0	49.9	48.5	Integrated Environment Laboratory
19	03:00 AM		46.8	49.7	48.3	Integrated Environment Laboratory
20	04:00 AM		46.6	49.4	48.0	Integrated Environment Laboratory
21	05:00 AM		46.3	49.2	47.8	Integrated Environment Laboratory
22	06:00 AM		46.1	49.0	47.6	Integrated Environment Laboratory
23	07:00 AM		45.9	48.8	47.4	Integrated Environment Laboratory
24	08:00 AM		45.7	48.6	47.2	Integrated Environment Laboratory
NEQS limit : 65 dB(A)		Day Time				
55 dB(A)		Night Time				
WHO Limit : 70 dB(A)						

NEQS: National Environmental Quality Standards

WHO: World Health Organization

Leq: Log Equivalent Continuous Sound Level

## Note:

- Selected measurement units were dB (A) otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
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Signature of Analyst:

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NOISE LEVEL MONITORING REPORT					
Reference Number	KPCIP/ENV/99-2020	Site Address:			
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	Near Muhammad Zai Fort, Obian Camp, Kohat			
Monitoring Date:	27-05-2020	Reporting Date:	04-06-2020	Integrated Environment Laboratory	
Source:	Ambient Condition	Monitoring Instrument:	Noise Meter-IEC651-Type-2	Integrated Environment Laboratory	
Location:	Lal Maila			Integrated Environment Laboratory	

Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq
1	09:30 AM	dB(A)	50.7	53.6	52.2
2	10:30 AM		50.5	53.4	51.9
3	11:30 AM		50.3	51.6	50.9
4	12:30 PM		50.1	53.0	51.5
5	01:30 PM		49.8	52.7	51.3
6	02:30 PM		49.6	52.5	51.1
7	03:30 PM		49.4	52.3	50.9
8	04:30 PM		49.2	52.1	50.6
9	05:30 PM		49.0	51.9	50.4
10	06:30 PM		48.8	51.7	50.2
11	07:30 PM		48.5	51.4	50.0
12	08:30 PM		48.3	51.2	49.8
13	09:30 PM		48.1	51.0	49.6
14	10:30 PM		47.9	50.8	49.3
15	11:30 PM		47.7	50.6	49.1
16	12:30 AM		47.4	50.3	48.9
17	01:30 AM		47.2	50.1	48.7
18	02:30 AM		47.0	49.9	48.5
19	03:30 AM		46.8	49.7	48.3
20	04:30 AM		46.6	49.4	48.0
21	05:30 AM		46.3	49.2	47.8
22	06:30 AM		46.1	49.0	47.6
23	07:30 AM		45.9	48.8	47.4
24	08:30 AM		45.7	48.6	47.2
NEQS limit : 65 dB(A)		Day Time			
55 dB(A)		Night Time			
WHO Limit : 70 dB(A)					

NEQS: National Environmental Quality Standards

WHO: World Health Organization

Leq: Log Equivalent Continuous Sound Level

**Note:**

- Selected measurement units were dB (A) otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
- The measurements were carried out on client request.
- The client is responsible lawful usage of reported data in future.
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Signature of Analyst:

Signature of Chief Chemist



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Integrated Environment Laboratory

**NOISE LEVEL MONITORING REPORT**

Reference Number	KPCIP/ENV/99-2020	Site Address:	Near Muhammad Zai	Integrated Environment Laboratory	
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project		Fort, Oblan Camp, Kohat	Environment Laboratory	
Monitoring Date:	28-05-2020	Reporting Date:	04-06-2020	Integrated Environment Laboratory	
Source:	Ambient Condition	Monitoring Instrument:	Noise Meter-IEC651-Type-2	Integrated Environment Laboratory	
Location:	Oblan Camp				
Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq
1	10:00 AM	dB(A)	55.2	58.1	56.6
2	11:00 AM		55.0	57.8	56.4
3	12:00 PM		54.7	58.5	56.6
4	01:00 PM		54.5	57.4	56.0
5	02:00 PM		54.3	57.2	55.8
6	03:00 PM		54.1	57.0	55.5
7	04:00 PM		53.9	56.8	55.3
8	05:00 PM		53.7	56.5	55.1
9	06:00 PM		53.4	56.3	54.9
10	07:00 PM		53.2	56.1	54.7
11	08:00 PM		53.0	55.9	54.5
12	09:00 PM		52.8	55.7	54.2
13	10:00 PM		52.6	55.5	54.0
14	11:00 PM		52.4	55.2	53.8
15	12:00 AM		52.1	55.0	53.6
16	01:00 AM		51.9	54.8	53.4
17	02:00 AM		51.7	54.6	53.2
18	03:00 AM		51.5	54.4	53.0
19	04:00 AM		51.3	54.2	52.8
20	05:00 AM		51.1	53.9	52.5
21	06:00 AM		50.8	53.7	52.3
22	07:00 AM		50.6	53.5	52.1
23	08:00 AM		50.4	53.3	51.9
24	09:00 AM		50.2	53.1	51.7
NEQS limit : 65 dB(A)		Day Time			
		55 dB(A)	Night Time		
WHO Limit : 70 dB(A)					

NEQS: National Environmental Quality Standards

WHO: World Health Organization

Leq: Log Equivalent Continuous Sound Level

Note:

- Selected measurement units were dB (A) otherwise stated.
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Signature of Analyst:

Signature of Chief Chemist



Integrated Environment Laboratory

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## **Annexure E**

# **Occupational Health and Safety Plan**

## **General**

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

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

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

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

### a. Screening and regular unannounced checking of workers

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

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

### b. Minimizing hazards and risks at the workplace.

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

- i. Installation of signboards and symbols in risky and hazardous areas, to inform workers to be careful.
- ii. Construction of barricades around construction sites and deep excavated pits, to cordon off and deter entry of unauthorized personnel and workers into these areas.
- iii. Providing a safe storage site/area for large equipment such as power tools and chains, to prevent misuse and loss.
- iv. Proper Housekeeping: Ensuring that materials are all stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse. Brick stacks will not be more than 7 feet in height and for concrete blocks they will not be more than 6 feet high.
- v. Removing all scrap timber, waste material and rubbish from the immediate work area as the work progresses.

vi. Where scaffolds are required, ensuring that each scaffold or its components shall be capable of supporting its own weight and at least 4 times the maximum intended load applied or transmitted to it. The platform/scaffold plank shall be at least 15 inches wide and 1.5 inches thick. The rope shall be capable of supporting at least 6 times the maximum intended load applied or transmitted to that rope. Pole scaffolds over 60 feet in height shall be designed by a registered professional engineer and shall be constructed and loaded in accordance with that design. Where scaffolds are not provided, safety belts/safety nets shall be provided;

vii. Ensure that all ramps or walkways are at least 6 feet wide, having slip resistance threads and not inclined at more than a slope of 1 vertical and 3 horizontal.

viii. Stacking away all excavated earth at least 2 feet from the pit to avoid material such as loose rocks from falling back into the excavated area and injuring those working inside excavated sites.

ix. Constructing support systems, such as bracing to adjoining structures that may be endangered by excavation works nearby.

x. Only a trained electrician to construct, install and repair all electrical equipment to prevent risks of electrical shocks and electrocution.

xi. Install fire extinguishers and/or other fire-fighting equipment at every work site to prepare for any accidental fire hazards.

c. Provision of Personal Protective Equipment

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

i. High visibility clothing for all personnel during road works must be mandatory.

ii. Helmet shall be provided to all workers, or visitors visiting the site, for protection of the head against impact or penetration of falling or flying objects.

iii. Safety belt shall be provided to workers working at heights (more than 20 ft) such as roofing, painting, and plastering.

iv. Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on feet.

v. Ear protecting devices shall be provided to all workers and will be used during the occurrence of extensive noise.

vi. Eye and face protection equipment shall be provided to all welders to protect against sparks.

vii. Respiratory protection devices shall be provided to all workers during occurrence of fumes, dusts, or toxic gas/vapor.

viii. Safety nets shall be provided when workplaces are more than 25 feet (7.5 m) above the ground or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors or safety belts is impractical.

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

Table E.1 PPE Requirement List

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

d. Procedures to Deal with Emergencies such as Accidents, Sudden Illness and Death of Workers

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

- i. Provision of dispensaries by the individual EPC contractor.
- ii. A vehicle shall be on standby from the Project Office so that emergency transportation can be arranged to take severely injured/sick workers to the nearest hospital for immediate medical attention.

iii. A designated Health Officer/worker for the Project will be identified as a focal person to attend to all health and safety related issues. This employee's contact number will be posted at all work sites for speedy delivery of emergency services. The focal person shall be well versed with the medical system and facilities available at the hospital.

iv. Communication arrangements, such a provision of radios or mobile communication for all work sites, for efficient handling of emergencies, will be made.

e. Record Maintenance and Remedial action

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

f. Compensation for Injuries and Death

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

g. Awareness Programs

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

i. Dissemination sessions will clarify the rights and responsibilities of the workers regarding interactions with local people (including communicable disease risks, such as HIV/AIDS), work site health and safety, waste management (waste separation, recycling, and composting), and the illegality of poaching.

ii. Make workers aware of procedures to be followed in case of emergencies such as informing the focal health person who in turn will arrange the necessary emergency transportation or treatment.

h. Nomination of a Health and Safety Focal Person

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

i. Function as the focal person/representative for all health and safety matters at the workplace;

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

# **Annexure F**

# **Emergency Response Plan**

## F.1 PURPOSE

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

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

## F.2 EMERGENCY PREPARATION AND RESPONSE MEASURE SCOPE

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

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

## F.3 RESPONSIBILITIES

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

**Table F.1 Emergency Response Team**

Action Group	Responsibility
Emergency Coordinator	<p>Overall control of personnel and resources.</p> <p>The Emergency Coordinator will support and advise the Site Safety Supervision as necessary.</p> <p>Serves as public relations spokes persons, or delegates to some staff member the responsibility for working with news media regarding any disaster or emergency. Also assure proper coordination of news release with appropriate corporate staff or other designated people.</p>
Site Safety Supervision (Emergency Commander)	<p>Overall responsibility for activating emergency plan and for terminating emergency actions.</p> <p>Be alternative of emergency response chairpersons.</p> <p>Disseminates warnings and information as required to ensure all people in the immediate area have been warned and evacuated either by alarms or by word of mouth.</p> <p>Supervise the actions of the Emergency Response Team to ensure all persons are safe from the danger.</p> <p>Notify outside authorities if assistance is required.</p> <p>Carries the responsibility for coordinating actions including other organizations in accordance with the needs of the situation.</p> <p>Ensure maximum co-operation and assistance is provided to any outside groups called to respond to an emergency.</p> <p>Establish and appoint all emergency organization structure and team.</p> <p>Assures adequate delegation of responsibilities for all key positions of assistants on the Project to assist with any foreseeable emergency.</p> <p>Ensure resources available to purchase needed emergency response equipment and supplies.</p> <p>Assures that all persons on the Emergency Response Team aware and fully understand their individual responsibilities for implementing and supporting the emergency plan.</p>

Action Group	Responsibility
	<p>Establish the emergency drill schedule of all identified emergency scenarios, track the status and evaluate the emergency.</p> <p>The Emergency Commander shall ensure that senior management personnel have been reported of the emergency as soon as practical after the event.</p>
Security Team	<p>Ensure that the exit route is regularly tested and maintained in good working order.</p> <p>Maintain station at the security gate or most suitable location to secure the area during any emergency such that only authorized personnel and equipment may enter, prevent access to the site of unauthorized personnel.</p> <p>Assist with strong/activation of services during an emergency.</p> <p>Ensure vehicles and obstructions are moved to give incoming emergency vehicles access to the scene, if ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct any incoming emergency service to the site of emergency.</p>
Rescue & Medical Team	<p>Protect the injured from further danger and weather.</p> <p>Provide treatment to the victim(s) to the best of their ability by first aid and then transfer to hospital.</p> <p>Remain familiar with the rescue activities and rescue apparatus.</p> <p>Assist outside medical services personnel when they arrive</p>
General Administration Team	<ul style="list-style-type: none"> <li>▪ Response to support any requested general facilities for assisting Emergency Response Team in their work.</li> </ul>
Government Relation Team	<p>Coordinate with local government on a matter of concerned in the emergency response plan to liaise with local officers in their affair for support Emergency Response Team.</p> <p>Coordinate emergency plan with the government authorities, local community.</p>
Environment Team	<ul style="list-style-type: none"> <li>▪ In case of emergency related to the environmental pollution such as the chemical spill, oil spill into the ambient, the environment team will support the technical advice to control and mitigate the pollution until return to the normal situation.</li> </ul>

Action Group	Responsibility
Department Heads	<p>Call up of personnel into the safe location for protective life and property.</p> <p>Take immediate and appropriate action while Emergency Response Team is being mobilized.</p> <p>Keep in touch with the Emergency Commander</p> <p>Control and supervise operators and contractors on the implementation of this procedure, with consultation with Safety Team as necessary.</p> <p>Provide and maintain emergency equipment of their responsible areas.</p>
Other Staff and Employees	<p>All other staff and employees will remain at their workstations or assembly point unless directed otherwise from Emergency Response Team.</p> <p>Each supervisor will ensure that all members of his work group are accounted for and keep in touch with each of their Department Head.</p>

#### F.4 PROCEDURE

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

**Figure F.1 Emergency Procedure for Fire**

**Figure G.2 Emergency Procedure for Serious Accident**

## **F.5 COMMUNICATION WITH AUTHORITIES / PRESS AT SITE**

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

### **First Aid Persons**

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

Provide treatment to the victim(s) to the best of his/her ability.

Ensure the safety of victims by ceasing any work activity in the area.

Protect the injured from further danger and weather.

Assist medical services personnel when they arrive.

### **General Administration Team**

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

### **Security Team**

If ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct vehicle closest to the scene.

Prevent access to the site of unauthorized personnel (press, etc.).

### **Emergency Coordinator**

The Emergency Coordinator shall assist emergency personnel at the scene as required through allocation of company resources.

The Emergency Coordinator shall ensure next-of-kin are properly notified as soon as possible and give whatever company support and assistance is necessary to assist them bundle the situation

The Emergency Coordinator shall ensure that senior management personnel are advised of the emergency as soon as practical after the event.

## F.5 INCIDENT AND ACCIDENT REPORT

# **Annexure G**

## **Archaeological ‘Chance Find’ procedure**

## Background

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

Archaeological sites are an important resource that is protected for their historical, cultural, scientific and educational value to the general public and local communities. Impacts to archaeological sites must be avoided or managed by development proponents. The objectives of this ‘Archaeological Chance Find Procedure’ are to promote preservation of archaeological data while minimizing disruption of construction scheduling/ It is recommended that due to the moderate to high archaeological potential of some areas within the project area, all on site personnel and contractors be informed of the Archaeological Chance Find Procedure and have access to a copy while on site.

### Potential Impacts to Archaeological Sites

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

### Archaeological ‘Chance Find’ Procedure

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

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

- (i) Workers will be trained in the location of heritage zones within the construction area and in the identification of potential items of heritage significance.
- (ii) Should any potential items be located, the site supervisor will be immediately contacted and work will be temporarily stopped in that area.
- (iii) If the site supervisor determines that the item is of potential significance, an officer from the department of Archaeology (DoA) will be invited to inspect the site and work will be stopped until DoA has responded to this invitation.
- (iv) Work will not re-commence in this location until agreement has been reached between DoA and proponent as to any required mitigation measures, which may include excavation and recovery of the item.
- (v) A precautionary approach will be adopted in the application of these procedures.

### Detailed Procedural Steps

If the Director, department of Archaeology receives any information or otherwise has the knowledge of the discovery or existence of an antiquity of which there is no owner, he shall, after satisfying himself as to the correctness of the information or knowledge, take such steps with the

approval of the Government, as he may consider necessary for the custody, preservation and protection of the antiquity.

Whoever discovers, or finds accidentally, any movable antiquity shall inform forth with the Directorate within seven days of its being discovered or found.

If, within seven days of his being informed, the Director decides to take over the antiquity for purposes of custody, preservation and protection, the person discovering or finding it shall hand it over to the Director or a person authorized by him in writing.

Where the Director decides to take over an antiquity, he may pay to the person by whom it is handed over to him such cash reward as may be decided in consultation with the Advisory Committee.

The Director or any officer authorized by him with police assistance may, after giving reasonable notice, enter into, inspect and examine any premises, place or area which or the sub-soil of which he may have reason to believe to be, or to contain an antiquity and may cause any site, building, object or any antiquity or the remains of any antiquity in such premises, place or area to be photographed, copied or reproduced by any process suitable for the purpose.

The owner or occupier of the premises, place or area shall afford all reasonable opportunity and assistance to the Director.

No photograph, copy or reproduction taken or made shall be sold or offered for sale except by or with the consent of the owner of the object of which the photograph, copy or the reproduction has been taken or made.

Where substantial damage is caused to any property as a result of the inspection, the Director shall pay to the owner thereof reasonable compensation for the damage in consultation with the Advisory Committee.

If the Director after conducting an inquiry, has reasonable grounds to believe that any land contains any antiquity, he may approach the Government to direct the Revenue Department to acquire such land or any part thereof and the Revenue Department shall thereupon acquire such land or part as for a public purpose.

# **Annexure H**

## **Dust Management Plan**

## General

The purpose of this plan is to describe the measures that the project shall take to ensure that the risk of emissions from dust generated by site operations during construction are minimized and that best practice measures are implemented.

Dust emissions from construction can cause ill health effects to Contractor staff along with nuisance and annoyance to members of the local community. Dust will be controlled through:

Elimination

Reduction/Minimisation

Control

This dust management plan shall be implemented based on the measures already provided in the Environmental Management Plan (EMP) relating to controlling dust emissions.

## Methodology

The following methodology will be undertaken for each project section:

### Step 1 – Identify the dust generating activities

Construction activities that are likely to produce dust will be identified. The activities that will be taken into account are:

Haulage Routes, Vehicles and Asphalt/Concrete Batching Plant

Roads, surfaces and public highways

Static and mobile combustion plant emissions

Tarmac laying, bitumen surfacing and coating

Materials Handling, Storage, Spillage and Disposal

Storage of material

Stockpiles

Spillages

Storage of Waste

Site Preparation and Restoration after Completion

Earthworks, excavation and digging

Storage of spoil and topsoil

Demolition

## Construction and Fabrication Processes

### Step 2 – Identify Sensitive Receptors

Sensitive receptors have already been identified. The nature and location of the sensitive receptors will be taken into account when implementing control measures.

### Step 3 – Implement Best Practice Measures to Control

Based on the nature of the activity producing the dust, the likelihood of dust being produced and the possible consequence of dust based on the sensitive receptors, the most effective control measure will be identified and implemented.

### Step 4 – Monitor effectiveness of control

Construction Supervision Staff (CSC) will have the responsibility to ensure that dust control measures are being implemented and are effective.

### Step 5 – Record and report result of monitoring

All inspections, audits and results of monitoring will be recorded and kept as part of the site filing system.

## Method Statements and Risk Assessments

The Contractor's Risk Assessments and Method Statements will be required to be approved by the CSC prior to commencing work and will be required to contain environmental aspects of the task, including dust control measures where required.

Where dust has been identified within the risk assessment as a significant issue, the method statement will be required to cover the following:

Methods and materials that will be used to ensure that dust generation is minimized.

The use of pre-fabricated materials where possible.

Optimum site layout:

Dust generating activities to be conducted away from sensitive receptors

Supply of water for damping down.

Good housekeeping and management

All employees will be briefed on the Risk Assessment and Method Statement before starting work.

## Training

All Contractor staff will be required to attend training seminars as already mentioned in the EMP document. A site-specific induction will also be required before being allowed to work on site. These will include site-specific sensitive receptors and details regarding dust control measures to be taken.

Toolbox talks on air pollution and minimizing dust emissions will be provided on a regular basis to Contractor staff.

### **Identification of Dust Generating Sources and Control Methods**

<b>Haulage Routes, Vehicles and Asphalt/Concrete Batching Plant</b>	
Dust Source	Dust Control Methods
Major haul roads and traffic routes	Haul roads will be dampened down via a mobile bowser, as required.
Public Roads	Road sweeper will be used to clean public roads as required.
Site traffic management	Site traffic will be restricted to constructed access roads as far as possible.  Site speed limit will be set at 10 mph as this will minimize the production of dust.
Road Cleaning	A mechanical road sweeper will be readily available and used.
<b>Handling, Storage, Stockpiling and Spillage of Dusty materials</b>	
Material handling operations	The number of times a material will have to be handled will be kept to a minimum to prevent double handling and ensure dusty materials are not handled unnecessarily.
Transport of fine dusty materials and aggregates.	Closed tankers will be used or sheeted vehicles.
Vehicle loading/unloading materials on to vehicles and conveyors.	Dusty materials will be dampened down  Drop heights will be kept to a minimum and enclosed where possible.
<b>Storage of Materials</b>	
Bulk cement, bentonite etc.	Bentonite will be delivered in tankers and stored in dedicated enclosed areas. Bulk cement will be transported through tractor trollies or trailers.
Fine dry materials	These will be protected from the weather and by storing in appropriate containers and indoors, where necessary.
Storage location	Material will be stored in dedicated lay-down areas.

<b>Storage of Stockpiles</b>	
Stockpile location	Stockpiles will be placed so as to minimize double handling and facilitate the site restoration.
Building stockpiles	Stockpiles, tips and mounds will not be stored at an angle greater than an angle of repose of the material.
Small and temporary stockpiles	<p>Where possible, stockpiles will be placed under sheeting.</p> <p>Dusty material will be damped down.</p> <p>Wind barriers (protective fences) of a similar height to the stockpile will be erected, if required.</p>
Large and long term stockpiles	<p>Long-term stockpiles will be vegetated and stabilized as soon as possible.</p> <p>Stock piles will be dampened down until stabilized, where necessary.</p> <p>Wind barriers (protective fences) of a similar height to the stockpile will be erected, if required.</p>
<b>Waste Material from Construction</b>	
Disposal method	<p>A dedicated lay-down area will be available for waste.</p> <p>Waste will not be allowed to build up and will be disposed off at the designated locations as per EMP.</p>
<b>Site Preparation and Restoration</b>	
Earthworks, excavation and digging	These activity areas will be kept damp where required and if possible, will be avoided during dry and windy periods.
Completed earthworks	Surfaces will be stabilized by re-vegetation as soon as possible, where applicable.
<b>Construction and Fabrication Process</b>	
Crushing of material for reuse, transportation and disposal	Authorization will be obtained from PMU and ADB before using any mobile plant on site for activities such as crushing and screening.

	Any crushing or screening activities will be located away from sensitive receptors.
Cutting, grinding, drilling, sawing, trimming, planning, sanding	These activities will be avoided wherever possible.  Equipment and techniques that minimize dust will be implemented.  Water will be used to minimize dust.
Cutting roadways, pavements, blocks	Water sprinkling to be used.
Angle grinders and disk cutters	Best practice measures will be used such as dust extraction.

### **Monitoring Arrangements**

Monitoring will be conducted at sensitive receptor locations in the project area as provided in the EMP. Furthermore, at locations where PM levels are exceeding applicable guidelines, additional stringent measures will be implemented at the respective location(s) in the project area to ensure dust levels are controlled as far as possible.

# **ANNEXURE I**

## **Site Specific EMP (SSEMP) Guide & Template for Guidance to Contractor**

## **Guide for Development of SSEMP**

Step 1: Define Boundaries

Step 2: Identify Sensitive Receptors

Step 3: Specify construction activities

Step 4: Conduct Risk Assessment

Step 5: Assign Environment Management measures

Step 6: Prepare Site Plans

Step 7: Prepare Environment Work Plans (if required)

Step 8: Monitoring

**Step 1:** The project area needs to be clearly defined.

**Step 2:** The mapping of sensitive receptors has already been conducted and needs to be presented clearly in a map.

**Step 3:** The tentative construction activities to be conducted are as follows:

Site Surveying and Vegetation (Trees and plants) Clearance

Establishment of Work Camp, Batching and Asphalt plant and access roads

Dismantling of Asphalt and existing structures including Utilities

Preparation of ground for Asphalting

Asphalting

Landscaping

**Step 4:** The Risk Assessment matrix template is provided in the table below.

Risk is assessed as the likelihood that the activity will have an effect on the environment as well as the consequence of the effect occurring. It is often described like this:

## Risk = Likelihood × Consequence

### Likelihood Scale

Likelihood	Definition	Scale
Certain	Will certainly occur during the activity at a frequency greater than every week if preventative measures are not applied	5
Likely	Will occur more than once or twice during the activity but less than weekly if preventative measures are not applied	3
Unlikely	May occur once or twice during the activity if preventative measures are not applied	2
Rare	Unlikely to occur during the project	1

### Consequence Scale

Consequence	Definition	Score
Catastrophic	The action will cause unprecedented damage or impacts on the environment or surrounding community e.g. extreme loss of soil and water resources and quality from stormwater runoff extreme pollution of soil and water resources including major contamination from hazardous materials widespread effects on ecosystems with deaths of fauna/flora widespread community impacts resulting in illness, injury or inconvenience loss or destruction of archaeological or historical sites Occurrence will almost certainly result in the work being halted and a significant fine.	5
Major	The action will cause major adverse damage on the environment or surrounding communities' e.g.  major loss of soil and water resources and quality from stormwater runoff  major pollution of soil and water resources including contamination from hazardous materials  significant effects on ecosystems with isolated deaths of non-vulnerable flora and fauna  significant annoyance or nuisance to communities	3

<b>Consequence</b>	<b>Definition</b>	<b>Score</b>
	<p>major damage to or movement required to archaeological or historical sites</p> <p>Occurrence may result in work being halted and a fine</p>	
Moderate	<p>No or minimal adverse environmental or social impacts e.g.</p> <p>no measurable or noticeable changes in stormwater quality. Water quality remains within tolerable limits</p> <p>little noticeable effect on ecosystems</p> <p>no or isolated community complaints</p> <p>no or unlikely damage to archaeological or historical sites</p> <p>no likelihood of being fined</p>	2
Minor	<p>No or minimal adverse environmental or social impacts e.g.</p> <p>no measurable or noticeable changes in stormwater quality. Water quality remains within tolerable limits</p> <p>little noticeable effect on ecosystems</p> <p>no or isolated community complaints</p> <p>no or unlikely damage to archaeological or historical sites</p> <p>no likelihood of being fined</p>	1

### Risk Score Table

Likelihood	Consequence				
		Catastrophic	Major	Moderate	Minor
Certain	25	15	10	5	
Likely	15	9	6	3	
Unlikely	10	6	4	2	
Rare	5	3	2	1	

**Risk: Significant: 15-25**

**Medium: 6-10**

**Low 1-5**

Any Medium to Significant risk requires an environmental management measure to manage the potential environmental risk. Judgement will be required concerning the application of an environmental management measure to mitigate low risk situations.

The higher the risk the more intensive the required mitigation measure will need to be; e.g. where site sedimentation is deemed to be low risk, then silt fences may be needed but as the risk increases, then sediment traps may be required. The selection of the appropriate mitigation measure will require judgement based on the level of risk and the specific site parameters.

**Step 5:** The Environmental Management measures are to be extracted from the IEE study for the project and shall be added in the last column of the table below.

No.	Construction Activity	Hazards to Consider	Likelihood that the site or sensitive receptors will be affected?	Consequence of the site or sensitive receptors being affected?	Risk Score (consequence x likelihood)	Environmental Management Measures
i	Site Surveying & vegetation clearance	Damage to vegetation beyond project footprint				These can be taken from the EMP provided in the IEE report  (If Risk Score is 6 or more)
		Erosion of exposed areas and sediment				
		Loss of topsoil				
		Dust generation				
		Noise				
ii	Establishment of Work Camp, Batching plant etc.	Soil deposited onto roads from tires				
		Stockpile erosion				
		Noise & Vibration				
		Traffic congestion				

No.	Construction Activity	Hazards to Consider	Likelihood that the site or sensitive receptors will be affected?	Consequence of the site or sensitive receptors being affected?	Risk Score (consequence x likelihood)	Environmental Management Measures
		Fuel spills				
iii	Dismantling of Asphalt and existing structures including Utilities	Noise and vibration				
		Dust generation				
		Community safety				
		Worker safety				
		Traffic Congestion				
iv	Preparation of Sub-Base	Noise and vibration				
		Dust generation				
		Traffic Congestion				
v	Asphalting	Noise and vibration				
		Dust generation				

No.	Construction Activity	Hazards to Consider	Likelihood that the site or sensitive receptors will be affected?	Consequence of the site or sensitive receptors being affected?	Risk Score (consequence x likelihood)	Environmental Management Measures
		Traffic Congestion				
		Community safety				
		Labor safety (PPEs)				
vi	Landscaping	Dust generation				
		Sediment runoff				
		Failure of vegetation to take root				

**Step 6:** The Site plans are a critical part of the SSEMP and will need to be prepared, otherwise the ADB will consider the document as incomplete.

The site plan will need to provide the following:

Indication of North and scale

Existing and planned supporting infrastructure (e.g. access roads, water supplies and electricity supplies)

Location of planned work

Contours

Drainage systems

Locations of sensitive receptors

**Step 7 (if required)<sup>25</sup>:** The completed SSEMP provides details of all the environmental management requirements for all stages of the construction process. For individual work teams who are responsible for only a small part of the overall construction works it can be confusing as to what is required for their particular work component. For example, the work team responsible for stripping soil for the construction areas are not going to be interested in the requirements for pouring concrete for footings and foundations. However, it is essential that the soil stripping team knows exactly what to clear and what to leave and where to put stockpiles of soil for later use.

In situations where different work activities are required at different times or at different locations, environmental work plans can be prepared. These are similar to the work method statements that are often produced for major construction projects.

**Step 8:** A detailed monitoring plan will be provided along with frequency and responsibilities to ensure all key environmental parameters are monitored to ensure compliance with both national and ADB requirements.

Template for SSEMP

Introduction

Project Overview

Scope of SSEMP

Objectives of SSEMP

Map of Sensitive Receptors

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<sup>25</sup> ADB, Safeguards Unit for Central & West Asia Department, *Environmental Management for Construction Handbook*.

Construction Activities

Activities

Risk Assessment

Risk Assessment Matrix & Mitigation Measures

Site Plan(s)

Environmental Monitoring Plan

Instrumental Monitoring of Environmental Parameters by Contractor as per EMP

In-house monitoring

Third Party environmental monitoring

Visual monitoring of Environmental Parameters by Contractor as per EMP

Responsibilities

Organizational Responsibilities and Communication

Responsibility of EA

Responsibility of Construction Supervision Consultant (CSC)

Responsibility of Contractor

Responsibility of EPA

# **ANNEXURE J**

## **Traffic Management Plan**

## **J.1 Need for Plan**

The construction of the SWMF will take over 24 months and in this period, huge vehicular movement carrying large amount of material and machinery is expected. This will definitely interrupt the local traffic and is therefore important to manage the traffic to avoid the nuisance to local residents in terms of noise, dust, congestion and inconvenience.

## **J.2 The plan**

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

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

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

Undertake a road conditions assessment prior to and following the peak construction period, to assess any damage to road infrastructure that can be attributed to Project construction.

Repair damage as appropriate or enter into a voluntary agreement with the relevant roads authority to reimburse the cost of any repairs required to the public road network as a result of the Project.

Spoil dumpsites located close to Project site to minimise journey distance and limit movements to site access roads.

Concrete mixing plant located at Project site limiting traffic movements associated with concrete delivery to site access roads

Construction of worker accommodation on site to reduce light vehicle movements relating to travel to/ from the site

Provision of bus/minibus services for personnel living in nearby settlements

Movements of construction workers will be planned to avoid the busiest roads and times of day when traffic is at its greatest.

Schedule deliveries and road movements to avoid peak periods

Road maintenance fund to leave a useful asset for communities after the construction phase.

Driver training for HGV drivers and refresher course every six months for Project drivers

Speed restrictions for project traffic travelling through communities (to be agreed with Traffic Management Authority)

Run a safety campaign to improve the people's knowledge of the traffic hazard on their roads, public information and other activities to address the issues.

Run a pedestrian awareness programme

Temporary signage

The traffic management plan is provided below.

### **J.3 Other Recommendations**

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

#### **J.3.1 Public Access Routes**

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

Vehicle size, width and type of load

Time limits

Parking

Pedestrian conflicts

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

#### **J.3.2 Site Workers Traffic**

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

#### **J.3.3 Site Rules**

Access to and from the site must be only via the specified entrance.

On leaving the site, vehicles must be directed to follow the directions given.

Drivers must adhere to the site speed limits.

All material deliveries to site must keep allocated time limits.

No material or rubbish shall be left in the loading-unloading area.

Develop a map for alternate routes showing material delivery services.

Assign designated personnel on site to receive deliveries and to direct the vehicles.

Monitor vehicle movement to reduce the likelihood of queuing or causing congestion in and around the area.

Project vehicles shall have a unanimous badge or logo on windscreens displaying that they belong to the SWMF project.

#### **J.4 Contractor's Obligation**

The traffic management plan of the Contractor shall be safe enough and widening of access roads and construction of the detours must be completed before start of project construction activities so that heavy vehicular transportation for construction activities do not hinder the normal course of traffic lanes. While widening the access roads, the safe movement of the vehicles, people, animals and wildlife must be ensured. It will be sole responsibility of Contractor. The roads widening shall be designed on the basis of the traffic survey, summarized and estimated site traffic. Contractor must ensure that road closures are carried out by a competent person. The Contractor obligation must include the display of traffic signs according to the need to divert the traffic volume and to guide the road users in advance. The traffic sign, traffic light shall be placed from any diverting route or road marking.

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

# **ANNEXURE K**

## **NEQS Guidelines**

**National Environmental Quality Standards for Noise<sup>1</sup>**

S/No.	Category of Area/Zone	Limit in dB(A) Leq	
		Day Time	Night Time
1	Residential area (A)	55	45
2	Commercial area (B)	65	55
3	Industrial area (C)	75	65
4	Silence zone (D)	50	45

**1:** Effective from 1<sup>st</sup> July, 2012.

Note: 1. Day time hours: 6 am to 10 pm

2. Night time hours: 10 pm to 6 am

3. Silence zone: Zones that 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 mentioned categories by the competent authority.

#### National Environmental Quality Standards for Motor Vehicle Exhaust and Noise

**National Standards for Drinking Water Quality**

# **ANNEXURE L**

## **WHO Guidance on Laboratory Biosafety**



## **ANNEXURE M**

### **WHO advice on Use of Masks for the COVID-19 Virus**



## **ANNEXURE N**

# **Solid Waste Management Framework**

# **Framework for Solid Waste Management**

## **1. Introduction**

1.1 Importance of MSW Management

1.2 Origins and Use of the Framework

1.3 Structure and Content of the Framework

## **2. Describing Municipal Solid Waste Management**

2.1 Definitions

2.2 Goals and Principles of MSWM

2.3 Scope of MSWM

2.4 Actors and Partners

2.4.1 Households, Communities and Other Service Users

2.4.2 Non-Governmental Organizations

2.4.3 Local Government

2.4.4 National Government

2.4.5 Private Sector Enterprises

2.4.6 Informal Private Sector

2.4.7 External Support Agencies

2.5 Context

2.5.1 Political Context

2.5.2 Socio-Cultural Context

2.5.3 Economic Context

2.5.4 Environmental Context

## **3. Strategic Aspects**

### 3.1 Political Aspects

- 3.1.1 Goals and Priorities
- 3.1.2 Role and Jurisdiction
- 3.1.3 Legal and Regulatory Framework
- 3.1.4 Summary of Political Objectives
- 3.1.5 Outline of Political Issues

### 3.2 Institutional Aspects

- 3.2.1 Decentralization and Distribution of Responsibilities
- 3.2.2 Institutional Arrangements and Sectoral Integration
- 3.2.3 Planning and Management Methods and Procedures
- 3.2.4 Capacities of Municipal Waste Management Institutions
- 3.2.5 Private Sector Involvement and User Participation
- 3.2.6 Summary of Institutional Objectives
- 3.2.7 Outlines of Institutional Issues

### 3.3 Social Aspects

- 3.3.1 Waste Generation and Disposal Patterns
- 3.3.2 User Participation
- 3.3.3 Social Conditions of Waste Workers
- 3.3.4 Summary of Social Objectives
- 3.3.5 Outline of Social Issues

## **ANNEXURE O**

### **IBAT Model Results**



# Integrated Biodiversity Assessment Tool

## PROXIMITY REPORT

### LANDFILL-KOHAT

**Country:** Pakistan

**Location:** [ 33.6, 71.4 ]

**Date of analysis:** 08 March 2021 (GMT)

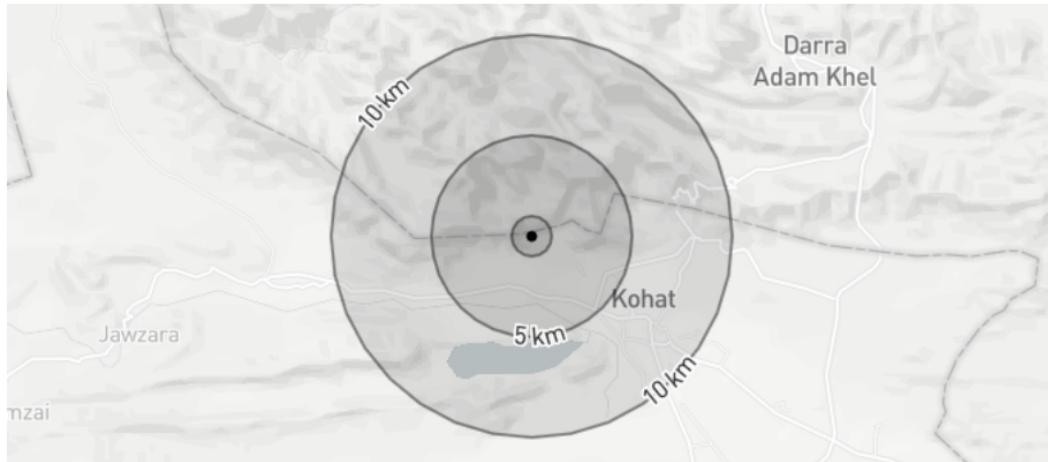
**Buffers applied:** 1 km | 5 km | 10 km

**Generated by:** Shazia Shahid

**Organisation:** ADB

#### Overlaps with:

Protected Areas	1
Key Biodiversity Areas	0
IUCN Red List	23



Displaying project location and buffers: 1 km, 5 km, 10 km



## About this report

This report presents the results of [1400-14490] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 1 km, 5 km, 10 km.

This report is one part of a package generated by IBAT on 08 March 2021 (GMT) that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a 'How to read IBAT reports' document.

**WARNING:** IBAT aims to provide the most up-to-date and accurate information available at the time of analysis. There is however a possibility of incomplete, incorrect or out-of-date information. All findings in this report must be supported by further desktop review, consultation with experts and/or on-the-ground field assessment. Please consult IBAT for any additional disclaimers or recommendations applicable to the information used to generate this report.

Please note, sensitive species data are currently not included in IBAT reports in line with the [Sensitive Data Access Restrictions Policy for the IUCN Red List](#). This relates to sensitive Threatened species and KBAs triggered by sensitive species.

## Data used to generate this report

- UNEP-WCMC and IUCN, 2021. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: [www.protectedplanet.net](http://www.protectedplanet.net) - March 2021.
- BirdLife International (on behalf of the KBA Partnership), 2020. Key Biodiversity Areas - October 2020.
- IUCN, 2021. IUCN Red List of Threatened Species - January 2021.



### Protected Areas

The following protected areas are found within 1 km, 5 km, 10 km of the area of interest.

For further details please refer to the associated csv file in the report folder.

Area name	Within buffer of
Tanda Dam	5 km

### Key Biodiversity Areas

The following key biodiversity areas are found within 1 km, 5 km, 10 km of the area of interest.

For further details please refer to the associated csv file in the report folder.

No KBAs within buffer distance

### IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest.

For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Vanellus gregarius	Sociable Lapwing	AVES	CR	Decreasing	Terrestrial
Gyps bengalensis	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
Sarcogyps calvus	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
Manis crassicaudata	Indian Pangolin	MAMMALIA	EN	Decreasing	Terrestrial
Oxyura leucocephala	White-headed Duck	AVES	EN	Decreasing	Terrestrial, Freshwater



Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
<i>Rynchops albicollis</i>	Indian Skimmer	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Haliaeetus leucoryphus</i>	Pallas's Fish-eagle	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Neophron percnopterus</i>	Egyptian Vulture	AVES	EN	Decreasing	Terrestrial, Freshwater
<i>Aquila nipalensis</i>	Steppe Eagle	AVES	EN	Decreasing	Terrestrial
<i>Falco cherrug</i>	Saker Falcon	AVES	EN	Decreasing	Terrestrial, Marine, Freshwater
<i>Tor putitora</i>		ACTINOPTERYGII	EN	Decreasing	Freshwater
<i>Panthera pardus</i>	Leopard	MAMMALIA	VU	Decreasing	Terrestrial
<i>Ursus thibetanus</i>	Asiatic Black Bear	MAMMALIA	VU	Decreasing	Terrestrial
<i>Wallago attu</i>		ACTINOPTERYGII	VU	Decreasing	Freshwater
<i>Bagarius yarrelli</i>		ACTINOPTERYGII	VU	Decreasing	Freshwater
<i>Anacyclus pyrethrum</i>	Atlas Daisy	MAGNOLIOPSIDA	VU	Decreasing	Terrestrial
<i>Marmaronetta angustirostris</i>	Marbled Teal	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
<i>Aythya ferina</i>	Common Pochard	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater



Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Sterna aurantia	River Tern	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
Clanga clanga	Greater Spotted Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Aquila rapax	Tawny Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Aquila heliaca	Eastern Imperial Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
Ovis vignei	Urial	MAMMALIA	VU	Decreasing	Terrestrial



### **Recommended citation**

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### **How to use this report**

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the specified location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a "first-step", providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.



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## **ANNEXURE P**

### **Estimation of Leachate Leaking Effect on Ground Water Quality**

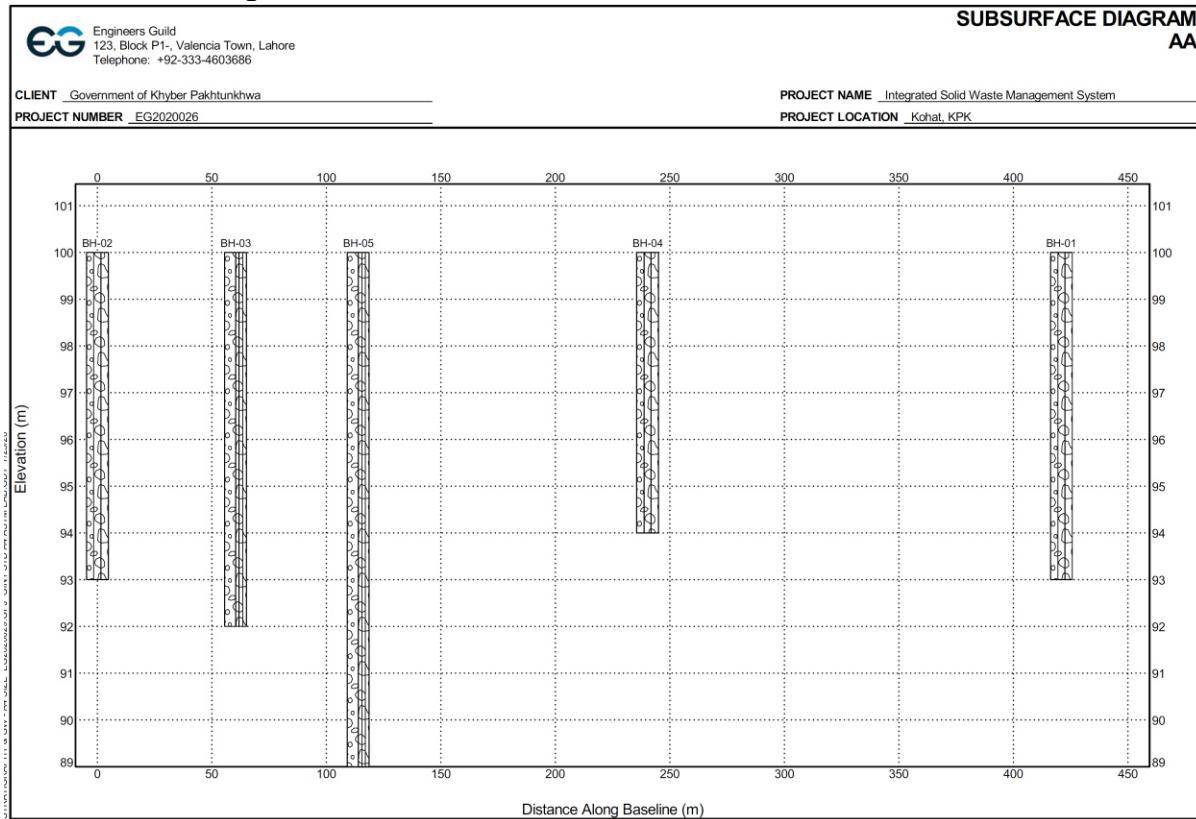
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## 13 Part 1: Problem statement

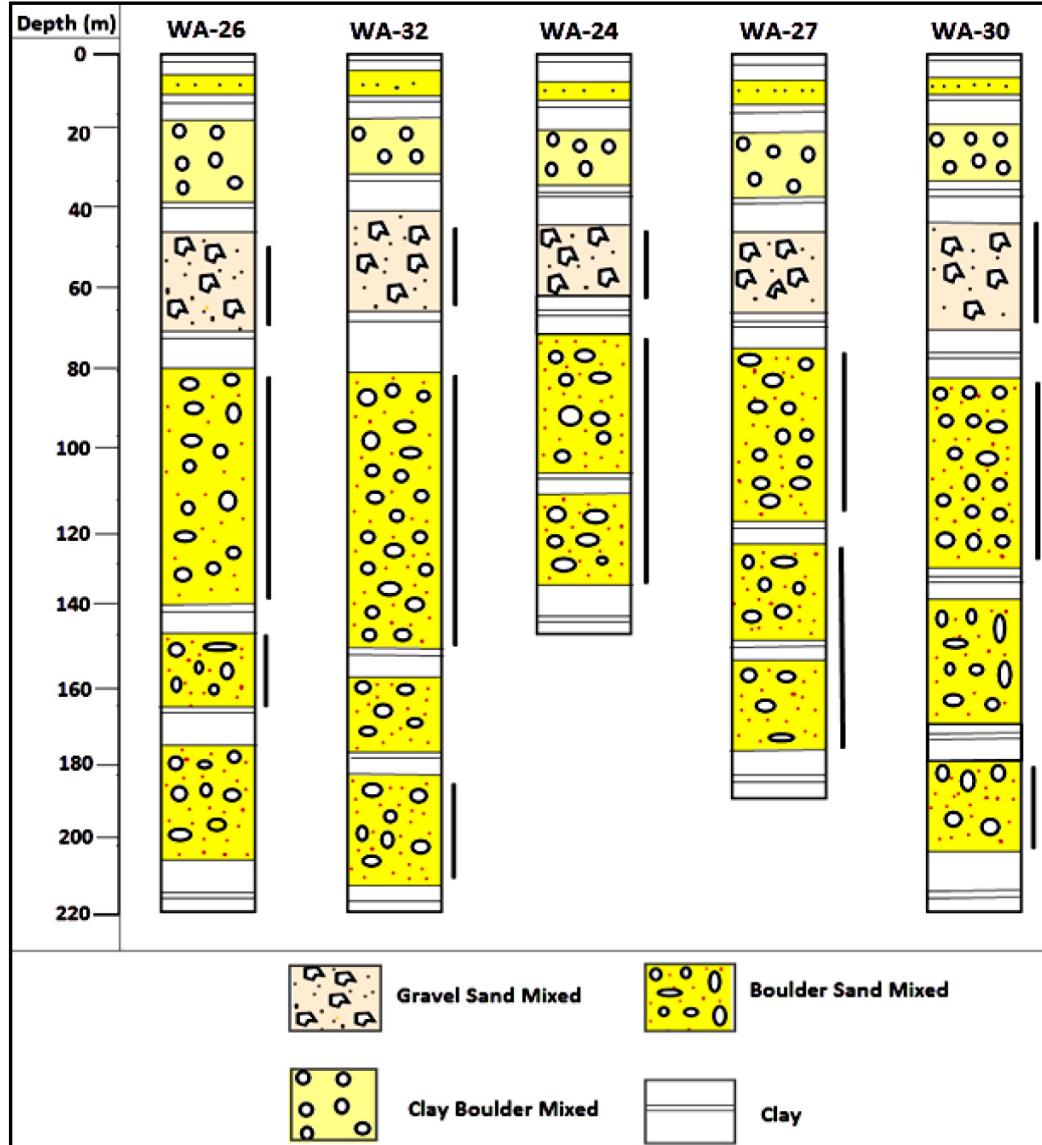
Sanitary landfills generally are constructed by placing wastes in excavations and covering the material daily with soil--thus the term "sanitary" to indicate that garbage and other materials are not left exposed to produce odours or smoke or attract vermin and insects. Even though a landfill is covered, leachate may be generated by the infiltration of precipitation and surface runoff. Fortunately, many substances are removed from the leachate as it filters through the unsaturated zone, but leachate may contaminate groundwater and even streams if it discharges at the surface as springs and seeps. This study aims at estimating the possible pathways through which the contamination may travel and contaminate ground water and identify the probably targets and estimates of contamination reaching those targets.

The ground comprises of dense to very dense clayey silty gravel/poorly sorted silty gravel up to maximum investigated depth of 11.0 m below existing ground level. Groundwater was not encountered during the geotechnical investigation up to 11 m depth. As informed by local residents living close-by, the groundwater table is generally available about depth of 200-250 ft below NSL. Soil profile for different boreholes carried out during the geotechnical investigation is shown below in **Figure 1**.



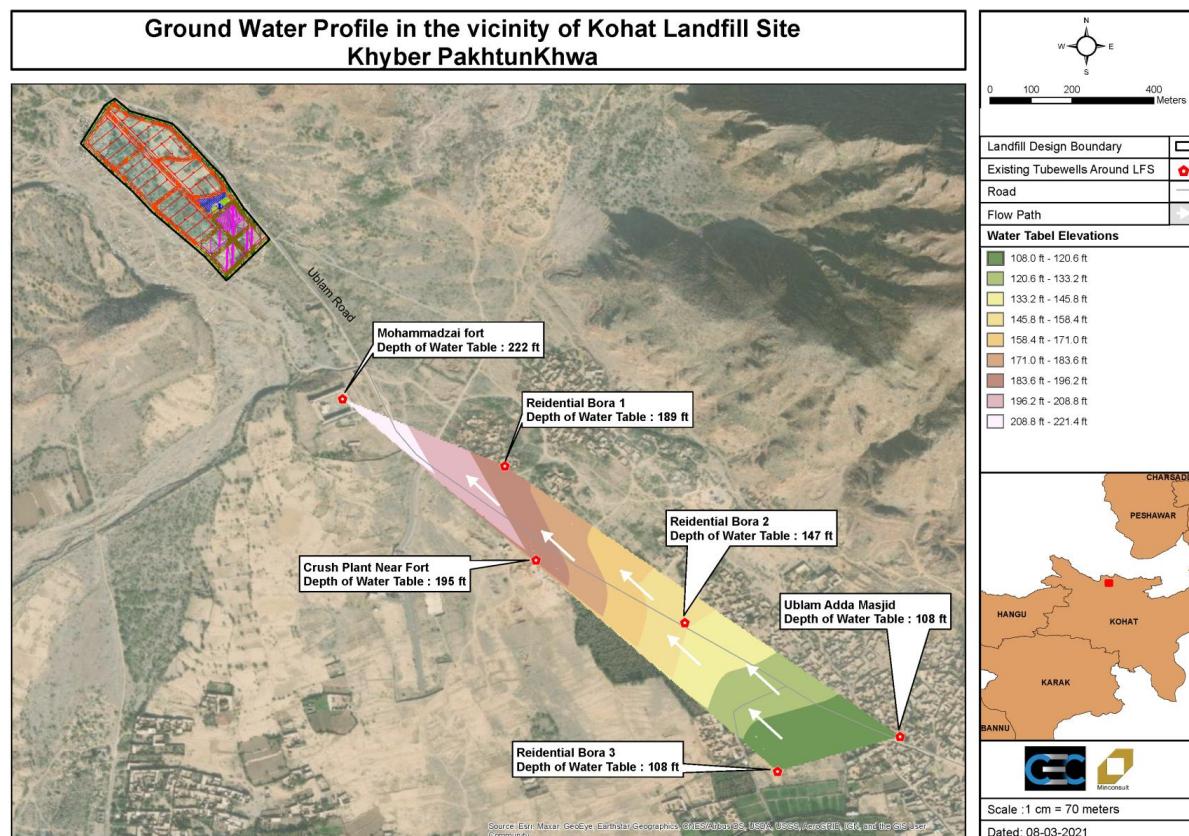
**Figure 2: Soil Profile from Borehole logs**

Five (5) storage cells are proposed by the designer of LFS in Kohat. A leachate leak from any of the storage cells may result in the contamination of the water table below the LFS. The geology of the site is clayey silty gravel/poorly sorted silty gravel up to maximum investigated depth of 11.0 m, the other studies conducted in the area suggest that depth of the water table is around 65 to 70m below natural surface level with impervious clay strata at around 80m depth (**Figure 2**).



**Figure 3: Borehole logs for Kohat Basin (Khan et al, 2018)**

The water table, based on actual data from site as well as the surroundings of LFS, shows that the water table is sloping towards nearby storm water drain and then towards the valley. **Figure 3** below shows the location and water table depths at existing water tube wells at the site and in the surrounding of the LFS. The **figure 4** also shows the water table sloping from LFS towards the nearby storm water drain and the estimated flow pattern.



**Figure 3: Location of tube wells and groundwater levels showing underground flow direction**



Figure 4: Kohat LFS location showing direction of flow (Google earth, 2021)

S.No	Name of TW	Depth of Water Table (ft)
1	Mohammadzai fort	222
2	Residential Bore 1	183
3	Residential Bore 2	147
4	Bore at Crush Plant Near Fort	195
5	Ublam Adda Masjid	108

**Table 5: Data of existing water sources at and near LFS**

As per **Figure 3** above, the nearest communities with respect to the proposed LFS and in the direction of the flow is Mohammad zai village at 2000m distance from the site. Due to the greater depth of water table and no surface water flow it is unlikely that the contamination will reach Mohammad Zai village before getting neutralized due to dispersion, chemical diffusion and bio-decay.

## 14 Part 2: Conceptual model

The conceptual model analysis return no available targets for contamination within the investigated vicinity of the landfill site.

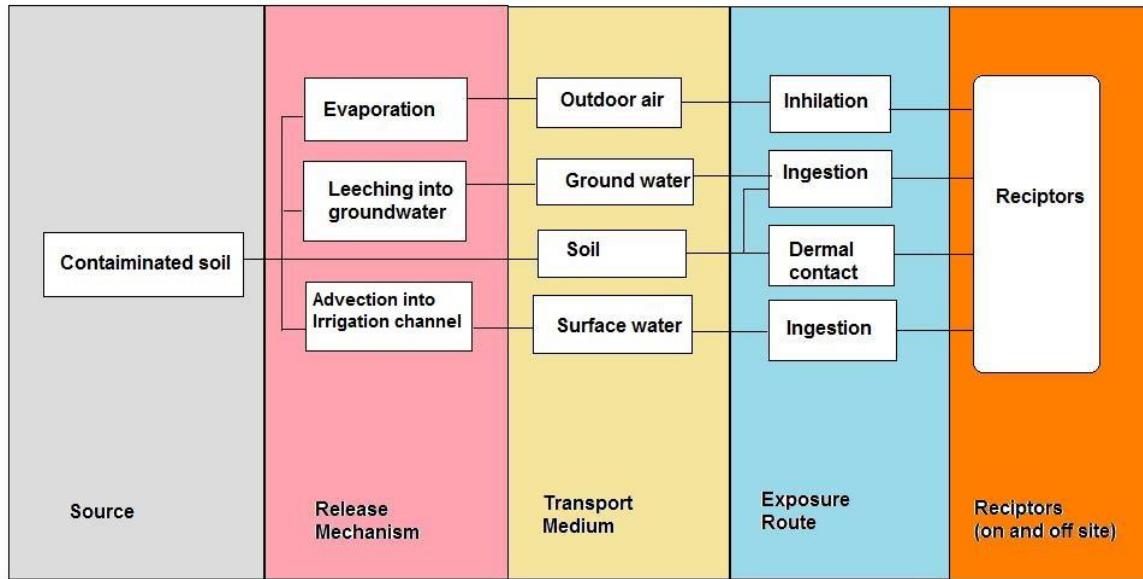
## 15 Part 3: Sources pathways and targets

The SPT (Sources, Pathway, Target) analysis of the site indicate the following Sources, Pathway and potential Targets

**Source:** Contamination leakage from Landfill cell in the form of leachate consisting of Biochemical contamination (details provided in landfill design document).

**Pathway (s):** Only one pathway was considered to be possible to carry the contamination in this case. The contamination of ground water and subsequent flow resulting in uptake by usage of water for drinking and washing by the community.

**Target (s):** There were no targets identified within 2000m distance in the direction of the ground water flow.



**Figure 5: Transport and fate mechanisms for contaminant movement**

## 16 Part 4: Qualitative risk assessment

The qualitative risk assessment for the study is described in the following steps:

- Step 1: Identification of Key Risks based on the data collection
- Step 2: Establishment of PI matrix to categorize different risks
- Step 3: Assigning PI to the agreed risks to calculate risk score from PI matrix
- Step 4: Ranking the risk scores to create a severity table and finalize ranks for different key risks

### Step 1 Identification of Key Risks

Risk No	Description
1	Contamination of groundwater from leachate leaking cell
2	Contamination of surface water in storm water drain
3	Contamination uptake in drinking water by the town inhabitants
4	Evaporation of contaminant in the air to reduce air quality
5	Dermal contact while using water for washing and cleaning
6	Danger to the aquatic life in the area
7	Contamination uptake in vegetation and subsequent ingestion (eating)

**Step 2 PI Matrix**

Impact ↓					
Very High	Med. Risk	Med. Risk	High risk	High risk	High risk
Serious	Med. Risk	Med. Risk	Med. Risk	High risk	High risk
Moderate	Low risk	Med. Risk	Med. Risk	Med. Risk	High risk
Minor	Low risk	Low risk	Low risk	Med. Risk	Med. Risk
Insignificant	Low risk	Low risk	Low risk	Med. Risk	Med. Risk
Probability→	Very Low	Low	Medium	High	Very High

**Step 3 Assigning PI to the agreed risks to calculate risk score from PI matrix**

Risk No	Description	Impact	Probability	Risk score
1	Contamination of groundwater from leachate leaking cell	Serious	low	Medium
2	Contamination of surface water in storm water drain	Serious	Very Low	Medium
3	Contamination uptake by the town inhabitants	Very High	Very Low	Medium
4	Evaporation of contaminant in the air to reduce air quality	Minor	Low	Low
5	Dermal contact while using water for washing and cleaning	Moderate	Low	Low
6	Danger to the aquatic life in the area	Minor	Low	Low
7	Contamination uptake in vegetation and subsequent ingestion (eating)	Insignificant	Low	Low

**Step 4 Ranking the risk scores to create a severity table**

Risk No	Description	Impact	Probability	Risk score	Rank
1	Contamination of groundwater from leachate leaking cell	Serious	low	Medium	1
2	Contamination of surface water in storm water drain	Serious	Very Low	Medium	1
3	Contamination uptake by the town inhabitants	Very High	Very Low	Medium	1
4	Evaporation of contaminant in the air to reduce air quality	Minor	Low	Low	2
5	Dermal contact while using water for washing and cleaning	Moderate	Low	Low	2
6	Danger to the aquatic life in the area	Minor	Low	Low	2
7	Contamination uptake in vegetation and subsequent ingestion (eating)	Insignificant	Low	Low	2

The above risk analysis indicates that the contamination of groundwater from possible leakage of a storage cell is moderate to low. Therefore, there is no need to quantitative estimation of contaminant movement.

## 17 Part 5: Conclusions and Recommendations.

- The hydrogeological analysis results indicate that the depth of water table is well below the base of storage cells of LFS.
- The nearest community is far enough from the land fill site and in case of cell breach there is moderate to low chances of contamination reaching the community.
- Although the water table depth is considerable and there is no chance of water springs, however; the water springs (if any) on the downstream side of groundwater flow between storm water drain shall be identified and blocked to prevent possible contaminant movement into the river.
- The leachate discharge shall be measured on regular basis to indicate barrier breach from loss of leachate.