Initial Environmental Examination

Project Number: 51036-002
August 2021

Pakistan: Khyber Pakhtunkhwa Cities Improvement Project

Construction of Rorya Sewage Treatment Plant and Revamping of Sewerage System in Mardan

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

GOVERNMENT OF KHYBER PAKHTUNKHWA
PROJECT MANAGEMENT UNIT
KHYBER PAKHTUNKHWA CITIES IMPROVEMENT PROJECT
LOCAL GOVERNMENT, ELECTIONS &
RURAL DEVELOPMENT DEPARTMENT, PESHAWAR

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No: LGE&RD/KPCIP/2021/712-713 **Dated: 24 August 2021**

To:

Mr. Kiyoshi O. Nakamitsu
Principal Urban Development Specialist
CWRD, ADB, 6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel: +63-2-632-4444
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 Rorya 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 30 July 2021	Currency Unit – Pak Rupees (Pak Rs.)
Pak Rs 1.00 = $ 0.0062	US$1.00 = Pak Rs. 161

CONVERSIONS

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

ACRONYMS

ADB	Asian Development Bank
AD	Anaerobic Digestion
AIIB	Asian Infrastructure Investment Bank
AIP	Access to Information Policy
AMSL	Above Mean Sea Level
AL	Aerated Lagoons
ASP	Activated Sludge Process
BC	Before Construction
BOD	Biological Oxygen Demand
BOQ	Bill of Quantities
COD	Chemical Oxygen Demand
COVID-19	Corona Virus Infectious Disease-2019
CSC	Construction Supervision Consultant
DC	During Construction
DO	During Operation
DWF	Dry Weather Flow
EA	Executing Agency
EA (ASP)	Extened Aeration (Activated Sludge Process)
EDCM	Engineering Design Construction Management
EGL	Existing Ground Level
EHS	Environmental, Health, and Safety
EIA	Environment Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
GoP	Government of Pakistan
GRM	Grievance Redress Mechanism
HDPE	High Density Polyethylene
IA	Implementing Agency
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IWMS	Integrated Waste Management System
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
MBR	Memberane Bioreactor
MGD	Million Gallons per Day
MLSS	Mixed liquor suspended solids
MLVSS	Mixed liquor volatile suspended solids
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
PESCO	Peshawar Electric Supply Company
PF	Peaking Factor
PGA	Peak Ground Acceleration
PMU	Project Management Unit
PPE	Personal Protective Equipment
PST	Primary Sedimentation Tank
RCC	Reinforced Cement Concrete
REA	Rapid Environmental Assessment
RFP	Request for Proposal
RP	Resettlement Plan
SN	Sewerage Network
SOPs	Standard Operating Procedures
SS	Suspended Solids
SPS	Safeguard Policy Statement
STP	Sewage Treatment Plant
SSEMP	Site Specific Environmental Management Plan
SST	Secondary Settleing Tank
TF	Trickling Filters
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
WSP	Waste Stablization pond
WWTP	Waste Water Treatment Plant

NOTE

In this report, "$" refers to US dollars

DEFINITION OF TERMS

"Activated Sludge" The activated sludge process is a type of wastewater treatment process for treating sewage or industrial wastewaters using aeration and a biological floc composed of bacteria and protozoa

"Carbon Monoxide" (also CO) A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

"Carbon Dioxide" (also CO_2) A colorless, odorless, incombustible gas, CO2, 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.

"Discharge" means spilling, leaking, pumping, depositing, seeping, releasing, flowing out, pouring, emitting, emptying or dumping;

"Effluent" means any material in solid, liquid or gaseous form or combination thereof being discharged from industrial activity or any other source and includes a slurry, suspension or vapour;

"Force Mains/Rising Main" A force main or rising main is a pressurized sewer pipe that conveys wastewater under pressure from the discharge side of the pump.

"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.

"Manholes" Manholes are vertical underground confined spaces used by utility personnel as a point of access to a sewer system

"Particulates" (also PM_{10}) 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.

“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.

“SCADA” Supervisory control and data acquisition (SCADA) is a system of software and hardware elements that allows industrial organizations to Control industrial processes locally or at remote locations

“Self-cleansing velocity” Self cleansing velocity may be defined as the minimum velocity of flow at which the solid particles present in the sewage will be held in suspension and also at which the scour of the deposited particles will take place so that the sewer will be kept clean

“Sewage” Sewage, or domestic/municipal wastewater, is a type of wastewater that is produced by a community of people**.**

“Sewerage” Sewerage is the infrastructure that conveys sewage or surface runoff (storm water, meltwater, rainwater) using sewers. It encompasses components such as receiving drains, manholes, pumping stations, storm overflows, and screening chambers of the combined sewer or sanitary sewer

“Sludge” It is a semi-solid slurry that can be produced from a range of industrial processes, from water treatment, wastewater treatment or on-site sanitation systems

“Sulfur Dioxide” (also SO_2) 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

S/No.	Version	Date	Summary of Revisions made
1	1	21-04-2021	First Draft of IEE report
1	2	26-07-2021	Final 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 livable; 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 Khyber Pakhtunkhaw Cities Improvement Project (KPCIP) is being processed through the Project Readiness Finance (PRF) modality by Asian Development Bank (ADB) under Loan 6016-PAK, being executed by Khyber Pakhtunkhwa Local Government, Elections and Rural Development Department (KP LGE&RDD). The project is focused on investments of subprojects related to water supply, sanitation and drainage, solid waste management and urban/green spaces. The project has the following four major components:

- Improvement of water supply systems in five (5) cities.
- Improvement of sewerage and drainage systems in five (5) cities, including provision of sewage treatment plants (STPs)
- Provision of Integrated Solid Waste management (ISWM) system in five (5) cities
- Development of Urban/Green Spaces in five cities.

6. The proposed Rorya Sewage Treatment and Mangament System for Mardan city is a subproject proposed under KPCIP and has the following two main components:

- **Component 1**: Revamping and Rehabilitation of existing Sewerage System
- **Component 2:** Construction of New Rorya Sewage Treatment Plant (STP)

7. This Initial Environmental Examination (IEE) has been prepared to address the adverse environmental and social impacts of the sewage management system in Mardan city.

8. The total proposed length of sewerage network is 82.4 km. Consturction of new sewerage system include improvement and upgradation of exisiting sewerage collection network in Mardan. It involves Interception/Connection Works, Conveyance network, construction of manholes, construction and installation of pumping stations and construction of septic tanks if required during construction stage.

9. The proposed sewage treatment plant will serve the current as well as ultimate future flows from Mardan City for 25 years. Accordingly, adopted design flow for the proposed sewage treatment plant is 5.8 MGD (21,953 m^3/day).

10. The proposed location of STP is located about 2km Sheikhmaltoon town, near zarra Rorya, situated in Union Council Rorya of District Mardan. A map showing the location of Rorya Sewage Treatment plant is provided as **Figure ES-1** while map showing proposed sewerage networks, trunk lines, manholes and sewerage treatment plant is provided as **Figure ES-2.**

11. The total area of the STP is approximately 261 Kanals. The land is already owned by the WSSC Mardan. Site is accessible by a paved road and is located at a distance of 2.3km from Mardan bypass on N45, 6.5Km from Rashakai Interchange M1. Coordinates of Mardan STP location are mention below.

Mardan STP Location Coordinates		
	Latitude	**Longitude**
STP	34.167234°	72.055189°

12. The proposed sewerage system for Mardan will be developed in six (6) urban union councils under jurisdiction of WSSC Mardan. These Six union councils i.e. Bari cham, Bicket Gunj, Muslimabad, Hoti, Guli bagh and Rorya are the major urban settlements in District Mardan. The proposed sewerage system shall be connected to Rorya Sewage treatment plant.

Project Need

13. The existing sewerage system for Mardan was installed in the three urban Union Councils (UCs) i.e. Bari cham, Bicket Gunj and Guli bagh, having total length of approximately 14.8 km. This system was constructed under the “Second Urban Development Project (SUDP)” in the years from 1991 to 2000. Sewerage network was also laid in other parts of District Mardan at that time. The sewerage network of these three UCs was connected to a Sewage treatment plant (STP) located in union council Rorya. This STP, named as Rorya STP, was also constructed under the same SUDP project.

14. Currently in Mardan the entire sewerage network and the sewage treatment plant are non-operational. The existing open drains are currently the main carriers of the storm water and sewage water in project area which are discharging in Kalpani River without any treatment, thus contaminating the local water bodies. Therfore, a new collection and disposal system for domestic sewage along with re-design and operationalization of Rorya Sewage Treatment Plant is an utmost requirement to safely collect and dispose the generated sewage flow from the catchment areas and to comply with the regulatory compliance requirements.

Study Methodology

15. 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.

16. Detailed ambient air quality and noise monitoring at different key receptor points in the project area were conducted. Apart from exceedances in PM_{10} at couple of monitoring 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 day time while exceedance was observed at one location is observed during the night time. Ground water samples from four sources i.e. Masjid Spin Jumaat, Special Branch, Chakker Pul and Masji near Bacha University was analysed and discussed in the report. Surface water sample of wali-abad residency was collected. Results of ground and surface water samples shows that water quality is well within NEQS.

17. 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

18. Stakeholders' consultations with local communities and institutional stakeholders were organized with a total of about 35 different stakeholders consulted. Consultations were organized with local communities in Februray/March 2020 while secondary stake holders like KP EPA and WSSC Mardan were also consulted in July 2020. Information on positive and negative impacts associated with constructional and operational stage and proper mitigation of adverse impacts were shared during these consultations.

19. The people living in the vicinity of the project area had major concerns related to the drainage system of the city. Odor issues and spread of diseases from open sewage system, as it became a source of vector borne diseases in the nearby population. People urged a secure system should be created and constructed which will resolve the past hitches and avoid further problems as much as possible. Moreover, stakeholders also emphasis that the project should be executed and completed on priority without delay.

Analysis of Alternatives

20. If ‘no project’ option is considered, it will result in loss of all positive impacts that project will pose on Mardan city; such as eradicating direct disposal of sewage in water bodies, clogging of sewerage drains, 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 and clogged drains and seepage likely to contaminate ground water and adjacent utilities like water supply. It would also limit the urban development of the area in a sustainable manner.

21. On the other hand, if the project is implemented, it will result in rehabilitation of an abandoned site, replacement of effluent collection and conveyance system, new and updated treatment plant, and a safe sewage disposal system. Furthermore, project implementation will also result in environmental compliance with respect to sewage management and improved urban quality. Project 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 feasible option.

22. The existing sewage treatment plant at Rorya Mardan which is not functional at present is planned to be rehabilitated. No potential alternative sites have been considered since the current site satisfies each of the selection criteria to a great extent.

23. The site is located at a reasonable buffer from the surrounding population. The existing drainage network, although in need of capacity enhancement, already meets the design criteria to service the respective union councils as well as minimize excess storm water entry. Adequate road access to the site already exists. The capacity and the topography of the site is adequate to support wastewater treatment plant operations. There will be no land acquisition costs since the land is already acquired and serving the purpose of a sewage treatment plant.

24. Keeping in view all these factors in which the current site adequately satisfied the selection criteria, no other site was considered and the site has been finalized for this purpose

25. For preliminary treatment different types of grit removal mechanisms are available e.g. Vortex grit chamber, horizontal flow grit chamber, aerated grit chambers. Vortex and aerated types require power and higher maintenance. Therefore, simple horizontal flow grit removal chamber prior to the primary settling tanks has been proposed for Rorya wastewater treatment plant.

26. For primary treatment considering simplicity in operation, influent characteristics, treatment efficiencies and known applications in Pakistan, Primary settling tanks are proposed as primary treatment and will be located upstream of biological treatment.

27. A comparison summary of Secondary treatment technologies is given below table E1.

ES: 1 Summary of Secondary Treatment Technologies

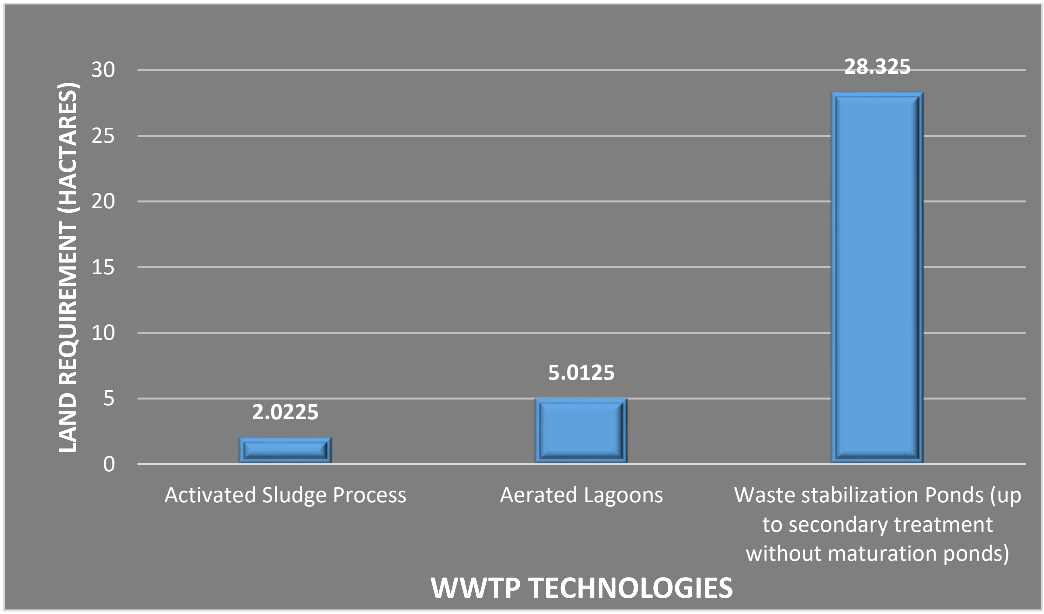
Parameter	Type of Secondary Treatment Technology					
	Activated Sludge Process (ASP)	Trickling Filters (TF)	Extended Aeration (EA)	Aerated Lagoons (AL)	Membrane Bio reactor (MBR)	Waste Stabilization Ponds (WSP)
Area Requirement	Minimum	Moderate	Moderate	Moderate	Minimum	Large
Process Mechanical Equipment	Yes	Yes	Yes	Yes	Yes	No
Capital Construction Cost	High	High	High	High	High	Moderate
Operation and Maintenance Cost	High	Moderate	High	High	Very High	Minimum
Process Energy Requirement	High	Moderate	High	High	Very High	Nil
Operational Supervision & Control	High	High	High	High	High	Minimum
Quantities of Sludge Produced	High	Moderate	Moderate	High	Moderate	Minimum
Daily Waste Sludge Disposal	Yes	Yes	Yes	Yes	Yes	No
Odor Problems	Minimum	Moderate	Minimum	Moderate	Minimum	Moderate
Vector/Mosquitoes Problems	Minimum	High	Moderate	Moderate	Minimum	Moderate

Environmental Analysis of Adopted Secondary Treatment Technology

28. Various secondary treatment technologies and their merits and demerits are analyzed Membrane Bio Reactor (MBR) process although require low foot print, however, it has complex system, high energy requirements, high Operation and Maintenance (O&M) cost, require skilled labour and membrane is not locally available, technology not implemented yet in Pakistan. Therefore, MBR process is not considered for the proposed Rorya sewage treatment plant.

29. Waste stabilization ponds have high land requirements and negative environmental impacts like odor, ground water contamination due to seepage, mosquito growth, proximity to the city etc. Also, the available land for treatment plot is about 261 kanals. which cannot accommodate the ponds required for the design wastewater flow. Land requirement for ASP, Ponds and ALs is given below.

ES: 1 Comparison of Land for AST, AL and Ponds Requirement



30. As available land 261 kanals is not adequate to accommodate the ponds, therefore, waste stabilization ponds are not considered for the proposed Rorya STP.

31. Aerated lagoons also require large area, high energy for mixing and have higher environmental impacts therefore not considered for Rorya STP.

32. Trickling filters have high cost and performance depends on the natural aeration. Trickling filters have high potential of clogging due to algal growth which could lead to limited aeration, low performance and overflow from the tank. Also, maintenance will be high if clogged. Considering drawbacks of trickling filter and local conditions, these are not considered for the Rorya STP.

33. Extended aeration activated sludge process is a reliable technology, however it has higher energy requirements as compared to conventional activated sludge process. Also extended aeration process is used when nutrients removal is required.

34. Conventional activated sludge process is a proven technology for treatment of sewage and industrial wastewaters. It requires less land as compared to lagoons, has high reliability in performance and higher potential for absorbing shock pollution loads. . Considering National Environmental Quality Standards (NEQS), local conditions and other factors discussed above, conventional activated sludge process is considered most appropriate technology for Rorya STP, Mardan City. In general, the activated sludge system, with Solids Retention Times (SRT) values within the conventional range of 4 – 10 days, can furnish Biological Oxygen Demand (BOD) removal efficiencies of above 90 %, under good operational supervision and control. The process also removes suspended solids and Chemical Oxygen Demand (COD).

35. Considering above, Rorya STP for Mardan City has been designed considering the conventional activated sludge process as secondary biological treatment due to low area requirement, easy and cost effective in operation and maintenance with minimum odor issues.

Baseline Conditions

36. **Physical Environment:** The proposed location of STP is located about 2km Sheikhmaltoon town, near zarra Rorya, situated in Union Council Rorya of District Mardan. The existing Rorya STP is located on relatively on a flat piece of land. However, the topography of the site is adequate to support wastewater treatment plant operations. As per Pakistan Building Code 2007, this site in Mardan, Mardan lays in Zone 2B with PGA of 0.16 to 0.24g. The soil strata encountered during geotechnical investigation mainly comprises of Silt with Sand and Silt from 5ft up to 30ft depth.

37. Ground water encountered during geotechnical investigation is around 15 feet from existing ground levels. Ground water samples from four sources i.e. Masjid Spin Jumaat, Special Branch, Chakker Pul and Masji near Bacha University was analysed. All physical, chemical and Biological parameters were examined and results indicates that all parameters are within most stringent guidelines. Most of the streams in the project area drain into Kabul River. Kalpani, an important stream of the district rises in the Baizai and flowing southwards join Kabul River. Surface water of wali-abad residency was also analysed and all examined parameters were with NEQS. The pH of surface water was 6.8 while BOD_5 and COD was 68 and 101 mg/l respectively. The surface water also did not show any heavy metal contamination.

38. Mardan has a hot semi-arid steppe climate, which is very dry with little rainfall. It may rain at any time of the year but the rain does not last long. As well as being arid, the climate is extremely hot in the summer but slightly cooler in the winter months.

39. Ambient noise levels being within the most stringent guidelines during the daytime, however, exceedance was observed at the night time at one location i.e near mardan sports complex in the project area. Air shed seems to be of good quality with the ambient air quality within the acceptable NEQS standards with PM_{10} being the only pollutant that is slightly exceeding the most stringent guidelines at couple of monitored locations.

40. **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. The common trees are mesquite, ber, different species of acacia and jand. The most common shrubs are tarmariax, articulata, spands, akk, small red poppy, spera, pueghambrigul, drab grass, spera, eamelthorl and pohli chaulai etc. No endangered species are available present in the project area. Red Fox, Golden Jackal and Wild Boar are important mammals of the area with IUCN least conern status. The commonly found avifauna of the project area are Shikra (*Accipiter badius*), Crow (*Corvus splendens*), Common kite (*Milbus migrans*), Sparrow (*Passer domesticus*), Pigeons (*Columba livia*), Dove (*Strato pielia*), Parrot (*Psittacula kramerl*), Partridges. No migratory birds or their routes were found near the project site.

41. **Social Environment:** The project area falls in the jurisdiction of Union Council (UC) Rorya, Mardan in Khyber Pakhtunkhwa Province. According to Census 2017, the total population of District Mardan is 2,373,061, including both urban and rural settlements. The Rural population of the District is 1,933,736 persons, while the urban population is 439,325 persons. In the District, the total Number of males is 1,200,871, while the total Number of

females is 1,172,192. The City is home to textile and vegetable oil mills, as well as one of the largest sugar refineries in South Asia. Its industries also include the Pakistan Railways Locomotive Factory, small to large cigarette manufacturing industries, and flour, marble, and paper mills. Several financial agencies (banks) have established their presence in the City.

42. There are few densely populated residential societies situated around the proposed Sewerage Treatment Plant, Mardan. The major societies around proposed project area are Sheikh Maltoon Town, Jibran Colony, Itehaad Colony, Misriabad, Waliabad

43. The existing sewage treatment plant established in 1996 but is not in operational condition. TMA (Tehsil Municipal Administration) acquired the land in 1993 and compensation was made to displaced people. TMA handed over the site to WSSC Mardan in 2019.

44. The proposed corridor for the sewerage system is therefore based on the best available option as per the topographic survey. The corridor is mostly adopted at one edge of the exiting road carriageway keeping in mind the existing house ramps and utilities at both sides of the road carriageway

45. According to KPCIP Consolidated Social Due-Diligence Reoprt the project does not have any impact on land and non-land assets, hence is categorized as C for Involuntary Resettlement (IR)/ Indigenous People (IP) category. It is also confirmed that none of the IP is existing in the project area.

Potential Major Impacts

46. The screening matrices for the impacts anticipated during pre-construction/design, construction and operation phases of the proposed sewage treatment plant (STP) and construction of sewerage sytem in Mardan are provided below as **Tables ES.2, ES.3** and **ES.4**.

47. **Pre-construction/design phase**: The key potential impacts that have been assessed and for which necessary mitigation measures have been proposed, are as follows:

- Improper flow computations for Sewerage Network and STP
- Improper design of Sewerage Network and STP
- Improper location of STP

48. **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:

- Poor Construction of sewage treatment plant and other structures not in accordance with finalized design
- Air, water and soil contamination
- Noise generation
- Generation of wastes
- Clearance of vegetation and impacts on fauna
- Traffic congestion
- Community health and safety issues
- Occupational health and safety (OHS) issues Improper handling and/or disposal of hazardous and non-hazardous waste and

- Influx of labor and social conflicts

49. **Operation phase:** The key potential impacts that have been assessed and for which necessary mitigation measures have also been proposed, as required are as follows:

- Emergencies and Plant failure
- Generation of sludge and other wastes
- Generation of objectionable odor
- Impact of the effluent
- Change of the drainage pattern
- Leaks and overflows and resulting issues such as soil and water contamination
- Community health and safety issues during maintenance activities and
- Occupational health and safety issues during maintenance activities.

Key Mitigation Measures

50. Mitigation measures associated with design, construction and operation phases are detailed in the IEE report. Necessary design considerations have been included for calculating peak flows in sewerage system and location of pumping stations, septic tanks and sewage treatment plant have been selected after assessment of hydraulic profile of sewerage system. Flow for sewerage system is calculated as per international and national practices. For residential plots, the sewage flow is considered as 85% of the water consumption of the development. The water consumption is assumed as 35 gallons per capita per day (gcpd)/132 liters per capita per day (lpcd), which results in a sewage flow of 30 gpcd (i.e. 85 % of water consumption). For nonresidential population 12 gpcd (WASA Lahore criteria) has been estimated. Moreover, to cater urban flooding and peak events Peak factor of 2 has been used for calculating Peaks flows for sewers and STP. Sewers are designed on self-cleansing velocity i.e. 0.75 m/s to 2.5 m/s to avoid accumulation of solid in sewer lines. The location of STP is carefully selected to avoid land acquisition impacts and natural topography to assist natural flow of influent before and during treatment, as well the discharge of effluent into an abutting Kalapani stream.

51. Major impacts associated with construction activity are clearance of vegetation, traffic hindrance, OHS issues, and commuicable diseases including COVID-19, air quality deterioration, soil and water contamination, noise generation and social conflicts during laying of sewer networks within project area. Proposed STP is located on existing Rurya STP location. Contractor camp shall be located on a vacant land to avoid unnecessary clearance. Good practices of construction for both sewer and STP shall be followed to mitigate the potential adverse impacts Traffic management plan shall be developed to avoid hindrance to locals while laying of sewer line. Access spoil shall be removed and disposed in burry pits identified during construction phase after approval from construction supervision consultants (CSC).

1. Mitigations associated with operations phase are related to handling of solid waste and sludge generated during operation phase. Solid waste management plan shall be developed to manage solid waste generated during operation. Sludge from primary settling tank (PST) and secondary setlling tank (SST) shall be transferred to gravity thickener where sludge will be thickened and conveyed to sludge drying beds for further drying. The sludge from sludge drying beds shall be transported into nearby landfill site at Saeedabd to be built under KPCIP project. To avoid plant failure generator shall be provided as a backup power supply source in case power from the electricity utility is not

available. Moreover, two separate sets of blowers will be installed in the blower building. Each set of blowers will consist of 3 blowers (2 duty + 1 standby) and will feed one aeration tank. In case of breakdown/malfunctioning of blower, standby blower will be used. The proposed treatment (ASP) is aerobic in nature and it will not produce odor as compared to other treatment technologies such TF, APs, ALs etc. However, in order to address any potential odor issue, a buffer zone of 50 feet wide all around the STP site consisting of thick plantation will be ensured as a precaution The code of practice for the maintenance activities for sewer and STP including OHS codes shall be developed. A communicable diseases prevention program will be prepared for staff/workers of STP in light of WHO guidelines on COVID-19 specific measures and Ministry of National Health Services, Regulations and Coordination, GoP guidelines for COVID-19. PMU KPCIP and WSSC Mardan will ensure the implementation of SOPs issued by GoP and WHO related to COVID-19.

2. **Climate Risk and Vulnerability Assessment of Proposed Construction of Sewerage Networks and Sewage Treatment Plant at Mardan**

3. Climate change can impact different aspects of the project activities due to projected increased temperatures and intense floods from heavy rainfalls at the catchment areas of sewerage networks and STP. These expected climatic changes in Mardan also have serious consequences on the operations of STP as extreme temperatures may cause bacteria to die and reduce efficiency of activated sludge process.

Climate Change Adaptation Measures for Water Treatment Plant and Distribution Networks

4. Detailed catchment studies including populations analysis has been conducted as part of estimating design flow. To cater urban flooding peak factor of 2 has been used for calculating peak flows.

5. Sewer network structures i.e manholes, reinforced cement concrete (RCC) sewers, pumping stations and septic tanks have been designed to withstand flash flooding in event of intensive rain.

6. Concrete ducts have been provided around sewers in areas which are prone to land sliding or areas adjacent to water channels.

7. In order to protect the plant site from external runoffs, drains outside of the STP boundary (on three sides) have been provided which will collect the runoff and will convey to the downstream of the plant site

8. Distribution chamber has been provided which will equalize the inflow and reduce impact of flooding in STP in case of urban flooding. Moreover, emergency drain shall be provided to divert incoming flow to water body in case of emergencies or high floods.

9. Neutralization chamber shall be provided to maintain pH of system in case of acid rains, or unforeseen events which abruptly change pH values of incoming flows from sewers.

Cumulative Impacts

10. No other infrastructure works are planned to be constructed in the project area while these project works shall be executed. Thus, no cumulative impacts are expected.

Indirect and Induced Impacts

11. Potential impacts arising from each phase of the proposed sewerage system and sewage treatment plant 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 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.

12. The, negative indirect and induced impacts from the construction of STP and sewerage network will of short term keeping in view nature of construction works while induced impacts are not expected from construction as well as from operation of STP.

Institutional Arrangements

13. During the construction phase, the overall responsibility for the implementation and monitoring of the Environmental Management Plan (EMP) rests with the Project Director (PD), Project Management Unit (PMU) KPCIP, 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. During operation phase responsibility of EMP implantation lies with Water and Sanitation Services Company WSSC Mardan with limited support from PMU. Monthly environmental monitoring data/reports will be incorporated 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 during construction and operation. Upon clearance, all such reports will be uploaded on the PMU and ADB websites.

Grievance Redress Mechanism

14. 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 will be established by PMU KPCIP. It will provide a public forum to the aggrieved to raise their objections and the GRM would address such issues adequately. 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.

Conclusion & Recommendations

15. An action plan with clear roles and responsibilities of stakeholders is provided in the IEE 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 STP, institutional review and capacity building (IRCB) component is included in the project design to enhance services delivery of WSSC Mardan.

16. 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.

17. 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, leaks and overflows etc., to name a few. These shall be mitigated through necessary measures.

18. 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-2: 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 flow computations	Unlikely	Moderate	Medium	Long Term
2	Improper design of STP and Sewerage network	Likely	Major	Medium	Long Term
3	Improper location of STP and Pumping stations	Rare	Moderate	Medium	Long Term
4	Lack of integration of IEE/EMP requirements into Construction bid documents	Likely	Moderate	Medium	Short Term
5	Material Haul routes	Likely	Moderate	Medium	Short Term
6	Contractor's Environmental Safeguards Capacity	Likely	Moderate	Medium	Short Term
7	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
8	Cultural Heritage & Religious Sites, Social Infrastructure	Unlikely	Moderate	Low	No residual Impact
9	Land acquisition and resettlement impacts	Unlikely	Moderate	Low	Long Term
10	Impacts due to natural hazards	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 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	Poor construction of sewerage network and STP not in accordance with finalized design	Likely	Major	Medium	Long term
2	Impacts associated with construction of sewer lines	Likely	Major	Medium	Short Term
3	Degradation of air quality due to construction works	Likely	Moderate	Medium	Short term
4	Impacts on surface water quality	Likely	Moderate	Medium	Short term
5	Increased Traffic	Likely	Moderate	Medium	Short term
6	Community Health & Safety	Likely	Major	Significant	Short term
7	Occupational Health & Safety	Likely	Major	Significant	Short term
8	High noise levels from construction activities	Likely	Moderate	Medium	Short term
9	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Major	Significant	Short term
10	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium	Short term
11	Soil Contamination	Likely	Moderate	Medium	Short term
12	Employment Conflicts	Likely	Moderate	Medium	Short term
13	Communicable diseases incl. COVID-19	Likely	Moderate	Medium	Short term
14	Vegetation and Wildlife Loss	Unlikely	Moderate	Low	No residual Impact
15	Historical/Archaeological Sites	Unlikely	Moderate	Low	No residual Impact

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)
16	Influx of Labor	Likely	Moderate	Medium	Short term
17	Gender Issues including GBV	Unlikely	Moderate	Low	No residual Impact
18	Child Labor	Unlikely	Moderate	Low	No residual Impact
19	Restricted Access	Unlikely	Moderate	Low	No residual Impact
20	Construction of Process and Non Process building Infrastructure	Likely	Moderate	Medium	Short term
21	Site Restoration	Likely	Major	Significant	Short term

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

Table ES-4: 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	Possible Emergencies and Plant failure	Rare	Moderate	Medium	Short term
2	Leaks and Overflows	Likely	Major	Medium	Short Term
3	Odor Generation	Unlikely	Moderate	Medium	Long term
4	Generation of Sludge and disposal	Likely	Major	Medium	Long term
5	Disease Vector Generation & Transmission	Likely	Major	Medium	Long term
6	Occupational Health and Safety	Likely	Major	Medium	Long term
7	Generation of solid waste	Likely	Major	Medium	Long Term
8	Discharge of treated effluent	Likely	Major	Medium	Long Term
9	Improvements in Public Health	Positive impacts expected			Long term positive residual impact
10	Lower Loads on Aquatic Environment	Positive impacts expected			Long term positive residual impact

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

Positive Impacts

Figure ES-1: Location Map of Rorya Sewage Treatment Plant

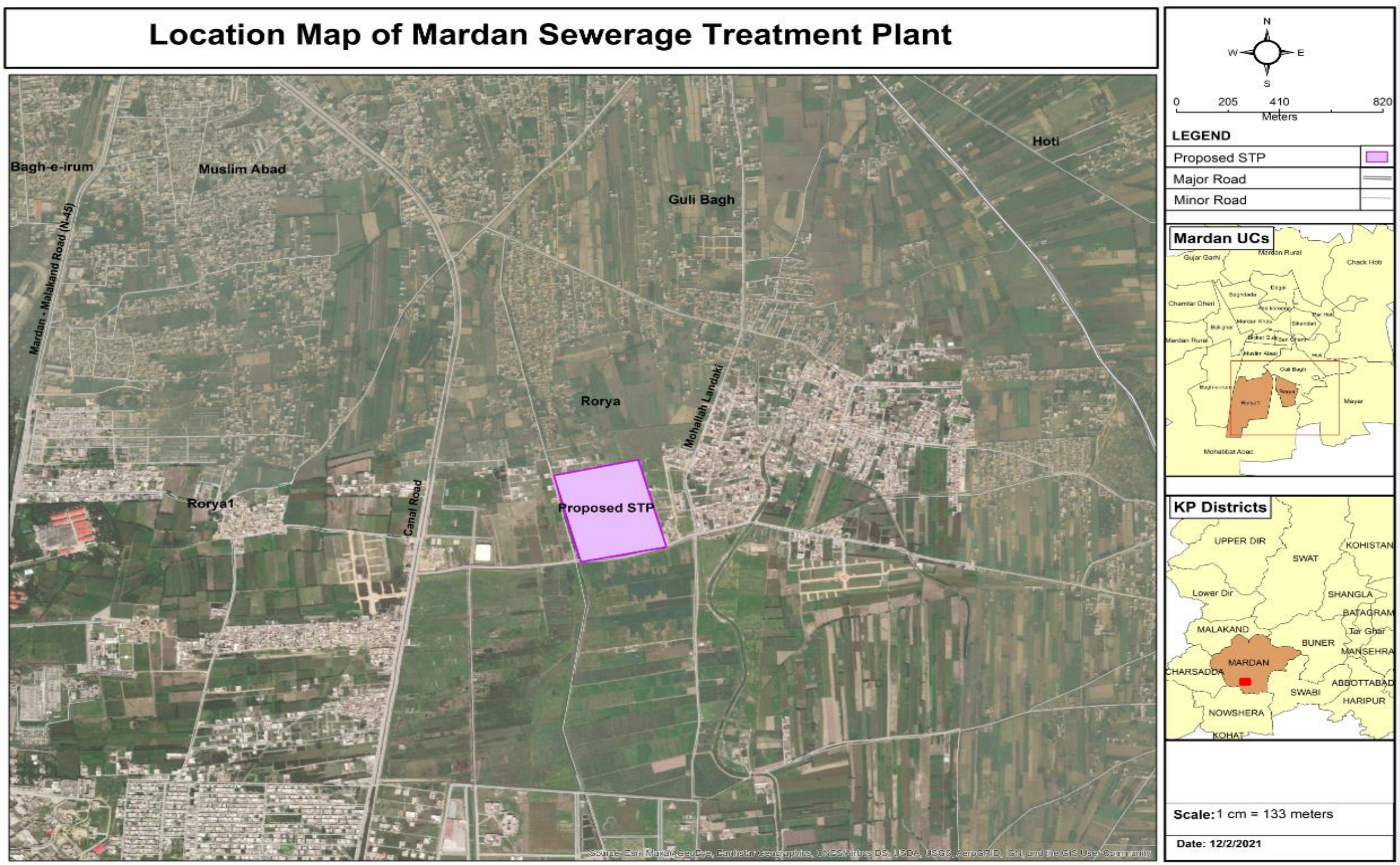
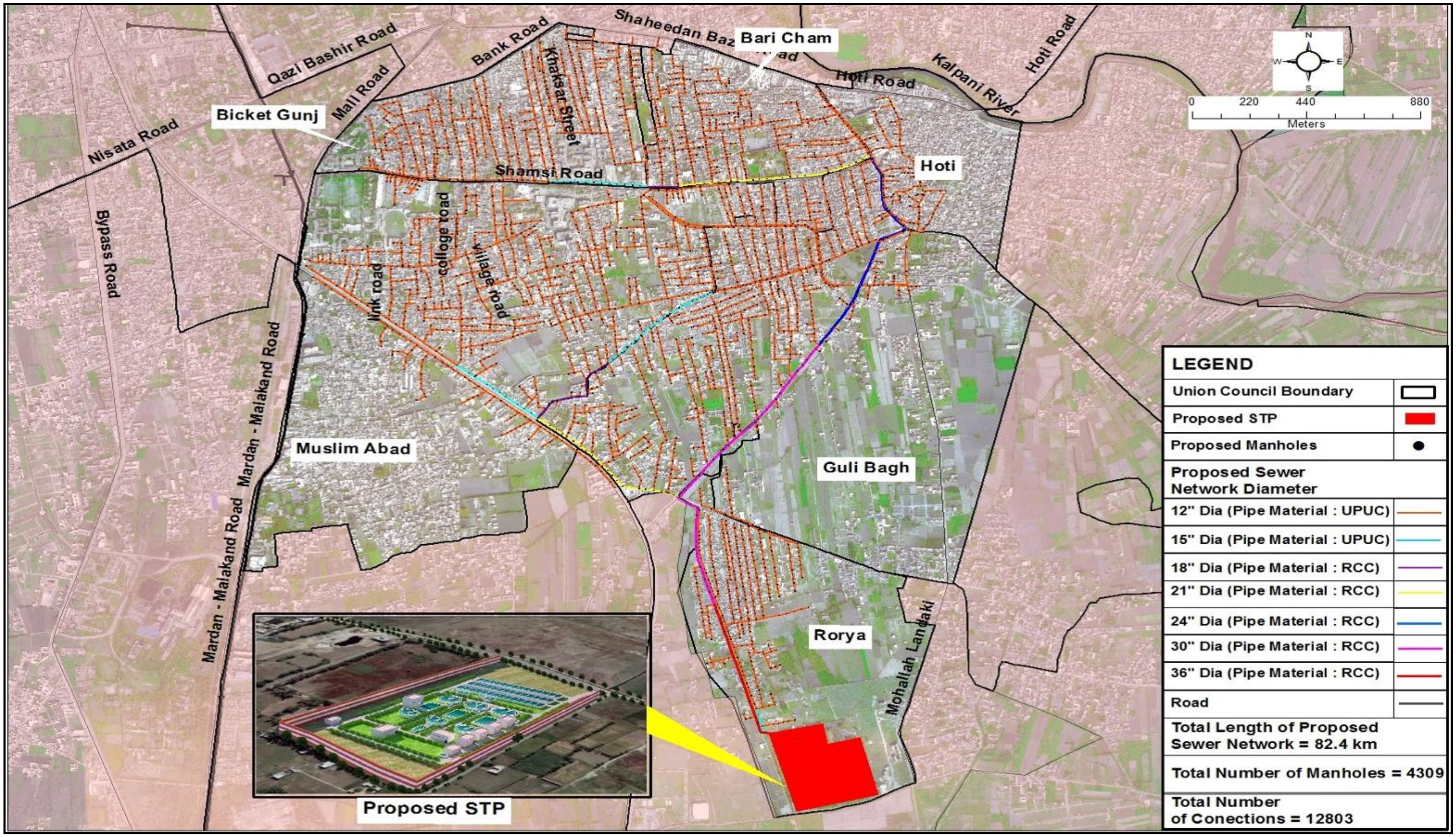


Figure ES-2: Proposed Utility Map



1 Introduction

1.1 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 livable; 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 Khyber Pakhtunkhaw Cities Improvement Project (KPCIP) is being processed through the Project Readiness Finance (PRF) modality by Asian Development Bank (ADB) under Loan 6016-PAK, being executed by Khyber Pakhtunkhwa Local Government, Elections and Rural Development Department (KP LGE&RDD). The project is focused on investments of subprojects related to water supply, sanitation and drainage, solid waste management and urban/green spaces. The project has the following four major components:

- Improvement of water supply systems in five (5) cities.
- Improvement of sewerage and drainage systems in five (5) cities, including provision of sewage treatment plants (STPs)
- Provision of Integrated Solid Waste management (ISWM) system in five (5) cities
- Development of Urban/Green Spaces in five cities.

6. The proposed Rorya Sewerage Treatment System at Mardan) is one of the subprojects under the KP-CIP and has the following two main components:

- **Component 1**: Revamping and Rehabilitation of existing Sewerage System
- **Component 2:** Construction of New Rorya Sewage Treatment Plant (STP)

7. Currently in Mardan the entire sewerage network and the sewage treatment plant are non-operational. The existing open drains are currently the main carriers of the storm water and sewage water in project area which are discharging in Kalpani River without any treatment, thus contaminating the local water bodies. Therefore, a new collection and disposal system for domestic sewage along with re-design and operationalization of Rorya Sewage Treatment Plant is an utmost requirement to safely collect and dispose the generated sewage flow from the catchment areas and to comply with the regulatory compliance requirements. Envrionmental audit report of existing sewerage treatment plant and sewerage network is attached as **Annexure O.**

8. The proposed sewage treatment plant will serve the current as well as ultimate future flows from Mardan City. Accordingly, adopted design flow for the proposed sewage treatment plant is 5.8 MGD (21,953 m^3/day).

9. The total proposed length of sewerage network is 84.2 km. Consturction of new sewerage system include improvement and upgradation of exisiting sewerage collection network at Mardan. It involves Interception/Connection Works, Conveyance network, construction of manholes, construction and installation of pumping stations and construction of septic tanks if required during execution.

1.2 Project Location

10. The proposed location of STP is located about 2km Sheikhmaltoon town, near zarra Rorya, situated in Union Council Rorya of District Mardan. A map showing the location of Rorya Sewage Treatment plant is provided as **Figure 1-1** while map showing proposed sewerage networks, trunk lines, manholes and sewerage treatment plant is provided as **Figure 1-2.**

11. The total area of the STP is approximately 261 Kanals. The land is already owned by the WSSC Mardan. Site is accessible by a paved road and is located at a distance of 2.3km from Mardan bypass on N45, 6.5Km from Rashakai Interchange M1. Coordinates of Mardan STP location are provided below.

Mardan STP Location Coordinates		
	Latitude	**Longitude**
STP	34.167234°	72.055189°

12. The proposed sewerage system for Mardan will be developed in six (6) urban union councils under jurisdiction of WSSC Mardan. These Six union councils i.e. Bari cham, Bicket Gunj, Muslimabad, Hoti, Guli bagh and Rorya are the major urban settlements in District Mardan. The proposed sewerage system shall be connected to Rorya Sewage treatment plant.

1.3 Environmental Category of Project

13. According to ADB's Safeguard Policy Statement (SPS) 2009, a Rapid Environmental Assessment (REA) Checklist was prepared for the proposed Rorya STP works (Annexure **A**). Based on the initial findings, it was ascertained that no major adverse environmental impacts are expected due to development of the Rorya STP, most of the impacts are reversible, short term, mitigatable and thus the subject project is considered environmentally "B" category as per ADB SPS, 2009. Therefore, the present IEE has been conducted.

1.4 Objectives of the IEE

14. Following are the objectives of this IEE study:

- Assess the existing environmental conditions of STP, 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 development pre-construction/design, construction, operation, on the physical, biological and socioeconomic environment of the project area;
- To propose mitigation measures that will help KP LGERDD and WSSC Mardan 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 will assist KP LGE&RDD and WSSC Mardan in the effective implementation of the recommendations of the IEE.

1.5 IEE Team

15. The IEE study team comprised of following experts.

- Environment Specialists by ADB, PMU KPCIP
- EDCM Technical Team of Waste Water
- 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

16. The following methodology was employed for this IEE:

1.6.1 Understanding of the Proposed Operation

17. This involved collecting information from the ADB, PMU KPCIP 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

18. 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 LGREDD as the Executing Agency will adhere to during implementation of the project.

1.6.3 Secondary Data Collection

19. 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)

20. 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.

21. 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 has 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.

22. 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.

23. Review of secondary information on the physical, biological and ecological aspects, physical cultural resources and infrastructure utilities in the Mardan STP area was conducted.

1.7 Public Consultations

24. 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's "Safeguard Policy Statement (SPS)-June 2009"/ Environmental Assessment 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 project and to seek their response/recommendation.

1.7.1 Impacts Identification and Assessment

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

1.7.2 Recommendations for Mitigation Measures

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

1.7.3 Development of Environmental Management Plan (EMP)

27. 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.

1.8 Proponent of Project

28. The LGERDD, GoKP is the Executing Agency (EA) for Construction of Rorya STP and associated Sewer network at Mardan while the project will be implemented through WSSC Mardan with support from PMU.

29. 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), KPCIP, 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	pdkpcip@gmail.com, info@kpcip.gov.pk
Web	Kpcip.gov.pk

1.9 Structure of the Report

30. 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
- Environmental Management Plan& Institutional Requirements
- Public Consultation
- Grievance Redressal Mechanism
- Findings, Recommendations and Conclusions
- References

1.10 Further Additions & Updating of IEE Study

31. This version of the report will be further updated after disclosure and comments from the general stakeholders. These revisions shall be incorporated into any subsequent updated versions of this IEE report. The updated IEE report will incorporate results of detailed engineering design and of any additional baseline monitoring as required (e.g., air, noise, ground and surface water quality) and will be submitted to ADB for approval and disclosure at ADB website. IEE/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.

Figure 1-1: Location Map of Mardan Sewage Treatment Plant

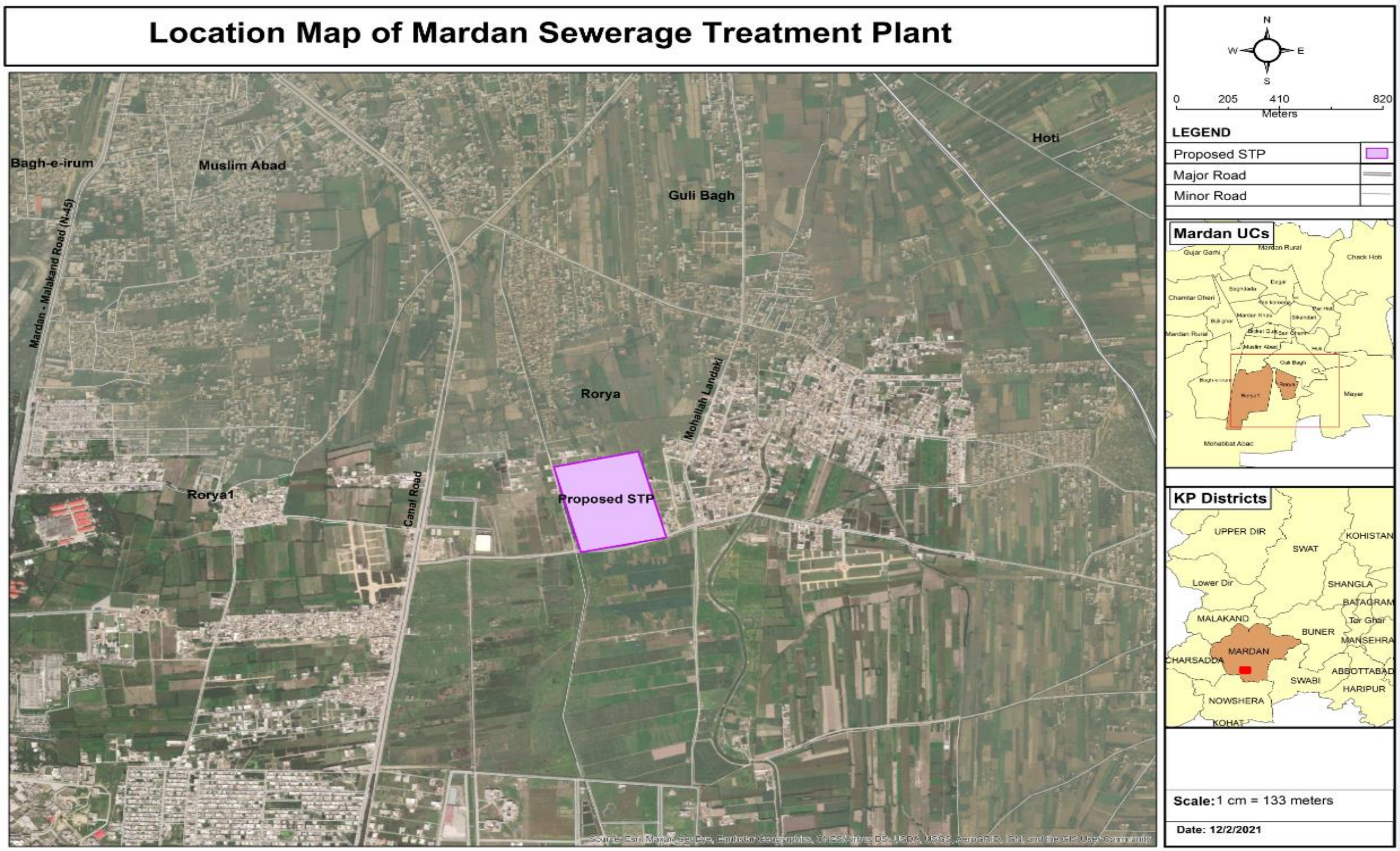
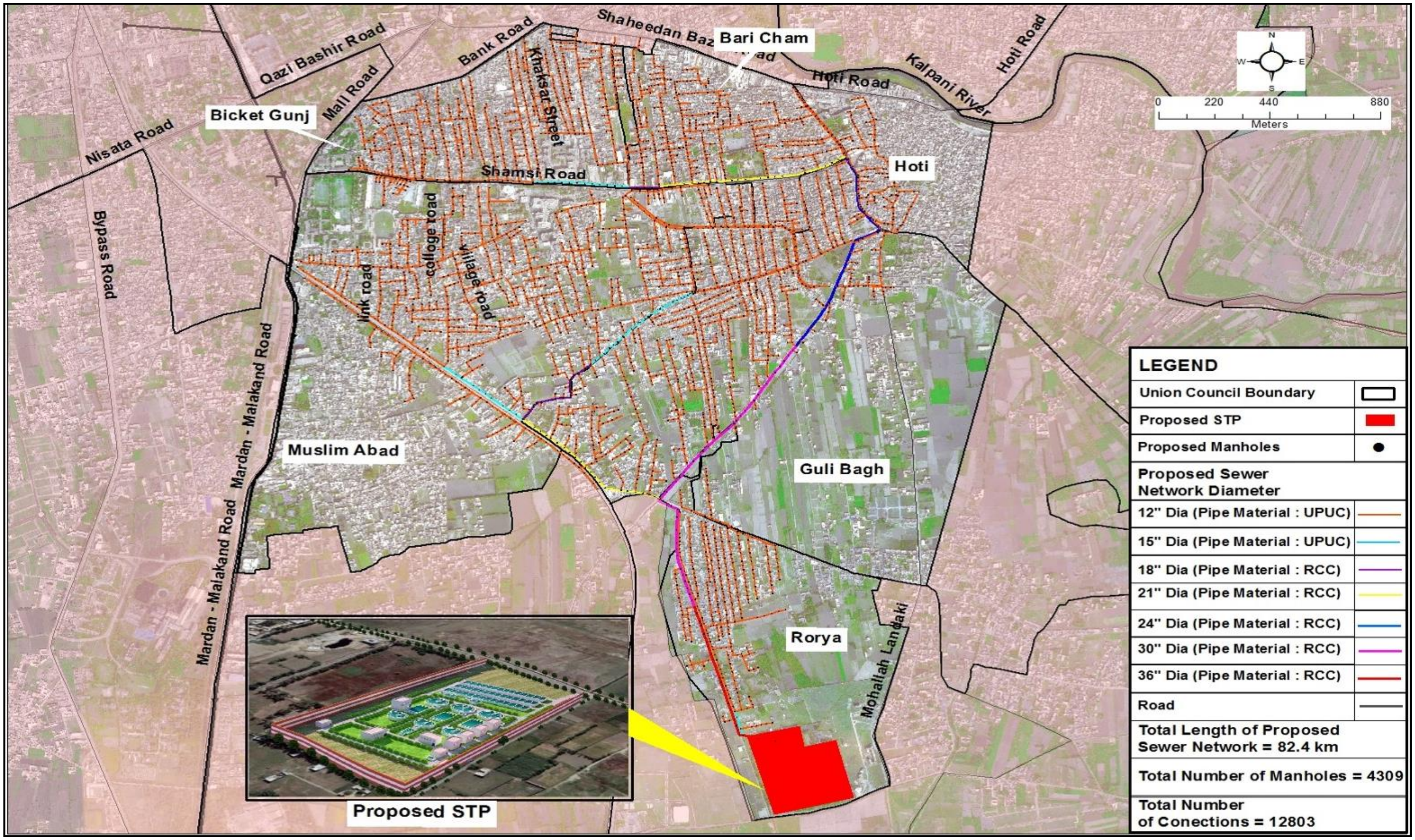


Figure 1-2: Project Area Map



2 Policy and Legal Framework

2.1 General

32. This section provides an overview of the policy framework and national legislation that applies to the proposed sewage treatment plant and rehablitation/development of sewerage network at, Mardan city, Pakistan. The project will comply with all national legislation relating to the environment in Pakistan and will obtain all the regulatory clearances required for financing agency, ADB.

2.2 National Policy and Legal Framework

33. 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 STP development are pollution prevention and abatement and increasing energy efficiency while conserving biodiversity.

34. 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. In consequence of 18th Constitutional Amendment Khyber Pakhtunkhwa Environment Protection Agency (KPEPA) has also promulgated the Khyber Pakhtunkhwa Environment Protection Act 2014.

2.3 Regulations for Environmental Assessment, KP EPA

35. Under Section 13 (subsequent amendment of the PEPA 1997), a project falling under any category specified in Schedule I of the IEE/EIA Regulations (SRO 339 (I0/2000), requires the proponent of the project to file an IEE with the concerned EPA. Projects falling under any category specified in Schedule II require the proponent to file an EIA with the provincial agency, which is responsible for its review and accordance of approval or request any additional information deemed necessary. In present case the project falls in the administrative jurisdiction of Khyber Pakhtunkhwa Environment Protection Agency.

2.4 Regulatory Clearances, KP EPA

36. In accordance with provincial regulatory requirements, an 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.

2.5 Guidelines for Environmental Assessment, Pakistan EPA

37. 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 & 2010

38. The National Environmental Quality Standards (NEQS), 2000 & 2010, 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 (02 parameters) in gaseous emissions from vehicle exhaust and noise emission from vehicles;
- Maximum allowable concentration of pollutants (08 parameters) in ambient air;
- Maximum allowable ambient noise levels;
- Maximum allowable noise levels from vehicles;
- Maximum allowable concentration of parameters in drinking water

39. NEQS guidelines are provided as **Annexure K** of this IEE report.

2.7 Other Environment Related Legislations

40. The national policies, laws and regulations are provided in **Table 2.1** below.

Table 2—1: Environmental Policies, 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

Legislation/Guideline	Description
	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 topping of trees, branches in reserved and protected forests. No protected forest is situated in the project area of STP at Mardan.
Khyber Pakhtunkhwa Wildlife and Biodiversity Act, 2015	It empowers the government to declare certain areas reserved for the protection of wildlife and control activities within in 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.
The KP Antiquities Act (2016)	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. No Archaeology site is available within a close vicinity of STP location.
Pakistan Penal Code (1860)	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.
NATIONAL ENVIRONMENTAL AND CONSERVATION STRATEGIES	
National Conservation Strategy	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.

Legislation/Guideline	Description
Biodiversity Action Plan	The plan recognizes IEE/EIA as an effective tool for identifying and assessing the effects of a proposed operation on biodiversity.
INTERNATIONAL CONVENTIONS	
The Convention on Conservation of Migratory Species of Wild Animals (1981)	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 sewerage treatment plant works.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	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.
International Union for Conservation of Nature and Natural Resources Red List (2000)	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.
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention) **(1971)**	The Ramsar Convention deals with the protection of water bodies of international importance and their associated biodiversity, as well as promoting wise use of allied resources. The Convention was adopted in 1971 at Ramsar, Iran and entered into force in 1975. Pakistan signed the Ramsar Convention in 1971, and ratified it in July 1976. There are 19 Ramsar sites in Pakistan.
Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal **(1992)**	The Basel Convention deals with the controlled trans-boundary movement of hazardous wastes and their disposal. The Convention was adopted on March 22, 1989, and entered into force on May 5, 1992; Pakistan signed the Convention in May 1992 and ratified it in October 1994.
United Nations Framework Convention on Climate Change (UNFCCC)	This convention highlights broad guidelines for protecting the climate of the planet. It was adopted in 1992 and came into force in 1994. Pakistan signed the UNFCCC in 1992 and ratified it in June 1994.

Legislation/Guideline	Description
(1994)	
Kyoto Protocol to UNFCCC **(2005)**	The Kyoto Protocol seeks to mitigate climate change and to reverse the pace of climate change through the use of carbon sequestration and carbon credits known as Certified Emission Reduction trading. The Protocol was adopted in 1997 and came into force in 2005; Pakistan signed the Protocol in December 1997 and ratified it in January 2005.

2.8 Implications of national policies and regulations on proposed project

41. The Pak-EPA formulated regulations in 2000 for 'Review of IEE and EIA' which categories 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.

42. 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.

43. 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.

44. The LGERDD, GoKPK, 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.

45. According to the regulations, no construction, preliminary or otherwise, relating to the project shall be undertaken until and unless approval from KPEPA has been issued.

46. The PMU KPCIP will submit the EIA Report in compliance to IEE/EIA Regulations 2000 on a prescribed application along with the processing fee to KP EPA. After submission of the EIA report, a forty-five (45) day period for review 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.

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

47. 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.

48. 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:

49. **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.

50. **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.

51. **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.

52. **Category FI**: A proposed project is classified as category FI if it involves investment of ADB funds to or through a financial intermediary (FI).

53. Since the proposed project of sewerage treatment will cause negligible environmental impacts, of which mostly are reversible and short terms, therefore, as per SPS 2009, the proposed project of Mardan STP is categorized as category "B" subproject.

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

54. 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

55. 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

56. 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.

57. 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.

58. 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 stakeholders throughout project implementation. Establish a grievance redress mechanism.

No.	Policy principle	Summary
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 phase outs.
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.

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

Table 2—3: ADB Environmental Assessment Requirements for Category 'B' projects

Aspect	Environmental Assessment & Management Requirements
Project processing	
Reporting	▪ Prepare full-scale Initial Environmental Examination (IEE)
Public consultations	▪ 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.
Disclosure of environmental assessment report	▪ Disclose Final IEE on its completion or project Board Approval whichever is earlier
Project implementation	
Reporting	▪ Submit semiannual reports during project construction, and annual reports during project operation to ADB for disclosure.

2.13 IFC Environmental, Health, and Safety Guidelines for Water and Sanitation[1]

60. The IFC EHS Guidelines for Water and Sanitation include information relevant to the operation and maintenance of (i) potable water treatment and distribution systems, and (ii) collection of sewage in centralized systems (such as piped sewer collection networks) or decentralized systems (such as septic tanks subsequently serviced by pump trucks) and treatment of collected sewage at centralized facilities.

61. Environmental issues associated with water and sanitation projects may principally occur during the construction and operational phases, depending on project-specific characteristics and components.

62. Guidelines are related to following impacts associated with sewerage collection system as follows:

- Domestic wastewater discharges
- Industrial wastewater discharges
- Leaks and overflows

63. The most significant environmental impacts and guidelines related to wastewater and sludge treatment, discharge include:

- Liquid effluents
- Solid waste
- Air emissions and odors

2.14 Environmental Health and Safety Guidelines for Waste Water and Ambient Water Quality[2]

64. The IFC guideline for Environmental Health and Safety Guidelines for Waste Water and Ambient Water Quality applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment. These guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. Process wastewater may include contaminated wastewater from utility operations, storm water, and sanitary sewage. It provides information on common techniques for wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors. These guideline is meant to be complemented by the industry-specific effluent guidelines presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines. Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or storm water should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.

[1] https://www.ifc.org/wps/wcm/connect/83217cd8-b9a5-4383-97b5-5af26182b3b8/2007+Water+and+Sanitation.pdf?MOD=AJPERES&CVID=m3CdtQr

[2] https://www.ifc.org/wps/wcm/connect/3d9a54ae-c44c-488d-9851-afeb368cb9f9/1-3%2BWastewater%2Band%2BAmbient%2BWater%2BQuality.pdf?MOD=AJPERES&CVID=ls4Xbfn

2.15 Comparison of International and Local Environmental Legislations

65. 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.

66. 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.

67. 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.

68. 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.

69. 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 construction of STP and associated sewerage system in Mardan.

70. Comparison of local and international water quality standards is provided as **Table 2.7.**

71. Comparison of International and Local effluent quality standards has been provided in **Table 2.8.** IFC guidelines are stringent for BOD_5, COD and TSS however Mardan STP is designed to comply NEQS.

72. 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_{eq},8h
Light industry (decreasing demand for oral communication)	50-65 Equivalent level L_{eq},8h

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_2	3 hrs 1 hr	0.5 ppm 75 ppb	24 hr 10 min	20 ug/m^3 500 ug/m^3	Annual Mean 24 hrs	80 ug/m^3 120 ug/m^3
CO	8 hrs 1 hr	9 ppm (11 mg/m^3) 35 ppm (43 mg/m^3)	-	-	8 hrs 1 hr	5 mg/m^3 10 mg/m^3
NO_2	Annual Mean 1 hr	100 ug/m^3 (53 ppb) 100 ppb	1 yr 1 hr	40 ug/m^3 200 ug/m^3	Annual Mean 24 hrs	40 ug/m^3 80 ug/m^3
O_3	8 hrs	0.07ppm (148 ug/m^3)	8 hrs	100 ug/m^3	1 hr	130 ug/m^3
TSP	-	-	-	-	Annual Mean 24 hrs	360 ug/m^3 500 ug/m^3
PM_{10}	24 hrs	150 ug/m^3	1 yr 24 hr	20 ug/m^3 50 ug/m^3	Annual Mean 24 hrs	120 ug/m^3 150 ug/m^3
$PM_{2.5}$	Annual Mean 24 hrs	15 ug/m^3 35 ug/m^3	1 yr 24 hr	10 ug/m^3 25 ug/m^3	Annual Average 24 hrs 1 hr	15 ug/m^3 35 ug/m^3 15 ug/m^3

*: 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
Bacterial			
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
Physical			
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	
Chemical			
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

Parameter	Unit	NEQS	WHO/IFC
Copper	mg/l	2	2
Cyanide	mg/l	≤0.05	0.07
Fluoride	mg/l	<1.5	1.5
Lead	mg/l	≤0.05	0.01
Manganese	mg/l	≤0.5	0.5
Mercury	mg/l	≤0.0001	0.0001
Nickel	mg/l	≤0.02	0.02
Nitrate	mg/l	≤50	50
Nitrite	mg/l	≤3	-
Selenium	mg/l	0.01	0.01
Residual Chlorine	mg/l	0.2-0.5 at consumer end	-
Zinc	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.

Table 2—8: Comparison of International and Local Sanitary/Domestic Effluent Quality Standards

Parameters	Into Inland Water	Into Sewage Treatment[b]	IFC Guidelines[3] For Treated Sanitary Sewage Discharge
Temperature or temperature increase[c]	≤3°C	≤3°C	
PH	6-9	6-9	6-9
Biochemical Oxygen Demand (BOD_5) at 20°C[d]	80	250	30
Chemical Oxygen Demand (COD)[d]	150	400	125
Total Suspended Solids (TSS)	200	400	50
Total Dissolved Solids (TDS)	3,500	3,500	
Grease and oil	10	10	10
Phenolic compounds (as phenol)	0.1	0.3	
Chloride (as Cl^-)	1,000	1,000	
Fluoride (as F)	10	10	
Total cyanide (as CN-)	1.0	1.0	
An-ionic detergents (as MBAS)[e]	20	20	
Sulphate (SO_4)	600	1000	
Sulphide (S-)	1.0	1.0	
Ammonia (NH_3)	40	40	
Pesticides[f]	0.15	0.15	
Cadmium[g]	0.1	0.1	
Chromium (trivalent & hexavalent)[g]	1.0	1.0	
Copper[g]	1.0	1.0	
Lead[g]	0.5	0.5	
Mercury[g]	0.01	0.01	
Selenium[g]	0.5	0.5	
Nickel[g]	1.0	1.0	
Silver[g]	1.0	1.0	
Total Toxic metals	2.0	2.0	
Zinc	5.0	5.0	

[3] https://www.ifc.org/wps/wcm/connect/3d9a54ae-c44c-488d-9851-afeb368cb9f9/1-3%2BWastewater%2Band%2BAmbient%2BWater%2BQuality.pdf?MOD=AJPERES&CVID=ls4Xbfn

Parameters	Into Inland Water	Into Sewage Treatment[b]	IFC Guidelines[3] For Treated Sanitary Sewage Discharge
Arsenic[g]	1.0	1.0	
Barium[g]	1.5	1.5	
Iron	8.0	8.0	
Manganese	1.5	1.5	
Boron[g]	6.0	6.0	
Chlorine	1.0	1.0	

Notes

a All values are in mg/l, unless otherwise defined
b Applicable only when and where sewage treatment is operational and BOD5=80 mg/L is achieved by the sewage treatment system
c The effluent should not result in temperature increase of more than 3°C at the edge of zone where initial mixing and dilution take place in the receiving body. In case zone is defined, use 100 meters from the point of discharge
d Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent
e Modified Benzene Alkyl Sulphate; assuming surfactant as biodegradable
f Pesticides include herbicide, fungicides and insecticides
g Subject to the total toxic metals discharge should not exceed level of total toxic metals

3 Project Description

3.1 General

73. The treatment and ultimate disposal of municipal wastewater/sewage of Mardan city is a major problem. A treatment plant based on ponds was constructed in past however, for long time, it is not operational. Also, the capacity of existing ponds is not adequate to treat the current as well as future flows from the Mardan City. As current ponds are not operational and does not have adequate capacity, therefore, the raw sewage is being directly discharged into nearby water bodies. This practice is environmentally unsafe, a violation of Environmental Protection Act and could be a major cause of diseases in the area.

74. The proposed Rorya Sewerage Treatment System at Mardan has the following two main components:

- **Component 1**: Revamping and Rehabilitation of existing Sewerage System
- **Component 2:** Construction of New Rorya Sewage Treatment Plant (STP)

75. The Component 1 i.e the proposed sewerage system for Mardan will be developed in six (6) urban union councils under jurisdiction of WSSC Mardan. These Six union councils i.e. Bari cham, Bicket Gunj, Muslimabad, Hoti, Guli bagh and Rorya are the major urban settlements in District Mardan. The proposed sewerage system shall be connected to Rorya Sewage treatment plant details are discussed in later section of report.

76. The Component 2 is to treat the wastewater, generated from the project area, and bring pollution parameters (BOD_5, COD, TSS) within prevailing provincial environmental standards i.e. National Environmental Quality Standards (NEQS), a sewage treatment plant is proposed for Mardan City

77. The detailed engineering design for the Rorya Sewage Treatment plant of Mardan, includes, Engineering design of various components of the proposed treatment plant, (Pumping station, Grit Chamber, Aeration Tank, etc.), Hydraulic Design of the proposed treatment plant shall be discussed in this section.

3.2 Existing Condition of Sewerage System and STP in Mardan

78. The existing sewerage system in the project area was constructed in the year 1991 under SUDP. The total length of the existing sewerage network in the project area is approximately 14.8 kilometers, which is fully clogged, abandoned or damaged. The existing sewerage system has never been fully connected to the existing Rorya STP. The existing sewerage system is catering to three urban union councils of Mardan i.e. Bari cham, Bicket Gunj and Guli bagh. Exisiting condition of sewerage system are provided as **Figure 3-1.** Envrionmental audit report of existing facilities is attached as **Annexure O.**

79. The diameter of existing sewerage network varies from 6 inches to 36 inches. The tertiary network is mostly of 6 to 8 inches diameter passing through the middle of the streets. The secondary sewer line is approximately 24 inches diameter, while the primary sewerage network near the outfall/Rorya STP is of 36 inches diameter. The length of existing tertiary sewers is 8.5 kilometers, secondary sewers is 0.8 kilometer and primary sewer is 5

kilometers. The locations of existing primary, secondary and tertiary sewerage network along with the Rorya sewage treatment plant (STP) is shown below in Figure 3-1.

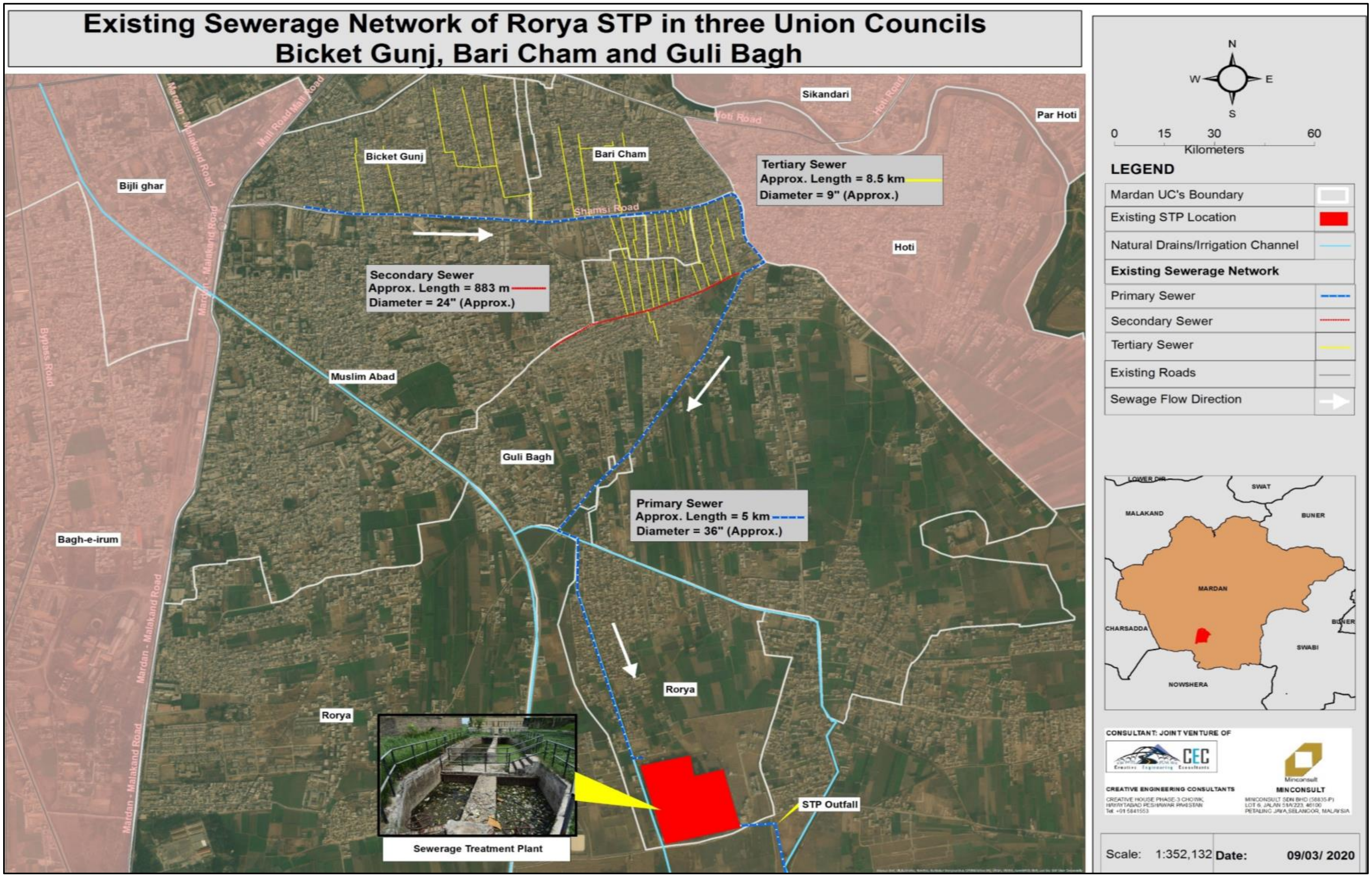
80. During the preliminary assessments carried out during concept design stage, it was observed that the existing sewerage system in the project area is totally abandoned or dysfunctional. As a result, the locals have disconnected their house connections from the existing sewerage system and connected them to the open drains in the streets. It was also observed that some of the open drains have been diverted in to the primary sewer line which is passing near the Rorya sewage treatment plant. The location where the open drains are diverted to the primary sewer line is shown in **Figure 3-2** below. Pictures taken during the social and engineering assessment surveys are also given below.

81. A treatment plant based on ponds was constructed in past however, for long time, it is not operational. Also, the capacity of existing ponds is not adequate to treat the current as well as future flows from the Mardan City. As current ponds are not operational and does not have adequate capacity, therefore, the raw sewage is being directly discharged into nearby water bodies. This practice is environmentally unsafe, a violation of Environmental Protection Act and could be a major cause of diseases in the area.

Figure 3-1:Existing Condition of Sewerage System in Mardan

	
Open drain already filled with Sewerage Water	Clogged open drain due to dumping of cow dung
	
Manhole of Abandoned Sewerage System	Abandoned tertiary sewer manhole in union council Bari cham
	
Another view of exisiting drainage system	Streets in UC Guli Bagh having no drains on both sides

Figure 3-2 Existing Sewerage System of Mardan



3.3 Detailed Engineering Design for Mardan Sewerage System

3.3.1 Design Criteria

82. A design criterion based on the criteria established by WASA Lahore for similar projects in Pakistan and also considering the international best practices has been selected. The design criteria are summarized below in Table 3.1.

Table 3—1: Design Criteria for Mardan Sewerage System

No.	Parameter	Criteria
Collection system for Sewerage network		
1	Peaking factor	Babbit Formula/WASA criteria
2	Infiltration rate	10% of generated sewage flow
3	Minimum velocity	0.75m/s
4	Maximum velocity	2.50m/s
5	Pipe material	uPVC for <= 395.7mm (15”) dia. RCC for > 395.7mm (15”) dia.
6	Manning’s n	0.013 for RCC 0.009 for uPVC
7	Minimum pipe cover for sewer	0.9m (3ft)
8	Utility crossing vertical clearance	200mm
9	Maximum manhole to manhole distance	90m
10	Minimum backdrop height	0.7m
11	Connector pipe from house to manhole	160mm
12	Pipe full fraction for trunk sewer (maximum)	0.75 D
13	Minimum pipe slope	1:1000
Sewage flow		
15	Residential	30 gpcd (85% of water demand) Water demand is considered as 35 gpcd.
16	Non-Residential	12 gpcd (WASA Lahore) Or will be estimated based on available data

3.3.2 Population Estimation

83. The population and associated sewage flow estimates for Mardan is based on the digitized planning base maps and land use details The total residential population for the six (6) urban union councils for the catchment area contributing to Rorya STP in Mardan is calculated as 124,090 while the non-residential population is calculated as 24,930.

3.3.3 Sewerage Flow Computations

84. The average daily water demands for Mardan is calculated by considering 35 US gallons as per capita (GPCD) as the daily water consumption rate. The estimated sewage flow is considered as 85% of water supply demand which is approx. 30 GPCD. The per capita sewage flow for non-residential population is assumed to be 12 GPCD. An infiltration allowance of 10% of total sewage flow was considered to cater for any infiltrated water into the proposed sewerage network.

85. Similarly, a peak factor was applied to the total flow to come up with the peak sewage flow. The peak flow estimates are routed through the networks in a hydraulic model to establish the design (size) of the proposed sewerage pipes.

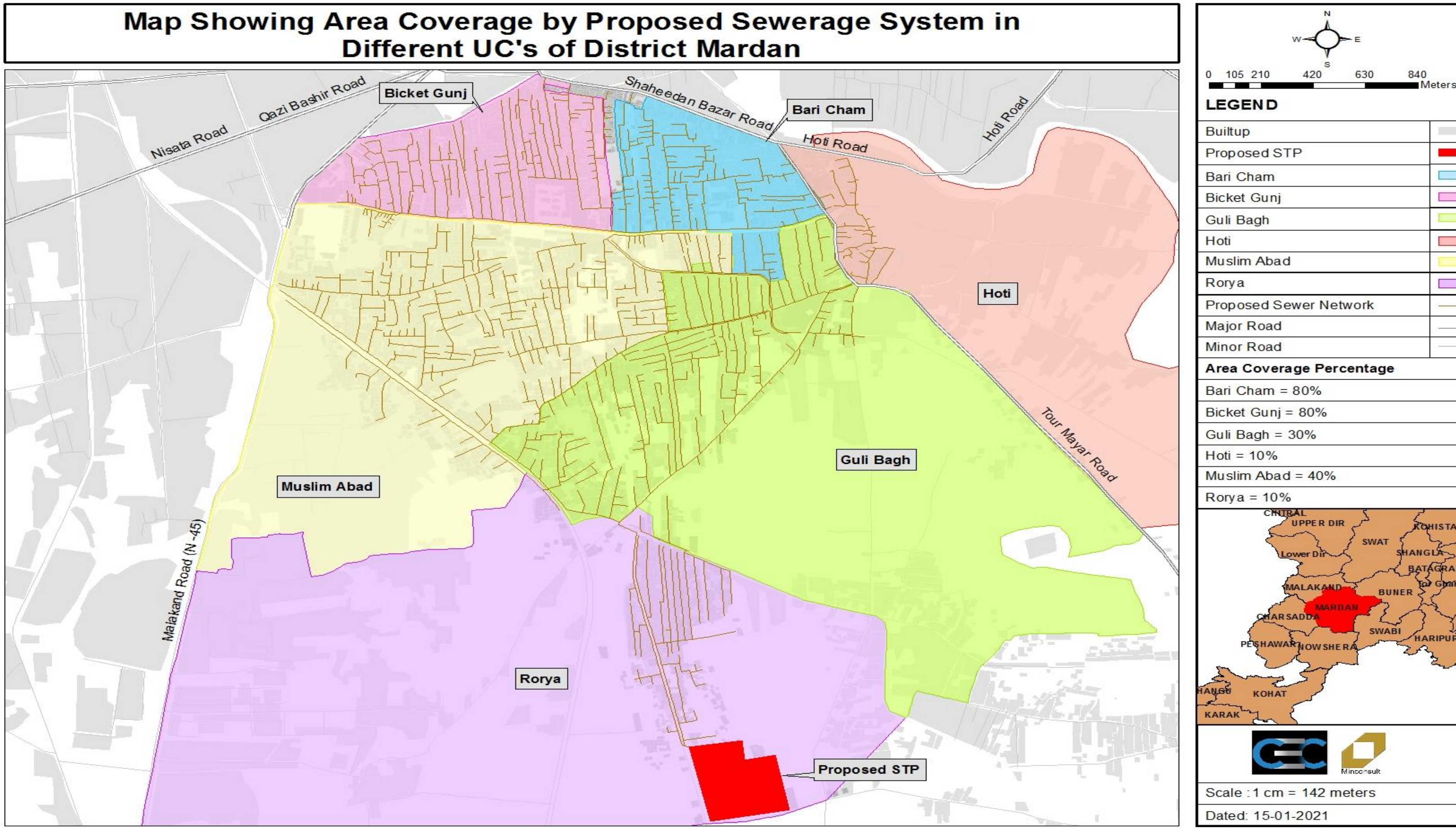
86. Average and peak sewage flows are calculated for each manhole by assigning the number of plots to each manhole and thus come up with the sewage flows that contributes to the manholes. The total average sewage flow for Mardan is calculated as approximately 4.42 US Million Gallons per Day (GPD). The population estimate and calculated sewage flow for Mardan is summarized below in Table 3-3

Table 3—2: Population and Sewage Flow Estimates of Mardan

Population (Residential)	Population (Non-Residential)	Total Population	Total Sewage Flow Res & Non- Res. (GPD)	Infiltration @10% of TSF (GPD)	Peak Factor	Total Peak Flow (GPD)
124,090	24,930	149,020	4,021,861	402,186	2.0	8,445,909

87. Proposed Catchments for Sewerage network and for Mardan is provided as Figure 3-3.

Figure 3-3: Proposed Catchment for Sewerage Network in Mardan



3.3.4 Sewer size and depths

88. As per design criteria, the minimum acceptable gravity pipe diameter for all newly proposed sewer lines shall be 8-inches. Since the project area is having very narrow streets, it was therefore proposed to reduce the size of the minimum pipe size from 9 inches to 8 inches to reduce the foot prints for the excavation of the trenches. For the house connection, 60mm (6 inches) of pipe size is considered.

89. Similarly, the minimum depth for the proposed sewer line is considered as 0.9m (3ft) above the crown of the proposed sewer. Concrete encasement is proposed for the pipes having less than 0.9m depths. The concrete encasement is proposed for all the road crossings of house connection pipe since these pipes are shallow in depth.

3.3.5 Bedding of Sewers

90. Bedding of Sewers will be sand filling around the pipes.

3.3.6 Velocity at Design Flow

91. It is proposed that minimum gradient to be adopted be such that to maintain a self-cleansing velocity of 0.75m/s at 0.75D of pipe flows, where D is the depth of flow in pipeline. The maximum non-scouring velocity is considered as 2.5m/s.

3.3.7 Design Flows

92. For residential plots, the sewage flow is considered as 85% of the water consumption of the development. The water consumption has been assumed as 35 gcpd/132 lpcd, which results in a sewage flow of 30 gpcd (i.e. 85% of water consumption).

93. For the non-residential plots like schools, mosques, parks, commercial areas, offices etc. area-based population is estimated as below

94. For commercial centers (shops, restaurants, theaters, cafés, etc.) – 1 customer per 10 m^2 area;

- For offices – 1 staff per 25 m2 area;
- For parks – 1 visitor per 100 m2;
- For Schools – 150 to 400 students per school depending on the size;
- For mosques – 500 persons per bigger mosques and 150 persons for smaller ones
- For hospitals/health centers – 1 person per 100 m^2;
- For petrol stations – 1 person per 375 m^2;
- For graveyard – 1 person per 500 m^2

3.3.8 Peaking Factor

95. Peaking factors are important to reflect the diurnal and seasonal flow variations of flow components and responses of inflow and base flows during storm events. Peak flows can

be determined by multiplying the average dry weather flow (DWF) by the peaking factor (PF). For the proposed sewerage system of Mardan City, the criterion established by WASA Lahore based on Harmon peaking factor is considered. Population based peaking factors were also used for hydraulic modeling purposes in the current project. Population based peaking factors decrease with increasing populations. For cumulative sewerage flow, the following criteria based on the population, have been used for the current project.

Table 3—3: Peaking factor as a function Population

Population on thousand	Peak Factor
Up to 5	4.50
5 - 10	4.00
10 - 25	3.50
25- 50	3.00
50-100	2.50
More than 100	2.00

3.3.9 Manholes

96. Generally, one manhole is considered for two plots or houses. Due to the nature of the development, being mostly fully built-out, rider sewer is very difficult to construct, therefore one sewer line with manhole for every two houses is proposed. The maximum spacing between the proposed manholes is considered as 90m.The total number of manholes proposed for Mardan City is 4,309. The proposed manholes are designed as RCC structure with circular shape. The manholes having shallow depth are having less internal diameter as compared to the deeper manholes having bigger internal diameter.

3.3.10 Interception/Connection Works

97. The total no. of house connections proposed in Mardan City are approximately 12,803. Since the house connection pipes are generally shallow, concrete encasement is therefore proposed for the house connection pipes where the house connection chamber is located on the opposite side of the road.

98. The interceptor works for the project mainly includes the house connection from existing or proposed development in to the nearest proposed manhole/sewerage system.

99. For Mardan City, three different types of approaches are considered for the interception works:

- For the existing residential and non-residential development; where there is any existing house chamber which is structurally in good condition, a new connection pipe of 160mm diameter is proposed to be laid between the existing house connection chamber to the proposed manhole/ new sewerage system;
- For the existing residential or non-residential development, if there is any existing house chamber which is structurally not in good condition, a new house connection chamber as well as house connection pipe of 160mm diameter is proposed to be provided to connect to the proposed manhole/ new sewerage system;
- For the future residential or non-residential development; a new house connection chamber as well as a connection pipe of 160mm diameter is proposed to connect to

the proposed manhole/ new sewerage system.

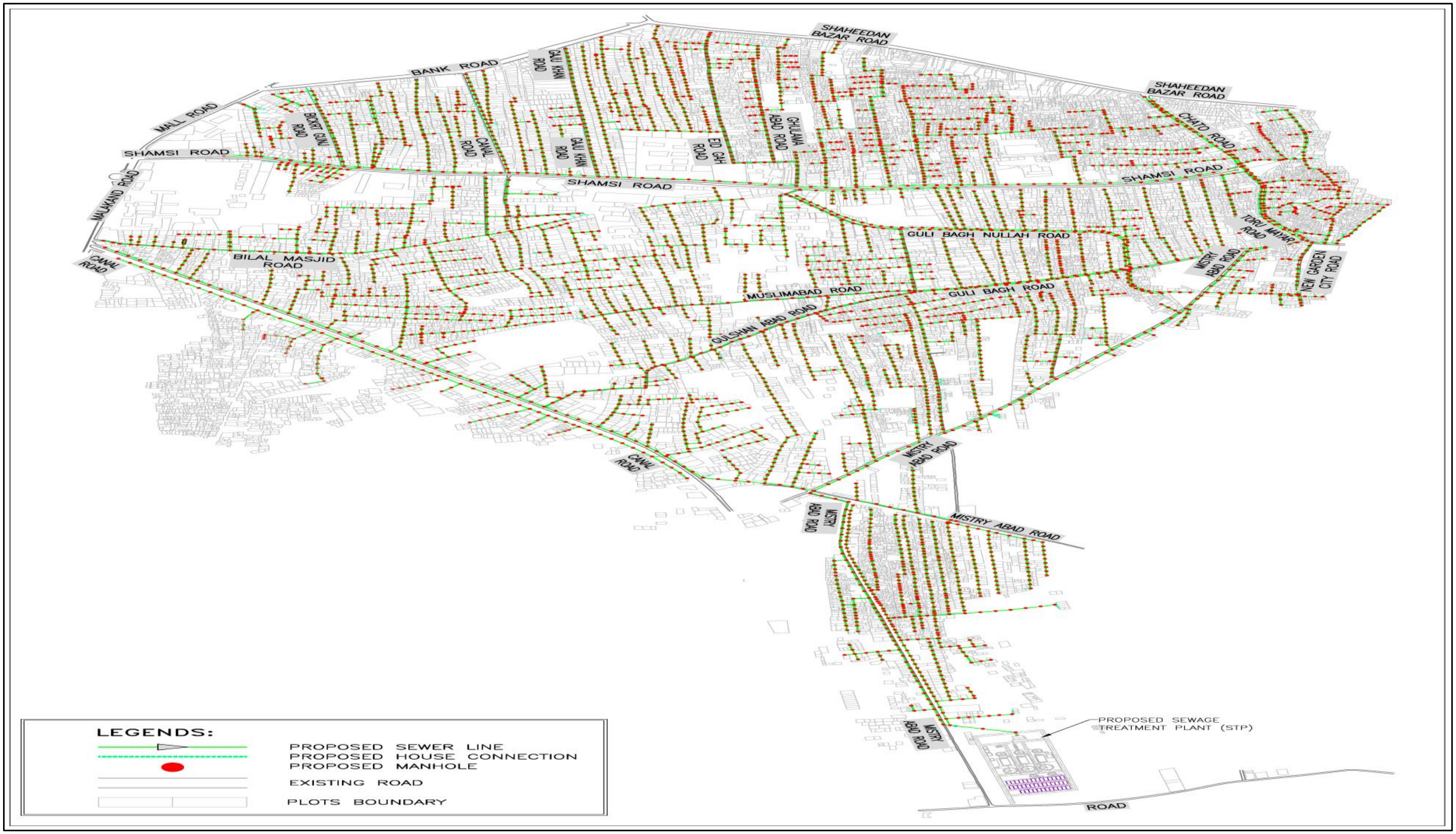
3.3.11 Conveyance Network

100. Lateral sewer pipes are generally used to collect the sewage directly from the interception and collection works and are conveyed to the main/trunk sewers. As the sewage is generally conveyed under gravity flow, therefore, the pipes are sloped towards final disposal point i.e. either a pump station or the proposed Sewage Treatment Plant (STP). To the extent possible, the system is designed to flow by gravity to the STP, however, if the grades do not allow, intermediate pump stations are designed to lift the water back to the gravity network and ultimate disposal to STP. The proposed sewer pipes are to be laid between every two manholes.

101. The total length of the proposed conveyance network in Mardan is approximately 79.85 kms.

102. The project area of Mardan is congested in nature. It is therefore proposed to provide a smaller diameter of sewer pipes for the initial reaches i.e. 8 inches to reduce the trench width in the streets. Due to narrow streets and small sizes of houses, smaller lengths of the proposed sewer pipes are proposed for Mardan due to less spacing of proposed manhole. **Figure 3-4** below shows the proposed conveyance system for the proposed sewerage system in Mardan.

Figure 3-4: Proposed Overall Sewerage System Layout Plan of Mardan City



3.3.12 Sewer Pipeline materials

103. Two different types of pipe materials are considered for the proposed Sewer lines. The proposed pipes having low diameter i.e. up to 12inches are designed as uPVC pipes due to its local manufacturing, ease of availability and transportation. For bigger sizes i.e. 15 inches and above, the Reinforced Cement Concrete (RCC) pipes are proposed in the detailed design.

3.3.13 Utility Corridor

104. The sewerage system for Mardan is proposed for the already developed area in Mardan City. The project area consists of very congested settlements which makes the demarcation of a proper utility corridor very challenging for the proposed sewerage system in these existing developments. The proposed corridor for the sewerage system is therefore based on the best available option as per the topographic survey. The corridor is mostly adopted at one edge of the exiting road carriageway keeping in mind the existing house ramps and utilities at both sides of the road carriageway. Road reinstatement costs are therefore considered in the detailed Bill of Quantities (BOQ) of the project.

3.4 Proposed Sewerage Treatment Plant at Mardan City

3.4.1 Design Considerations

105. The proposed wastewater treatment plant will serve the current as well as ultimate future flows from Mardan City. Accordingly, adopted design flow for the proposed wastewater treatment plant is 5.8 MGD (21,953 m^3/day).). Three parallel streams, 1.93 MGD (7,318 m3/day) each, will be constructed to achieve flexibility in operation. Layout of proposed sewerage treatment plant at Mardan City is provided as Figure.3-5 3D view of proposed WWTP at Mardan City is provided as **Figure.3-6**Ultimate /design wastewater flows for the proposed STP are summarized in the following Table. 3-2.

Table 3—4 Design Wastewater Flow

Description	Ultimate Average Flow (including 10 % infiltration)	
	MGD	**m^3/day**
Projected Flows from Mardan City		
Flow from Catchment Areas	4.75	17,980
Additional / Future Provision	1.05	3,973
Total Average Flow	**5.8**	**21,953**
Design Flows for the WWTP		
Average Daily Flow	**5.8MGD (21,953 m^3/day)**	
Peak Hour Factor	**1.935**	
Peak Hourly Flow	**1,770 m^3/hr**	

Figure 3-5: Layout of Proposed Sewerage Treatment Plant

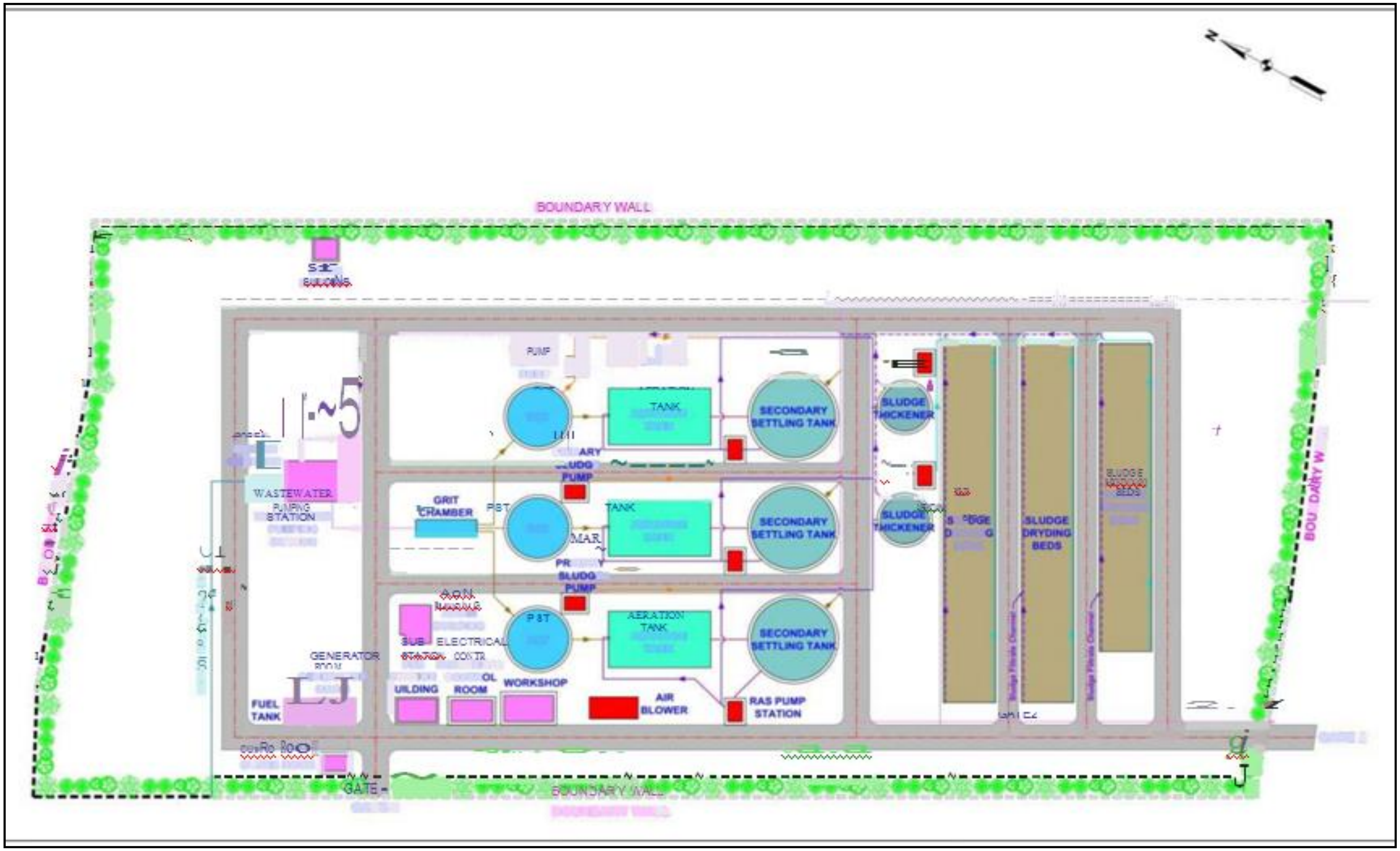


Figure 3-6: 3D View of Proposed Mardan STP

3.4.2 Influent Wastewater Characteristics

106. Main objective of the proposed STP for Mardan is to bring the sewagecharacteristics within NEQS limits. Table 3-5 below presents the applicable NEQS values, design influent & effluent characteristics along with respective required treatment efficiencies:

107. The design effluent concentrations for BOD, COD and TSS are kept equal to those achievable, under normal operating conditions, in a typical well-designed aerobic treatment plant.

Table 3-5 Treated Effluent Requirements

Parameter	NEQS Value	Design Concentrations Influent (mg/l)	Design Concentrations Effluent (mg/l)	Required Treatment Efficiency (%)
BOD(mg/l)	80	250	30	88
COD (mg/l)	150	450	150	67
TSS (mg/l)	200	350	150	57

3.4.3 Wastewater Treatment Plant Components

108. In this section of the report, details of treatment technology adopted for the proposed wastewater treatment plant and components of the treatment plants are discussed

3.4.4 Proposed Waste Water Treatment Process

109. Various treatment technologies were compared during detailed design and conventional Activated Sludge Process (ASP) was found most suitable biological treatment technology for Mardan city. ASP is widely used for the treatment of domestic and industrial wastewater. Schematic diagram of Activated Sludge process is shown in **Figure 3.7.**

Figure 3-7: Schematic Diagram of Conventional Activated Sludge Process (ASP)

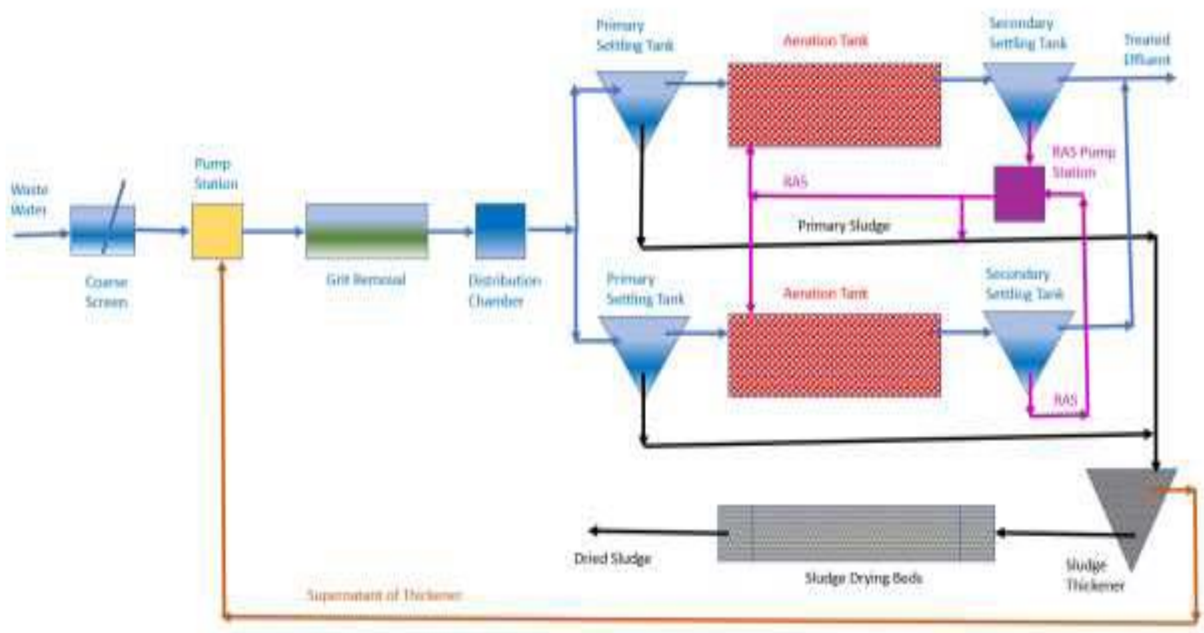
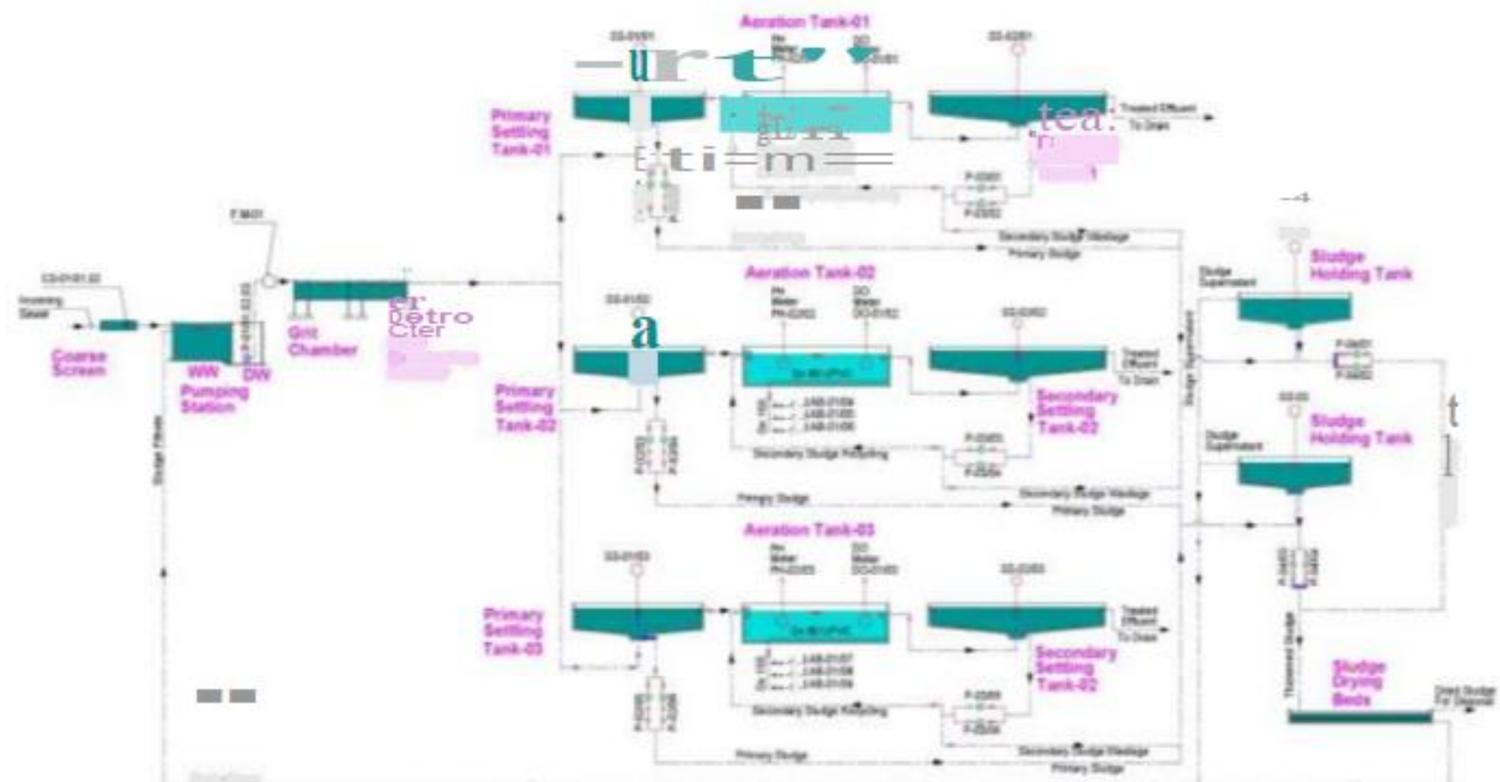


Figure 3-8 Process flow Diagram of Proposed Treatment Plant at Mardan

List of Abbreviation

AB-01	Air Blower	P-04	Thickened Sludge Pump
AT	Aeration Tank	PH-02	pH Meter in Aeration Tank
CS-01	Coarse Screen in Screen Chamber	PST	Primary Settling Tank
DO-01	DO meter in Aeration Tank	SDB	Sludge Drying Bed
DW	Dry Well	SS-01	Half Bridge End Driven Sludge Scrapper in PST
F.M-01	Flow Meter	SS-02	Half Bridge End Driven Sludge Scrapper in SST
FDC	Flow Distribution Chamber	SS-03	Half Bridge End Driven Sludge Scrapper in ST
P-01	Wastewater Pumps	SST	Secondary Settling Tank
P-02	Primary Sludge Wastage Pumps	ST	Sludge Thickener
P-03	Secondary Sludge Recycling/Wastage	GC	Grit Chamber
		WW	Wet Well



3.4.5 Main Components of Mardan WWTP

110. Proposed treatment plant has various components which can be divided into following main categories.

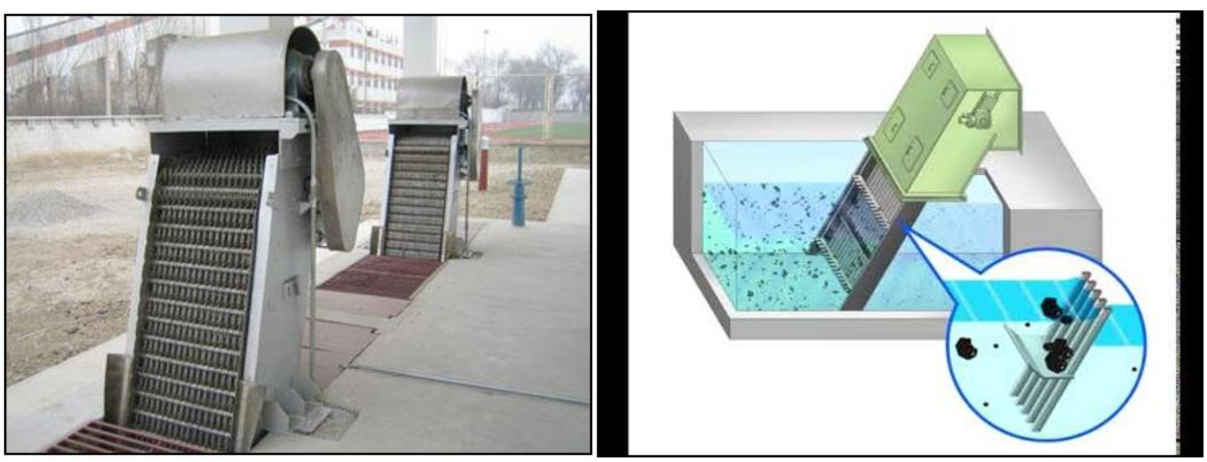
- Wastewater process stream
- Sludge processing facilities
- Process buildings
- Non-process buildings
- Other site facilities

3.5 Waste Water Process Streams

3.5.1 Coarse Screen Chambers

111. Wastewater from gravity sewer line will pass through the coarse screen prior to its entrance in the wet well of the proposed pump station. The screen (of 20 mm spacing) will capture the large size floating materials which can otherwise cause damage to the pumps if not removed. Type of proposed screen shall be bar screen of 20 mm spacing with mechanical mechanism to collect the screenings and convey to the ground skips. One duty and one standby mechanical screen (20 mm spacing) with mechanical mechanism to collect the screenings and convey to the ground skips have been proposed. To be installed at angle of 45 – 60^{o} the upstream of the pump station. Typical view of the coarse screens is shown in below Figure. 3-9.

Figure 3-9: Typical View of Coarse Screens



3.5.2 Pump Stations

112. After passing through the bar screens, wastewater will enter the wet well of the proposed pump station. Proposed pump station configuration is dry-wet well type. Wet well of volumetric capacity of 94 m^3 will receive raw sewage, whereas, four pumps of 475 m^3/hr will be installed in the dry well. Pump station is proposed to lift the raw sewage to the elevated fine screens chamber from where sewage will flow by gravity to the downstream components of the treatment plant.

113. All pipe work inside the pump room will be Ductile Iron, whereas pipe material outside of the pump station up to grit chamber will be HDPE. Flow meter is proposed on the force main to measure the flow and keep the records of incoming flows. Proposed pump station will pump sewage to the elevated grit chamber, from where it will be distributed to the downstream components of the wastewater treatment plant.

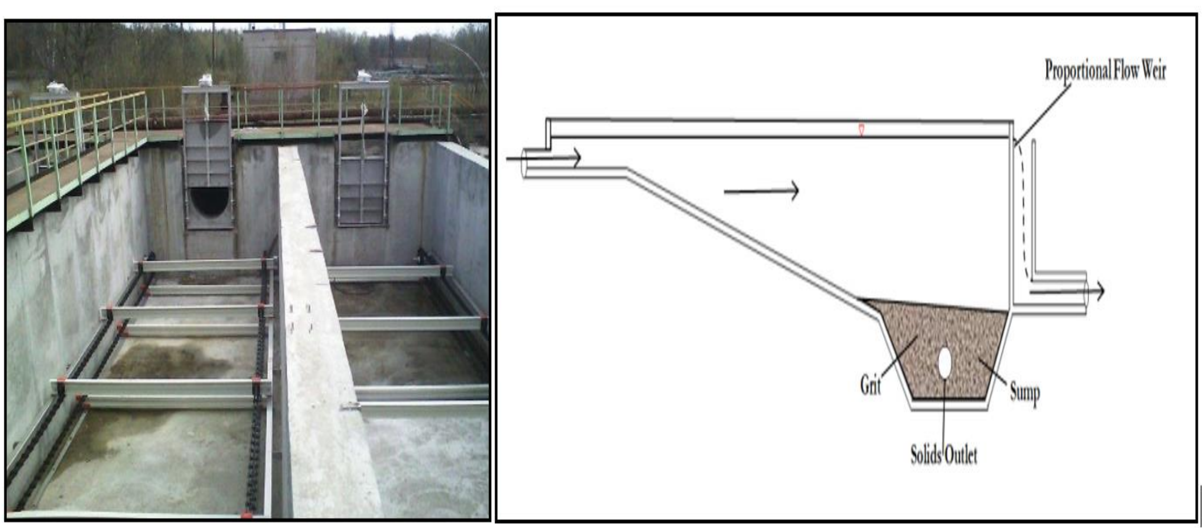
3.5.3 Grit Removal and Flow Distribution Chamber

114. Elevated horizontal flow gravity grit removal chamber has been proposed for the removal of grit from the wastewater. Grit chamber will receive wastewater from inlet pump station. Two parallel chambers (top rectangular with trapezoidal bottom type) are proposed to facilitate operation and maintenance. Wastewater will flow at low velocity in the grit chamber where grit will be settled in the bottom of the girt chamber and will be removed through drain pipes in the bottom. Grit removed from the grit chambers will be collected in the skips and will be sent to disposal site.

115. After passing through grit chamber, wastewater will flow into the flow distribution chamber. Flow distribution chamber and girt chambers are combined in one structure. At flow distribution chamber, three weirs have been provided to equally distribute the wastewater and divert it to the three distribution boxes, from where wastewater will be distributed to the two parallel wastewater treatment streams.

116. Flow at distribution chamber will split into three streams as at the downstream of flow distribution chamber, three parallel wastewater treatment streams have been proposed. From flow distribution chamber, wastewater will be diverted to the three primary settling tanks by gravity through three pipelines. In pipelines leading to primary settling tank, isolation valves are provided to allow isolation of any primary settling tank in case of emergency. Typical view of grit removal and flow distribution chamber is provided as **Figure 3-10.**

Figure 3-10: Typical View of Grit Removal and Flow Distribution Chamber



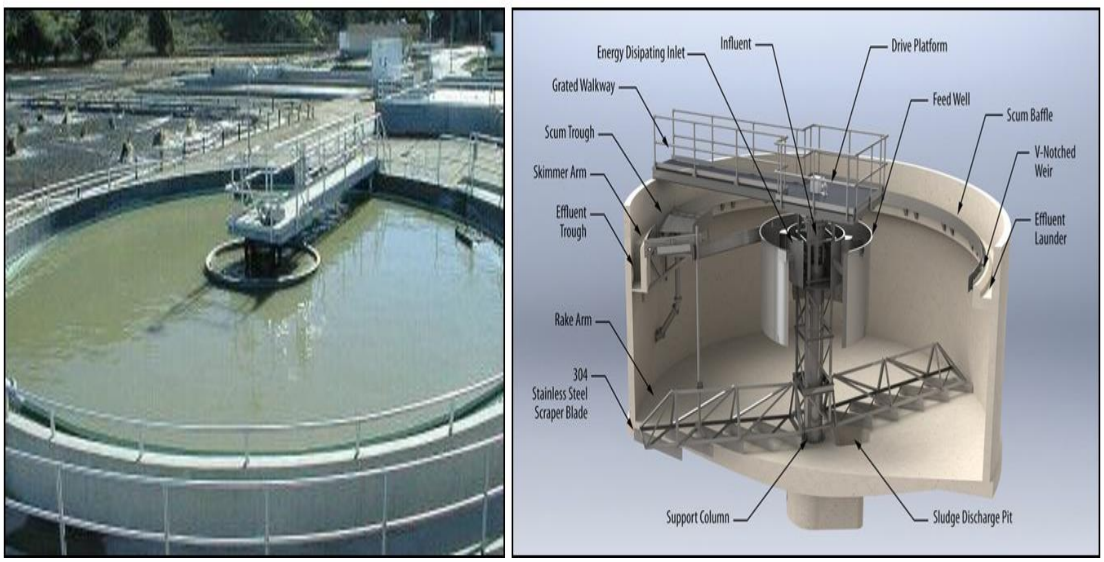
3.5.4 Primary Settling Tanks

117. After passing though grit and flow distribution chamber, wastewater will flow to the primary settling tanks. Three primary settling tanks (one in each stream) have been proposed to

remove the settleable solids from the sewage prior to biological treatment. Circular settling tanks with end driven rotating half bridge type scrapers are proposed. Primary settling tanks are designed with adequate retention time to allow the settlement of suspended solids. Supernatant from the primary settling tanks will overflow through weir arrangements and will be conveyed to the aeration tanks through pipelines for biological treatment. Settled solids from the bottom of the tank will be removed periodically and will be conveyed to the sludge thickener through primary sludge pumps for further processing. Removal efficiencies in the PSTs are taken as 50% for TSS, 15% for BOD and 15% for COD. Three primary sludge pump stations, on for each stream, are proposed.

118. After Primary settling tanks, wastewater will flow to the Aeration tanks through three pipelines. Each pipe to Aeration tank has isolation valve to allow isolation of Aeration tank in case of emergency.

Figure 3-11: Typical View of Primary Settling Tanks



3.5.5 Aeration Tanks

119. After settling of TSS in the Primary settling tanks, wastewater treated in PSTs will flow to the Aeration tanks. Three Aeration tanks (one in each stream) are proposed where biological treatment of the wastewater received from the primary settling tanks will be carried out. Aeration tank is a rectangular structure, where micro• organisms are used to biologically oxidize the organic matter present in the sewage. Air will be supplied to the tanks to maintain the aerobic conditions in the tank. Air will be supplied by the blowers and will be discharged into the tank through fine bubble diffusers. Air supply will keep the content of the tank in suspension and will also maintain the aerobic conditions inside the tank. Mix liquor Suspended Solids (MLSS) will be maintained to ensure the desired solids retention time in the tanks.

120. Conventional activated sludge process has been proposed for biological treatment. Considering word wide practice for design, the design of aeration tanks is based on the Solids Retention Time (SRT) and Mixed Liquor Suspended Solids (MLSS).

121. After treatment in aeration tanks, treated wastewater will flow to the secondary clarifiers through three pipelines. Each pipeline to secondary clarifier has isolation valve to enable isolation of secondary clarifier in case of emergency.

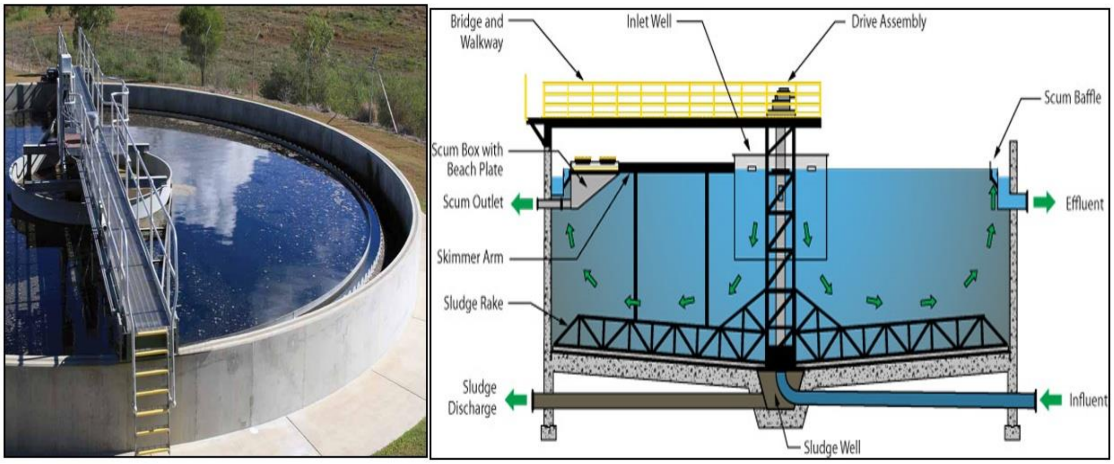
122. Air to the aeration tanks will be supplied by the blowers to the aeration tanks. Circular disc, fine bubble diffusers will be installed in the aeration tanks to supply air to the wastewater. Blowers will be housed in the proposed blower buildings. Typical view of the aeration tank is shown in **Figure 3-12.**

Figure 3-12: Typical View of Aeration Tanks

3.5.6 Secondary Settling Tanks

123. After biological treatment in aeration tank, treated sewage will flow into the secondary settling tanks. Three secondary settling tanks (one in each stream) are provided. In secondary settling tanks, biological mass will be settled and clarified effluent will be discharged to the effluent pipe for disposal to the outside receiving body. Circular settling tanks with end driven, rotating half bridge type scrapers have been proposed. Settled sludge from the secondary settling tanks will be recirculated to the Aeration tank through sludge recirculation pump stations and waste sludge will be transferred to the gravity sludge thickener for further processing. Three return activated sludge pump stations are proposed, one for each stream. Typical view of secondary settling tank is provided as **Figure 3-13.**

Figure 3-13: Typical View of Secondary Settling Tanks



124. Treated effluent from the three secondary settling tanks will flow to a common proposed pipeline which will discharge the treated effluent to an existing drain. A 1000 mm OD HDPE pipeline has been proposed to convey the treated effluent to the drain.

3.6 Sludge Processing Facilities

125. Sludge treatment facilities consist of the following components.

- • Primary Sludge Pump Stations
- • Secondary Sludge /Return Activated Sludge (RAS) Pump Station
- • Gravity Sludge Thickener
- • Thickened Sludge Pump Station
- • Sludge Drying Beds

Design details of these components are given in below sections.

3.6.1 Primary Sludge Pump Stations

126. Three primary sludge pumping stations have been proposed (one for each stream). Pumps will be used to collect the sludge from the bottom of primary settling tanks and discharge to the gravity sludge thickener for further dewatering. Primary sludge pumps will be housed in small buildings near primary settling tanks. Horizontal shaft, end suction, non-clogging/ solids handling centrifugal type pumps have been proposed at the primary sludge pump stations. Isolation valves on suction and discharge sides of the pumps have been provided to facilitate operation and maintenance. Additionally, flow meter, pressure gauges and cleanouts for line flushing are provided in the pumping main leading to sludge thickener. Details of Primary sludge pump stations are given in **Table 3.13.**

Table 3—6 Design Details of Primary Sludge Pump Stations

Parameters	Units	Values
Primary Sludge Pump Stations		
Total Primary Sludge Flow	m/d	96
No. of Primary Sludge Pump Stations	No.	3
Primary sludge flow per pump station	m3 /d	32
Type of Pumps		Horizontal shaft, end suction, non-clogging/solids handling centrifugal type
Total Number of Primary Sludge Pumps for three pump stations	No	6 (3 duty + 3 standby)

3.6.2 Secondary Sludge /Return Activated Sludge (RAS) Pump Station

127. Circulation of activated sludge from secondary settling tank to the aeration tanks is important process to keep the efficient operation of the plant. Three secondary sludge / Return Activated Sludge (RAS) pumping stations have been proposed (one for each stream). Pumps will be used to collect the sludge from bottom of the secondary settling tanks and return to the inlet of aeration tanks. Same pumps will be used to waste the daily excess secondary sludge to the sludge thickener. Secondary sludge pumps will be housed in small buildings near secondary settling tanks. Horizontal shaft, end suction, non-clogging/ solids handling centrifugal type pumps have been proposed at the secondary sludge/RAS pump stations. Isolation valves on suction and discharge sides of the pumps have been provided to facilitate operation and maintenance. Additionally, flow meters, pressure gauges and. cleanouts for line flushing are provided at the discharge side of the pump stations. Isolation valves are provided to control the diversion of sludge flow to aeration tank and/ or thickener as required.

Table 3—7 Design Details of Secondary Sludge/ RAS Pump Station

Parameters	Units	Values
Recirculation Pumps Capacity		
No. of Pumps at each Pump Station	No	2 (1 duty + 1 standby)
Capacity of Each Pump	m/hr	300
Total Number of RAS Pumps for two pump stations	No	6 (3 duty + 3 standby)

Parameters	Units	Values
Waste Secondary Sludge		
Secondary Waste Sludge Flow	m/d	570
No. of Pump Stations	No	3
Secondary waste sludge flow per pump station	m3 /d	190

3.6.3 Gravity Sludge Thickener

128. Gravity sludge thickeners have been provided for dewatering of pnmary and secondary waste sludge. Sludge thickeners will receive waste sludge from primary and secondary sludge pump stations. Two gravity sludge thickeners have been proposed which will receive waste sludge from three streams. Circular gravity sludge thickeners with end driven, rotating half bridge type scrapers with mixing pickets are proposed. Sludge will be settled in the bottom of the thickeners and supernatant will over flow through weirs. Supernatant will be conveyed to the inlet pump station through gravity pipelines. Thickened sludge from the thickeners will be pumped to the sludge drying beds.

129. Typical view of the gravity sludge thickener is given as **Figure 3-14.**

Figure 3-14: Typical View of Gravity Sludge Thickner

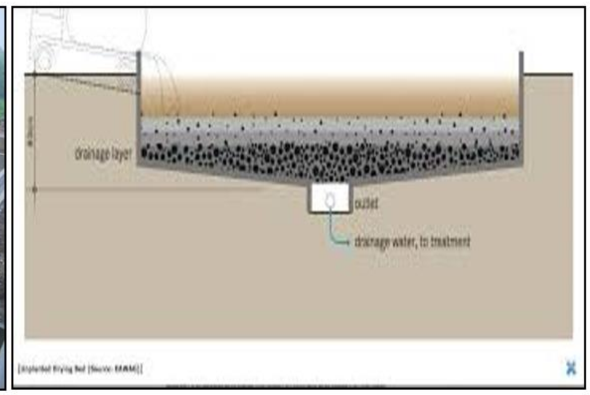
3.6.4 Thickened Sludge Pump Station

130. Two thickened sludge pumping stations have been proposed adjacent to the sludge thickeners. Sludge pumps of 100 m^3/hr each capacity will be used to collect the sludge from bottom of the sludge thickener and pump to the sludge drying beds for further dewatering and drying. Thickened sludge pumps will be housed in a small building near sludge thickener. Horizontal shaft, end suction, non-clogging/ solids handling centrifugal type pumps have been proposed at the thickened sludge pump station. Isolation valves on suction and discharge sides of the pumps have been provided to facilitate operation and maintenance. Additionally, flow meters, pressure gauges and cleanouts for line flushing are provided in the pumping mains leading to sludge drying beds.

3.6.5 Sludge Drying Beds

131. Sludge drying beds have been provided to dewater/ dry the sludge through evaporation by sunlight and filtration at the bottom. Sludge drying beds will receive thickened sludge from gravity sludge thickener which will be distributed over the sludge drying beds. Gravel and sand bed with perforated pipes will allow the filtration and filtered water will be collected through the perforated pipe and will be conveyed to the gravity pipeline leading to inlet pump station. Dried sludge will have high solids content and will be transported to the nearest landfill site. There will be 40 sludge drying beds for Mardan WWTP, each bed has dimension of 16 meters length and 8 meters width. Typical view of sludge drying beds is given in Figure 3-15.

Figure 3-15: Typical View of Sludge Drying Beds

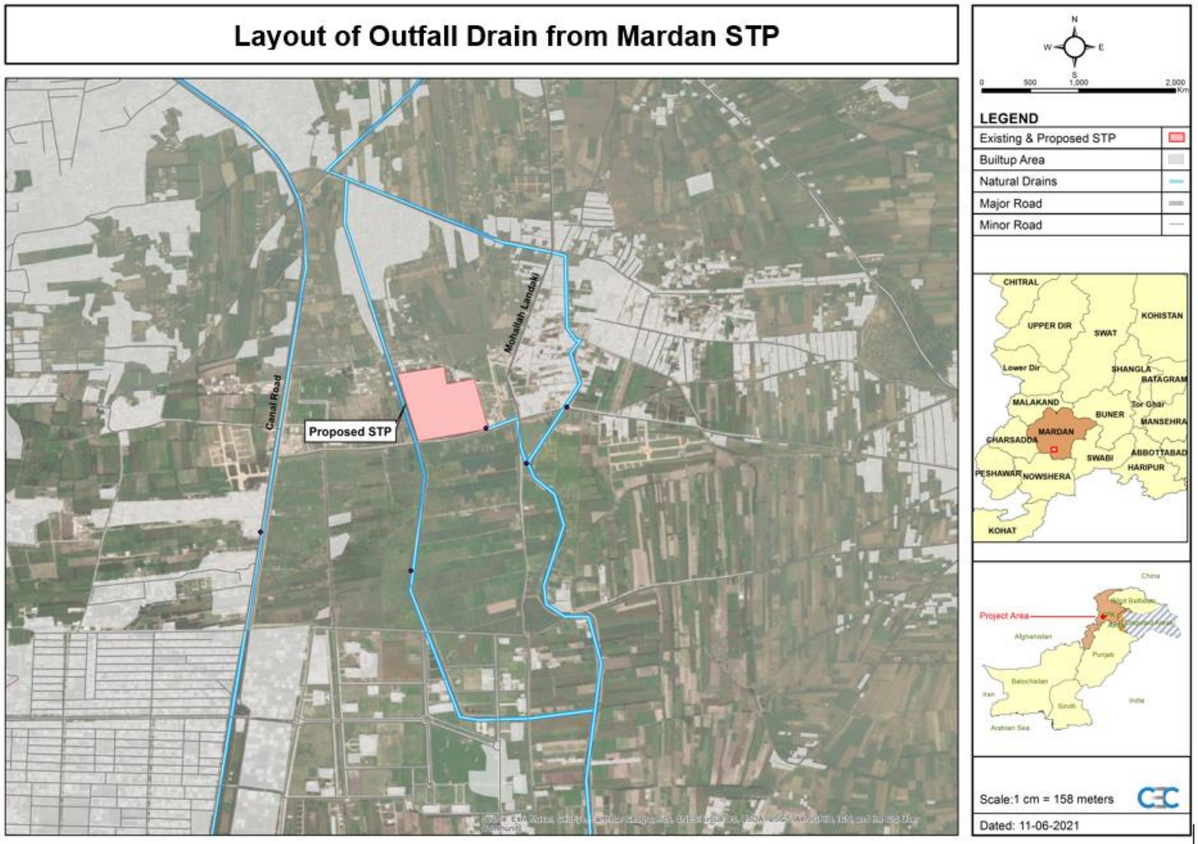


3.7 Final Disposal of Treated Waste Water from Mardan STP

132. Currently untreated sewage is discharged into multiple Naullah which drain into kalapani stream. After construction of STP, the treated sewage will be discharged directly to the Kalpaani stream through natural drain. Construction of STP will have positive impact on the quality of the Kalapani stream as treated sewage will be discharged instead of raw sewage. The kalapani stream is located around 3 Km from Rorya STP Location. Map showing layout of proposed outfall drain to Kalpani stream is provided as **Figure 3-16.**

133. STP will treat sewage to applicable NEQS and quality of treated effluent will be monitored through in house labortoary within adminsteration building. It shall have basic labortary equipment to perform routine test e.g. BOD, COD, TSS, VSS, MLSS, SVI, % solids, pH, dissolved oxygen (DO), TKN. Common tests e.g. TSS, MLSS, pH, SVI, DO will be checked daily whereas other tests like BOD, COD TKN and others shall be done twice a week.

Figure 3-16: Layout of Proposed Outfall drain of Mardan STP



3.8 Mechanical Equipment

134. Most important mechanical equipment used in various components of the treatment plant is given below.

- Mechanical coarse screen & Penstocks
- Wastewater Pumps
- Sludge pumps
- Sludge Scrapers for Primary and Secondary settling Tanks
- Aerators
- Fine Bubble diffusers
- Sludge Scraper for sludge thickener
- Cranes
- Flow Meters and valves

3.9 Details on Process Buildings

135. Following process buildings have been provided in the treatment plant.

3.9.1 Blower building

136. Two air blower buildings are proposed to house the air blowers which will be used to supply air to the three aeration tanks. Air blower building has been designed to have proper ventilation. One common blower building for two streams have been provided however, two separate sets of blowers will be installed in this blower building. For third stream, one separate blower building is providing. Each set of blowers will consist of 3 blowers (2 duty + 1 standby) and will feed one aeration tank. Overhead cranes and access have been provided for removal of blowers in case of maintenance.

3.9.2 Electrical substation building

137. Substation building has been proposed to house the transformers and electrical control room.

3.9.3 Generator building

138. Generator building has been provided which will house the generator. Generator will be used as a backup power supply source in case power from WAPDA is not available. Due to short fall of power in Pakistan, load shedding is the main issue which needs an attention in ensuring plant continuous operations. In order to ensure continuous power supply to the plant, a diesel generator of 2000kVA, 50Hz, 400V has been proposed along with an Auto Transfer switching mode

3.9.4 SCADA Control Room (located inside Administration building)

139. Process instrumentation will be provided to facilitate monitoring. SCADA system has been proposed for the proper monitoring, control and recording of data related to the plant. Central SCADA control room has been provided inside the Administration building and SCADA system will enable plant operators to efficiently operate the plant.

3.10 Details on Non-Process Buildings

140. Following non process buildings have been provided in the wastewater treatment plant.

3.10.1 Administration building

141. A common administration building for the staff has been proposed which will have following facilities.

- • Offices
- • SCADA Control Room
- • Laboratory
- • Meeting Room
- • Kitchen
- • Toilets.

3.10.2 Workshop

142. A work shop/store has been proposed to facilitate the maintenance activities inside the plant. Workshop will be equipped with a 5 ton crane.

3.10.3 Guard Room

143. Guard house has been proposed near the entrance for security reasons and for monitoring and control of the access to the plant.

3.10.4 Staff building

144. A staff building with two rooms has been provided for the accommodation of full- time residence staff at the site.

3.10.5 Other facilities

145. Following are other facilities that have been provided in the wastewater treatment plant.

Internal Roads

146. Internal roads have been proposed to provide access to all buildings and facilities having mechanical equipment e.g. lift station, screens & skips, grit collection chamber, blower building, settling tanks, sludge thickener and aeration tank. Internal road around the sludge drying beds has been provided to facilitate removal of sludge from the sludge drying beds by trucks/trolleys. Walkways have been proposed around the structures & buildings.

Car Parking

147. Car Parking has been provided near the administration building for visitors and staff.

Plant Potable Water

148. Potable water tank and associated plumbing & piping have been provided for the administration building, guard room and staff building.

Plant Sewerage System

149. Plumbing and sewers have been provided to collect the sewage from toilets located in the admiration building, guard room and staff building, and convey to the pump station by gravity.

Plant Piping

150. Plant piping has been provided for the conveyance of raw sewage, sludge, water, electric cables, fiber optic cables etc. within the plot boundaries.

Storm Water Drains outside Plant

151. Stormwater drainage system shall be provided along the plant boundaryin order to protect the plant site from external runoffs, drains outside of the plant boundary have been provided which will collect the runoff and will convey to the downstream of the plant site.

3.11 Construction Phase Details for Mardan City Sewerage System and STP

3.11.1 Construction Schedule

152. 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.

3.11.2 Construction phase activities

153. The activities to be conducted during construction phase of the project are provided below:

3.11.3 Development of Construction and Labor Camps

154. 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.

155. 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. Contractor may select exsiting residential building in close proximityon rent within Mardan city to use it as labor camp however in such cases social norms will be complied.

156. 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.

157. 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.

158. 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)

3.11.4 Main construction activities

Sewerage System

159. Following are major civil works involved in construction of Mardan sewerage system and STP.

- Scarification of existing road pavement
- Excavation for the Sewer pipes and Manholes in well graded gravels.
- Stock pile of the useable material for back fill and disposal of the rejected material at designated place.
- Backfilling with suitable excavated material in layers including compaction
- Laying of common fill material form outside source
- Laying of local sand filling around the pipes including compaction complete in all respects as per drawings, specifications and as instructed by the Engineer.
- Fixing of HDPE pipes class 'B' for Sewer drainage with push fit rubber joint including all fitting.
- Laying of R.C.C. pipe sewers, moulded with cement concrete 1:1-1/2:3 conforming to ASTM specification C-76-79, Class IV, Wall B, including carriage, lowering in trenches to correct alignment and grade, jointing with rubber ring, cutting pipes where necessary, testing, etc. complete:-30" i/d, Wall B
- Construction of RCC manholes including, base slabs, Walls and top RCC slabs, Ductile Iron Heavy Duty cover with frame, GI steps, CC benching water proof internal

plaster inlet/out connections and external water proofing

- Construction of the Backdrop Manhole.
- Construction of RCC House Connection Chamber including base, walls and top RCC slab, Cast Iron cover with frame, GI steps, CC benching water proof internal plaster inlet/out connections and external water proofing,
- Construction of RCC Septic tank (5m x 12m x 2m water depth) with material including, excavation, base top slab bedding, GI steps, CI double covers, internal etc.
- Laying of PCC concrete (1:2:4) surround for pipes under the road area and utility crossing area or as per the site situation
- Laying of PCC Concrete for Road Pavement 4000 PSI

STP

- Construction of waste water screen chambers and installation of screens
- Installation and commission of motorized penstocks
- Construction of Pumping station including installation of Inlet pumps, sump pumps, flow motor
- Construction of grit chambers and flow distribution chambers with MS Grating and Motorized penstocks
- Construction and installation of primary and secondary settling tanks,
- Installation of aeration tanks
- Primary and secondary sludge pumping stations
- Installation of gravity sludge thickener, thickened sludge pump station
- Construction of sludge drying beds
- Construction of process and non-process buildings
- Construction of other facilities including internal road network and water supply and sanitation system

Construction Machinery Requirement

160. 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.

161. The **Table 3.6** below outlines the approximate number of major machinery and vehicles that are envisaged to be required for the project construction works.

Table 3—8: Estimated Contractor's Equipment and Machinery

Sr. No.	Machinery / Equipment	Quantity required*
1	Excavators	4
2	Batching Plants	1
3	Loaders	2
4	Power Generators	4
5	Rollers	2
6	Tractor Trolley	6
7	Compactor / Roller	2
8	Crane	1
9	Concrete Pump	1
10	Vibro Hammer	1
11	Watering Tanks (moveable)	3
12	Haulage Trucks	20
13	Cars/Pickups	8

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

Construction Materials Requirement

162. During the construction phase, construction materials in considerable volumes will be required. Typical material required for STP and associated sewerage network is available locally and same will be utilized. The common source of the material require for civil work are described in **Table 3.7** below.

Table 3—9: 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 13 feet 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 Peshawar.

Sr.#	Raw Material	Source
7	Reinforcement steel	Steel re-rolling mills in Peshawar meeting the standards from the billet produced either by Pakistan steel or imported. These will serve the purpose of steel availability.
8	Energy	Electricity supplies are available at the site through WAPDA grid.

Manpower Requirements during construction phase

163. Estimated manpower requirements during construction phase would be about 250-300 persons for both sewerage system and construction of STP. Manpower requirements may change if construction work of sewerage network is divided into construction packages awarded to more than one contractor.

3.12 Operation Phase Details for STP and Sewerage System

3.12.1 Main O & M Phase activities

Sewerage System

164. Sewers are categorized into two from the view point of different O&M activities. These are main/sub-main sewers and sewer network including house connections. The former shall be managed by technical monitoring team of WSSC Mardan, while for the latter not only technical countermeasures, but also the activities for the development of the relationship with people by the team of WSSC Mardan shall be considered to get understanding from beneficiary residents on sewerage requirements with proper sewerage user payment. There would be sewer usage fee that will be collected by WSSC Mardan. All households and commercial establishments falling under the jurisdiction of WSSC Mardan will be connected to the sewerage system and WSSC Mardan will charge for its service. For the O&M of main/sub-main sewers, the city shall be divided into different areas/zones for proper O&M of sewer systems in the entire city. Periodic inspection of sewerage network will be carried out by WSSC Mardan and all type of repairs and maintenance works (cleaning of lines and removal of clogged material) will be carried out in timely and professional manner. WSSC Mardan will prepare emergency plans for monsoon to manage extra loads on the system.

STP

- Maintenance of an inventory of all civil works, mechanical, electrical equipment, electronics and other instrumentation at the STP with detailed specifications;
- Preparation of O&M Manual for STP operations
- Treating and disinfecting the effluent in conformity with the production capacity, consumption of chemical and electricity, besides maintaining effluent quality requirements
- Maintain the laboratory (required as part of contract) and shall carry out the routine analysis of various indices following established frequencies by WSSC Mardan in the

Contract.

- Develop and train staff working within STP facility
- Operation of the STP using the recommended procedure for each unit treatment process as per the detailed O&M Manual
- Minor and major repairs to equipment installed at the STP and periodic inspection of the system
- Prepare and maintain asset management plan
- Monitoring and control of STP in use of SCADA system
- Separate register showing following details shall be maintained at STP site.

  a) Personnel: Name of the employees in each shift, their attendance records

  b) Individual log book of each equipment, instrument etc.

  - Daily Record of Operation
  - Date and Details of Preventive maintenance (spares and consumables used) Break down and major reason thereof
  - Dates and duration of out of operation hours
  - Details of breakdown maintenance (date, spares, consumables etc.)
  - Dates of calibration and results thereof

  c) Separate Registers shall be maintained

  - Shift wise use of Chemicals separately for treatment and disinfection showing the amount of chemicals used either in kg or liters of chemical solution (with strength).
  - Equipment wise Fuel and other consumables used
  - Shift wise power use and Power Produced (if at the plant power generation is installed)
  - Shift wise quantity of sewage pumped into the Plant and effluent discharged
  - Daily Test results of effluent water quality
  - Calibration results of facilities (including reuse and power generation)

3.12.2 Operation Equipment and Machinery

165. Most important mechanical equipment used in various components of the treatment plant is given below.

- Mechanical coarse screen & Penstocks
- Wastewater Pumps
- Sludge pumps
- Sludge Scrapers for Primary and Secondary Settling Tanks
- Aerators
- Fine Bubble diffusers

- Sludge Scraper for sludge thickener
- Cranes
- Flow Meters and valves

Manpower Requirements during operation & maintenance phase

166. It is expected that existing organizational capacity of WSSC Mardan may not be able to successfully run the future model. The institutional design of the WSSC Mardan 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 sewage management system.

167. An institutional review and capacity building firm has been engaged under the project to successfully operationalize the project and improve the capacity of WSSC Mardan in terms of efficient Sewage management service delivery.

168. Estimated manpower requirements during operation phase would be 50 persons

3.13 Climate Risks from Project

3.13.1 Climate Change Trends and Extremes in Mardan

169. Increases in precipitation, urban flooding and possibly high temperature are considered as the key potential climate change impacts for Mardan city. These are expected to increasingly effect household and business assets, livelihoods and water supply. 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 Mardan 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.

170. Dominated by the monsoon seasonal patterns, Mardan'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.

171. 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 Mardan 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 Mardan. Increase in such events will also affect waste water and solid waste disposals.

172. Future climate projections based on GCM (CanESM214) show increase in summer days (> 25°C) under RCP 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.

173. 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°C to 5.45°C during 2011-2100 compared to 1976-2005. Similarly, minimum temperature is expected to rise between 0.94°C to 4.8°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.

174. 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 Mardan where frequency of wind storms is higher in these months as compared to other seasons according to a study[4].

175. 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.

176. 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 Mardan as well as disrupted waste water and solid waste disposal systems. The observed climatic changes and their potential impact is summarized in **Table 3.8**.

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

Table 3.10: Climate Change and potential impacts for Mardan

Climate Trend	Description	Current/ Potential Impact
Temperature rise	A temperature rise of 1.55°C observed in the month of May over last 62 years. Monsoon period shows a decline in maximum as well as minimum temperature 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	Risk of more frequent and intense heat waves in Mardan, leading to increased mortality and morbidity in the region Increased per capita demand for water consumption due to warmer weather Decline in ground and surface water availability leading to drought like conditions Crop failure in surrounding peri-urban areas that could reduce regional food security Increased demand for electricity, and damages to power lines and infrastructure Increased damages to road surface and other communication infrastructure
Increased summer days	Summer days (temperature > 25°C) are projected to be increased by 92.6 days during 2011-2100.	Increased demand for water and Electricity Increased incidence of vector borne diseases including dengue, malaria and cholera
Increased annual precipitation and changes to hydrological regime	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 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).	Increased flooding from storms and heavy rainfall (especially flash and riverine flooding 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 Increased demands on drainage and storm water management systems; sewer overflow Higher levels and period of humidity caused by high temperatures combining with increased precipitation, affecting human health and infrastructure. Increased water supply contamination and health effects.

3.13.2 Climate Risk and Vulnerability Assessment of the Mardan STP and Sewerage System

177. Climate change can impact different aspects of the project activities due to projected increased temperatures and intense floods from heavy rainfalls at the drains and sewerage treatment plant location. These climatic changes in the nearby areas can also have serious consequences on the sewerage system and STP due to flash flooding in the drains and upto some extent to the structure of STP.

178. Further increased temperature may affect activiated sludge process of STP as it is sensitive to temperature. It will also impact the sludge drying process. In order to protect the plant site from external runoffs, drains outside of the plant boundary have been provided which will collect the runoff and will convey to the downstream of the plant site.

3.13.3 Climate Change Adaptation Measures for Water Treatment Plant and Distribution Networks

179. Detailed Catchment studies has been conducted as part of designing Mardan sewerage system and sewerage treatment plant. Extreme precipitation event analysis should be carried out for the site.

180. Additional storm water flooding is incorporated in design of the project. Also additional Infiltration @ 10% of flow is added in the ultimate flow considered for treatment at STP. To cater urban flooding peak factor of 3 has been used for calculating peak flows. Design of storm water system is based on analysis of local precipitation data and considering 10 years return period. Precipitation data of years has been analyzed.

181. Swerage system should be designed keeping in view the urban flooding patterns in case of extreme precipitation events to avoid damages.

182. Sewerage structures has been designed to withstand flash flooding in event of intensive rain.

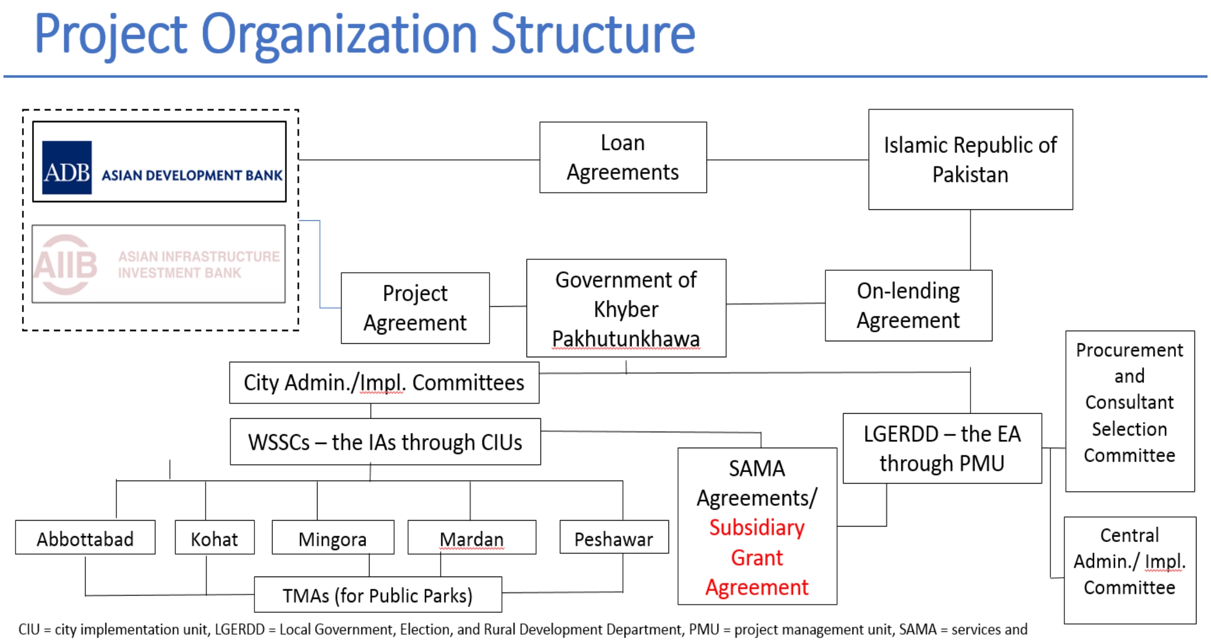
183. Suruface treatment plant must be protected from external runoffs through provision of drains outside the plant boundary.

184. Site should be graded so as to direct rainwater and water away from all planned structures. Under no circumstances, the foundation shall get inundated during the whole period of construction. Utmost care shall be taken not to allow drainage water to seep into the soil.

3.14 Project Organization Structure

185. For project execution KP LGERDD will act as executing agency through PMU KPCIP. KP LGERDD through PMU will liaise with ADB to address any issues during design and implementation; will Approve Procurement Plan of KPCIP; will coordinate relevant provincial department for project implementation, including social and environmental safeguard approval and plans. KP LGERDD will be responsible for institutional reforms road map, including processing tariff reforms/revisions and signing and execution/oversight of SAMAs. KP LGERDD will approve annual Budget as per recommendation of PMU and WSSCs; and approve delegation of authorities to PMU and WSSCs. Project organization structure is provided as **Figure 3-17**.

Figure 3-17: Project Organization Structure



CIU = city implementation unit, LGERDD = Local Government, Election, and Rural Development Department, PMU = project management unit, SAMA = services and assets management agreement, WSSC = water supply and sanitation company,

4 Description of Environment

4.1 General

186. Mardan is a metropolitan city and is located at the north-west end of Pakistan, about 140 km west of Federal capital Islamabad at 34°12'0N, 72°1'60E. It is the second largest city in Khyber Pakhtunkhwa, while 19th largest city of Pakistan.

187. The STP site is located in the outskirts of Mardan city, however, in vicinity of newly developed Rorya town at a distance of approximately 20.5 km from the city center. Completely new sewerage system of length about 82.4 Km is designed covering six Urban Union Councils of Mardan (some fully and some partially) i.e. UC Bicket Gunj, UC Bari Cham, UC Muslim Abad, UC Guli Bagh, UC Hoti and UC Rorya.

188. 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

189. Mardan is situated near the eastern end of the Khyber Pass and sits mainly on the Iranian plateau along with the rest of the Khyber-Pakhtunkhwa.

190. Mardan district may broadly be divided into two parts, north eastern hilly area and south western plain. The entire northern side of the district is bounded by the hills. In the district, the highest points in these hills are Pajja or Sakra, 2056 meters high above mean sea level

(amsl) and Garo or Pato, 1816 meters high (amsl). The south western half of the district is mostly composed of fertile plain with low hills strewn across it. It is generally accepted that this plain once formed the bed of a lake which was gradually filled up by the load of the river flowing into from the surrounding hills. From the foothills the plain runs down at first with a steep slope which carried the rain water to the lower levels and ultimately to the Kabul river.

191. The existing Rorya STP is located on relatively on a flat piece of land. However, the topography of the site is adequate to support wastewater treatment plant operations

4.2.2 Soils

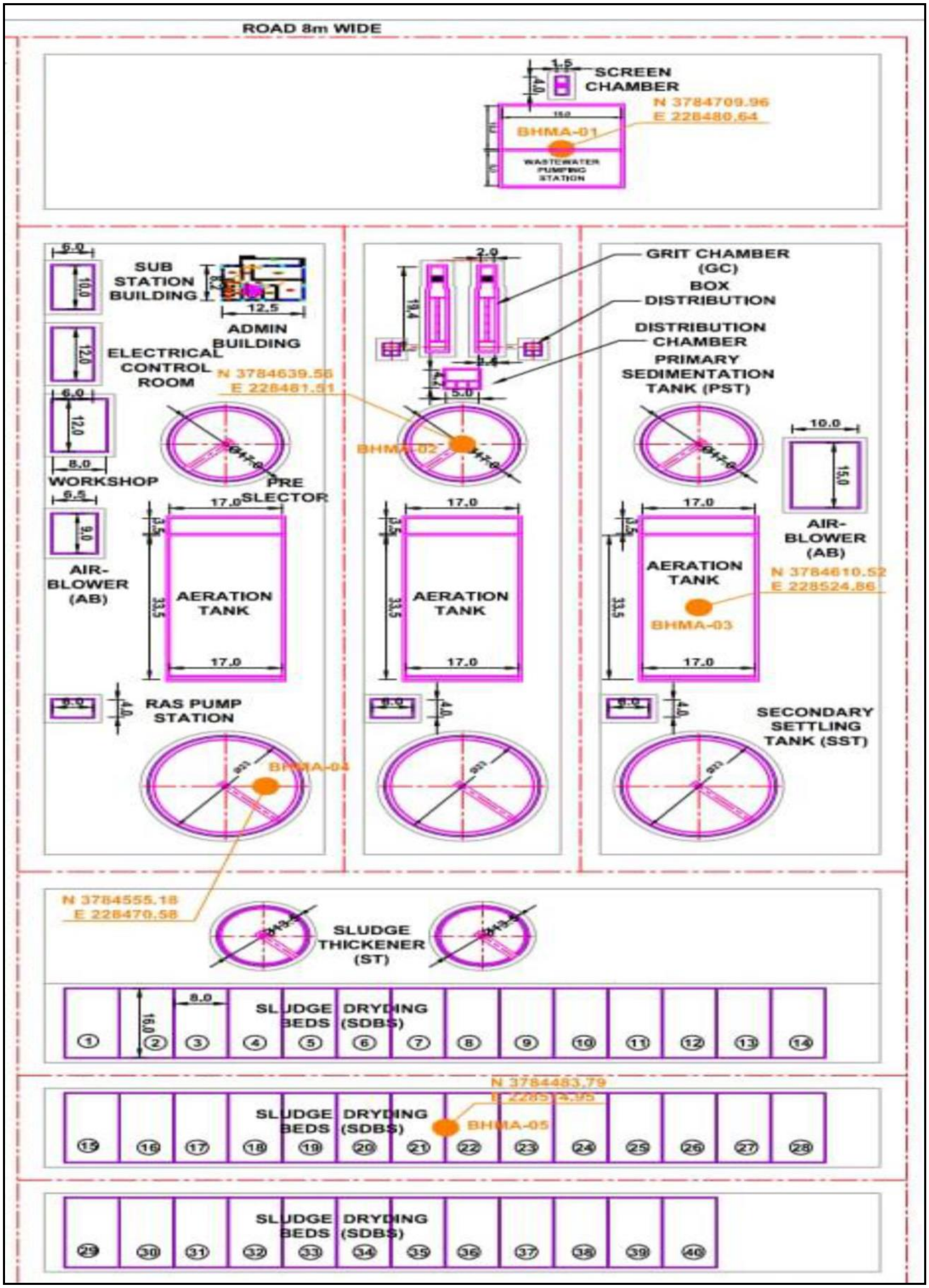
192. The soils investigation conducted for the site, five boreholes were conducted across the project site to ascertain the soil bearing capacity and composition as shown in **Figure 4.1**.

193. Summary of the ground soil conditions based on five boreholes investigations 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.	Description
BH-01	The strata encountered in this borehole mainly comprises of Silt with Sand and Silt from5ft up to 30ft depth. Percentage of gravels decreased with depth ranged from 4.1% to0%, Percentage of sand decreased with depth ranged from 12.4% to 0.4%, percentageof fines ranged from 83.5% to 99.6%. Plasticity of soil remained low to mediumthroughout drilling depth.
BH-02	The strata encountered in borehole # 2 was mainly comprises of Silt from 5ft up todrilling depth. Percentage of gravels ranged in 2% up to 3%, Percentage of sanddecreased with depth ranged from 4.1% to 1.4%, percentage of fines ranged from 90%to 96.2%.
BH-03	The strata encountered in this borehole mainly comprises of Silt from 5ft up to 20ftdepth, while at 30ft depth soil strata encountered was Silty Clay. Percentage of gravelsranged from 2.4% to 0.6%, Percentage of sand ranged from 7.6% to 1.0%, percentageof fines ranged from 90% to 98.4%.
BH-04	The strata encountered in this borehole mainly comprises of Silt from 5ft up to 30ftdepth. Percentage of gravels ranged from 2.5% to 1.1%, Percentage of sand rangedfrom 11.3% to 1.0%, percentage of fines ranged from 86.3% to 7.9%.
BH-05	The strata encountered in borehole # 5 mainly comprises of Silt with Sand from 5ft up to15ft depth, while from 15ft up to 30 depth soil strata encountered was Silty Clay.Percentage of gravels ranged from 5.6% to 2.8%, Percentage of sand ranged from14.8% to 1.9%, percentage of fines ranged from 79.5% to 95.3%.

Figure 4-1: Locations of Boreholes across Project Site



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

- The excavation required for the construction of foundation upto a shallow depth of about 1.0-3.0 m, can be made without provision of any supporting system. The excavation for the STP area can be easily done with simple mechanical means. Since the adjacent areas are open therefore, no major stability issues are anticipated to results in to property loss.
- 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 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.

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

- Proper paving should be provided along the periphery of the major structures.
- Adequate water 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 should also be provided to avoid moisture movement through the concrete.

Figure 4-2: Geology of Project Area

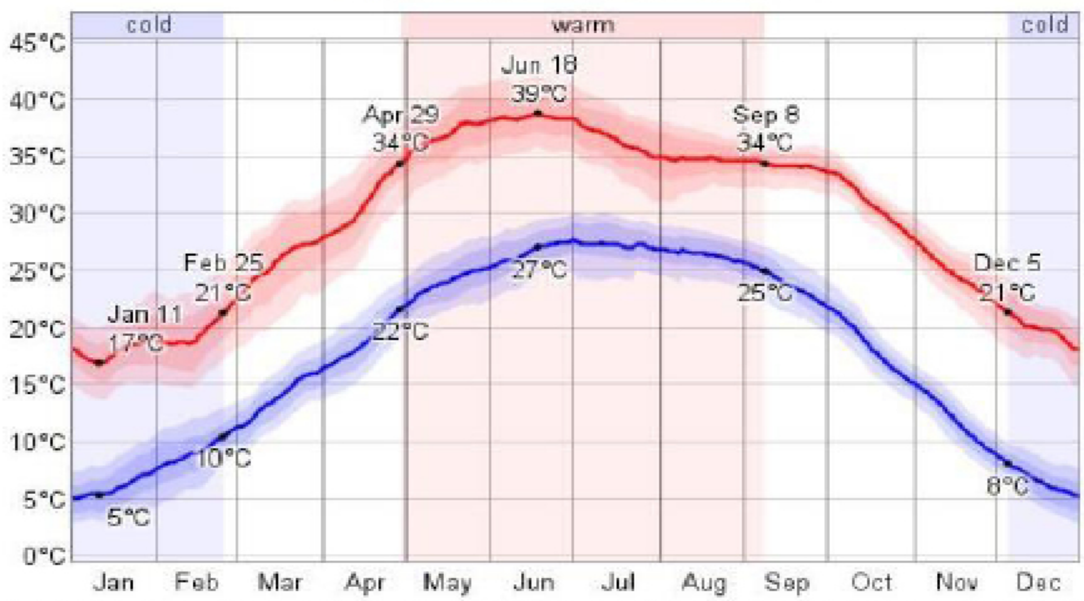
4.2.3 Climate

196. Mardan has a hot semi-arid steppe climate, which is very dry with little rainfall. It may rain at any time of the year but the rain does not last long. As well as being arid, the climate is extremely hot in the summer but slightly cooler in the winter months. There is no monsoon period. Throughout the year, temperatures fall dramatically at night, sometimes by as much as 20°C.

Temperature

197. The warm season lasts from the April to September with an average daily high temperature of above 34°C. The cold season lasts from the December to February with an average daily high temperature below 21°C. The temperature profile for Mardan is shown as **Figure 4.3** below.

Figure 4-3: Year round Temperature Profile of Mardan City

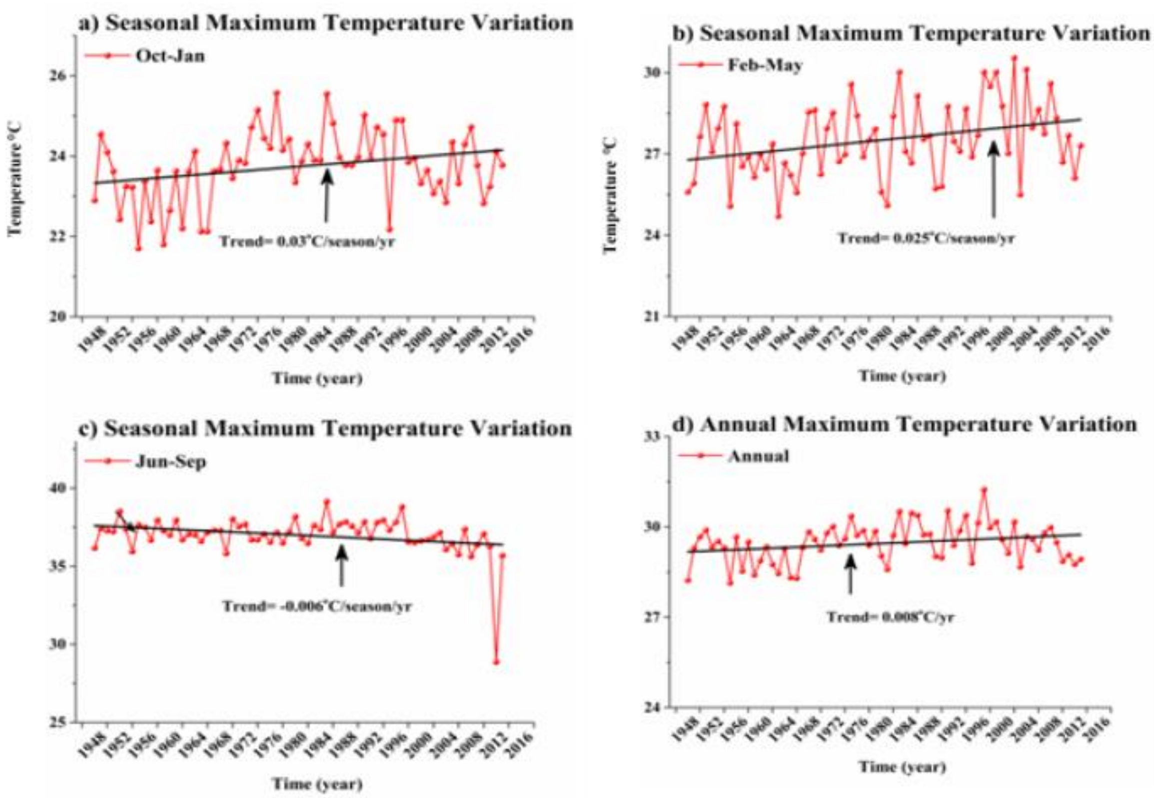


The daily average low (blue) and high (red) temperature with percentile bands (inner band from 25th to 75th percentile, outer band from 10th to 90th percentile).

198. Analysis of historical data for Mardan[5] 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 while the mean minimum temperature ranged between 15°C to 17.7°C. Temperature trend analysis of Mardan is shown in **Figure 4.4** below.

[5]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), Mardan City, Khyber Pakhtunkhwa, Pakistan.

Figure 4-4: Temperature trend analysis of Mardan (1951-2016)



199. Except for February in most of the winter to early summer months (December to May), the temperature shows rising trends ranging from 0.015°C/month/yr to 0.033°C/month/yr for December and May respectively. This means a rise in maximum temperature between 1°C to 2.2°C during last 68 years. Seasonal temperature rise is ranging between 1.6°C to 2°C (for Feb-May and Oct-Jan respectively), whereas monsoon season shows a statistically insignificant decline in temperature. Overall, it shows a temperature increase of 0.53°C during past six decades where annual maximum temperature raised at 0.008°C/year.

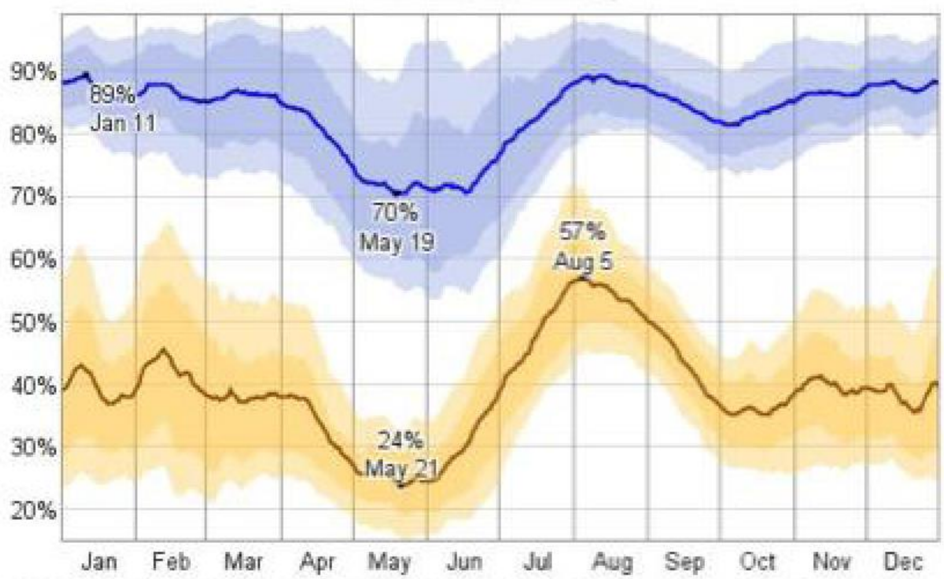
200. Except for January, the minimum temperature shows rise during September-May where trends are statistically significant. During 1950-2015, monthly rise in minimum temperature ranges between 0.72°C for September and 2.3°C for February, which means more rise in minimum temperature compared to maximum temperature, and suggests increase in warm nights compared to warm days. For the same period, minimum temperature for October to January shows a rise of 1.13°C while February to May shows a rise of 1.83°C. Statistically insignificant rise in minimum temperature is observed in monsoon. Overall, there is an increase of 1.06°C during 1950-2016 with annual minimum temperature rising at 0.016°C/year.

Relative Humidity

201. 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 4.5** below.

202. The air is driest around the 21st of May, at which time the relative humidity drops below 29% (dry) three days out of four; it is most humid around the 11th of January, exceeding 85% (humid) three days out of four.

Figure 4-5: Humidity Profile of Mardan City



The average daily high (blue) and low (brown) relative humidity with percentile bands (inner bands from 25th to 75th percentile, outer bands from 10th to 90th percentile).

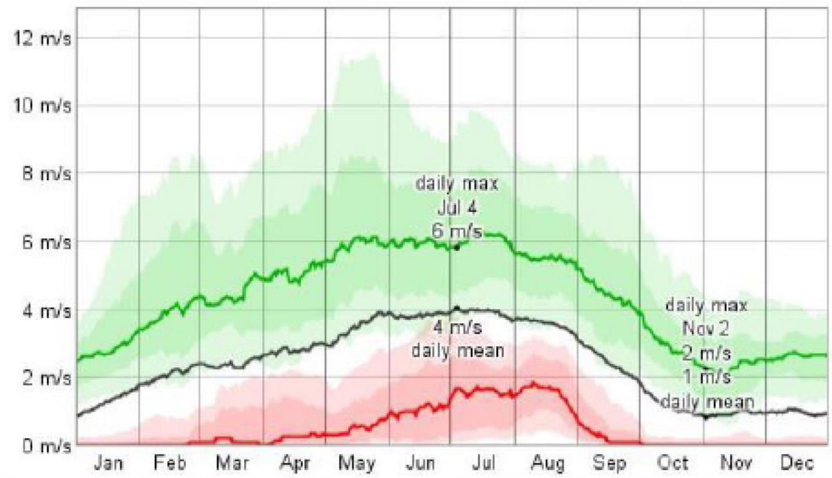
203. Although heatwaves[6]do not have a statistically significant trend in Mardan, longer periods of rate of increase of maximum and minimum temperature together with heat waves and increased precipitation can cause increases in humidity and water consumption.

4.2.4 Wind Speed

204. Over the course of the year, the typical wind speed vary between 0 m/s and 6 m/s (calm to moderate breeze), rarely exceeding 12m/s (strong breeze) as can be seen in **Figure 4.6** below.

[6]Heatwaves period can be defined as when consecutive 3-days temperature remains >45°C/day.

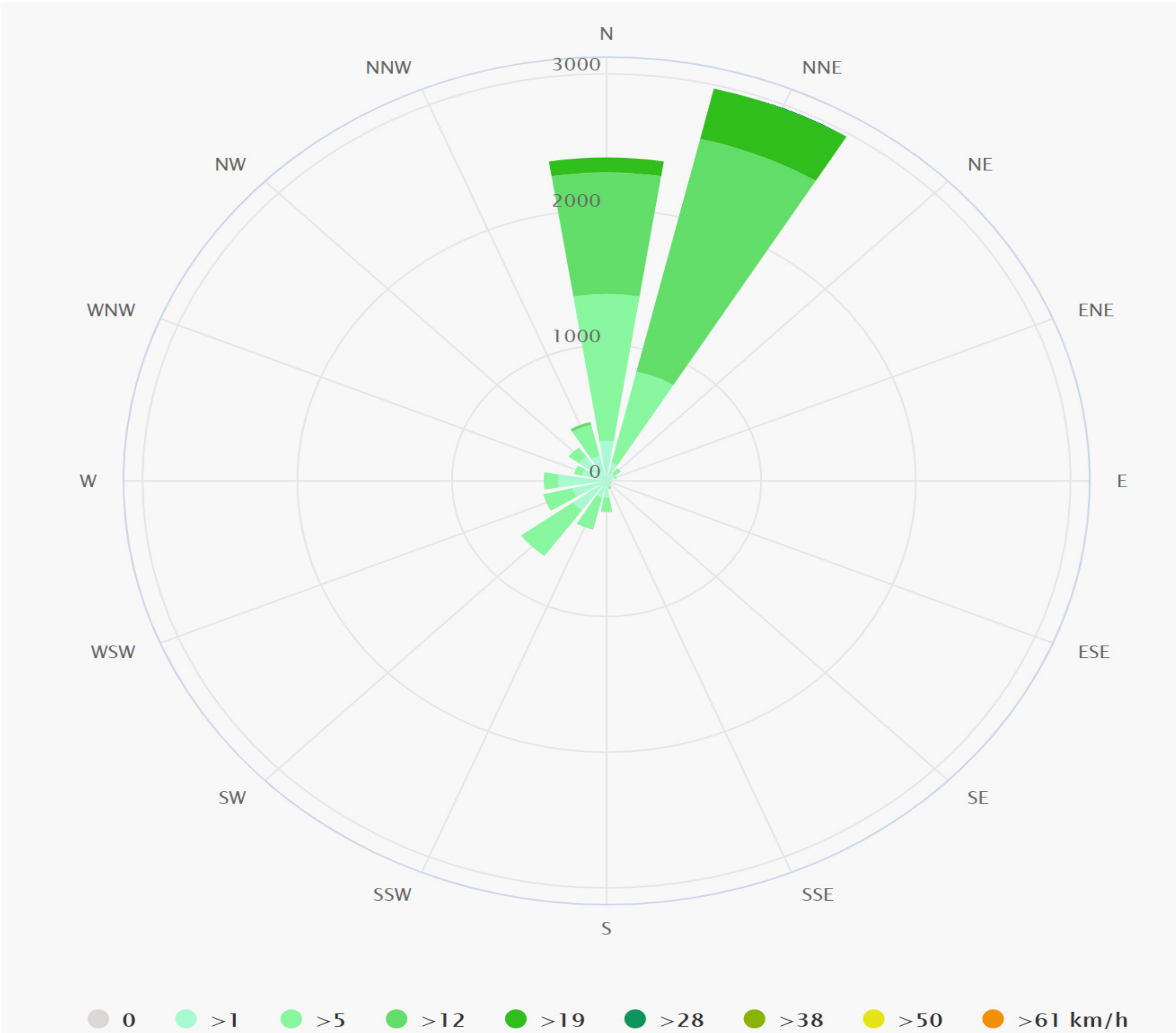
Figure 4-6: Wind Speed Profile of Mardan City



The average daily minimum (red), maximum (green), and average (black) wind speed with percentile bands (inner band from 25th to 75th percentile, outer band from 10th to 90th percentile).

205. The Windrose profile for Mardan is provided as **Figure 4.7** below. The wind rose for Mardan shows how many hours per year the wind blows from the indicated direction. The persistant down wind direction in Mardan is SSW and South.

Figure 4-7: Windrose for Mardan[7]

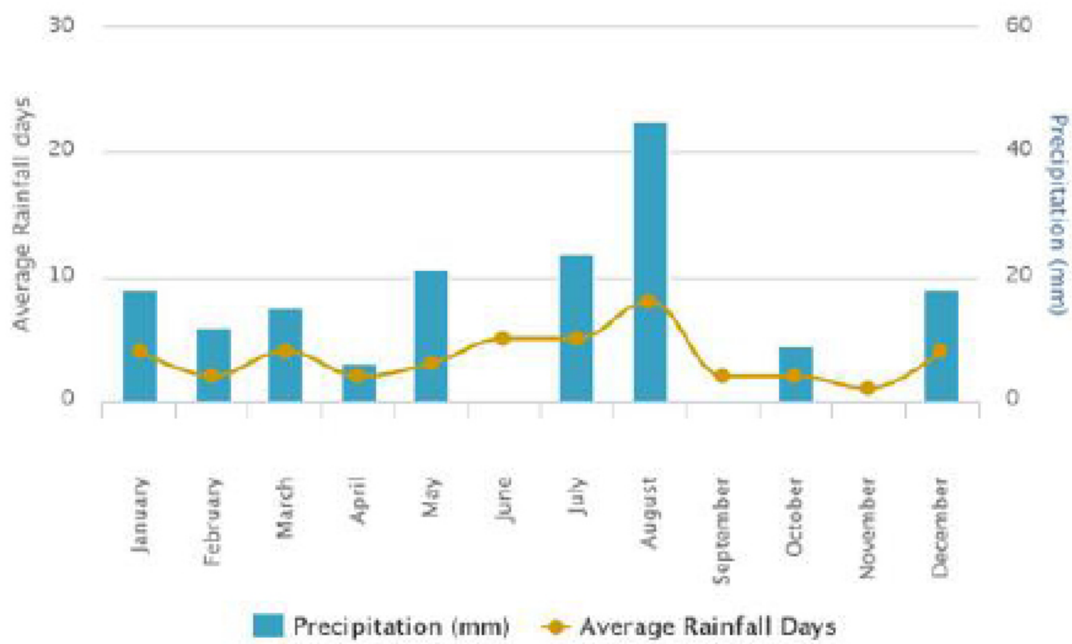


Precipitation

206. The city's average annual rainfall during 1961-2015 period was 474.4 mm with the highest annual rainfall of 904.5 mm recorded in 2003 while the highest daily precipitation (274 mm) was recorded on 29th July 2010. The lowest rainfall (190 mm) was recorded in 1974 based on Pakistan Meteorological Department, (PMD) Mardan climate station data. The annual precipitation together with an increase in extreme precipitation events in Mardan have increased according to the historic precipitation data. During the last 50 years, overall 212 mm increase in annual precipitation during last five decades have been observed according to the precipitation extreme indices. Likewise, heavy precipitation events (rainfall > 10mm) increased by 8.2 days, while heavy precipitation events (> 20mm and > 25 mm) increased by 5 and 4 days respectively.

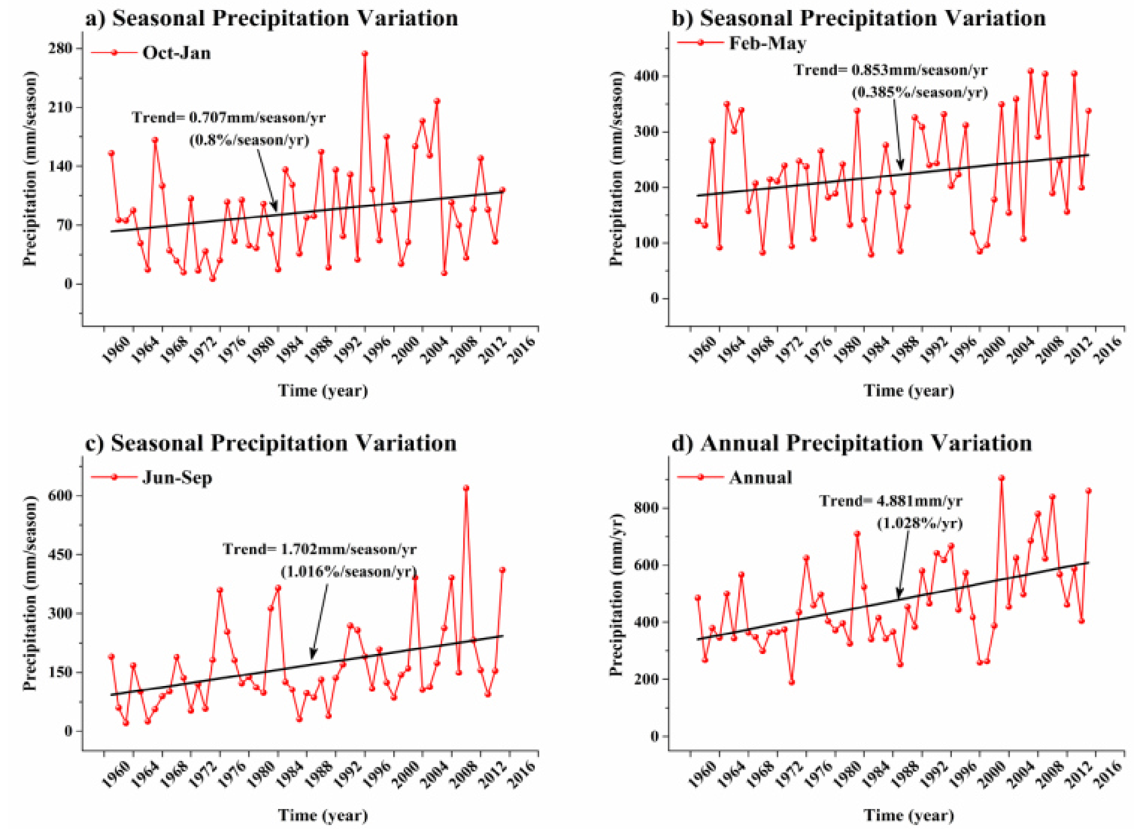
[7] https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/Mardan_pakistan_1168197, The meteoblue climate diagrams are based on 30 years of hourly weather model simulations and available for every place on Earth at 30 Km spatial resolution.

Figure 4-8: Average Rainfall Profile of Mardan City



207. During the months of January, February, June, September and October statistically significant increase is observed in monthly precipitation data. Over the last 55 years, a total rise of about 18mm (maximum percentage increase of about 2.1% rise/month/yr) is observed in June precipitation data. During the same period (1961-2015), quantitatively maximum rise occurred during September, where a total of 23mm rise. Increasing trends are observed in seasonal precipitation during winter (October to January) and monsoon period (June to September). Spring to early summer period also shows rising trend but not statistically significant. Annual precipitation shows a statistically significant rising trend with a total of about 268.3 mm rise during 1961-2015 at a rate of 4.88mm/yr (about 1.02%/yr).

Figure 4-9: Precipitation trend analysis of Mardan (1951-2016)



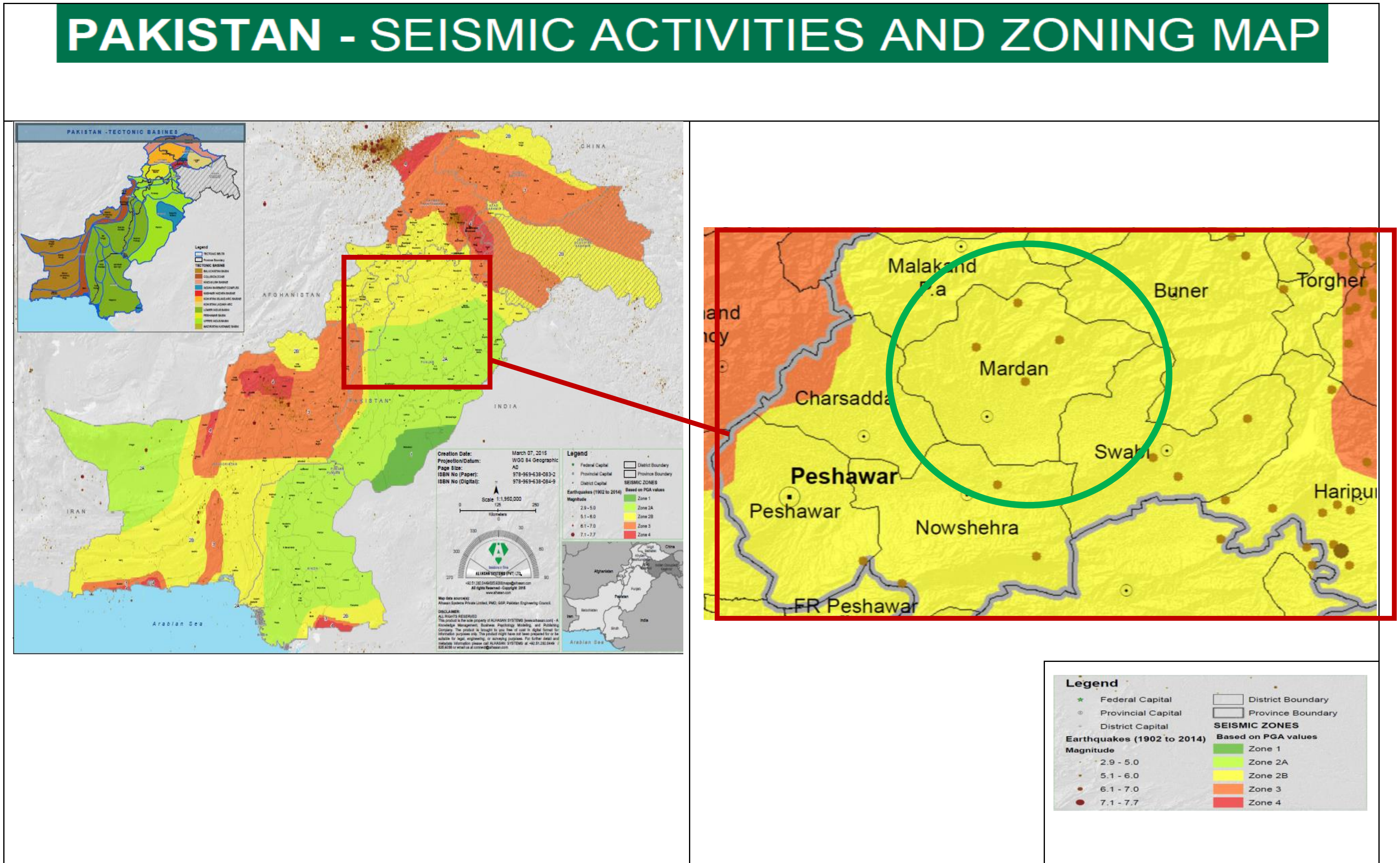
4.2.5 Seismology

208. The seismic hazard in Mardan 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 4.10** below.

209. Mardan is placed in Zone 2B, which 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.

210. It is therefore, recommended that the project structures should be designed to cater for the requirements of Zone 2B of Building Code of Pakistan (2007).

Figure 4-10: Seismic Zones of Pakistan



*Source National Diaster Management Authority

4.2.6 Surface water

211. Most of the streams in the project area drain into Kabul River. Kalpani, an important stream of the district rises in the Baizai and flowing southwards join Kabul River. Other important streams which join Kalpani are Baghiari Khawar on the west and Muqam Khawar, coming from Sudham valley and Naranji Khawar from the Narangi hills on the left.

212. There is heavy dependence on the Kabul, Bara and Swat rivers to obtain water for daily use for the residents of Mardan.

213. Agriculture in Mardan is largely dependent on Canals. Moreover, tube wells irrigation is also available in some places. The irrigated land in district Mardan constitutes a large percentage as compared to other districts of Khyber Pakhtunkhwa.

214. Surface water sample of wali-abad residency was collected on 8th May, 2020 and analysed. All examined parameters were within NEQS. The pH of surface water was 6.8 while BOD_5 and COD was 68 and 101 mg/l respectively. The surface water also did not show any heavy metal contamination. The results of the tests are presented as **Annexure D.** Surface water sampling location is shown in **Figure 4-11.**

4.2.7 Groundwater

215. 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, irrigation and industrial needs.

216. Underground water is plentifully available which is being harnessed by the local community and will continue as the source of water even for the project. Under ground water from a depth of around 15 feet as the first aquifer is harnessed by the locals for human consumption and irrigation on a limited scale.

217. As part of IEE baseline, four ground water samples were collected on 8th and 9th May, 2020 and analyzed from KP EPA certified lab. Ground water samples from four sources i.e. Masjid Spin Jumaat, Special Branch, Chakker Pul and Masji near Bacha University was analysed. All physical, chemical and Biological parameters were examined and results indicates that all parameters are within most stringent guidelines. The results of the tests are presented as **Annexure D**. Ground water sampling locations are provided in Figure 4-11.

218. As ground water table in the project area is at a depth of 13-16ft and thus the water storage pond/clarifier will be constructed above ground on a concrete base with liner being installed below the concrete base. The 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.

4.2.8 Noise

219. Noise monitoring was carried out from 8-11 May 2020 in project area. Results indicates that ambient noise levels were within the most stringent guidelines during the daytime, however, exceedance was observed at the night time at one location i.e near mardan sports complex in the project area. The receptor map showing the selected ambient noise monitoring locations is provided as **Figure 4.11** while with the comparison of the results

also presented in **Table 4.6.** Special branch HQ, Jibran colony and Misiriabad are considered as critical sensitive receptors as these are falling within 50 meter from the perimeter of STP.

4.2.9 Air Quality

220. Ambient air quality has been carried out (between 8-11 May 2020) in all the directions of the STP site and locations have been selected keeping in view the wind direction during the monitoring day. The map showing the selected air quality monitoring locations and their respective ambient air quality readings are provided as **Figure 4.11** while with the comparison of the results presented as **Table 4.7**

221. In general air shed seems to be of good quality with the ambient air quality within the acceptable NEQS standards with PM_{10} being the only pollutant that is slightly exceeding the most stringent guidelines at couple of monitored locations. The major reason for the exceedance of PM_{10} may be due to increased traffic and industrial emmisions in Mardan city.

4.2.10 Land Use

222. Current landuse of the project area (2 Km radius for STP site) shows majority of the area is crop land (56%), barren land (21%) followed by settelments (20%) and only (3%) of the area has tree cover. Land use map of the project area is shown as **Figure 4-12.**

Figure 4-11: Sampling Locations for Environmental Monitoring

Figure 4-12: Landuse map of the project area

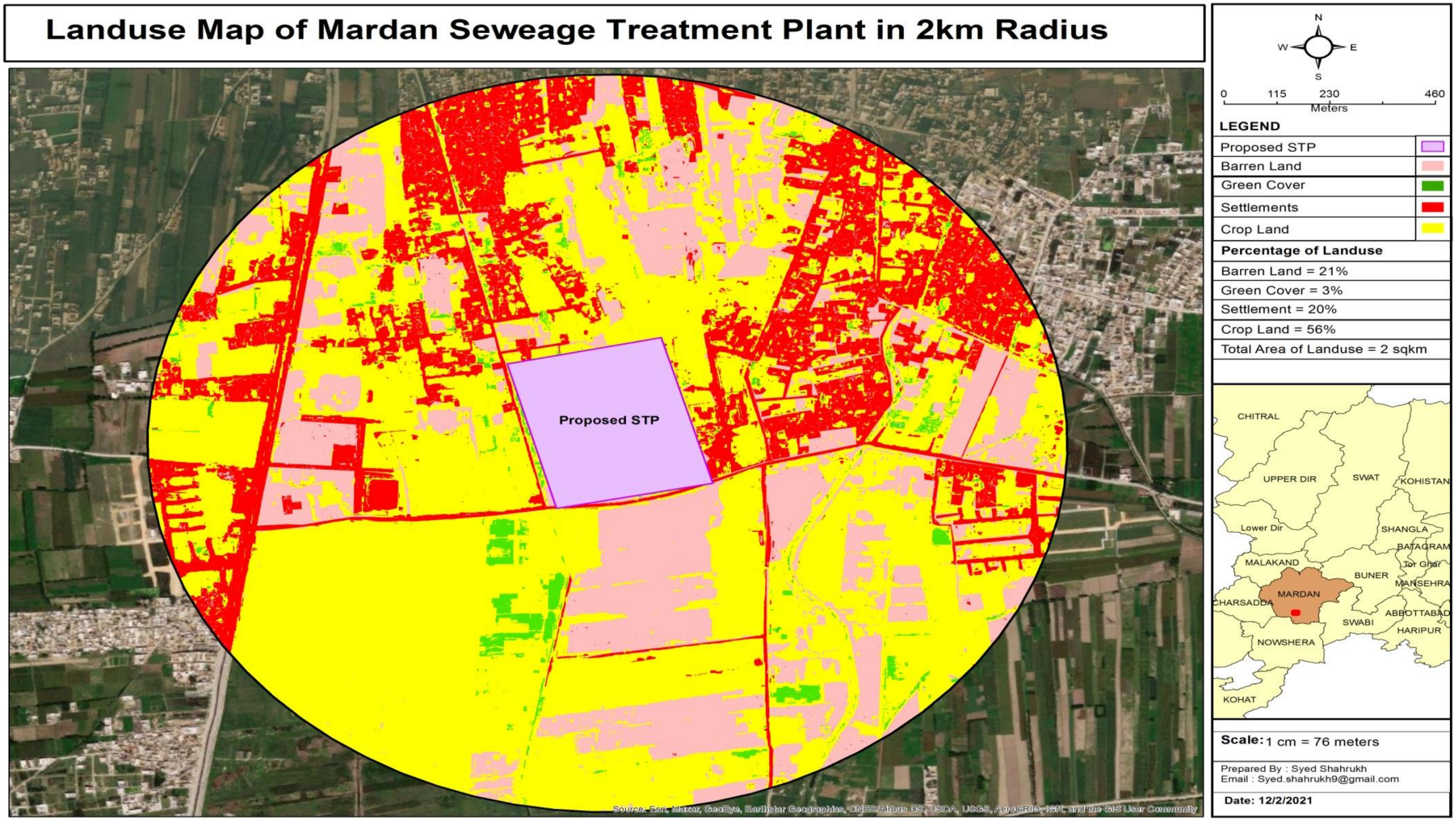


Table 4—2: Ground water Analysis of Project Area

Parameter	Unit	NEQS	WHO/IFC	Ground water Sample (Masjid Spin Jumaat)	Ground water Sample Special Branch Near STP site	Ground water Cahkker Pul	Ground water Masjid facing Bacha Khan University
Bacterial							
E-Coli	numbers/ml	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	0	0	0	0
Total Coliform	numbers/ml	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	0	0	0	0
Physical							
Color	TCU	≤ 15 TCU	-	3	3	5	3
Taste	No objectionable/Acceptable	-	-	Non objectionable	Non objectionable	Non objectionable	Non objectionable
Odor	No objectionable/Acceptable	-	-	Non objectionable	Non objectionable	Non objectionable	Non objectionable
Turbidity	NTU	< 5 NTU		2	4	3	2
Total Hardness	mg/l	< 500 mg/l		69	61	279	69
TDS	mg/l	< 1000		180	186	183	149
pH		6.5-8.5		7.1	7.2	7.3	6.9
Chemical							
Aluminum	mg/l	≤0.005 (P)	0.2	N.D	N.D	N.D	N.D
Antimony	mg/l	≤0.005 (P)	<0.005 (P)	N.D	N.D	N.D	N.D
Arsenic	mg/l	≤0.005 (P)	0.01	N.D	N.D	N.D	N.D
Barium	mg/l	0.7	0.3	N.D	N.D	N.D	0.2
Boron	mg/l	0.3	0.3	N.D	N.D	N.D	N.D
Chloride	mg/l	<250	250	91	76	96	92
Chromium	mg/l	≤0.05	0.05	N.D	N.D	N.D	N.D
Fluoride	mg/l	<1.5	1.5	0.78	0.78	0.89	0.73

Parameter	Unit	NEQS	WHO/IFC	Ground water Sample (Masjid Spin Jumaat)	Ground water Sample Special Branch Near STP site	Ground water Cahkker Pul	Ground water Masjid facing Bacha Khan University
Manganese	mg/l	≤0.5	0.5	N.D	N.D	N.D	N.D
Mercury	mg/l	≤0.0001	0.0001	N.D	N.D	N.D	N.D
Nitrate	mg/l	≤50	50	3.4	4.1	4.7	5.9
Nitrite	mg/l	≤3	-	0.03	0.06	0.0079	0.008
Selenium	mg/l	0.01	0.01	N.D	N.D	N.D	N.D
Zinc	mg/l	5	3	0.84	1.6	1.07	1.08

Table 4—3: Ambient Noise Monitoring Results (24 hrs) in Project Area

Monitoring Location	Parameter	Noise Reading Results	Noise Guideline (Commercial Area)	Compliance Status for Commercial Areas
Day Time Readings (0600 to 2200)			**Day time**	
STP Quarters	dB(A) Leq	**44.0**	65	
Mardan Sports Complex		**58.7**		
New Police Line Near Chakkar Pull		**54.6**		
Special Branch Near STP Site		**50.0**		
Night Time Readings (2200 to 0600)			**Night time**	
STP Quarters	dB(A) Leq	**41.7**	55	
Mardan Sports Complex		**55.3**		
New Police Line Near Chakkar Pull		**53.3**		
Special Branch Near STP Site		**48.8**		

Exceedance from applicable guidelines

'Within' applicable guidelines

Table 4—4: Comparison of ambient air quality results versus applicable Air Quality standards8

Monitoring Location	Parameter	NO (ug/m^3)	NO_2 (ug/m^3)	CO (mg/m^3)	SO_2 (ug/m^3)	$PM_{2.5}$ (ug/m^3)	PM_{10} (ug/m^3)
Applicable Guideline (ug/m^3) for 24 hrs	**Average**	**-**	**80**	**-**	**20**	**25**	**50**
STP Quarters	-	9.76	9.36	0.79	11.58	13.05	46.14
Mardan Sports Complex	-	8.98	9.42	0.67	11.76	10.20	62.41
New Police Line Near Chakkar Pull	-	10.21	11.97	0.82	10.74	9.97	51.11

Exceedance from applicable guidelines

'Within' applicable guidelines

[8] The ambient air quality was monitored using the AQM 65, which is a fully integrated air monitoring station that delivers near reference levels of performance. The AQM 65 offers the optimal balance for measuring crtieria pllutants to WHO air quality limits. With the AQM65 continiously measuring of common air pollutants was carried out and then results are produced on 24 hours average. AQM 65 esnures air quality data is reliabale and robust in compliance to USEPA (40 CFR Part 53) and EU (2008/50/EC).

4.3 Ecological Environment

223. 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 Mardan consists of an urban landscape with patches of plants and trees present across the city for the purpose of beautification and landscaping.

224. EDCM survey report listed species which are dominant and common in the project area. Red fox, Golden Jackal, Indian crested porcupine and wild bore are the mammals found in the project area which have IUCN Least Concern Status. Only Lutra persipiciliata (Ludhar) is on IUCN Red List since 1996. Ludhar species is occurring in most of the Indian subcontinent and Southeast Asia, with a disjunct population in Iraq. As project is located in agriculture land with semi-urban/rural settlements and no key biodiversity area has been identified therefore no significant impact on flora and fauna of the area is anticipated from the project.

4.3.1 Flora

225. In the Mardan 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.

226. In many villages in the Mardan, there are extensive pear, peach and apricot orchards and grape vineyards. Tobacco is also an important crop near the town of Nowshera. Wheat, cotton, pepper and particularly Tobacco and sugarcane are grown for the market as well as for local consumption.

227. 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 tarmariax, articulata, spands, akk, small red poppy, spera, pueghambrigul, drab grass, spera, eamelthorl and pohli chaulai etc with the different flora in the project area shown in **Table 4.5** below.

228. 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—5: Existing Flora in Project Area

Scientific Name		Common Name	IUCN Status
Tree	Eucalyptus camaldulensis	Safeda	Data Deficient (DD)
	Olea Cuspidata	wild olive	Data Deficient (DD)
	Dodonaea Viscosa	Broad leaf hopbush	Least Concern (LC)

Scientific Name		Common Name	IUCN Status
	Acacia Modesta	Phulai	Data Deficient (DD)
Shrub	Gymnosporia Royleana	Royle's Spike Thorn	Data Deficient (DD)
	Ziziphus nummularia	Jujube	Data Deficient (DD)
	Monotheca Buxifolia	-	Data Deficient (DD)
Grass	Aristida Depressa	Aristida	Data Deficient (DD)
	Cymbopogon Jawarnica	East Indian lemongrass	Data Deficient (DD)
	Eleusine Flagellifera	Goosegrass	Data Deficient (DD)
Fodder Grass	Bothriochloa Pertusa	Indian bluegrass	Data Deficient (DD)
	Digitaria Bicornis	Crabgrass	Data Deficient (DD)

Source: EDCM Ecology Survey, April 2020

4.3.2 Fauna

229. The fauna present in the project area of the STP site is provided in **Table 4.6** below.

Table 4—6: Existing Fauna in Project Area

Common Name	***Scientific Name***	***Common Name***	***Scientific Name***
Mammals			
Mongoose	*Herpestes anropunctatus*	Hare	*Lepus nigricolus*
Gheese/House Shrew	*Suncus marinus*	Ludhar	*Lutra persipiciliata*
Bat	*Pipistralius terwis*	Jackal	*Canis auries*
Black Rat	*Ratus ratus*	Fox	*Vulpe bengalensis*
House Rat	*Mus musculus*	Hedge Hog	*Hemiechinus Sp.*
Mole Rat	*Bandicota bengalensis*	Porcupine/She	*Hystrise indirca*
Squirrel	*Fumbulus penanti*		
Birds			
Dove/Common Dove	*Streptophelia senegalusis*	Indian Sand Martuis	*Riparia paludicola*

Common Name	***Scientific Name***	***Common Name***	***Scientific Name***
Dove/Common Dove	*Streptophelia tranquefabria*	Indian River Term	*Sterna auranlia*
Larks	*Mirfa erythroptra*	Black Partridge	*Francolinus francolinus*
Larks	*Erimopterix grisea*	Common Babler/Bagla/Chakkira	*Turdoides candatus*
Larks	*Calaendrella cristata*	Neel Kanth	*Gracius garrulous*
Weaver Bird	*Ploceus phillipinus*	Grey Partridge	*Pyeronotus xythopygos*
Jungle Pigeon	*Teron walia*	Shrieks/Lali/Myna	*Passeriformes Sp.*
Crow	*Corcives abyssinica*	Owl	*Bubo africanus*
Sparrow	*Passer Sp.*	Black Rock Pigeon	*Columbia livia*
Reptiles			
Indian Cobra	*Naja naja*		

Source: EDCM Ecology Survey, April 2020

230. Mammal species found in the vicinity of the project area are mentioned below in the **Table 4.7** with their respective IUCN status in the Red List. No endangered species are reported in the project area during IEE baseline survey.

Table 4—7: IUCN Status of Fauna in Project Area

Scientific Name		**Common Name**	**IUCN Status***
Mammals	Vulpes 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*

231. The commonly found avifauna of the project area are Shikra (*Accipiter badius*), Crow (*Corvus splendens*), Common kite (*Milbus migrans*), Sparrow (*Passer* domesticus), Pigeons (Columba *livia*), Dove (*Strato pielia*), Partridges. No migratory birds or their routes were found near the project site.

232. There is no protected area in the vicinity of the project area. Nearest games reserves is Garyalla Karmar Community Game Reserve is located at a distance of about 32km from project area.

Figure 4-13: Flora and Fauna of the Project area

	
Typical view of project area	Cropland adjacent to the project area
	
Grey Patridge	Streaked weaver

4.4 Socio-economic Environment

233. 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.

234. To assess the socioeconomic conditions of the project area, 5 FGDs were carried out with 31 participants including 45% male and 55% female participation. 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 (2019-20), Bureau of Statistics (2019-20), District Population Census 2017 of KPK and MICS of KP have been consulted. Survey questionnaire for conducting FGDs is provided as **Annexure B**.

235. Detailed social survey was conducted for project scoping during February/March 2020. For the purpose of the environmental and social assessment and sensitive receptor data

collection, project area union councils i.e. Bari cham, Bicket Gunj, Muslimabad, Hoti, Guli bagh and Rorya 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.

236. The names of the major settlements falling in area of influence but not limited to are Misri-Abad, Shaamilat, Hafiz-abad, and Sheikhmaltoon town.

4.4.1 Administrative Setup

237. The project area falls in the jurisdiction of Union Council (UC) Rorya, Mardan in Khyber Pakhtunkhwa Province. Under the latest revision of Pakistan's administrative structure, promulgated in 2001. Like any other district in the country, district Mardan is headed by Deputy Commissioner (DC) who is a chief administrative, revenue officer and representative of government in district. DC is responsible for coordination of work of all the sister offices and public facilities and implementation of government policies in the district. District Mardan has two Tehsils i.e. Mardan & Takht Bhai. Each tehsil comprises of certain numbers of union councils. There are 75 union councils in district Mardan with 60 rural and 15 urban. Map showing urban union councils of Mardan district is provided as **Figure 4-14**.

4.4.2 Demography and Population

238. The population of Mardan city in 1998 was 358,604[9]. The city's annual growth rate is estimated at 2.58 % per year, and the population of Mardan district is 2,373,061 according to the 2017 census. The Rural population of the District is 1,933,736 persons, while the urban population is 439,325 persons. In the District, the total Number of males is 1,200,871, while the total Number of females is 1,172,192.

Districts	Area (km^2)	Population (2017)	Density (people/km^2)
Mardan	1,632	2,373,061	1,454

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

4.4.3 Religion

239. 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 014 percent respectively. Other minority is Hindu who is 0.02 percent of the total population. The population of rural and urban area are 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 [10].

[9]https://en.wikipedia.org/wiki/Mardan

[10] Bureau of Statistics (2019-20), District Population Census 2017 of KPK.

4.4.4 Cultural and Archaelogical sites

240. No archaeological and cultural site was observed observed in close proximity of Mardan STP or along the ROW of sewerage network. Sewerage network will be constructed within ROW of MDA which is designated for such works in urban environment. However, in case of any chance find during excavation works, Archaeological department will be informed and consulted. Archaeological Chance Find Procedure is attached as **Annexure G.**

4.4.5 Ethnicities in Project Area

241. 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 4.11** below.

Table 4—8: Ethnicities in Project Area

Settlement	Caste/ Tribe	Decision Making Process in Settlements	Locally Used Language
Hafizabad	Yousafzai	Court of Law, Within caste group	Pashto
Misriabad	Maingan	Court of Law, within caste group	Pashto
Shamilaat	Yousafzai	Court of Law, within caste group	Pashto
Sheikh Maltoon	Yousafzai	Court of Law, within caste group	Pashto
Mardan	Yousafzai/Toru	Court of Law, within caste group	Pashto

4.4.6 Languages

242. The primary native language spoken in Mardan 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 Mardan is overwhelmingly Pashto-speaking; though the Hindko-speaking minority is concentrated in Mardan's old city, Hindko speakers in Mardan 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.

4.4.7 Dress/Clothing

243. 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.

4.4.8 Marriages/Deaths

244. 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.

245. 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).

4.4.9 Dwellings

246. 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.

4.4.10 Main Sources of Livelihood/Income

247. The City is home to textile and vegetable oil mills, as well as one of the largest sugar refineries in South Asia. Its industries also include the Pakistan Railways Locomotive Factory, small to large cigarette manufacturing industries, and flour, marble, and paper mills. Several financial agencies (banks) have established their presence in the City.

248. Most of the people in Mardan are doing private/government jobs while second most source of income is agricultural. People are also doing small business.

4.4.11 Education Facilities in project area

249. 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.

250. The government is the largest provider of education. The Number of primary schools is 1419; Middle school 176, high school 167, higher secondary school 67, degree college 17, and postgraduate 2.

4.4.12 Literacy Rate

251. The literacy rate for population 10 years and above (2010-2011) was 54 percent which increased to 59% in 2013. For the urban rural comparison, the urban literacy rate is higher than the rural, which is 62 percent. Among urban community, literacy ratio for male is 75 and for female it is 47; whereas the rural literacy ratio is 45 percent, and in rural community, literacy ratio for male is 61 and for female it is 29. Adult literacy rate (> 15 years) is 51 percent. Gross Enrollment Rate (GER), at the primary level, is 93% (Male: 101%, Female: 85%). Net Enrollment Rate (NER), at the primary level, is 56% (Male: 59%, Female: 52%).

4.4.13 Social Amenities in project area

252. During the field survey, the access/availability of the social amenities/ basic infrastructure in the vicinity of the STP 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.

253. Mardan has 83 health facilities, including hospitals and rural health centers, with a combined strength of 826 beds. The hospitals are in Mardan City and two other urban settlements. In project area, private health care centres are present to facilitate the health of people in the project area and its near inhabitants

4.4.14 Major Source of Drinking Water

254. The major sources of drinking water within the vicinity of the project area include community tube wells, individual and communal hand pumps. Proper water supply schemes available in the project area but not well maintained.

4.4.15 Archaeological and Cultural Heritage

255. There are no sites of archaeological or cultural heritage located in the project area. Sewerage network will be constructed within ROW of MDA which is designated for such works in urban environment. In case of any chance found during execution of project activities, Archaeological chance find procedure will be implemented. Archaeoloigcal chance find procedure is provided as **Annexure G.**

4.4.16 Energy Supplies

256. 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 supplies.

4.5 Findings of Social Due Diligence

257. The Consolidated Social Due Diligence Report (SDDR) has been prepared as a document of land acquisition and resettlement related impacts of the subprojects selected under the proposed Khyber Pakhtunkhwa Cities Improvement Project (KPCIP) to be financed by the Asian Development Bank (ADB). The SDDR has been prepared by the social safeguard team of the Project Management Unit (PMU) under the Local Government Department (LG) Government of Khyber Pakhtunkhwa (KP) as the executing agency (EA) for the proposed KPCIP project.

258. The ADB's Safeguard Policy Statement (SPS) 2009 (for IR policy) aims to "avoid involuntary resettlement wherever possible or to minimize impacts if avoidance is not possible by exploring project and design alternatives; enhance or at least restore livelihoods of those affected by the Project relative to pre-project levels and to improve the standards of living of those poor and other vulnerable groups. Following this aim of the SPS, the KPCIP project has been carefully conceptualized to either avoid all potential social impacts of proposed subprojects where possible or keep impacts to insignificant

thresholds through adopting no or least impacts project designs. Following this concept, the social safeguard team of PMU undertook due diligence of the proposed subprojects to assess the land acquisition and resettlements (LAR) impacts of the subprojects, screen all subprojects, and categorize them under the SPS's projects categorization criterion for involuntary resettlement (IR) and indigenous peoples (IP) impacts, prepare land acquisition and resettlement plans (LARP) as required and compensate all DPs prior to starting of construction work.

259. As per ADB Safeguard Policy Statement (SPS-2009), the LAR impacts are considered significant if 200 or more persons experience significant impacts that are physically displaced from housing and lose 10% or more of their income-generating resources. As far as overall KPCIP is concerned, it is a stand-alone project and falls in the IR category C as no DPs will face physical dislocation from housing or lose 10% or more of their resources that are income-generating.

260. The DDR team carefully reviewed the project documents and consultations with the project staffs and consultants for the presence of any IPs communities. It was found that the entire population is Muslims and they did not consider themselves to be called any other type of population such as indigenous peoples as the ADB's SPS 2009 describes the IPs to be. As the Project is not entailed any significant impact on indigenous peoples owing to the nonexistence of the IP, hence the IP (Indigenous peoples) category "C" will stand here as reflected in. Therefore, an Indigenous Peoples Development Plan (IPDP) is not required for this Project.

261. Details of findings of Due Diligence Work for Mardan STP and sewerage system has been summarized in **Table 4-7**

Table 4—9: Due Diligence Work for Mardan STP and Associated Sewerage Network

S#	City	Project	IR/IP Category	Remarks
1	Mardan	Operationalization and upgrade sewerage system and STP	C	**Screening results:** a) Up-gradation of existing waste water treatment plant established in 1996 but is not in operational condition. b) Land acquired in 1993 and compensation is made to DPs. c) TMA handed over the Mardan STP land to WSSC through letter no 2253/TMA (M) dated 05/8/2019. d) Sewerage network will be constructed within ROW which is in possession of MDA. e) **IR/IP categorization** As per detailed design, the project does not have any impact on land and non-land assets, hence is categorized as C for IR/IP category. It is also confirmed that none of the IP is existing in the project area.

4.6 Sensitive Receptor Mapping

262. The STP site located closed to sensitive receptors i.e. residential settlements in the form of clusters and individual settlements as shown in **Fgure 4.15**. The respective distances of these sensitive receptors from the proposed site are provided in **Tables 4.12.** 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.

263. Special branch HQ, Jibran colony and Misiriabad are considered as critical sensitive receptors as these are falling within 50 meter from the perimeter of STP. No major concern was raised by the inhabitants, however, the execution agency will further ensure that social grivenece may cause due to project implementation and operation on this receptor.

264. The proposed sewerage system for Mardan will be developed in six (6) urban union councils under jurisdiction of WSSC Mardan. The settlements of these Six union councils i.e. Bari cham, Bicket Gunj, Muslimabad, Hoti, Guli bagh and Rorya are sensitive receptors.

265. The sewerage system for Mardan is proposed for the already developed area in Mardan City.The proposed corridor for the sewerage system is therefore based on the best available option as per the topographic survey. The corridor is mostly adopted at one edge of the exiting road carriageway keeping in mind the existing house ramps and utilities at both sides of the road carriageway

Figure 4-14: Sensitive Receptors and Prominent Structures In Project Area

Table 4—10: Sensitive Receptors and Prominent Structures within Project Area and Distance from STP

Sr. No	Pictorial View	Coordinates	Distance from site (meters)	Description
01		X:72.53480 Y:34.16892	36	Misriabad This Housing society is Situated opposite to STP
02		X:72.53010 Y:34.16182	430	Masjid 01 (Khadija tul Kubra) Capacity:100-120(persons)
03		X:72.51420 Y:34.16880	168	Jibran Colony This Housing Society is Situated near to STP
04		X:72.50350 Y:34.16900	287	Masjid Jibran Colony Capacity : 25-30(persons)
05		X:72.47860 Y:34.16917	509	Canal road nehr, Waliabad This is a surface flow canal flowing throw nearby residencies of STP

Sr. No	Pictorial View	Coordinates	Distance from site (meters)	Description
06		X:72.47780 Y:34.16965	175	Govt Primary School, Zaman Abad Student strength : 175
07		X:72.46470 Y:34.16150	863	Govt Primary and middle school, khura Banda Student strength : 300
08		X:72.47200 Y:34.16411	664	Ameer Muhammad Khan campus Under-construction
09		X:72.47440 Y:34.16597	590	Board of Intermediate and Secondary Education, Mardan
10		X:72.50970 Y:34.17800	1067	Masjid 02 (Speenjumaat) Capacity :100-120(persons)

Sr. No	Pictorial View	Coordinates	Distance from site (meters)	Description
11		X:72.50600 Y:34.17754	1026	Forward Islamic Model School Student strength : 70 – 100 (persons)
12		X:72.56820 Y:34.17883	1122	Mosque 03 (Masjid Quba, Madrassa Aarbiya Anwarulquran) Capacity : 130-145
13		X:72.60920 Y:34.17468	818	Chakkarr Bridge, Waliabad This bridge is famous by its name chakkar in mardan
14		X:72.59570 Y:34.17081	429	Sakeena Model School Student strength (125)
15		X:72.60460 Y:34.17140	479	Mosque 04 (SpeenJumaat) Capacity : 120-135(persons)

Sr. No	Pictorial View	Coordinates	Distance from site (meters)	Description
16		X:72.60750 Y:34.16729	316	Govt Primary School, Itehaad Colony Student strength (140)
17		X:72.61560 Y:34.16683	371	Chakkar Pull, Itehaad Colony This bridge is situated near to STP
18		X:72.59130 Y:34.16621	136	Ameer Muhammad Khan research farm, Agriculture University Under-construction
19		X:72.57720 Y:34.16579	05	Special Branch Mardan Situated near to boundary of STP
20		X:72.50610 Y:34.16491	338	Abdul Wali Khan University, Sports Complex This sports complex is situated along the route of STP

5 Analysis of Alternatives

5.1 Overview

266. 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 of sewage in an environmentally sound manner and are successfully running in developed countries in particular and recommend the most suitable set of options for Mardan city keeping in view its land requirement, energy consumption, complexity of operations, sludge generations and handling.

267. The development of the proposed STP and Sewerage System is based on detailed feasibility assessments focusing on assessing the city requirements with regards to STP and then determining the most suitable and effective technology and location for development of the required infrastructure.

268. This process of analysis of the different alternatives for development of the sewage treatment plant 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 No project Option

269. If ‘no project’ option is considered, it will result in loss of all positive impacts that project will pose on Mardan city; such as eradicating direct disposal of sewage in water bodies, clogging of sewerage drains, 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 and clogged drains and seepage likely to contaminate ground water and adjacent utilities like water supply. It would also limit the urban development of the area in a sustainable manner.

5.3 Alternatives Types

270. The availability of alternatives ensures to a degree that a comparative analysis will lead to a well informed decision regarding the selection of the most optimal option among all that are brought into consideration. The analysis for Mardan STP lays a primary emphasis on factors influencing economic viability, environmental sustainability and social acceptability that may arise from the execution of the project, during both construction and operation

271. Two key components of this particular analysis are:

(1) Site Selection

(2) Technology Selection

5.4 Site Selection

272. There are many different, often inter-related, criteria that go into the selection of an appropriate site for a sewerage treatment plant. These may be based on any number of technical, environmental, geological-hydrogeological, operational, economic, social and

political factors. The site analysis of the wastewater treatment plant in question will attempt to integrate the major factors into a few relevant categories that effectively describe the process and provide some justification to the selection.

5.4.1 Environmental Sensitivity (Climate, Nature Conservation)

- Pollution of ambient environment and ground water is one concern.
- Wind and rain are common climatic factors influencing site selection. For high rainfall areas, effective storm water diversion is essential to minimize interference with plant operations.
- Locations with higher potential for nature conservation or agriculture should not be considered, e.g., wetlands etc.

5.4.2 Infrastructure

- This primarily includes the drainage infrastructure of the area, and may also include the road access to the potential site.

5.4.3 Site capacity and operability

- Identified site should have enough capacity.
- Site topography and ground features should be conducive to plant operations.

5.4.4 Land Acquisition, Cost

- Each location has its monetary value, and certain due processes for its acquisition.
- Existing and possible future developments, residential etc., adjacent to the site should be considered.

5.4.5 Social Acceptability

- The location identified should be accepted socially.

5.4.6 Site Alternatives

273. The existing sewerage treatment plant at the site which is not functional at present is planned to be rehabilitated. No potential alternative sites have been considered since the current site satisfies each of the selection criteria to a great extent.

274. The site is located at a reasonable buffer from the surrounding population. The existing drainage network, although in need of capacity enhancement, already meets the design criteria to service the respective union councils as well as minimize excess storm water entry. Adequate road access to the site already exists.

275. The capacity and the topography of the site is adequate to support sewerage treatment plant operations.

276. There will be no land acquisition costs since the land is already acquired and serving the purpose of a sewerage treatment plant.

277. Finally, regarding social acceptability, the surrounding population and other relevant stakeholder have not expressed any particularly significant issues with either the present use of the area for the purpose of sewerage treatment or with its planned rehabilitation and upgradation.

278. Keeping in view all these factors in which the current site adequately satisfied the selection criteria, no other site was considered and the site has been finalized for this purpose.

Parameter	Rorya Existing site	Altogether new site
Land Availability	Sufficient land is already available No new land acquisition will be required	Purchase of new land will be required.
Environmental concerns	Existing site has available infrastructure and less environmental concerns.	New site may cause the environmental hazards in terms of new siting, loss of ecology etc.
Social /Resettlement issue	No social or resettlement issues	Social or resettlement issues since land is already own by the WSSC.

5.5 Technology Selection

279. Similar to the site selection of the sewerage treatment plant, the selection of suitable technology from the available alternatives is also a process which takes into account multiple factors that revolve around the economic viability, environmental sustainability and social acceptability of the plant. The selection criteria is based on the following factors categorized as follows.

5.5.1 Wastewater Characteristics

280. The appropriate physical, chemical and biological treatment processes required at the plant will be determined by the nature of pollutants to be removed and their strengths in the wastewater. The selected wastewater treatment system must ensure the adequate removal of pollutants to acceptable target levels.

5.5.2 Land Availability and Topography

281. The availability of land and the topography of the plant site with reference to the system hydraulic requirements are the principal physical constraints, which govern the selection of the treatment technology.

5.5.3 Cost

282. The expense occurring for the construction (initial capital cost) and operation (running or operational cost) of the equipment plays a key role in determining its feasibility and suitability.

5.5.4 Operational Complexity

283. Skills required for the routine operation and maintenance of the treatment system should be locally available. The proposed system must have easy operation and maintenance procedures.

284. The selected system should employ equipment of minimal complexity. Locally manufactured mechanical equipment should be preferred where possible.

5.5.5 Nuisance/Pollution

285. The degree of odor and noise must be below the nuisance thresh-hold, especially, with reference to the proximity of the treatment system to the build-up areas.

286. Potential for ground water contamination is also a factor.

5.5.6 Available Technologies

287. Different treatment technologies are available to meet the objectives of above mentioned degrees of treatment. Some common and appropriate technologies are selected and compared as alternatives for proposed Rorya STP of Mardan. A brief description of these technologies is provided below.

5.5.7 Preliminary Treatment Technologies

288. Preliminary treatment of effluent consists of following operational components.

- Screens
- Grit Removal

1: Screens

289. Screens and racks are used to remove floating material and coarse pollutants that may damage downstream operations of pumps and other mechanical equipment and clog weirs, pipes and valves. Two types of screens namely coarse screen and fine screen are used for the preliminary wastewater treatment.

a) **Coarse Screens**

290. Coarse screens have clear openings ranging from 6 mm to 50 mm and are used to protect pumps, valves, pipelines and other appurtenances from damage or clogging by rags and large objects. Coarse screens are designed as either hand cleaned or mechanically cleaned.

b) **Fine screens**

291. Fine screens have clear openings between 6 to 25 mm. They have various purposes including:

- Preliminary treatment (following coarse bar screens)
- Primary treatment (as substitute of primary clarifier)

292. For Rorya STP, Mardan it is proposed to install coarse screens at the upstream of the pump station to protect the pumps and fine screens prior to the grit removal chamber.

2: Grit chamber

293. Grit chambers are designed to remove grit, consisting of sand, cinders or other heavy solids that have subsiding velocities or specific gravities substantially greater than those of the organic putrescible solids in wastewater. Grit chambers are most commonly located after bar screens and before primary sedimentation tanks. These are used to;

- Prevent wear and tear of pumps and other mechanical equipment and transport pipes.
- Reduce deposit formation and consequent clogging in downstream unit operations and transport pipes.
- Avoid accumulation of inert solids in the primary sludge as it will eventually deposit a thick sand layer in sludge digester.

294. Different types of grit removal mechanisms are available e.g. Vortex grit chamber, horizontal flow grit chamber, aerated grit chambers. Vortex and aerated types require power and higher maintenance. Therefore, simple horizontal flow grit removal chamber prior to the primary settling tanks has been proposed for Rorya STP, Mardan.

5.5.8 Primary Treatment Technologies

295. Target of primary treatment is to remove the settleable solids and associated BOD. This removal enables reduced loading to the biological treatment. Primary treatment can be carried out by;

1. Primary Settling Tanks
2. Anaerobic Ponds / Tanks

1. Primary Sedimentation Tank

296. The objective of treatment by sedimentation is to remove readily settleable solids that remain in wastewater after preliminary treatment. A primary sedimentation can remove 40% to 50% of suspended solids and 15% to 20% of BOD.

297. Almost all treatment plants use mechanically cleaned sedimentation tanks of standardized circular or rectangular design. Sludge at the bottom of PSTs is diverted to collection pit with the help of scraper from where it is taken out to other treatment units for further thickening and dewatering.

2. Anaerobic Tanks/Ponds

298. Anaerobic tanks and earthen ponds are also used for the primary treatment of wastewater. These treatment units work in the absence of oxygen. Anaerobic bacteria grow under such conditions and use organic matter to produce biomass and Methane (CH_4). A good process control e.g. temperature and pH control are required.

299. Considering simplicity in operation, influent characteristics, treatment efficiencies and known applications in Pakistan, Primary settling tanks are proposed as primary treatment and will be located upstream of biological treatment.

5.5.9 Secondary Treatment Technologies

300. Various secondary treatment technologies are used worldwide for the treatment of sewage. Some of these are:

1. Waste Stabilization Ponds (WSP)
2. Conventional Activated Sludge Process (ASP)
3. Aerated Lagoons (AL)
4. Trickling Filters (TF)
5. Extended Aeration Activated sludge process (EA)

6. Membrane Bio Reactor (MBR)

301. Applicability of treatment technologies depend on the degree of treatment required, land requirements, capital and O&M costs, local conditions and impacts on surrounding environment. Above mentioned technologies are discussed below.

1. Waste Stabilization Ponds (WSP) / Natural Lagoons

302. Waste Stabilization Ponds comprise of a series of anaerobic, facultative and maturation ponds. Secondary treatment of wastewater take place in facultative ponds. Schematic diagram of waste stabilization ponds system is shown in Figure 5.1 below.

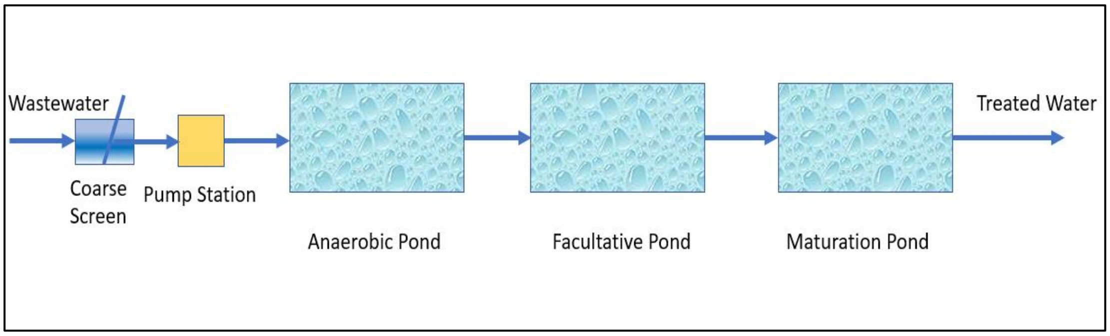


Figure 5-1: Schematic Diagram of Waste Stabilization Ponds

303. Facultative Ponds are employed for medium organic loadings where a mutual relationship prevails between algae, which provide oxygen, and facultative bacteria, which provide nutrients for the algal growth. Organic matter is consumed primarily by the facultative bacteria. Primarily, Anaerobic and Facultative Ponds are designed for BOD removal and Maturation Ponds are designed for pathogens removal, although, some BOD removal also occurs in Maturation.

304. Merits and demerits of waste stabilization ponds are presented below.

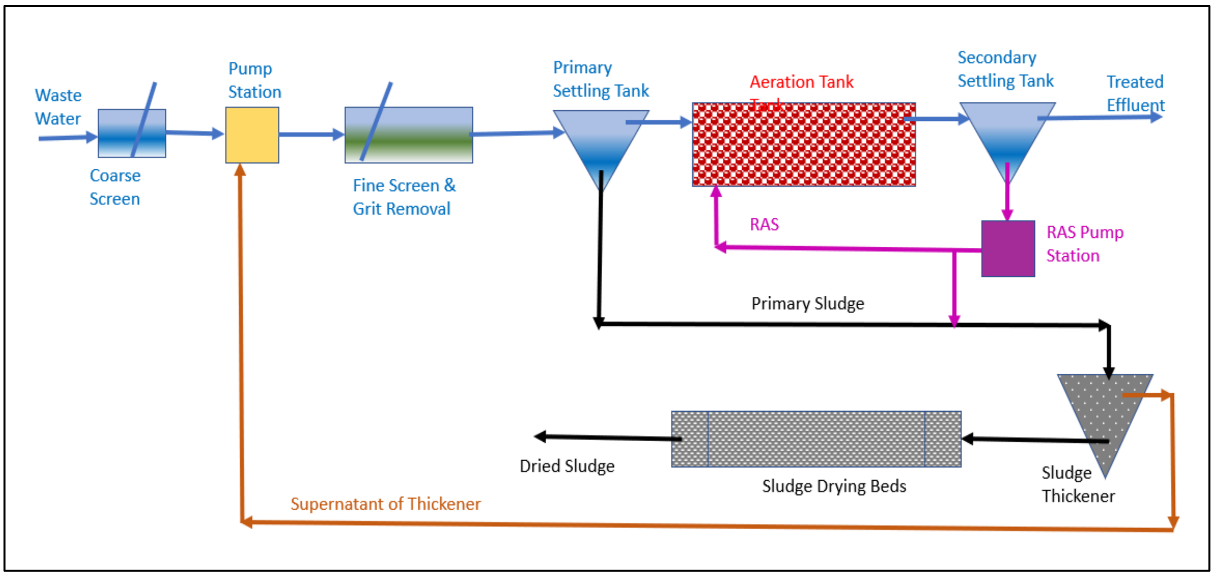
Table 5—1:Merits & Demerits of Waste Stabilization Ponds

Merits	Demerits
• Operational cost is very low • Very low energy requirement • Easy to operate and maintain • Can absorb shock loads • Very effective for pathogen removal • High performance in hot climates	• High land requirement and Capital cost • Potential odor problems in anaerobic ponds • Less effective for nutrients removal • Treated Effluent may contain Algae • Efficiency depends on climatic conditions • Seepage from Pond may pollute groundwater • Issues related to breeding of Vectors and mosquitoes

2. Conventional Activated Sludge Process (ASP)

305. Conventional Activated sludge (complete mix) process is employed to reduce the colloidal and dissolved BOD which remains after primary treatment. In activated sludge process, microorganisms are mixed with the wastewater in an aeration tank where microorganism stabilizes the influent organic matter and growth of microorganism also takes place. Air is supplied to the aeration tank to maintain the aerobic conditions in the tank. Part of microorganisms from the aeration tank flow with the wastewater to the settling tanks where these are separated from the treated water. Settled microorganism/activated sludge is recirculated to the aeration tank to maintain the specific concentration of suspended solids and solids retention time. Completely mix activated sludge process is a well proven technology and more commonly used for the treatment of sewage and industrial wastewaters. Schematic diagram of activated sludge process is shown in **Figure 5.2** below.

Figure 5-2: Schematic Diagram of Activated Sludge Process



306. Merits and demerits of activated sludge treatment technology are listed below.

Table 5—2: Merits and Demerits of Activated Sludge Process (ASP)

Merits	Demerits
• High degree of process control • Can absorb shock loads • Requires less area of land as compared with WSP & AL • Capable of meeting stringent effluent standards • Well proven and widely used in world for treatment of domestic and industrial wastewater • Employed in Pakistan for different applications	• Capital and operation costsare high • Uninterrupted power source is required • Requires skilled operators • Sludge treatment is required

3. Aerated Lagoons (AL)

307. Aerated Lagoons (ALs) are relatively shallow earthen basin varying in depth from 2 to 5 m and mechanical surface aerators are installed for aeration. The principle types of suspended growth lagoons, based on the solid handling inside the lagoon, include the following:

- Completely mix aerated lagoons
- Aerobic Flow through partial mixing
- Facultative partially mixed
- Aerobic with solid recycle

308. In completely mix aerated lagoons, air is required for biological process and complete mixing of the contents of lagoon. For low strength domestic wastewater, the aeration requirement for complete mixing exceeds to that of biological process. Therefore, the aeration requirement for aerated lagoons is comparable to other treatment process including activated sludge process and oxidation ditch. Merits and demerits of aerated lagoon system are discussed below.

Table 5—3: Merits and Demerits of Aerated Lagoons

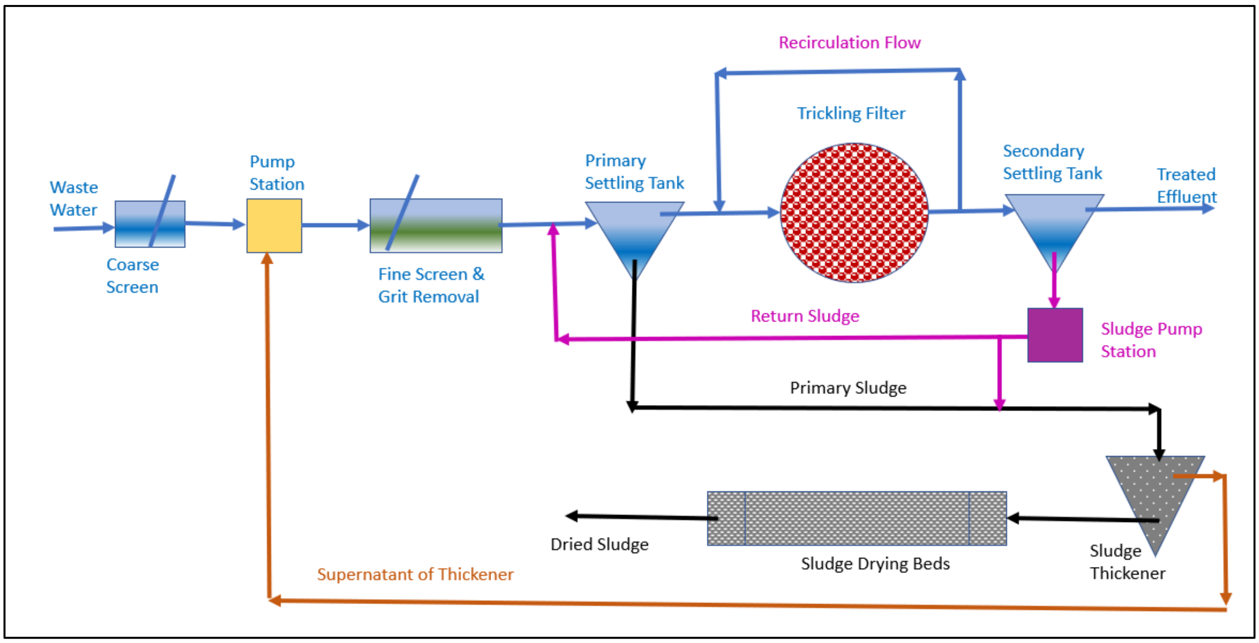
Merits	Demerits
• Capital cost is low compared with other mechanized systems • During power outage, will function as WSP with lesser efficiency • Sludge disposal is required after 1 to 2 years • Requires moderately skilled human resource compared with ASP • Less mechanical equipment is required as compared to other mechanized systems	• Operational cost is high as compared to WSP • Area requirement is more than mechanized treatment systemse.g ASP • Less effective for nutrient removal • High power requirements and uninterrupted power is required • Potential odor problems • Seepage from Pond may pollute groundwater • Issue of breeding of Vectors and mosquitoes

4. Trickling Filters (TF)

309. The trickling filter (TF) consists of a shallow bed filled with crushed stones or synthetic media and employ attached growth process for wastewater treatment. Wastewater is applied on the surface by means of a self-propelled or mechanical rotary distribution system. The organics are removed by the attached layer of microorganism (slime layer) that develops over media. The under-drain system collects the trickled liquid that also contains the biological solids detached from the media. Detached solids settle in the secondary clarifier and removed through pumping as sludge. Usually, water from the secondary clarifier is recirculated to dilute the concentrations of pollutants in the influent.

310. Trickling filter tanks are constructed on/ above ground level to provide space for air circulation beneath the tank. For dilution of incoming influent wastewater, recirculation of trickling filter effluent is required in the range of 100 - 300 %age of influent wastewater flow which also contributes in capital cost and operational costof the WWTP. Schematic diagram of trickling filter system is shown below.

Figure 5-3: Schematic Diagram of Trickling Filters



311. Merits and demerits of trickling filter system are discussed below.

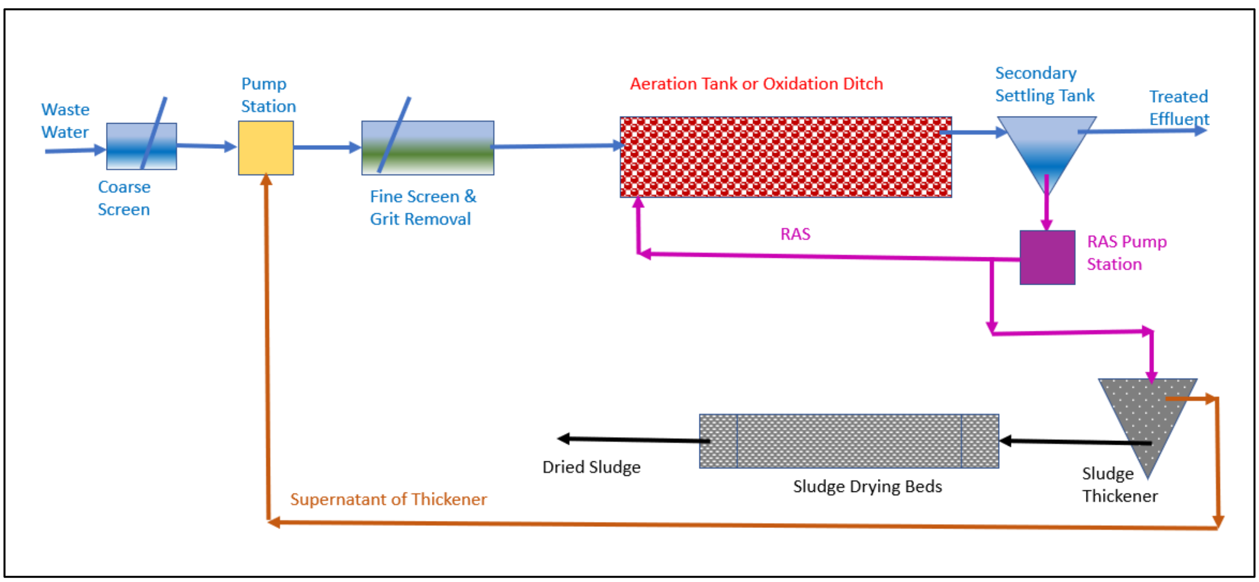
Table 5—4: Merits and Demerits of Trickling Filters

Merits	Demerits
• Less operational costcompared to ASP • Require less land than WSP & AL • Suitable for small to moderate populated communities	• Capital cost is high • Prone to flies, snails and odor problems • Higher potential of clogging • Potential of fungi growth which can clog the filter and ventilation becomes restricted. • Algae growth can clog the surface of the filter and clogging can cause odor and overflow • Clogging can lead to poor treatment efficiency • Requires skilled operators • Regular operator attention is needed • Regular maintenance is required

5. Activated Sludge Process - Extended Aeration (EA)

312. Extended aeration activated sludge process is a modified form of conventional activated sludge process and widely used for the treatment of municipal and industrial wastewaters. In extended aeration process, oxidation of organic matter and biological nitrogen and phosphorus removal take place. Biological nutrient removal involves the biomass to be sequentially exposed to anaerobic, anoxic and aerobic conditions. It needs careful operational control to fully utilize its potential capabilities. High solids and hydraulic residence times are required in aeration tanks, also, aeration requirements are higher than ASP. Primary sedimentation tank is usually not provided before extended aeration tank. Due to longer solid retention time, less sludge is produced as compared to ASP. Schematic diagram of extended aeration process is shownbelow.

Figure 5-4: Schematic Diagram of Extended Aeration Activated Sludge Process



20. Merits and demerits of extended aeration activated sludge process are presented below.

Table 5—5 : Merits and Demerits of Extended Aeration Activated Sludge Process

Merits	Demerits
• Can absorb shock loads • Requires less area as compared to WSP • Less sludge production • Can achieve nutrient removal • Widely used in treatment of sewage	• Capital cost and operational cost is high • High energy requirements for aeration • Uninterrupted power is required • Large Aeration Tanks as compared to conventional activated sludge process. • Anoxic Tank is required for denitrification • Requires skilled operators

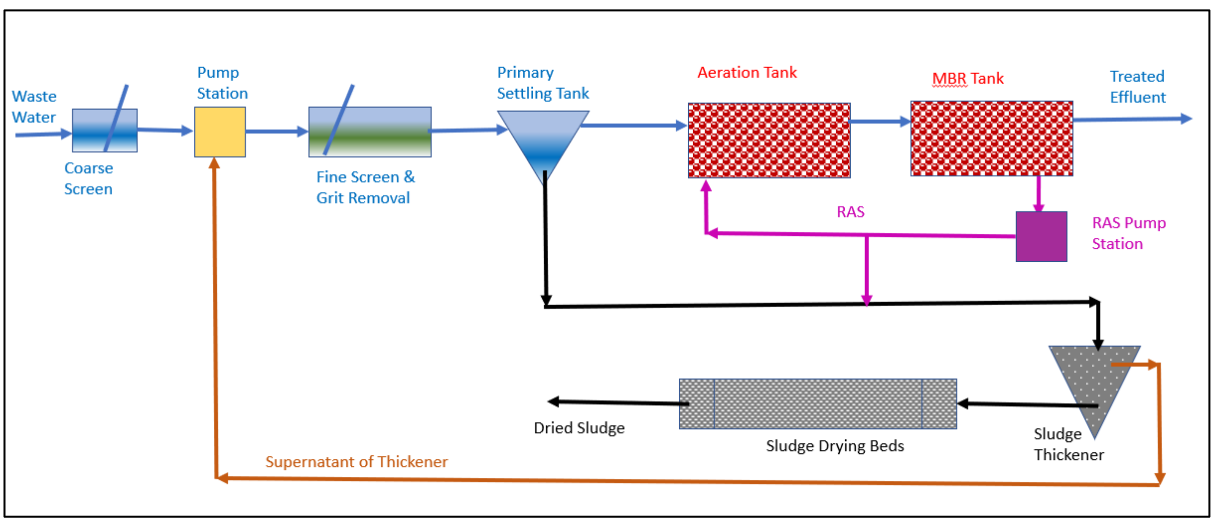
6. Membrane Bioreactor (MBR)

21. Membrane Bioreactors (MBR) are treatment processes, which integrate a semi-permeable membrane with a biological process. It is the combination of a membrane process like microfiltration or ultrafiltration with a suspended growth bioreactor. MBR technology is also used to upgrade existing wastewater treatment plants.

22. MBR processes can operate at higher mixed liquor suspended solids (MLSS) concentrations compared to conventional activated sludge process, thus reducing the reactor volume to achieve the same loading rate.

23. Two MBR configurations are; internal/submerged, where the membranes are immersed in and integral to the biological reactor; and external/side stream, where membranes are a separate unit process requiring an intermediate pumping step. Schematic diagram of MBR system is shown below.

Figure 5-5: Schematic Diagram of MBR Process



24. Merits and demerits of MBR system are presented below.

Table 5—6: Merits and Demerits of MBR Process

Merits	Demerits
• High removal efficiency • Better effluent quality • Ability to remove bacteria, and suspended solids • Less land requirement • Produces high quality effluent	• Complex Process • High power requirements • Uuninterrupted power source required • Membrane channel clogging • Membrane surface fouling • High Operation cost • Any damage to membrane can impact the process performance. • Membrane is not locally available so maintenance cost will be high • Require skilled operators • Technology not yet implemented in Pakistan, no skilled operators available.

25. A comparison summary of Secondary treatment technologies discussed above is given below.

Table 5—7: Summary of Secondary Treatment Technologies

	Type of Secondary Treatment Technology					
Parameter	**Activated Sludge Process (ASP)**	**Trickling Filters (TF)**	**Extended Aeration (EA)**	**Aerated Lagoons (AL)**	**Membrane Bio reactor (MBR)**	**Waste Stabilizati on Ponds (WSP)**
Area Requirement	Minimum	Moderate	Moderate	Moderate	Minimum	Large
Process Mechanical Equipment	Yes	Yes	Yes	Yes	Yes	No
Capital Construction Cost	High	High	High	High	High	Moderate
Operation and Maintenance Cost	High	Moderate	High	High	Very High	Minimum
Process Energy Requirement	High	Moderate	High	High	Very High	Nil

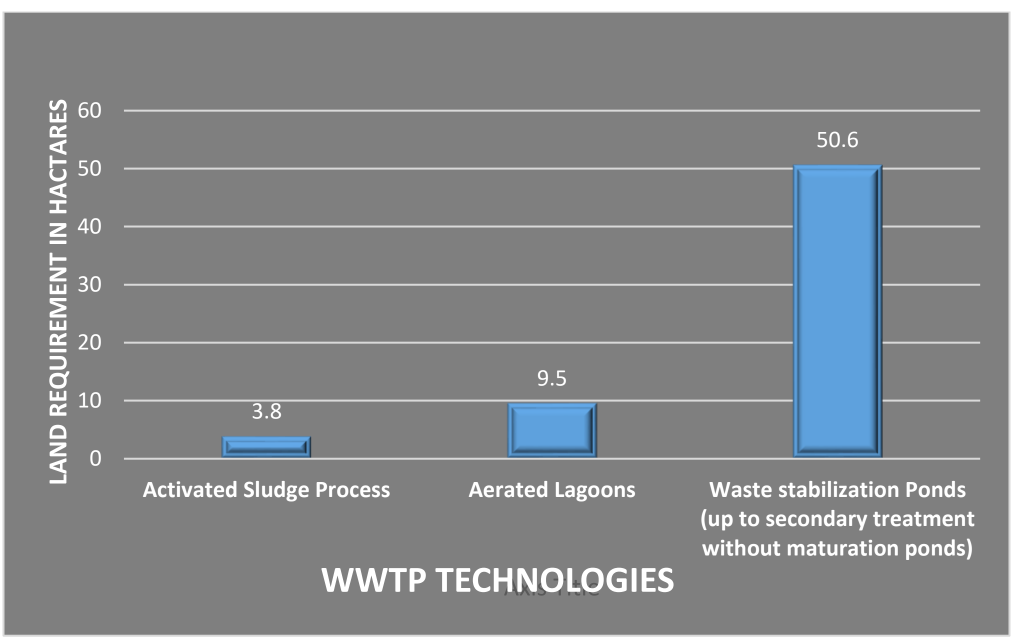
Operational Supervision & Control	High	High	High	High	High	Minimum
Quantities of Sludge Produced	High	Moderate	Moderate	High	Moderate	Minimum
Daily Waste Sludge Disposal	Yes	Yes	Yes	Yes	Yes	No
Odor Problems	Minimum	Moderate	Minimum	Moderate	Minimum	Moderate
Vector/Mosquitoes Problems	Minimum	High	Moderate	Moderate	Minimum	Moderate

5.5.10 Adopted Secondary Treatment Technology

26. Various secondary treatment technologies and their merits and demerits are discussed above. Membrane Bio Reactor (MBR) process although require low foot print, however, it has complex system, high energy requirements, high O & M cost, require skilled labour and membrane is not locally available, technology not implemented yet in Pakistan. Therefore, MBR process is not considered for the proposed STP, Mardan city.

27. Waste stabilization ponds have high land requirements and negative environmental impacts like odor, ground water contamination due to seepage, mosquito growth, proximity to the city etc. Also, the available land for treatment plot is appx. 12ha., which cannot accommodate the ponds required for the design wastewater flow. Land requirement for ASP, Ponds and ALs is given below.

Figure 5-6: Comparison of Land for AST, AL and Ponds Requirement



28. As available land is not adequate to accommodate the ponds, therefore, waste stabilization ponds are not considered for the proposed Rorya Wastewater Treatment Plant, Mardan.

29. Aerated lagoons also require large area, high energy for mixing and have higher environmental impacts therefore not considered for Rorya Wastewater Treatment Plant, Mardan.

30. Trickling filters have high cost and performance depends on the natural aeration. Trickling filters have high potential of clogging due to algal growth which could lead to limited aeration, low performance and overflow from the tank. Also, maintenance will be high if clogged. Considering drawbacks of trickling filter and local conditions, these are not considered for the Rorya STP, Mardan.

31. Extended aeration activated sludge process is a reliable technology, however it has higher energy requirements as compared to conventional activated sludge process. Also extended aeration process is used when nutrients removal is required.

32. Conventional activated sludge process is a proven technology for treatment of sewage and industrial wastewaters. It requires less land as compared to lagoons, has high reliability in performance and higher potential for absorbing shock pollution loads. . Considering National Environmental Quality Standards, local conditions and other factors discussed above, conventional activated sludge process is considered most appropriate technology for treatment of wastewater from catchment areas. In general, the activated sludge system, with Solids Retention Times (SRT) values within the conventional range of 4-10 days, can furnish BOD removal efficiencies of above 90 %, under good operational supervision and control. The process also removes suspended solids and COD.

33. Considering above, Rorya Wastewater Treatment Plant, Mardanhas been designed considering the conventional activated sludge process as secondary biological treatment.

5.5.11 Sludge Treatment Technologies

34. Sludge is produced during primary and secondary treatment of wastewater and for its treatment various sludge dewatering technologies are available; either involving physical operations or mechanical operations.

35. Some of the sludge treatment/dewatering system are as follows:

1. Sludge Thickener
2. Anaerobic Digester
3. Sludge Drying Beds
4. Mechanical Dewatering

1. Sludge Thickeners

36. These reduce the volume of sludge by thickening and reducing moisture content prior to further processing e.g. digestion and dewatering.

37. Thickening processes include gravity thickening, dissolved air flotation (DAF), gravity belt thickening and rotary drum thickening. Mechanical based technologies are expensive and

complex. Gravity sludge thickeners are most simple and easy to use and, therefore, are considered most appropriate for the local conditions. Filtrate from the sludge thickening devices is returned back to the WWTP for treatment.

2. Anaerobic Sludge Digesters

38. Anaerobic digestion is used for the stabilization of solids and bio-solids produced from WWTP. Anaerobic digestion involves decomposition of organic and inorganic matter in absence of oxygen. Major applications of anaerobic digestion involve stabilization of concentrated sludge produced from treatment of municipal and industrial wastewater. Anaerobic digestion of municipal wastewater sludge can produce bio-gas.

39. Process control of the digesters is complex and require control of parameters e.g. temperature, pH, alkalinity etc.

3. Sludge Drying Beds

40. Sludge drying beds are typically used to dewater thickened sludge. After drying, solids are removed and either disposed of in a landfill or use as soil conditioner. Conventional sand drying beds are more common. Other types of sludge drying beds include paved drying beds, artificial media drying beds, vacuum assisted drying beds and solar drying beds.

41. Conventional sludge drying beds use sand and gravel layer of certain size over which the thickened sludge is left for few days for dewatering through draining the water and evaporation. Drained water is collected in the undertrains and returned to WWTP.

42. The principal advantages of drying beds are low cost, infrequent attention required and high solids contents in dried product. The principal disadvantages are the large space required, effects of climatic changes on drying characteristics, labor intensive sludge removal, insect and potential odors.

4. Mechanical Dewatering

43. Different mechanical dewatering technologies are available which are;

- Belt filter press
- Mechanical centrifuges

44. Mechanical dewater equipment has higher dewatering efficiency and typically feed sludge with a solids content of 1-4% can converted to a final product with 12-35% solids. Disadvantage of mechanical dewatering is that the system is complex, require trained staff, high O&M cost and consume energy.

5.5.12 Adopted Sludge Treatment / Dewatering Technology

45. Various sludge treatment/dewater technologies are discussed above, however considering local conditions, O&M, complexity of process and requirement of trained staff, mechanical sludge dewatering technologies e.g. belt filter press & centrifuges are not adopted. Also, anaerobic digester which require process control and monitoring are not considered for Rorya STP, Mardan.

46. For treatment of sludge produced at Rorya STP, Mardan a combination of gravity sludge thickener and sludge drying beds is adopted. Thickened sludge from thickener will be dried on the sludge drying beds and dried sludge can be transported to nearest landfill site.

5.5.13 Summary of Adopted Wastewater Treatment Technologies for Rorya Wastewater Treatment Plant, Mardan

Primary Treatment

47. Primary treatment adopted for Rorya STP, Mardan consists of the following:

- Coarse screens
- Fine screens
- Grit removal Chamber
- Primary settling tanks

Secondary Treatment

48. Secondary treatment adopted for the plant has following components:

- Conventional Activated sludge process
- Secondary settling tanks

Sludge Treatment

49. Adopted sludge treatment/dewatering process for the plant has following components:

- Gravity Sludge Thickener
- Sludge Drying Beds

7 Potential Environmental Impacts and Mitigation Measures

50. Potential impacts arising from design, construction and operation phase of Rorya STP and associated Sewerage Networks 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 and operation phases of sewerage system and STP components such as, laying of sewerage pipes, construction of manholes, pumping stations, grit chambers, settling tanks, aeration tanks, sludge drying process, admin building and associated road network have been detailed in the section. The impact assessment of Rorya STP and Sewerage System has been carried in accordance with the requirements of KP EPA, 2014, Pak EPA-1997 and ADB SPS, 2009.

51. Impact-screening matrices during development phases i.e. project design; construction and operation are presented below.

7.1 Methodology for Impact Screening

52. The methodology for assessing the risk level associated with each potential impact is presented below.

53. 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 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

	Consequence				
		Catastrophic	Major	Moderate	Minor
Likelihood	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

54. Any ‘Medium’ to ‘Significant’ risk requires an environmental management measure to manage the potential environmental risk. Judgment will be required concerning the application of an environmental management measure to mitigate low risk situations.

7.2 Design/Pre-Construction Phase

Impact Screening Matrix

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

Table 7—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 flow computations	Unlikely	Moderate	Medium	Long Term
2	Improper design of STP and Sewerage network	Likely	Major	Medium	Long Term
3	Improper location of STP and Pumping stations	Rare	Moderate	Medium	Long Term
4	Lack of integration of IEE/EMP requirements into Construction bid documents	Likely	Moderate	Medium	Short Term
5	Material Haul routes	Likely	Moderate	Medium	Short Term
6	Contractor's Environmental Safeguards Capacity	Likely	Moderate	Medium	Short Term
7	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
8	Cultural Heritage & Religious Sites, Social Infrastructure	Unlikely	Moderate	Low	No residual Impact
9	Land acquisition and resettlement impacts	Unlikely	Moderate	Low	Long Term
10	Impacts due to natural hazards	Unlikely	Moderate	Low	No residual Impact

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

7.2.1 Improper flow computations

Impacts

56. Improper computations of design flow for sewerage system and STP may lead to choking of sewerage system, or reduce flow computation may cause deposition of solids in sewer lines. Furthermore, improper flow computations may also lead to reduced efficiency of STP. As reduced flows increase/decrease mixed liquor suspended solids/mixed liquor volatile suspended solids (MLSS/MLVSS) which likely to disrupt efficiency of STP.

57. Improper flow computations may lead to technical/operational complexities of STP and ultimately existing sewerage problems of Mardan will not be addressed adequately.

Mitigation Measures

- Flow should be calculated as per international and national practices. For residential plots, the sewage flow is considered as 85% of the water consumption of the development. The water consumption is assumed as 35 gcpd/132 lpcd, which results in a sewage flow of 30 gpcd (i.e. 85 % of water consumption). For nonresidential population 12 gpcd (WASA Lahore criteria) has been estimated.

- Infiltration calculated as 10 percent of total sewage flow.

- Peaking factors are important to reflect the diurnal and seasonal flow variations of flow components and responses of inflow and base flows during storm events. Peak flows can be determined by multiplying the average dry weather flow (DWF) by the peaking factor (PF). For the proposed sewerage system of Mardan the criteria established by WASA Lahore based on Harmon peaking factor is considered.

- The sewerage network has been designed with respect to six catchments and PF of 2 has been used based on Harmon peaking factor

- Project design should be sound enough to sustain against peak flows and necessary additional arrangements should be included in design for the same purpose.

7.2.2 Improper design of sewerage network and sewage treatment plant

Impacts

58. The possibility exists that in case sewerage network is not designed in accordance with international standards and guidelines[11] for water and sanitation it could result in multiple potential impacts that could adversely affect the settlements of project area.

59. If sewerage network has been not designed properly, it will lead to clogging of sewer pipes due to deposition of solids.

60. If velocity of flow is above non-scoring velocity it shall damage sewer pipes which may cause seepages, soil contamination or could lead to ground water contamination.

[11] https://www.ifc.org/wps/wcm/connect/83217cd8-b9a5-4383-97b5-5af26182b3b8/2007+Water+and+Sanitation.pdf?MOD=AJPERES&CVID=m3CdtQr

61. Improper design of STP may lead to noncompliance of effluent discharge standards. Further effluent will likely to pollute water body in which effluent is discharged.

62. The design criteria for STP is mainly based on the standards and specifications of WASA Lahore. Where required, international best practices were also considered in establishing the design criteria for the proposed sewerage network and sewage treatment plant. Design criteria of proposed sewerage system is summarized **Table 3.1** while design criteria and flow computations for sewage treatment plant is summarized in **Table 3.2**.

Mitigation Measures

63. The following design related measures will be implemented to ensure the project activities does not result in unanticipated, long term and potentially irreversible impacts:

- Project design should be in compliance to design criteria established against projects flow computations.
- Sewers shall be design on self-cleansing velocity i.e. 0.75 m/s to 2.5 m/s.
- Minimum velocity of 0.75 m/s shall be maintained to avoid clogging of solids.
- Before commissioning the sewerage network leakages and flow shall be tested from visual flow test.
- A SCADA system has been proposed to check compliance and monitoring of STP components.
- Minimum cover of 0.9-meter has been proposed from the top of pipe to reduce chances bursting due to traffic loads.
- Before commissioning the STP leakages shall be tested.
- PMU KPCIP will ensure that project design is in compliance to hydraulic calculations carried out for the project and such calculations are validated at the time of commissioning.
- PMU KPCIP will ensure that design of sewerage network should be sound enough to accommodate additional flows as result of precipitations in the area.
- PMU KPCIP will ensure that in house effluent quality analysis lab will be established to facilitate monitoring of treatment efficiency of STP and to assess the quality of effluent that will be discharged into nearby drain.

7.2.3 Improper location of STP and Pumping stations

Impacts

64. If location of pumping stations (if required) and STP are not carefully selected considering topography, geology and gravity flow of catchments may result in degradation of sewerage networks, reduce water inflows or increased chances of structure settlement due to weak geological conditions/weak bearing capacity of soil at STP location.

65. Proposed site of STP is located at Rorya which will receive untreated waste water from its catchments through gravity flow. STP site is feasible for gravity flows from Mardan City.

66. Minimum land acquisitions shall be conducted to avoid relocation of settlements of sensitive receptors.

Mitigation Measures

67. The following mitigation measures will be implemented:

- 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.
- The natural topography and slope of the selected location of the STP is enough to assist the natural flow of influent before and during treatment, as well the discharge of effluent into an Kalapani stream.
- STP shall be established on already acquired land by WSSC Mardan.
- STP is located ideally as no pumping station is required to lift waste water for preliminary treatment.

7.2.4 Lack of integration of IEE/EMP requirements into Construction bid documents

Impacts

68. 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

69. 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.

70. 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.

71. Project contractors shall have qualified and experienced environmental staff to plan, arrange, implement, monitor and report IEE/EMP requirements.

7.2.5 Material Haul Routes

Impacts

72. Hauling of material can have significant impacts on the community, public safety, traffic congestion, air quality and lifespan of the Mardan city road ways.

Mitigation Measures

73. The construction vehicles hauling materials along the Mardan 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.

7.2.6 Contractor’s Environmental Safeguards Capacity

Impacts

74. 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.

75. The responsibility of the PMU KPCIP in collaboration with the focal agencies is to review and finalize the bidding documents relating to environmental issues.

76. Contractors that do not possess the required capacity for safeguards management must not be pre-qualified and selected.

Mitigation Measures

77. PMU KPCIP shall review the contractor capacity with respect to safeguard management and contracts shall be awarded accordingly.

78. 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 should be developed and approved by the PMU in collaboration with the focal agencies before the Contractor commences any physical works on ground.

79. PMU KPCIP shall ensure the project contractors are selected on merit and necessary funds has been allocated in the contract documents for EMP implementation and monitoring.

7.2.7 Identification of Locations for Labor Camps and ancillary facilities

Impacts

80. The duration of the construction activity for sewerage network and STP 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

81. 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 resting area, drinking water, electricity, supply of water.

82. Solid and liquid effluent waste disposal facilities shall also be designed to cater waste of administration/office building etc.

83. 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.

7.2.8 Cultural Heritage & Religious Sites, Social Infrastructure

***Impacts*.**

84. No building/housing structure fall within proposed STP boundary as land is already in possession of WSSC Mardan. There are densely populated residential areas of varying sizes located close to the site perimeter. The sewerage networks will be laid within MDA RoW which may create nuisance and disturbance. However, the activity shall be of short term, excavation of trenches, laying of sewers, construction of manholes and covering shall be done within 40-45 days of a certain section.

85. As a result, no major significant impact will 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

86. No mitigation measures are required.

7.2.9 Land Acquisition and Resettlement Impacts

Impacts

87. The proposed project involves development of sewage treatment plant in existing Rorya STP land Mardan while 84.21 kms of sewerage system shall be laid on MDA owned RoW. Therefore, no land acquisition has been involved.

88. The Mardan STP and sewerage network is assessed as of IR/IP category C as no LAR impacts were identified on land and non-land asset. It is confirmed from the field that none of the IP is present in the area.

Mitigation Measures

89. The PMU KPCIP shall ensure the following:

- Social safeguard unit shall ensure that project affected people if any during project execution has been paid following appropriate procedures and there are no grievances about land acquisition process.

- PMU will ensure that no land acquisition or resettlement issue left before start of construction works and grievances are adequately addressed.

7.2.10 Impacts due to Natural and Climate hazards

Impacts

90. Site is located outside of seismically active area as it falls 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. Moreover, no fault lines or significantly fractured geologic structure is present that may allow unpredictable settlement/land sliding.

Mitigation Measures

- The PMU KPCIP shall ensure the proposed infrastructure shall be designed keeping in view the seismic zone 2B building considerations.
- Storm water drainage system shall be provided along the plant boundary.
- Sewerage network shall not be disrupted/impacted from urban flash flooding, potential seismic intervention and other climate hazards.
- 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.

7.3 Construction Phase

Impact Screening Matrix

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

Table 7—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	Poor construction of sewerage network and STP not in accordance with finalized design	Likely	Major	Medium	Long term
2	Impacts associated with construction of sewer lines	Likely	Major	Medium	Short Term
3	Degradation of air quality due to construction works	Likely	Moderate	Medium	Short term
4	Impacts on surface water quality	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)
5	Increased Traffic	Likely	Moderate	Medium	Short term
6	Community Health & Safety	Likely	Major	Significant	Short term
7	Occupational Health & Safety	Likely	Major	Significant	Short term
8	High noise levels from construction activities	Likely	Moderate	Medium	Short term
9	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Major	Significant	Short term
10	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium	Short term
11	Soil Contamination	Likely	Moderate	Medium	Short term
12	Employment Conflicts	Likely	Moderate	Medium	Short term
13	Communicable diseases incl. COVID-19	Likely	Moderate	Medium	Short term
14	Vegetation and Wildlife Loss	Unlikely	Moderate	Low	No residual Impact
15	Historical/Archaeological Sites	Unlikely	Moderate	Low	No residual Impact
16	Influx of Labor	Likely	Moderate	Medium	Short term
17	Gender Issues including GBV	Unlikely	Moderate	Low	No residual Impact
18	Child Labor	Unlikely	Moderate	Low	No residual Impact
19	Restricted Access	Unlikely	Moderate	Low	No residual Impact
20	Construction of Process and Non Process building Infrastructure	Likely	Moderate	Medium	Short term
21	Site Restoration	Likely	Major	Significant	Short term

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

7.3.1 Construction of Sewage treatment plant and other structures not in accordance with finalized design

Impacts

92. If the proposed STP and sewerage network is not constructed in accordance with the finalized design and its corresponding design parameters, it could lead to a number of unanticipated impacts such as in noncompliance of effluent parameters from NEQS, hindrance in bacterial growth in ASP, clogging of sewerage networks and leakages/malfunctioning of pumping stations due to clogging of solids in pumping screens.

Mitigation measures

93. 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 sewerage network and STP 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 STP.
- PMU KPCIP 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.

7.3.2 Impacts associated with Construction of Sewer Lines

Impacts

94. Construction activity of Sewer lines will be conducted along the roads in the town and mostly on the roads which are comparatively wide and less traffic. The work will be conducted by a team of 5 workers at each site. Excavation for sewer lines will be carried out in in Silty Clay with sand and gravel material. Excavation may result in soil dumps and may create congestion in the area

95. Trench will be excavated using excavator and where it is not feasible will be done manually. Excavator work may be source of noise and emissions. Excavated soil will be placed along the trench which may spread if not properly contained. A bed of sand of 100 mm thick will be prepared at the bottom and pipes will be placed and joined. Left over of sand bedding may be source of poor housekeeping if left unattended Excavated soil will

be replaced and compacted. Where the pipes are laid in the roadway, handheld pneumatic drill will be used to break the road surface. In such cases traffic disruption is anticipated or road closure may be required.

96. The pipeline/sewers are to be laid along the roads. The excavated soil, placed along the trench may get disturbed due to wind, rain water and the movement of workers, vehicles and pedestrians, and spill onto road way – disturbing road users, creating dust, road safety issues, etc., and also into nearby open drains.

97. Details of excavated soil from scarification of existing road pavement structures, excavation in silty clay with sand and gravel material for Mardan sewerage network are provided below.

Table 7—3: Details of Excavated Material for Construction of Sewer Lines

Description	Quantity (cubic meters)	Mode of Disposal
Scarification Of Existing Road Pavement Structure	14156.68	Disposal of the unsuitable material of Road pavement Structure at designated source
Excavation for the Sewer pipes and Manholes in Silty Clay with sand and gravel material	Upto 2m depth: 78460 Upto 5m depth: 65651 Upto above 5m depth: 41603 Extra slush/dadal 74428	Usable material will be used as backfill. Almost 92858 (CM) shall be backfilled Unsuitable material will disposed of at designated place
Additional Material required for backfilling	54,675	

Source: EDCM Design Report, 2020

98. Construction of the pipelines involves quite simple techniques of civil works, the invasive nature of excavation will result to impacts to the sensitive receptors of sub project locations such as residents, business and community in general.

99. These anticipated impacts are temporary and for short duration. Physical impacts will be reduced by the method of working and scheduling of work, whereby the project components will be (i) constructed by small teams working at a time; (ii) any excavation done near sensitive area like school, religious places and house will be protected as per standard construction practices.

Mitigation measures

100. Mitigation measures adopted for construction of sewer lines are provided below:

- Prior to starting of work, the contractor shall prepare a method statement for pipeline and sewer 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 pipeline/sewer works along the roads.
- 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 pipe laying, from excavation to road resurfacing/testing)
    - 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 (for example, Trench excavation will have risks such as trench collapse, persons/vehicles falling into trench, structural risk to nearby buildings, damage to buildings, infrastructure etc.)
    - 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 pipe trenching, 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 trench at each site 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 CSC/WSSC Mardan/MDA.

- 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 discouraging.

- Record of borrow materials will be maintained including details of quarry site, agreement and necessary approvals from concerned government authorities.

7.3.3 Degradation of Ambient Air Quality

Impacts

101. The proposed construction of STP will not involve large scale earth works and transporting and dumping large quantities of dry material. However, laying of sewer networks will involve excavation upto 2-5 meters in depth and approximate 1.0 to 1.5 meter in width for trenching. This will likely lead to an increase in SPM (Suspended Particulate Matter) in and around the construction zones.

102. 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.

103. Vehicles carrying construction material are expected to result in increased 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.

104. 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.

105. 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.

106. 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_{10} emissions from every activity on the construction site separately. Typical and worst-case PM_{10} emissions from construction sites have been estimated[12] as 0.27 mega gram per hectare per month of activity (Mg/ha-month) and 1.04 Mg/ha-month, respectively.

Mitigation Measures

107. The following mitigation measures will be adopted for preservation of the environment:

- At the STP 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.
- 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.

[12] Gaffney, G. and Shimp, D. 1997. *Improving PM_{10} Fugitive Dust Emission Inventories*. Sacramento, CA. California Air Resource Board. <www.arb.ca.gov/emisinv/pubs/pm10tmp.pdf>

- Dust emissions due to road travel shall be minimized through good construction practices (such as keeping stock piles down wind and away from communities), covering loose material 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

108. The source wise fugitive control measures are provided in **Table 6.3** below. The Dust Management Plan has been attached as **Annexure H**.

Table 7—4: Control measures for Fugitive Dust emissions

Source	Control Measures
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

Source	Control Measures
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 km/h.
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 emissions.
Track-out Control	Wash down of construction vehicles (particularly tires) prior to departure from site.

Vehicular & Equipment Emissions

109. 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 wastes at any site will not be allowed.
- The stack height of generators will be at least 3 meters above the ground.
- Training of the technicians and operators of the construction machinery and drivers of the vehicles.
- Idling time will be 3 to 5 minutes.
- Fuel-efficient and well-maintained vehicles shall be employed to minimize exhaust emissions.
- All type of machinery and generator must comply with the NEQS. Vehicles, which are not in compliance with NEQS are not allowed to use.
- Periodic emission monitoring of vehicles, generator and batching plants is proposed.
- Project activities shall be planned to avoid harsh weather conditions.

7.3.4 Impacts on surface water quality

Impacts

110. Poor solid waste management at sewer construction site near surface water body and waste dumping into streams by contractor staff may result in surface water quality degradation. The drainage of streams shall not be impeded by the works.

111. Soil erosion triggered by exposed soils on slopes is very unlikely to occur; therefore, no significant impact on surface water quality due to soil erosion is expected.

112. If labor camps are situated close to waterways, sanitary waste may cause surface water pollution. But the scattered nature of construction and short time may not require large scale labor camps. Construction of Sewerage network will be conducted along the roads therefore no impact on surface water quality is envisaged. Construction works during rainy season particular during monsoon shall be avoided. Construction work during rainy season can trigger slip, fall hazards, solid waste management problems, poo quality construction works and interruptions in material supply.

Mitigation Measures

- CSC will expedite the construction works at sewerage network sites near surface water body as much as possible to complete the taks with minimum time duration.
- Constrcution debris shall not be disposed off in water bodies.
- No stockpiling of materials will be carried out at bank of water bodies.
- No labor camp will be constructed at bank of water bodies. No solid waste will be diposed off in the streams.
- CSC will maintain good housekeeping during construction works at bank of water bodies
- After construction of sewerage network all constrction material left shall be picked up and site shall be restored to its original condition following best practices.

7.3.5 Increased Traffic

Impacts

113. The laying of sewerage network will involve the use of considerable machinery within Mardan City along with posing the risk of community members falling into trenches excavated for sewerage network and manholes. 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. Moreover, traffic congestion is also envisaged due to construction activity within city and also along canal road, Hoti road, Mayar Road and Toru Road etc.

114. Traffic congestion and mobility issues are also envisaged from STP construction activity as existing Canal road shall be used for mobilization of material and equipment to the STP location.

115. Hazards posed to the public, specifically in high pedestrian areas may include traffic accidents and vehicle collision with pedestrians. In most of the cases location of project sites are along the road ways, hence safety risk to community is to be considered. The sewer line work may require deep trenches including in narrow streets; unprotected trench excavation may endanger the stability of nearby buildings/structures.

116. Increased traffic in Mardan will be a source of public nuisance therefore project contractors will designate routes in consultation with WSSC Mardan and these routes will be only used for construction activities.

117. There is need of sound construction management plan coupled with traffic management within Mardan to manage traffic impacts. Traffic Management Plan has been attached as **Annexure J.**

Mitigation Measures

118. The following mitigation measures will be implemented:

- 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 used during laying of pipeline 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 streets and roads of project area UCs during laying of sewerage system must be restricted to specific routes containing least number of sensitive receptors and low traffic volumes.
- 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 laying of pipelines will 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.
- Temporary walkways shall be constructed on trenches for providing passage commuters.
- 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.
- Provide wooden bracing for all deep excavations that may require especially for sewer lines (> 2m); identify buildings at risk prior to start of excavation work and take necessary precautions for safe conduct of work
- Plan material and waste routes to avoid times of peak-pedestrian activities.
- PMU KPCIP will Liaise with WSSC Mardan/ Traffic department in identifying risk areas on route cards/maps.
- Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.
- Provide road signs and flag persons to warn of dangerous conditions for all the work sites along the roads.
- PMU KPCIP shall ensure the contractor staff working in the project area 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.

7.3.6 Community Health and Safety

Impacts

313. The main construction work of Mardan STP is characterized with limited public activities, movements, and settlements as project area has defined boundary wall therefore no impact of community health and safety is expected from construction of STP. Community health and safety may be compromised during road travel particularly in night hours if adequate barriers and lighting is not provided at construction sites. Another source of public nuisance may be setting up of machinery along the RoW of raods where width is very low. There is need to pay special attention to the safety of people in the short and long run of the project activities, as the potential harm on the life and well-being of the residents cannot be ignored.

Mitigation Measures

- Prior to starting of work, the contractor shall prepare a method statement for pipeline and sewer works. This shall be simple and explain the contractor's work process that is actually conducted on site, with safety and safeguard concerns.
- 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.

- CSC/PMU KPCIP shall ensure the contractor staff working in the components of 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.

- 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. Best industry practices related to Occupational Health and Safety standard (OHS) shall be adopted during the execution of the project.

- Contractor will ensure setting up of its machinery on the road for construction works in such way that it will not hinder the public traffic and will not compromise the public safety.

7.3.7 Occupational Health and Safety (OHS)

Impacts

119. There is invariably an OHS risk when construction works for the Sewerage network and STP are conducted, and precautions will be needed to ensure the safety of the workers. Occupational Health and Safety Plan has been attached as **Annexure E.**

120. The major OHS hazards expected during the proposed activities are as follows:[13]

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;

[13] https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_192256.pdf

- 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;

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

121. The Contractor will be required to prepare and implement an effective OHS Management 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.

122. 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 of CSC for approval an emergency evacuation plan and practice the procedure annually.
- The Contractor shall submit to the Engineer of CSC 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 of CSC 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.

123. 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:[14]

124. Emergency Response Plan has been attached as **Annexure F**.

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

Mitigation Measures for Physical Hazards

Rotating and Moving Equipment

125. 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.

- 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

126. 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.

127. 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.

128. Considering the project setting and type of construction activity, there is no potential risks with regards to vibration.

Electrical

129. 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 close 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

130. 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 Standard 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

131. 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 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. ·
- 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 that have contained flammable materials.

Industrial Vehicle Driving and Site Traffic

132. 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

133. 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

134. 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

135. 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

136. 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

137. 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.

7.3.8 High Noise Levels

Impacts

138. The proposed construction of Sewerage network and STP will result in different construction equipment and machinery i.e jack hammer, cutter etc being used which will generate high noise levels at the project site and in the project area.

139. 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.

140. 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

141. 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 proposed construction of Sewerage network and STP works include equipment, machinery, and transportation used for the construction activities. The equipment used for construction will be the major source of noise.

142. 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.

143. 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.

144. 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.

145. The **Table 6.4** below represents typical noise levels from various construction equipment items. It shall 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 7—5: Construction Equipment Noise Ranges, dB (A)

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

146. 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.

147. Nearest sensitive receptors with respect to noise are the settlements of UC Bari cham, Bicket Gunj, Muslimabad, Hoti, Guli bagh and Rorya as these settlements may observe increased noise levels during laying of sewerage network. Maximum noise shall be generated while using mechanical/potable Jack hammer for cutting hard surfaces but this activity is limited as proposed only for cutting hard surfaces. i.e concreate, however, excavators shall also be utilized for trenching, while in streets and congested areas, manual excavation has been proposed which do not produce high noise levels. No sensitive receptors are present close to the proposed location of STP therefore, no impact from noise has been envisaged.

148. The mitigation measures listed below shall be implemented to minimize noise levels during the construction activity as far as possible.

Mitigation Measures

149. 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.
- Manual excavation has been proposed for congested areas to reduce generation of noise.
- Limited use of jack hammer in populated areas.
- 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 shall be investigated and implemented, where feasible.

- Periodic medical hearing checks shall be performed on workers exposed to high noise levels.
- Grievance redress mechanism to deal any public complaints related to noise is established.
- All the equipment and machinery used during construction phase shall be well maintained and in compliance with NEQS.

7.3.9 Hazardous and Non-Hazardous Waste Management

Impacts

150. During construction/civil works potential sources of waste will include spoils generated during excavation of trenches, excavation waste for other civil works including STP infrastructure, domestic wastes (solid & wastewater), fuel or oil leakages or spills, onsite effluents from vehicle wash & cleaning, and cement spills.

151. 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.

152. The construction work is likely to generate considerable quantities of waste soil. The sewer laying work will generate surplus soil; as small diameter pipes/sewers are proposed it will generate only 15-20% as surplus as most of the soil will be used for refilling after the pipe is laid in trench. The surplus soil needs to be disposed safely. Indiscriminate disposal of the soil and waste may affect the local environment at the disposal location. These impacts are negative but short-term and reversible by mitigation measures.

153. Domestic wastes generated during construction of sewerage network and sewage treatment plant will include sewage, grey water (from kitchen, laundry, and showers), kitchen wastes, combustible wastes and recyclable wastes from contractor camps.

Mitigation measures

154. 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.

155. Licensed waste contractors will be engaged to dispose off all non-hazardous waste material that cannot be recycled or reused.

- Excavated material from trenches will be stored at site and it will be used as fill material after laying of sewers while access spoil shall be transported to spoil disposal site if required. Almost half of the spoil shall be used for backfilling while remaining shall be disposed of at designated site.

- PMU KPCIP will ensure the identification of disposal sites for unsuitable excavated material in consultation with CSC/WSSC Mardan/MDA.
- Excavated material generated during construction of STP components i.e. sedimentation tanks, aeration tank, etc will be used as a fill material with in STP location and access spoil shall be transported to spoil disposal site if required.
- 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 shall 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 refueling 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 Framework waste management plan has been prepared for the project and attached as **Annexure N** 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.

7.3.10 Camp & Batching Plant Effluent

Impacts

156. The staff and labor camps for the construction of the proposed Sewerage network and STP 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.

157. 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.

7.3.11 Soil Contamination

Impacts

158. 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.

159. 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.

7.3.12 Employment Conflicts

Impacts

160. The proposed construction of Sewerage network and STP 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 during construction. 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.

161. 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 local 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 KPCIP 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.

7.3.13 Communicable diseases incl. COVID-19

Impacts

162. Communicable diseases such as COVID-19 and HIV may be introduced due to the immigration of workers associated with the project.

163. 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

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

COVID-19 specific measures WHO

- 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)[15].
- 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 **Annexure L** and **Annexure M.**
- 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).
- Contact details of all workers will be kept in a register on site in order to efficiently trace

[15] 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).

165. WHO advice on Use of Masks for the COVID-19 Virus has been attached as **Annexure M**.

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.
- Adequate ventilation shall be provided in dining areas, resting places and sleeping areas.
- 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 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 a well ventilated area

- 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 to 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 a well ventilated area

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.

7.3.14 Vegetation and Wildlife Loss

Impacts

166. The STP site located on existing acquired land for STP located near densely populated residential areas of varying sizes. The land is under possession of WSSC Mardan. No agricultural or protected areas are located near STP location. The sewerage network will use RoW of TMA Mardan and mostly along existing roads and streets therefore, no vegetation and wildlife loss is envisaged.

167. No impact on vegetation and wildlife is expected due to limited vegetation cover within project site. Some minor shrubs and bushes that will be cleared up, if felt necessary, during the site preparation for STP.

Mitigation measures

- Consideration has been given to the visual appearance of the STP site during operation. Necessary plantation will be carried out, which will act as buffer zone from surrounding environment and will enhance the aesthetics of the area. Reasonable area has been allocated for plantation to improve landscape of the area.

- Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project. and

- Vehicles 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.

7.3.15 Historical/Archaeological Sites

Impacts

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

Mitigation measures

169. 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**.

170. Any works near graveyards will be carried out with due respect and precautions ensuring that no damage is caused to any graves, no effluents are released in the graveyards and no debris or litter is disposed inside such areas.

7.3.16 Influx of Labor

Impacts

171. During construction phase, influx of workers at site may pose a significant threat of communicable diseases, most common are HIV/AIDs (Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (AIDS), COVID- 19, tuberculosis, pulmonary infections, typhoid, cholera and dysentery, malaria, rabies and other skin disease, hepatitis A, B and C.

172. The influx of laborers, seeking construction jobs can be associated with a series of social challenges such as crime, illegal drug abuse and prostitution. Villainy such as drug abuse and prostitution will affect social harmony and security in the project area and ruining the image and intent of an otherwise a good project.

173. Construction workers and greater number of drivers, who are expected to pass through the communities, can also cause social disturbance in communities near the project site by spreading Human Immunodeficiency Virus (HIV) / Acquired Immune Deficiency Syndrome (AIDS) and Sexually Transmitted Infections (STIs) among people.

174. Many of the skilled labor employed from outside the project area may cause some antipathy among the local people and outsiders. This influx of labor may lead to growth of unplanned settlements as the workers will compete for limited resources. This impact will cause strain on local resources especially accommodation and social utilities such as medical facilities and schools located near the project area.

Mitigation Measures

- Limit the siting of any temporary facilities within the boundaries of the worksites;
- Use of non-wood fuel for cooking and heating;
- Code of conduct (CoC) for workers and employees will be enforced for the protection of local communities, gender based violence, other social issues, flora and fauna and a ban on tree cutting and hunting. Any violation of the COC will lead to strict punishment including termination of employment;
- Awareness among workers will be created on proper sanitation and hygiene practices to endorse proper health;
- Good housekeeping practices will be maintained at project site(s);

- Adequate personal hygiene facilities will be provided in good condition with adequate supply of clean water;
- Arrangements will be made to treat the affected workers on time to control the movement of vectors diseases;
- Workers and surrounding communities will be sensitized on awareness and prevention of HIV/AIDS and STI through training, awareness campaigns and workshops;
- Free HIV/AIDS and STI screening and provided for site workers
- counselling sessions will be held to made the workers award of the risks of HIV/AIDs and STI;
- Any employees will be terminated, who continues misconduct or lack of care, carry out duties amateurishly or inattentively, fail to conform to provisions of the contract, or persist in any conduct which is harmful to safety, health, or the protection of the environment;
- The use of drugs and alcohol will not be allowed at the work/construction site;
- Carrying weapons into the workplace premises will be prohibited;
- Site security arrangements will be listed as an item in the Bill of Quantities (BoQs) to avoid any delays; which may cause due to security issues;
- The contractor will create awareness of construction crew to sensitize them about security situation in the project area, in coordination with private/public security agencies;
- Appropriate fencing, security check points, gates and security guards will be provided at the construction sites to ensure the security of equipment, machinery and materials, as well as to secure the safety of site staff;
- The Contractor will ensure that good relations are maintained with local communities and their leaders to help reduce the risk of vandalism and theft;
- To avoid conflicts with local people on employment matters, it is recommended to the contractor to employ the locals in skilled, semi-skilled, and unskilled work. This will reduce pressure on resources such as residential and health facilities;
- The contractor will proactively manage the potential impacts from labor influx and potential cultural conflicts between local communities and workers, which include following:
- Construction camps will be built in the designated areas, located minimum 500m away from the village settlements;
- The Contractor’s monthly training program will cover topics related to respectful attitude while interacting with the local communities;

- Inclusion of COC obligations and the applicable legislation in the contracts of all employees and workers with the provision of sanctions and penalties in case of violations;
- World Bank Guidelines on [16]Influx of labor will be used for further guidance.

7.3.17 Gender Issues including Gender-Based Violence (GBV)

Impacts

175. Acts of violence committed against women including, *inter alia*, sexual violence, sexual harassment and other discriminatory practices based on gender, all fall within the ambit of GBV. In the project, gender inequality might arise during construction through discrimination made against women by unequal hiring, unequal work distribution and unequal pay structure among others. Sexual harassment against women might occur as a consequence of mixing of men and women at the construction site.

Mitigation Measures

176. The contractor will manage the potential risks of gender-based violence, 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 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;

[16] http://pubdocs.worldbank.org/en/863471511809509053/ESS2-FactSheet-WB-ESF.pdf

- World Bank Good Practice Note on Addressing GBV will be used as guidance. [17]

7.3.18 Child Labor

177. The child labor is common in the low-income groups. The parents of underage children prefer to get their children hired in small shops as helpers and waiters in hotels for earning money and supporting household livelihoods[18]. However, the local legislation prohibits the employment of children and restrict the employment of adolescents in certain occupations and processes such as construction industry. Moreover, in the project, no child having age below 18 will be allowed to be employed in any construction work by the – construction contractors, sub-contractors and service providers.

Mitigation Measures

- It will be ensured that contractor is having its employment policy in accordance with relevant acts and labor policies in Pakistan;
- Contractor will ensure that all persons at site are adults and have their government issued identity card with them.

7.3.19 Restricted Access

Impacts

178. The construction activities particular relating to the sewerage network rehabilitation may block local routes and access to houses and other buildings.

Mitigation Measures

- Do not block access of local communities to local roads, cultural and religious sites. In case of blockage, provide alternative safe access routes.
- Communicate with the local communities and potentially affected public through consultation meetings and placement of posters in local language regarding the scope and schedule of construction activities that will cause disruptions or restrictions to access.

7.3.20 Impact Due to Construction of Process and Non-Process Buildings and other infrastructure

Impacts

179. Mardan STP will have both process and non-process buildings including Blower building, Electrical substation building, Generator building, SCADA Control Room (located inside Administration building), Administration building, Workshop Guard room and staff residential building.

[17] http://documents.worldbank.org/curated/en/399881538336159607/Environment-and-Social-Framework-ESF-Good-Practice-Note-on-Gender-based-Violence-English.pdf

[18] Zafar *et al.* (2014), Socioeconomic Conditions of Child Labor in Lahore District, Pakistan Geographical Review, Vol. 69(1), 7-14

180. Internal Roads will be constructed to provide access to all buildings and facilities having mechanical equipment e.g. lift station, screens & skips, grit collection chamber, blower building, settling tanks, sludge thickener and aeration tank and to facilitate sludge removal. Other facilities include car parking, plant potable water, sewerage system, storm water drainage system and other piping networks.

181. Soil erosion is main impact during construction of building infrastructure and associated road network. 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.

182. The possibility of soil erosion from a 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 will the gravel-topped roads which will be compacted to sustain loads.

183. Other environmental impacts from construction of 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 activiites. 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.

184. On the basis of the above it can be assessed that on a macro level environmental impacts from construction of building and associated infrastructure including roads 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

185. Following are the mitigations 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.

7.3.21 Site Restoration

186. The contractor will have a full and rigorous program for closing up and removing temporary facilities as well as for cleaning up and/or restoring the sites occupied on temporary basis. The facilities to be used in the construction stage that will be either removed or dismantled are the camps and setting up other facilities such as batching plant, machinery pool and workshops Following are the main activities envisaged for removing all part of the facilities and restoring the intervened areas:

- Dismantling and full removal of worksite facilities and camps, including contractor offices, staff and workers' accommodation, machinery yard, warehouses, store rooms, maintenance shops, drinking water utilities, vehicle parking areas, batching plant, temporary materials stockpiling enclosures, and so on.
- Removal of drinking water facilities, including pipes and storage tanks, as well as sanitary facilities, i.e. modular sewage treatment plant chambers from camp plus the sewage network and toilets.
- Removal of electric facilities, including electrical posts and wiring installed by the project in some sectors; this job will be done by specialized personnel.
- Generating equipment set up in camp and work areas will also be removed.
- Removal of all solid construction waste piled up in temporary enclosures, as well as other wastes that may be scattered in camp, working faces or adjacent sectors.
- Removal of fencing, anchoring and other minor facilities, concrete left over from mixing, settling ponds, after all the movable elements have been removed.
- Cleaning the ground in the event of spillage of any liquids or other substances foreign to the ground which have been used for carrying out the works.

- Ground cleaning will be done by removing all the affected topsoil and transporting it to an authorized site for treatment and final disposal.
- De-compaction of any sectors that have been compacted (e.g. constructions, inner roads), once the area is clear of all kinds of facilities, elements or substances foreign to the environment. Addition of topsoil if required for this purpose.
- To the extent possible, restitution vegetation for purposes of erosion control, visual mitigation, and restitution of fauna habitats.

7.4 *Operation* Phase

187. The potential impacts from operation of the Sewerage network and STP are provided as **Table 6.5** below.

Table 7—6: 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	Possible Emergencies and Plant failure	Rare	Moderate	Medium	Short term
2	Leaks and Overflows	Likely	Major	Medium	Short Term
3	Odor Generation	Unlikely	Moderate	Medium	Long term
4	Generation of Sludge and disposal	Likely	Major	Medium	Long term
5	Disease Vector Generation & Transmission	Likely	Major	Medium	Long term
6	Occupational Health and Safety	Likely	Major	Medium	Long term
7	Generation of solid waste	Likely	Major	Medium	Long Term
8	Discharge of treated effluent	Likely	Major	Medium	Long Term
9	Improvements in Public Health	Positive impacts expected			Long term positive residual impact
10	Lower Loads on Aquatic Environment	Positive impacts expected			Long term positive residual impact

Critical Risk Level
Significant Risk Level

Medium Risk Level
Low Risk Level
Positive Impacts

7.4.1 Possible Emergencies and plant failure

Impacts

188. Operational difficulties may be experienced at plant start up or during periods when process equipment malfunctions, particularly the equipment providing air in aeration tanks. Even under such scenarios, the effluent discharged will be of limited volume and will still be of better quality and an improvement over the existing condition where raw and untreated wastewater is being directly discharged into the different water bodies.

189. The frequency of such incidents is likely to remain low as long as adequate training of operator personnel is maintained, provision of power supply backup and supplies of spare parts are kept available and utilized as recommended to keep all units operational at close to design efficiency levels.

Mitigation measures

- Generator shall be used as a backup power supply source in case power from electicity utility is not available.
- Two separate sets of blowers will be installed in the blower building. Each set of blowers will consist of 3 blowers (2 duty + 1 standby) and will feed one aeration tank. In case of breakdown/malfunctioning of blower, standby blower will be used.
- Operator Personnel training on a pre-defined frequency, at least once every quarter, shall be ensured to continue refreshing of the Standard Operating Procedures laid out in case of possible emergencies and/or plant failure.
- Preventive maintenance must be ensured on a pre-defined frequency with required spare parts available at the STP premises to ensure quick replacement of the faulty component(s) in order to resolve the technical issue and bring the plant back into operation at the earliest.
- Emergency response procedures shall be prepared. The O&M staff shall be trained on these procedures.

7.4.2 Leaks and Overflows from Sewerage Network

Impacts

190. Leaks and overflows from the sewerage system can cause contamination of soil, groundwater, and surface water. Depending on the elevation of groundwater, leaks in gravity mains may also allow groundwater into the sewer system, increasing the volume of wastewater requiring treatment and potentially causing flooding and treatment bypass. Overflows occur when the collection system cannot manage the volume of wastewater, for example due to high flows during rain events or as the result of power loss, equipment malfunctions, or blockages. The excess flows may contain raw sewage and polluted runoff.

Mitigation measures

- Consider the installation of separate sewer systems for domestic wastewater and storm water runoff in the overall planning and design of new sewerage systems;

- Limit the sewer depth where possible (e.g., by avoiding routes under streets with heavy traffic). For shallower sewers, small inspection chambers can be used in lieu of manholes;

- Use appropriate locally available materials for sewer construction. Spun concrete pipes can be appropriate in some circumstances but can suffer corrosion from hydrogen sulfide if there are blockages and/or insufficient slope;

- Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation;

- Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replace if broken to minimize entry of garbage and silt into the system;

- Equip pumping stations with a backup power supply, such as a diesel generator, to ensure uninterrupted operation during power outages, and conduct regular maintenance to minimize service interruptions. Consider redundant pump capacity in critical areas;

- Establish routine maintenance program, including:

  - Development of an inventory of system components, with information including age, construction materials, drainage areas served, elevations, etc.

  - Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning shall be conducted more frequently for problem areas. Cleaning activities may require removal of tree roots and other identified obstructions

  - Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or exfiltration

  - Monitoring of sewer flow to identify potential inflows and outflows

- Conduct repairs prioritized based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g., pump station failures, sewer line ruptures, or sewer line blockages);

- Review previous sewer maintenance records to help identify “hot spots” or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed;

- When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.). Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system.

7.4.3 Generation of Odor

Impacts

191. Odor is expected from the operation of STP as sewage characteristically anaerobic in nature and due to prevailing anaerobic conditions in PST, SST and sludge drying beds odor may be produced. The proposed treatment (ASP) is aerobic in nature and it will not produce odor as compared to other treatment technologies such as Trickling filters, Aerated ponds, Aerated lagoons etc.

192. Probable down wind direction in Mardan is SSW and South. A map showing the corridor of impact odor generation has been shown in Figure 6-1. Closest community in SSW and South direction is Sheikh Maltoon town which is around 2km from proposed location of STP. However, closet cumunity is Muhalla Landaki which is situated in eastern side of STP at 250 meters.

Mitigation measures

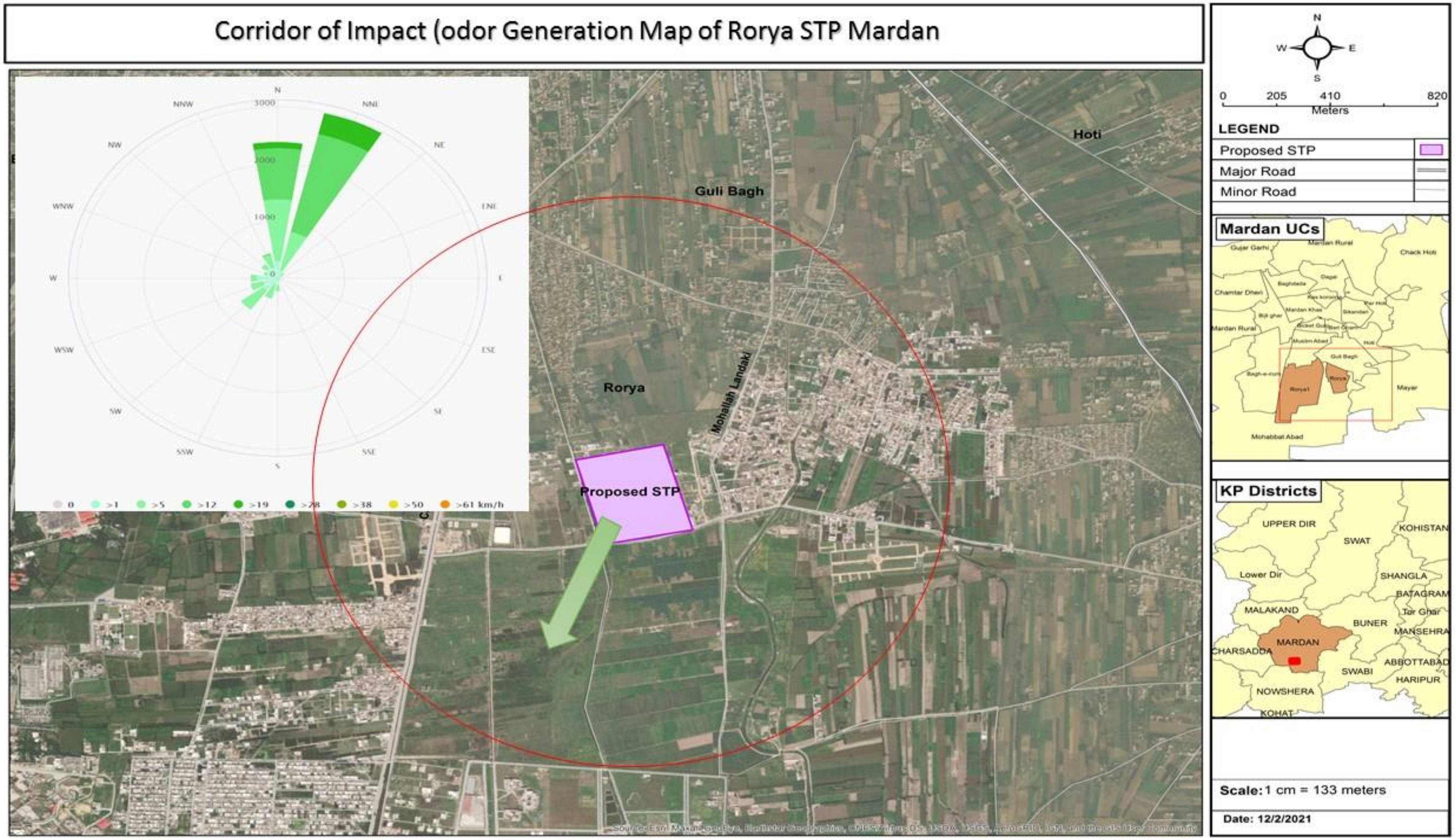
- A wall shall be built around STP which also serve as barrier however, in order to address any potential odor issue, a buffer zone of 50 feet wide all around the STP site consisting of thick plantation will be ensured as a precaution

- WSSC Mardan will ensure continuous flow of waste water and smooth operation of STP to avoid objectionable odour.

- WSSC Mardan will ensure that all the machinery is in working condition and necessary backup material/machinery is available to avoid any hault in the sewage treatment process to avoid odor issues

- Where necessary, consider updated aeration technologies or process configurations to reduce volatilization during the operation phase of the project

Figure 7-1: Corridor of Impact Odor Generation Map of Mardan STP



7.4.4 Generation of Sludge and Disposal

Impacts

193. If generated sludge from settlings tanks is not handled carefully it will lead to clogging to drains and force mains connecting pumps to tanks. Moreover, if sludge is not disposed or processed it will lead to soil contamination and create obnoxious odors, disease vector etc around STP.

194. During the operation phase of proposed STP sludge will be generated from two sources. Primary settling tanks (PST) and secondary settling tanks (SST). Settled solids from the bottom of the PST will be removed periodically and will be conveyed to the sludge thickener for further processing. While settled sludge from the (SST) will be recirculated to the Aeration tank through sludge recirculation pump stations and waste sludge will be transferred to the gravity sludge thickener for further processing. The residual disposal is carried out through:

195. Sludge treatment/dewatering process for the proposed STP has following components:

- Gravity Sludge Thickener
- Sludge Drying Beds

- Sludge Thickener will receive the waste sludge from primary and secondary settling tanks. Sludge will be settled in the bottom of the thickener and supernatant will over flow through weirs. Supernatant will be conveyed to the pump station through gravity pipeline. Thickened sludge from the thickener will be discharged to the sludge drying beds by gravity for further dewater/drying.
- Sludge drying beds shall be used to dewater/dry the sludge through evaporation by sunlight and filtration at the bottom. Sludge drying beds will receive the thickened sludge from gravity sludge thickener. Thickened sludge will be distributed on the sludge drying beds with a charge depth not exceeding 0.3 m. Gravel and sand bed with perforated pipes will allow the filtration and filtered water will be collected through the perforated pipe and will be conveyed to the gravity pipeline leading to pump station. Drying time of 7 days has been adopted. Dried sludge will have high solids content and will be transported to the nearest landfill site. There will be 40 sludge drying beds for Mardan STP, each bed has dimension of 14 meters' length and 8 meters' width.
- The dewatered sludge will be ready for final disposal when its water content is less than 60 percent.
- Generated dried sludge will be disposed of to the landfill site located at a distance of 10.7 KM. Both STP and Landfill site will be operated by WSSC Mardan therefore no special arrangements will be required for sludge disposal from site. Estimated amount of dried sludge will be about 4348 Kg/day that need to be disposed off from STP. WSSC Mardan will plan sludge transportation trips as per need basis.

Mitigation measures

- Sludge from PST and SST shall be removed periodically to ensure operational efficiency.
- Sludge drying beds shall be protected from scavenging activities.
- Sludge quality will be tested to explore its reuse. PMU KPCIP will explore sludge re-use options in collaboration with WSSC Mardan during operation phase of STP.
- Sludge after drying shall be transported to nearest landfill (to be constructed under KPCIP). In such cases inventory of sludge generated and transported will be developed and maintained at STP site.
- Dried sludge will be transported by WSSC Mardan to the proposed landfill site to build under KPCIP through its waste carrying vehicles. Landfill site is located at a distance of about 8 KM from STP site.
- PMU KPCIP will ensure that sludge generated from STP will be transported to landfill site and no other sludge dumping is being carried out.
- Ensure continuous maintenance of STP including sludge tanks, sludge collection and transportation system, thickening and drying components.

7.4.5 Disease Vector Generation & Transmission

Impacts

196. Considering the nature of the project with large volumes of wastewater being treated in the ATs and subsequent SST along with sludge being generated from the wastewater treatment process, there is a high risk of spread of different types of diseases due to disease vectors that could be generated from the stagnant water and the sludge, such as mosquitoes (including the specific mosquitoes responsible for spreading of dengue fever), flies, moths etc. that could carry the diseases to the receptors in the project area.

197. Workers and staff at the proposed STP facility, as well as operators of sludge collection vehicles, can be exposed to the many pathogens contained in sewage. Processing of sewage can generate bio aerosols which are suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, molds, and fungi. These microorganisms can remain suspended in the air for long periods of time, retaining viability or infectivity. Workers may also be exposed to endotoxins, which are produced within a microorganism and released upon destruction of the cell and which can be carried by airborne dust particles. Vectors for sewage pathogens include insects (e.g., flies), rodents (e.g., rats) and birds (e.g., gulls).[19]

[19] U.S. Environmental Protection Agency, Environmental Regulations and Policy Control of Pathogens and Vector Attraction in Sewage Sludge (Including Domestic Septage) Under 40 CRF Part 503, EPA/625/R-92/013, Revised July 2003. http://www.epa.gov/ord/NRMRL/Pubs/1992/625R92013.pdf

Mitigation Measures

- Pests will be kept out of the STP by ensuring the building is well sealed and clean, and available pest/vector control methods will be considered, including cultural practices and biological methods, with chemicals/pesticides being a last resort.
- Comprehensive plan must be developed and implemented to spray chemicals into the influent drains at different frequencies throughout the year based on the seasons
- Minimize the sludge inventory present at the STP as far as possible to prevent breeding of disease vectors
- Cover the sludge piles present at the STP as far as possible;
- Cover all influent drains within STP and inject pesticides and/or chemicals as required to minimize/prevent breeding of disease vectors;
- Maintain good housekeeping in sewage processing and storage areas;
- Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors;
- Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors and pesticides;
- Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods;
- Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin disease such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes;
- Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure;
- Encourage workers at STP to wash hands frequently
- Periodic medical screening/vaccination of workers working at STP
- Only approved pesticides with least toxicity and limited volume will be used.

7.4.6 Occupational Health and Safety (OHS)

Impacts

198. Work at sanitation facilities is often physically demanding and may involve hazards such as open water, trenches, slippery walkways, working at heights, energized circuits, and heavy equipment. Work at water and sanitation facilities may also involve entry into

confined spaces, including manholes, sewers, pipelines, storage tanks, wet wells, digesters, and pump stations. Methane generated from anaerobic biodegradation of sewage can lead to fires and explosions. Workers at STP can get infected from COVID-19 infection if SOPS related to COVID-19 protection are not well implemented by facility operator.

199. STP lab staff dealing with chemicals and equipment's shall pose health and safety risk to staff. Moreover, cutting, grinding and hot work shall be done in workshop which also has significant safety risk. 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 STP during its day-to-day operations.

200. Draft Occupational Health and Safety Plan has been attached as **Annexure E**.

Mitigation Measures

201. In order to ensure a safe and healthy working environment for the sanitary worker and staff of the STP and at all its auxiliary facilities, the following measures have to be strictly enforced, implemented and monitored:

- An OHS Management System will be established and implemented describing standard operating procedures, roles and responsibilities, training needs, emergency response procedures, and reporting and documenting needs.
- 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 (especially staff working in Laboratory/chemical building and workshop) must be ensured.
- Mandatory training of all employees, including sub-contractors, on Health and Safety Practices for STP and its auxiliary facilities. Tool Box talks are also recommended;
- Mandatory health and medical check-ups for all sanitary workers working in cleaning of pumping stations and sewers.
- 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 STP and its auxiliary facilities;
- Mandatory monitoring of air quality and noise levels in the chemical building and workshop to maintain the same within local standards and whenever possible near ambient levels;
- Control of inhalation exposure to hazardous substances such as bio-aerosoles by the effective use of general ventilation within chemical building and chlorination building Local Exhaust Ventilation (LEV) the appropriate use of respiratory protective equipment

(RPE);

- Accidental fires must be addressed immediately. Firefighting plan shall be developed and extinguishers shall be placed at appropriate location.
- 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. Heat levels must be monitored as well. Spot checks shall be done to ensure that workers' welfare is addressed especially during summer months.
- Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available;
- Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards[20]. Valves to process tanks shall be locked to prevent accidental flooding during maintenance;
- Use fall protection equipment when working at heights;
- Maintain work areas to minimize slipping and tripping hazards;
- Use proper techniques for trenching and shoring;
- Implement fire and explosion prevention measures in accordance with internationally accepted standards[21]
- When installing or repairing mains adjacent to roadways, implement procedures and traffic controls, such as:
    - Establishment of work zones so as to separate workers from traffic and from equipment as much as possible

[20] U.S. Occupational Safety and Health Administration regulations at 29 CFR 1910 Subpart J.
[21], National Fire Protection Association (NFPA) 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

- Reduction of allowed vehicle speeds in work zones;
- Use of high-visibility safety apparel for workers in the vicinity of traffic
- For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists
- Locate all underground utilities before digging.

7.4.7 Generation of solid waste

Impacts

202. Solid waste generated by sewage treatment operation include sludge and domestic waste which include sewage, grey water (from kitchen, laundry, and showers), combustible wastes and recyclable wastes from laboratory, chemical buildings and workshops.

203. Detailed impact assessment and mitigation measures for sludge has been provided in section 6.4.3.

204. Sewage and grey water from Admin building, laboratory and workshops shall be drained under gravity to the pumping station and then be mixed with sewage from external sewer to be treated in the STP.

205. Recyclable waste generated from administration building and workshop will be paper, cardboard and small plastic items, empty chemical bags and chemical drums, iron and tin items. These items shall be stored temporarily and sent to recycling facilities located in Mardan or Peshawar.

206. Non-recyclable waste such as demolition waste, food waste, debris, non-hazardous chemicals shall be transported to landfill site for ultimate disposal.

207. Hazardous waste generated during STP operation will be fuel or oil stains, leakage or chemical spill during activities and used pesticide/chemical containers.. Hazardous waste shall be stored briefly and after that shall be transported to approved waste contractor for disposal.

Mitigation measures

208. A waste management plan will be developed prior to the start of operation. 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 collection and an onsite hazardous waste storage facility i.e. designated area with secondary containment.

209. Licensed waste contractors will be engaged to dispose off all non-hazardous waste material that cannot be recycled or reused.

- All types of combustible and non-combustible waste including plastic or glass bottles and cans will be temporarily stored on site and later handed over to a waste/recycling contractor who will utilize these wastes for recycling purposes.

- Waste management training for all STP staff to be included in 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 shall be equal to 120% of the total volume of fuel stored.
- Fuel and hazardous material storage points must be included in STP layout plan. 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.
- 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.
- Spill kits, including sand buckets (or other absorbent material) and shovels must be provided at each designated location especially near Generator Room.
- Training will be provided to personnel for identification, segregation and management of waste.
- The Framework waste management plan has been prepared for the project and attached as **Annexure N.** Contractors will be required to prepare waste management plan for the site in light of guidelines provided in the framework waste management plan and submit to PMU/WSSC Mardan for approval

7.4.8 Impact of Discharge of Treated Effluent

Impacts

210. The treated sewage will be discharged directly to the Kalapani stream. Construction of STP will have positive impact on the quality of the Kalapani stream as treated sewage will be discharged instead of raw sewage. In house effluent quality analysis laboratory will be established to facilitate monitoring of treatment efficiency of STP and to assess the quality of effluent that will be discharged into Kalpani drain. Discharge of treated water may have a direct impact on the surrounding environment. The discharge of treated sewerage may result in nutrient rich conditions and may results algal growth or eutrophication in receiving water body. There is need to manage nutrient loading in the discharged sewerage to avoid impacts on surface water quality.

Mitigation measures

211. WSSC Mardan shall closely monitor the growth of algae and other fauna in receiving water body.

212. Eutrophication potential of the treated effluent shall be determined by the WSSC Mardan on periodic basis and accordingly operation shall be executed in such a way that there are no alarming nutrient loads in treated effluent being discharged in the drain.

213. Treated effluent will discharged after ensuring it compliance with NEQS through effluent quality testing at STP laboratory.

7.4.9 Improvements in Public Health

Impacts

214. The operation of the proposed STP will result in discharge of treated wastewater that will be meeting the NEQS standards and thus it will ensure that a number of the key toxic and hazardous chemical concentrations in the wastewater will be controlled and will not be allowed to enter the discharge water body. This is expected to result in an overall positive impact on the public health by preventing issues such as waterborne diseases, disease vector generation, groundwater aquifer contamination etc

Mitigation measures

215. No mitigation measures required

7.4.10 Lower loads on Aquatic Environment

Impacts

216. Wastewater effluent is a major contributor to a variety of water pollution problems.

217. The poor quality domestic effluents is responsible for the degradation of the receiving surface water body. The release of raw and improperly treated wastewater onto water courses has both short and long term effects on the environment and human health. There is a significant adverse impact on the ecosystems in case untreated effluent is disposed into the environment, resulting in negative impacts on the aquatic ecology of the receiving body with indirect impacts also taking place on the terrestrial flora and fauna present in proximity to these water courses.

218. The STP operation will result in discharge of treated water in compliance to NEQS and it will reduce load on the aquatic and terrestrial environment in proximity to the receiving water bodies i.e Kalapni stream. It will be improving the environmental quality of the area and will pose positive impacts on the ecosystem. Project will close existing bottlenecks in the system and as a result no polluted, untreated water will be discharged to environment. Significant reductions in the existing nutrient loads from the untreated wastewater are expected with majority of the nitrogen-ammonia being converted via nitrification to nitrates. This is expected to reduce ammonia concentrations to levels below those that have been reported to be toxic to different marine life and is expected to retard potential eutrophication occurring in the different water courses in which the treated wastewater will be discharged

Mitigation measures

219. No mitigation measures required.

7.5 Cumulative Impacts

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

7.6 Indirect and Induced Impacts

221. Potential impacts arising from each phase of the proposed construction of sewerage system and sewage treatment plant has 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 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.

222. The, negative indirect and induced impacts from the construction of STP and sewerage network will of short term keeping in view nature of construction works while induced impacts are not expected from construction as well as from operation of STP

8 Environmental Management Plan & Institutional Requirements

8.1 Introduction

223. The IEE has identified potential impacts that are likely to arise during development of sewerage treatment plant, Mardan 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 behavior 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.

224. The Environmental Management Plan (EMP) is developed to eliminate and/or mitigate the impacts envisaged at the design, construction and operation stages.

225. The detailed EMP provided in this document as Table 7.1 ensures that development of sewerage treatment plant Mardan 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.

8.2 Environmental Management Plan (EMP)

226. 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 incorporates environmental sound design and sustainability principles to minimize potential impacts of construction and operation on the environment and community.
- Ensure that the construction and operation work procedures minimize potential impacts on the environment and community.
- Develop, implement and monitor measures that minimize pollution and optimize resource use.

8.2.1 Objectives of EMP

227. 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.

8.3 Environmental Management/Monitoring and Reporting

228. 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), and KPLGE&RDD. 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.

229. During the operation phase, the overall responsibility for the implementation and monitoring of the EMP rests with CEO WSSC Mardan. Project will be administered and monitored through city implementation unit that will be developed within WSSC Mardan which will deliver services based on indicators sets out in services and assets management agreement (SAMA).

230. 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.

8.4 Inclusion of EMP in Contract documents

231. 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 will 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.

232. 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.

233. 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).

8.5 Institutional Arrangements

234. The environmental management plan will require involvement of the following organizations for its implementation during construction and operation phase of project:

8.5.1 Role of PMU, KP LGE&RDD

235. 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.

8.5.2 Role of the ADB

236. The ADB will:

- Support the coordination and administration of the project;
- Provide guidance to PMU KPCIP and WSSC Mardan 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;

8.5.3 Role of Construction Supervision Consultant (CSC)

237. 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 including staff from contractors.

8.5.4 Role of KP EPA

238. The KP EPA will have the following responsibilities with regards to this sewerage treatment plant Mardan project:

- Provides regulatory compliance works for the project.
- Reviews and approves environmental assessment report of Mardan STP construction, 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.

8.5.5 Role of Project Contractor

239. 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 as required. EMP 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.
- Preparation of site specific EMPs as required. Site Specific EMP Guide & Template for Guidance to Contractor has been attached as **Annexure I**. The following specific sub-plans will be prepared as part of SSESMP:
  - Communication Plan
  - Drinking Water Supply and Sanitation Plan
  - Emergency Preparedness Plan
  - Construction Camp Management Plan
  - Pollution Prevention Plan
  - Erosion, Sediment and Drainage Control Plan
  - Traffic Management Plan
  - Borrow Area Management and Restoration Plan
  - Community and Occupational Health and Safety Plan
  - Waste Disposal and Effluent Management Plan
  - Management Plan for protection of flora and fauna

- Fuel and Hazardous Substances Management Plan

- 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.

8.5.6 Role of WSSC Mardan

240. The WSSC Mardan 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.

- WSSC Mardan will be responsible to ensure that contractors engaged during operation phase of Maran STP are executing activities in compliance to IEE/EMP.

- WSSC Mardan will be required to have qualified Environmental Specialist designated for STP to ensure all mitigation measures are implemented in true letter and spirit.

- WSSCM 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.

- WSSCM will plan customer feedback surveys in order to ensure sustainable service delivery and to remove gaps in the system.

8.6 Monitoring Parameters

241. A monitoring plan for the pre-construction/design, construction and operation phases of the project, indicating environmental parameters, frequency and applicable standards is provided below as **Table 7.2, Table 7.3** and **Table 7.4** below.

242. 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.

243. During the construction period, the monitoring activities will focus on ensuring that any required environmental mitigation measures are implemented to address possible impacts.

244. 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.

245. 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 /CSC will guide the design engineers and Contractors on the environmental aspects and necessary EMP documentation. Monitoring during operation phase will be carried out by WSSC Mardan with support from PMU.

8.7 Environmental Training

8.7.1 Capacity Building and Training

246. 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.

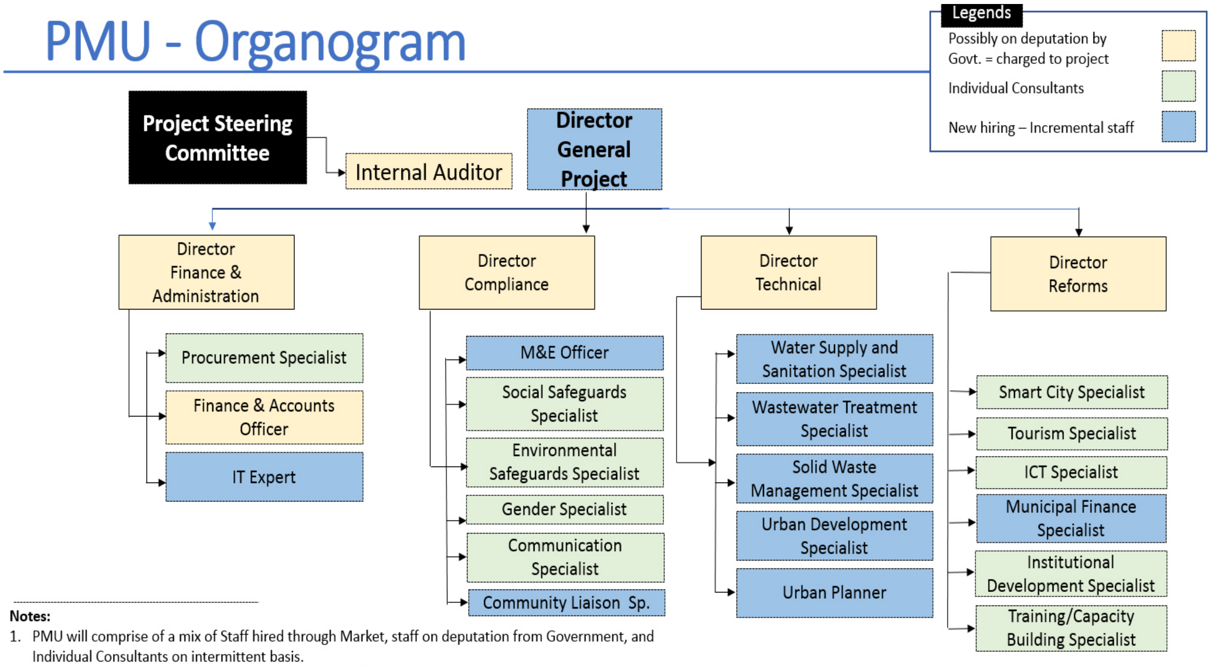
247. The details of this capacity building and training program are presented in the **Table 7.7** below.

8.7.2 Environmental Staffing and Reporting Requirements

248. EMP implementation will be responsibility of all project stakeholders including PMU, WSSC, Project Construction contractors, O&M contractor and other suppliers' involved in the project. Requirement of environmental staffing will be part of bidding documents and necessary cost will be allocated as BOQ item by the bidder. PMU will maintain environmental safeguard staffing (Environmentalist/Environment Associate) for construction and operation phase of the project to monitor and supervise EMP implementation and performance. Environment expert will also be part of CSC technical time and will produce bi-weekly and monthly environmental compliance reports during construction phase. Environment expert of CSC will be responsible to monitor the implementation of EMP during construction phase by project contractors. Project contractors will also hire sufficient environmental officers to implement the EMP requirements and prepare necessary EMP documentation. Project contractor EMP staff will prepare daily environmental reports and submit to CSC for approval and record. Within city implementation unit (CIU), WSSC Mardan will hire qualified environmental specialist during operation phase of the project who will be responsible for EMP implementation and reporting by WSSC Mardan and its O&M contractors during operation. Monthly environmental compliance report will be prepared by WSSC Mardan and circulated to concerned authorities.

249. Organogram of PMU KPCIP within LGERDD and City implementation unit (CIU) within WSSCs is provided as **Figure 7-1 and 7-2.**

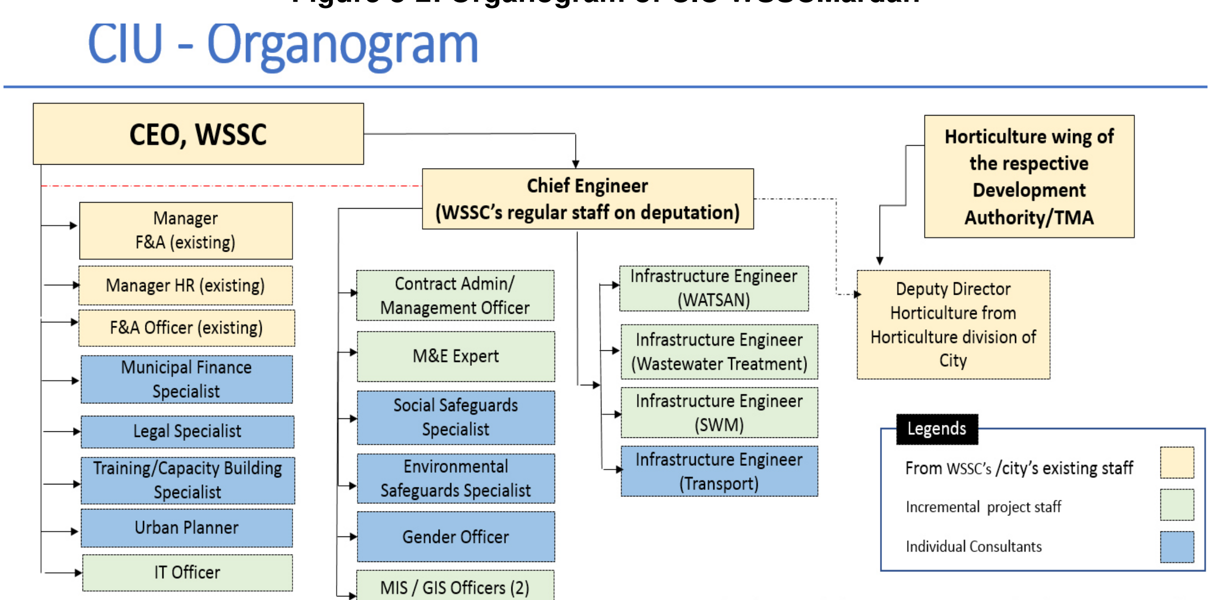
Figure 8-1: Organogram of PMU KPCIP



Notes:

1. PMU will comprise of a mix of Staff hired through Market, staff on deputation from Government, and Individual Consultants on intermittent basis.
2. The Project Director, Deputy Project Director, and DPD, and GMs will be assisted by support staff having relevant qualification and experience

Figure 8-2: Organogram of CIU WSSCMardan



F&A = finance and Administration, GIS = geographic information system, M&E = monitoring & evaluation, SWM = solid waste management, WATSAN = water supply and sanitation, TMA = tehsil municipal authority, WSSC = water supply an sanitation company

* CIU will have these positions according to their respective subsector portfolio.

250. EMP implementation will be responsibility of all project stakeholders including PMU , WSSC Mardan, Project Construction contractors, O&M contractor and other suppliers' involved in the project. Requirement of environmental staffing will be part of bidding documents and necessary cost will be allocated as BOQ item by the bidder. PMU will maintain environmental safeguard staffing (Environmentalist/Environment Associate) for construction and operation phase of the project to monitor and supervise EMP implementation and performance. Environment expert will also be part of CSC technical time and will produce bi-weekly and monthly environmental compliance reports during construction phase. Environment expert of CSC will be responsible to monitor the implementation of EMP during construction phase by project contractors. Project contractors will also hire sufficient environmental officers to implement the EMP requirements and prepare necessary EMP documentation. Project contractor EMP staff will prepare daily environmental reports and submit to CSC for approval and record. WSSC will hire qualified environmental specialist during operation phase of the project that will be responsible for EMP implementation and reporting by WSSC Mardan and its O&M contractors during operation. Monthly environmental compliance report will be prepared by WSSC Mardan and circulated to concerned authorities. Further third party environmental monitoring consultant will be hired on intermittent basis to monitor the EMP implementation and to report environmental non-compliances.

Table 8—1: Environmental Management Plan

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
Design/Pre-Construction Phase	1.1	Improper flow computation	▪ Flow shall be calculated as per international and national practices. For residential plots, the sewage flow is considered as 85% of the water consumption of the development. The water consumption is assumed as 35 gcpd/132 lpcd, which results in a sewage flow of 30 gpcd (i.e. 85 % of water consumption). For non residential population 12 gpcd (WASA Lahore critera) has been estimated. ▪ Infiltration calculated as 10 percent of total sewage flow. ▪ For the proposed sewerage system of Mardan the criteria established by WASA Lahore based on Harmon peaking factor shall be considered. ▪ The sewerage network has been designed with respect to six catchments and PF of 2 has been used based on Harmon peaking factor ▪ Project design shall be sound enough to sustain against peak flows and necessary additional arrangements shall be included in design for the same purpose.	EDCM	PMU	BC: during detailed designing of the sub-project
	1.2	Improper design of sewerage network and sewage treatment plant	▪ The design criteria shall be based on the standards and specifications of WASA Lahore or international best practices.	EPCM	PMU	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Sewers shall be design on self-cleansing velocity i.e. 0.75 m/s to 2.5 m/s. ▪ Minimum velocity of 0.75 m/s shall be maintained to avoid clogging of solids. ▪ A SCADA system shall be established to check compliance and monitoring of STP components. ▪ Minimum cover of 0.9-meter shall be proposed from the top of pipe to reduce chances sewer brusting due to traffic loads. ▪ Before commissioning the STP leakages shall be tested ▪ PMU KPCIP will ensure that project design is in compliance to hydraulic calculations carried out for the project and such calculations are validated at the time of commissioning. ▪ PMU KPCIP will ensure that design of sewerage network shall be sound enough to accommodate additional flows as result of precipitations in the area.			
	1.3	Improper location of STP and Pumping stations	▪ 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 ▪ The natural topography and slope of the selected location of the STP shall	PMU	-	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			be enough to assist the natural flow of influent before and during treatment, as well the discharge of effluent into an abutting Kalapani stream. ▪ STP shall be established on existing Rorya Mardan STP area. ▪ STP shall be located ideally as no pumping station is required to lift waste water for preliminary treatment.			
	1.4	Lack of integration of IEE/EMP requirements into Construction bid documents	▪ 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. ▪ 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. ▪ Project contractors shall have qualified and experienced environmental staff to plan, arrange, implement, monitor and report IEE/EMP requirements.	EPCM	PMU	BC: during detailed designing of the sub-project
	1.5	Material Haul Routes	▪ The construction vehicles hauling materials along the Mardan city roads	EPCM	PMU	BC: during detailed

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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			designing of the sub-project
	1.6	Inadequate Contractor's Environmental Safeguards Capacity	▪ PMU KPCIP shall review the contractor capacity with respect to safeguard management and contracts shall be awarded accordingly. ▪ 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. ▪ PMU KPCIP shall ensure the project contractors are selected on merit and necessary funds has been allocated in the contract documents for EMP implementation and monitoring.	PMU	-	BC: during detailed designing of the sub-project
	1.7	Identification of Locations for Labor Camps and ancillary facilities	▪ 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	PMU		BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			resting area, drinking water, electricity, supply of water. ▪ Solid and liquid effluent waste disposal facilities shall also be designed to cater waste of administration/office building etc. ▪ 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			
	1.8	Land Acquisition and Resettlement Impacts	▪ The PMU KPCIP shall ensure the following: ▪ Social safeguard unit shall ensure that project affected people if any during project execution has been paid following appropriate procedures and there are no grievances about land acquisition process. ▪ PMU will ensure that no land acquisition or resettlement issue left before start of construction works and grievances are adequately addressed.	EDCM	PMU	
	1.9	Impacts due to Natural and Climate hazards	▪ The PMU KPCIP shall ensure the proposed infrastructure shall be designed keeping in view the seismic zone 2B building considerations. ▪ Stormwater drainage system shall be provided along the plant boundary. ▪ Sewerage network shall not be disrupted/impacted from urban flash	EDCM	PMU	BC: during detailed designing of the sub-project

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			flooding, potential seismic activity and other climate hazards. ▪ 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.			
Construction Phase	2.1	Construction of Sewage treatment plant, sewerage network and other structures not in accordance with finalized design	▪ 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 Sewerage network and STP 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 STP. ▪ PMU KPCIP 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	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			activities of CSC and contractors involved in construction activities			

	2.2	Impacts Due to Construction of Sewers	▪ Prior to starting of work, the contractor shall prepare a method statement for pipeline and sewer works. This shall 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 pipeline/sewer works along the roads.
			▪ 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 pipe laying, from excavation to road resurfacing/testing)
			  ▪ PPE (helmet, gloves, boots, etc.) details for each type of work
			  ▪ Details of materials at each site
				Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			(type & quantity) ▪ Risks/hazards associated with the work (for example, Trench excavation will have risks such as trench collapse, persons/vehicles falling into trench, structural risk to nearby buildings, damage to buildings, infrastructure etc.) ▪ 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 pipe trenching, 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.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ 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 trench at each site 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 CSC/WSSC Mardan/TMA • CSC will inspect and monitor theborrow 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.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			• Already available quarry sites for additional backfill material will be utilized. Development of new quarry site will be discourages. ▪ Record of borrow materials will be maintained including details of quarry site, agreement and necessary approvals from concerned government authorities			
	2.3	Degradation of air quality due to construction works	▪ At the STP 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.	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ 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. ▪ 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 (>25m3) 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 stock piles down wind and away from communities) and sprinkling water over the access road. ▪ Maintaining levels of contaminant dusts, vapors and gases in the work			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	**Monitoring**	
			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 **Vehicular & Equipment Emissions** ▪ Where ambient air contains several materials that have similar effects on the same body organs (additive effects). ▪ Periodically check and conduct maintenance of the construction			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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 wastes at any site will not be allowed. ▪ The stack height of generators will be at least 3 meters above the ground. ▪ Training of the technicians and operators of the construction machinery and drivers of the vehicles. ▪ All heavy equipment, machinery and vehicle shall be fitted in full compliance with the national and local regulations. ▪ Idling time will be limited 3 to 5 minutes. ▪ All type of machinery and generator must comply with the NEQS. Vehicles, which are not in compliance with NEQS are not allowed to use. ▪ Periodic emission monitoring of vehicles, generator and batching plants is proposed.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Project activities shall be planned to avoid harsh weather conditions			
	2.4	Impacts on Surface Water Quality	▪ CSC will expedite the construction works at sewerage network sites near surface water body as much as possible to complete the taks with minimum time duration. ▪ Constrcution debris shall not be disposed off in water bodies. ▪ No stockpiling of materials will be carried out at bank of water bodies. ▪ No labor camp will be constructed at bank of water bodies. No solid waste will be diposed off in the streams. ▪ CSC will maintain good housekeeping during construction works at bank of water bodies ▪ After construction of sewerage network all constrction material left shall be picked up and site shall be restored to its original condition following best practices.	Contractor	CSC, PMU	DC
	2.5	Increased Traffic	▪ 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 used during laying of sewers is minimized during the peak traffic hours of the day in order to prevent congestion and accidents as far as	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			possible; ▪ Furthermore, the movement of heavy vehicles within with in streets of project area during laying of sewerage system must be restricted to specific routes containing least number of sensitive receptors and low traffic volumes. ▪ 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 laying of pipelines will 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. ▪ Temporary walkways shall be constructed on trenches for providing passage commuters. ▪ 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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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. ▪ Provide wooden bracing for all deep excavations that may require especially for sewer lines (> 2m); identify buildings at risk prior to start of excavation work and take necessary precautions for safe conduct of work ▪ Plan material and waste routes to avoid times of peak-pedestrian activities. ▪ PMU KPCIP will liaise with WSSC Mardan/ Traffic department in identifying risk areas on route cards/maps. ▪ Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure. ▪ Provide road signs and flag persons to			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			warn of dangerous conditions for all the work sites along the roads.			
	2.6	Community Health & Safety	▪ Prior to starting of work, the contractor shall prepare a method statement for pipeline and sewer works. This shall be simple and explain the contractor's work process that is actually conducted on site, with safety and safeguard concerns. ▪ 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. ▪ CSC/PMU KPCIP shall ensure the contractor staff working in the components of 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. ▪ 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. Best industry practices related to Occupational Health and Safety standard (OHS) shall be adopted	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			during the execution of the project. ▪ Contractor will ensure setting up of its machinery on the road for construction works in such way that it will not hinder the public traffic and will not compromise the public safety.			
	2.7	Occupational Health and Safety	**General** ▪ The Contractor will be required to prepare and implement an effective OHS Management 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. ▪ 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.	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ 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 of CSC for approval an emergency evacuation plan and practice the procedure annually. ▪ The Contractor shall submit to the Engineer of CSC 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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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. ▪ 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. ▪ Adequate ventilation shall be provided in dining areas, resting places and sleeping areas. ▪ 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 HSE protocols shall be implemented			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			in true letter and spirit. ▪ Contractor must appoint an HSE 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. ▪ 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:22 ▪ Mitigation Measures for Physical Hazards ▪ Rotating and Moving Equipment ▪ Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. ▪ Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of			

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

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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** ▪ 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.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			Electrical ▪ 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 examination and marking of all buried electrical wiring prior to any excavation work. ▪ Appropriate labeling of service rooms housing high voltage equipment (‘electrical hazard’) and where entry is controlled or prohibited; · **Eye Hazards** ▪ Use of machine guards or splash			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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** ▪ 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 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. · ▪ 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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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 ▪ 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 ▪ Facility and workstation design with 5th			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			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 ▪ 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			

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			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 ▪ 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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			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 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.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			Mitigations for Biological Hazards ▪ 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.			
	2.8	High noise levels from construction activities	▪ 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	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			access roads to work sites. ▪ Manual excavation has been proposed for congested areas to reduce generation of noise. ▪ Limited use of jack hammer in populated areas. ▪ 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. ▪ Temporary/portable noise barriers will be considered where necessary/appropriate particularly near sensitive receptors such as schools and healthcare facilities. ▪ Well-maintained haulage trucks will be used with speed controls. ▪ 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). ▪ Prior to the issuance of hearing protective devices as the final control			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls shall be investigated and implemented, where feasible. ▪ Periodic medical hearing checks shall be performed on workers exposed to high noise levels. ▪ Grievance redress mechanism will be established. ▪ All the equipment and machinery used during construction phase shall be well maintained.			
	2.9	Improper handling and/or disposal of hazardous and non-hazardous waste	▪ 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. ▪ Licensed waste contractors will be engaged to dispose off all non-hazardous waste material that cannot be recycled or reused. ▪ Excavated material from trenches will be stored at site and it will be used as fill material after laying of sewers while access spoil shall be transported to spoil disposal site if required. Almost	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			half of the spoil shall be used for backfilling while reaming shall be removed and sent for disposal ▪ Excavated material generated during construction of STP components i.e. settling tanks, aeration tank, etc will be used as a fill material with in STP location and access spoil shall be transported to spoil disposal site if required. ▪ PMU KPCIP will ensure the identification of disposal sites for unsuitable excavated material in consultation with CSC/WSSC Mardan and TMA Mardan ▪ 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 shall be equal to 120% of the total volume of fuel stored. ▪ Fuel and hazardous material storage			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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 refueling 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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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 N 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			
	2.10	Untreated disposal of effluent from worker camps and batching plant(s) and construction sites	▪ 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	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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			
	2.11	Soil Contamination	▪ Spill prevention trays shall be 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	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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.			
	2.12	Employment Conflicts	▪ 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 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.	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
	2.13	Communicable diseases incl. COVID-19	**COVID-19 specific measures** ▪ All workers must perform complete sanitization at the site as per SOPs/guidelines issued by WHO. ▪ 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. ▪ 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	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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 clinic premises and at the work site(s). ▪ 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. ▪ 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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			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. ▪ Adequate ventilation shall be provided in dining areas, resting places and sleeping areas. ▪ 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 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 a well ventilated area. ▪ 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.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ 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 to 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.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			▪ 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 a well ventilated area. ▪ 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.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			▪ 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			
	2.14	Vegetation and Wildlife Loss	▪ Consideration shall be given to the visual appearance of the STP site during operation. Necessary plantation will be carried out, which will act as buffer zone from surrounding environment. Reasonable area has been allocated for plantation to improve landscape of the area. ▪ Off-road travel will be strictly prohibited and observance of this will be monitored during execution of the project. and ▪ Vehicles 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.	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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	2.15	Historical/Archaeological Sites	▪ 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**. ▪ Any works near graveyards will be carried out with due respect and precautions ensuring that no damage is caused to any grave, no effluents are released in the graveyards and no debris or litter is disposed inside such areas.	Contractor	CSC, PMU	DC
	2.15	Impacts of construction of Process and non process building 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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			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.			
	2.16	Influx of Labor	▪ Limit the siting of any temporary facilities within the boundaries of the worksites; ▪ Use of non-wood fuel for cooking and heating; ▪ Code of conduct (CoC) for workers and employees will be enforced for the	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			protection of local communities, gender based violence, other social issues, flora and fauna and a ban on tree cutting and hunting. Any violation of the COC will lead to strict punishment including termination of employment; ▪ Awareness among workers will be created on proper sanitation and hygiene practices to endorse proper health; ▪ Good housekeeping practices will be maintained at project site(s); ▪ Adequate personal hygiene facilities will be provided in good condition with adequate supply of clean water; ▪ Arrangements will be made to treat the affected workers on time to control the movement of vectors diseases; ▪ Workers and surrounding communities will be sensitized on awareness and prevention of HIV/AIDS and STI through training, awareness campaigns and workshops; ▪ Free HIV/AIDS and STI screening and provided for site workers ▪ counselling sessions will be held to made the workers award of the risks of HIV/AIDs and STI; ▪ Any employees will be terminated, who continues misconduct or lack of care, carry out duties amateurishly or inattentively, fail to conform to			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			provisions of the contract, or persist in any conduct which is harmful to safety, health, or the protection of the environment; ▪ The use of drugs and alcohol will not be allowed at the work/construction site; ▪ Carrying weapons into the workplace premises will be prohibited; ▪ Site security arrangements will be listed as an item in the Bill of Quantities (BoQs) to avoid any delays; which may cause due to security issues; ▪ The contractor will create awareness of construction crew to sensitize them about security situation in the project area, in coordination with private/public security agencies; ▪ Appropriate fencing, security check points, gates and security guards will be provided at the construction sites to ensure the security of equipment, machinery and materials, as well as to secure the safety of site staff; ▪ The Contractor will ensure that good relations are maintained with local communities and their leaders to help reduce the risk of vandalism and theft; ▪ To avoid conflicts with local people on employment matters, it is recommended to the contractor to employ the locals in skilled, semi-skilled, and unskilled work. This will			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
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			reduce pressure on resources such as residential and health facilities; ▪ The contractor will proactively manage the potential impacts from labor influx and potential cultural conflicts between local communities and workers, which include following: ▪ Construction camps will be built in the designated areas, located minimum 500m away from the village settlements; ▪ The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local communities; ▪ Inclusion of COC obligations and the applicable legislation in the contracts of all employees and workers with the provision of sanctions and penalties in case of violations; ▪ World Bank Guidelines on Influx of labor will be used for further guidance.			
	2.17	Gender Issues including Gender-Based Violence (GBV)	▪ The contractor's COC shall cover a program to promote awareness of the construction workers on avoiding 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;	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ 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.			
	2.18	Child Labor	▪ It will be ensured that contractor is having its employment policy in	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			accordance with relevant acts and labor policies in Pakistan; ▪ Contractor will ensure that all persons at site are adults and have their government issued identity card with them.			
	2.19	Restricted access	▪ Do not block access of local communities to local roads, cultural and religious sites. In case of blockage, provide alternative safe access routes. ▪ Communicate with the local communities and potentially affected public through consultation meetings and placement of posters in local language regarding the scope and schedule of construction activities that will cause disruptions or restrictions to access.	Contractor	CSC, PMU	DC
	2.20	Impacts of construction of Process and non-process building 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.	Contractor	CSC, PMU	DC

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ 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.			
	2.21	Site Restorations	▪ Dismantling and full removal of worksite facilities and camps, including contractor offices, staff and workers'			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			accommodation, machinery yard, warehouses, store rooms, maintenance shops, drinking water utilities, vehicle parking areas, batching plant, temporary materials stockpiling enclosures, and so on. ▪ Removal of drinking water facilities, including pipes and storage tanks, as well as sanitary facilities, i.e. modular sewage treatment plant chambers from camp plus the sewage network and toilets. ▪ Removal of electric facilities, including electrical posts and wiring installed by the project in some sectors; this job will be done by specialized personnel. ▪ Generating equipment set up in camp and work areas will also be removed. ▪ Removal of all solid construction waste piled up in temporary enclosures, as well as other wastes that may be scattered in camp, working faces or adjacent sectors. ▪ Removal of fencing, anchoring and other minor facilities, concrete left over from mixing, settling ponds, after all the movable elements have been removed. ▪ Cleaning the ground in the event of spillage of any liquids or other substances foreign to the ground which have been used for carrying out the works.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Ground cleaning will be done by removing all the affected topsoil and transporting it to an authorized site for treatment and final disposal. ▪ De-compaction of any sectors that have been compacted (e.g. constructions, inner roads), once the area is clear of all kinds of facilities, elements or substances foreign to the environment. Addition of topsoil if required for this purpose. ▪ To the extent possible, restitution vegetation for purposes of erosion control, visual mitigation, and restitution of fauna habitats.			
Operation Phase	3.1	Possible Emergencies and Plant failure	▪ Generator shall be used as a backup power supply source in case power from electicity utility is not available. ▪ Two separate sets of blowers shall be installed in the blower building. Each set of blowers will consist of 3 blowers (2 duties + 1 standby) and will feed one aeration tank. In case of breakdown/malfunctioning of blower, standby blower will be used. ▪ Operator Personnel training on a pre-defined frequency, at least once every quarter, shall be ensured to continue refreshing of the Standard Operating Procedures laid out in case of possible emergencies and/or plant failure. ▪ Preventive maintenance must be	O&M Contractor/ WSSCM	WSSC Mardan, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			ensured on a pre-defined frequency with required spare parts available at the STP premises to ensure quick replacement of the faulty component(s) in order to resolve the technical issue and bring the plant back into operation at the earliest ▪ Emergency response procedures shall be prepared. The O&M staff shall be trained on these procedures.			
	3.2	Leaks and Overflows	▪ Consider the installation of separate sewer systems for domestic wastewater and storm water runoff in the overall planning and design of new sewerage systems; ▪ Limit the sewer depth where possible (e.g., by avoiding routes under streets with heavy traffic). For shallower sewers, small inspection chambers can be used in lieu of manholes; ▪ Use appropriate locally available materials for sewer construction. Spun concrete pipes can be appropriate in some circumstances but can suffer corrosion from hydrogen sulfide if there are blockages and/or insufficient slope; ▪ Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation; ▪ Design manhole covers to withstand	WSSCM	PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			anticipated loads and ensure that the covers can be readily replace if broken to minimize entry of garbage and silt into the system; ▪ Equip pumping stations (if required) with a backup power supply, such as a diesel generator, to ensure uninterrupted operation during power outages, and conduct regular maintenance to minimize service interruptions. Consider redundant pump capacity in critical areas; ▪ Establish routine maintenance program, including: ▪ Development of an inventory of system components, with information including age, construction materials, drainage areas served, elevations, etc. ▪ Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning shall be conducted more frequently for problem areas. Cleaning activities may require removal of tree roots and other identified obstructions ▪ Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			or near capacity; and suspected infiltration or exfiltration ▪ Monitoring of sewer flow to identify potential inflows and outflows ▪ Conduct repairs prioritized based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g., pump station failures, sewer line ruptures, or sewer line blockages); ▪ Review previous sewer maintenance records to help identify “hot spots” or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed; ▪ When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.). Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
	3.3	Odor Generation	▪ WSSC Mardan will ensure continuous flow of waste water and smooth operation of STP to avoid objectionable odor. ▪ WSSC Mardan will ensure that all the machinery is in working condition and necessary backup material/machinery is available to avoid any hault in the sewage treatment process to avoid odor issues ▪ In order to address any potential odor issue, a buffer zone of 50 feet wide all around the STP site consisting of thick plantation will be ensured as a precaution. ▪ Where necessary, consider latest aeration technologies or process configurations to reduce volatilization during the operation phase of the project. ▪ Where necessary, consider alternate aeration technologies or process configurations to reduce volatilization	\WSSCM	WSSCM PMU	DO
	3.4	Generation of Sludge and disposal	▪ Sludge from PST and SST shall be removed periodically to ensure operational efficiency. ▪ Sludge drying beds shall be protected from scavenging activities. ▪ Sludge quality will be tested to explore its reuse. PMU KPCIP will explore sludge re-use options in collaboration with WSSC Mardan during operation	WSSCM	WSSCM, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			phase of STP. ▪ Sludge after drying shall be transported to nearest landfill. In such cases inventory of sludge generated and transported will be developed and maintained at STP site. ▪ PMU KPCIP will ensure that sludge generated from STP will be transported to landfill site and no other sludge dumping is being carried out. ▪ Sludge after drying shall be transported to Mardan landfill site which will be constructed under KPCIP project. In such cases inventory of sludge generated and transported will be developed and maintained at STP site. ▪ Ensure continuous maintenance of STP including sludge tanks, sludge collection and transportation system, thickening and drying components			
	3.5	Disease Vector Generation & Transmission	▪ Pests will be kept out of the STP by ensuring the building is well sealed and clean, and available pest/vector control methods will be considered, including cultural practices and biological methods, with chemicals/pesticides being a last resort. ▪ Comprehensive plan must be developed and implemented to spray chemicals into the influent drains at different frequencies throughout the year based on the seasons	O&M Contractor/ WSSCM	WSSCM, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ Minimize the sludge inventory present at the STP as far as possible to prevent breeding of disease vectors ▪ Cover the sludge piles present at the STP as far as possible; ▪ Cover all influent drains within STP and inject pesticides and/or chemicals as required to minimize/prevent breeding of disease vectors; ▪ Maintain good housekeeping in sewage processing and storage areas; ▪ Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors; ▪ Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors and pesticides; ▪ Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods; ▪ Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			with spray and splashes; ▪ Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure; ▪ Encourage workers at STP to wash hands frequently ▪ Periodic medical screening/vaccination of workers working at STP ▪ Only approved pesticides with least toxicity and limited volume will be used.			
	3.6	Occupational Health and Safety	▪ In order to ensure a safe and healthy working environment for the sanitary worker and staff of the STP and all its auxiliary facilities, the following measures have to be strictly enforced, implemented and monitored: ▪ An OHS Management System will be established and implemented describing standard operating procedures, roles and responsibilities, training needs, emergency response procedures, and reporting and documenting needs. ▪ PMU KPCIP and WSSC MArdan through CSC will ensure the implementation of SOPs issued by GoP and WHO related to COVID-19. ▪ A communicable diseases prevention	WSSCM	WSSCM, PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			program will be prepared for staff/workers of STP in light of WHO guidelines on COVID-19 specific measures and Ministry of National Health Services, Regulations and Coordination, GoP guidelines for COVID-19. ▪ 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 (especially staff working in Laboratory/chemical building and workshop) must be ensured. ▪ Mandatory training of all employees, including sub-contractors, on Health and Safety Practices for STP and its auxiliary facilities. Tool Box talks are also recommended; ▪ Mandatory health and medical check-ups for all sanitary workers working in cleaning of pumping stations and sewers. ▪ Develop a written program (i.e. health information, instruction and training) which sets forth procedures,			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards of working in STP and its auxiliary facilities; ▪ Mandatory monitoring of air quality and noise levels in the chemical building and workshop to maintain the same within local standards and whenever possible near ambient levels; ▪ Control of inhalation exposure to hazardous bio-aersols by the effective use of general ventilation within labourtary area ▪ Accidental fires must be addressed immediately. Firefighting plan shall be developing and extinguishers shall be placed at appropriate location. ▪ 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			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			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. Heat levels must be monitored as well. Spot checks shall be done to ensure that workers' welfare is addressed especially during summer months. ▪ Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available; ▪ Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. Valves to process tanks shall be locked to prevent accidental flooding during maintenance; ▪ Use fall protection equipment when working at heights; ▪ Maintain work areas to minimize slipping and tripping hazards; ▪ Use proper techniques for trenching			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			and shoring; ▪ Implement fire and explosion prevention measures in accordance with internationally accepted standards ▪ When installing or repairing mains adjacent to roadways, implement procedures and traffic controls, such as: • Establishment of work zones so as to separate workers from traffic and from equipment as much as possible • Reduction of allowed vehicle speeds in work zones; • Use of high-visibility safety apparel for workers in the vicinity of traffic • For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists • Locate all underground utilities before digging.			
	3.7	Generation of solid waste	A waste management plan will be developed prior to the start of operation of STP. 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 collection and an onsite hazardous waste	WSSCM	PMU	DO

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			storage facility i.e. designated area with secondary containment. Licensed waste contractors will be engaged to dispose of all non-hazardous waste material that cannot be recycled or reused. ▪ 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 STP staff to be included in training plan. ▪ Fuel storage areas and generators (if required) 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. ▪ Fuel and hazardous material storage points must be included in STP layout plan. 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. ▪ Hazardous waste will be initially stored on site at designated area and then handed over to EPA certified contractor to final disposal.			

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
			▪ 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 especially near Generator Room. ▪ Training will be provided to personnel for identification, segregation and management of waste. ▪ The Framework waste management plan has been prepared for the project and attached as Annexure N. 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/WSSCM for approval			
		Impact of discharge of treated sewage	▪ WSSC Mardan shall closely monitor the growth of algae and other fauna in receiving water body i.e. Kalapani stream ▪ Eutrophication potential of the treated effluent shall be determined by the WSSC Mardan on periodic basis and accordingly operation shall be executed in such a way that there are no alarming nutrient loads are discharging in the receiving water body.	WSSCM	PMU	DO

CSC	Construction Supervision Consultant
BC	Before Construction
DC	During Construction
PMU	Project Management Unit
DO	During Operation

Table 8—2: 'Pre-Construction 'Environmental Monitoring Plan for Baseline Development

Parameter to be measured	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Ambient Air Quality	To establish baseline air quality levels	CO,VOCs, NO_2,SO_2, O_3 & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At three random receptor locations in the project area both upwind and downwind At one representative location in sewer network area both upwind and downwind	Once	CSC
Ambient Noise	To establish baseline noise levels	Ambient noise level near receptors in project area Leq A daytime (8-18:00) Leq A nighttime (18:00-8:00)	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour, and then averaged	At three random receptor locations in the project area	Once	CSC
Groundwater Quality in vicinity of project area	To establish groundwater quality in project area	Groundwater quality in project area, NEQS parameters	Water samples for comparison against NEQS parameters	At four locations around the STP site in the project area At two locations in the sewerage network area	Once	CSC

Table 8—3: Construction Phase Monitoring Requirements

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Noise 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 Leq A daytime (8:30 AM-20:30 PM) Leq A nighttime (20:30 PM:00-8:30 PM)	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 the same locations as the pre-construction monitoring	Quarterly basis on a typical working day	Contractor's Environmental officer, CSC
Air Quality Dust emissions from construction vehicles and equipment	To determine the effectiveness of dust control program on dust at receptor level	CO,NO_2 & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At the same locations as the pre-construction monitoring	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
Safety precautions by Safety workers	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

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Soil Contamination	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
Solid Waste & Effluent disposal 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 8—4: 'Operation Phase' Environmental Monitoring Plan

Parameter to be measured	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Ambient Air Quality	To assess ambient air quality within vicinity of STP	CO, NO_2 & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels for CO, NO2 & PM10 Once for Odor	At three random receptor locations in project area down wind direction of STP	**Bi annual**	WSSCMardan
Sludge	To assess whether Sludge generated during operation of STP is disposing as per procedure.	Sludge quality (%age of dried sludge solid content)	Analysis of Sludge	Sludge drying beds	Once in 15 days	WSSCMardan
Solid Waste Management Plan	To assess that solid waste generated from STP operation is managed as per IEE/EMP requirements	Solid waste inventory is being maintained	Solid waste inventory audit	Each component of STP	Monthly	WSSCMardan
Effluent	To assess the compliance of treated effluent	TSS, COD, BOD, N-NH3, P	NEQS measurement method	Outfall of STP	SS, MLSS, pH, SVI, DO Daily BOD, COD twice a week	WSSC Mardan

Table 8—5: Capacity Development and Training Programme

Provided by	Organized by	Contents	Target Audience	Venue	Duration
Pre-construction Phase Monitoring consultant/organization offering specialized services in environmental management and monitoring	CSC & PMU	Short seminars and courses on: Environmental Management Plan and Environmental Monitoring Plan Group exercise and participatory workshop to measure effectiveness of program	Contractor staff	WSSC Office, Mardan	One day long training seminar including group exercise/workshop
Construction Phase Monitoring consultant/organization 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 Safe driving practices for project drivers Hygiene, housekeeping aspects for camp staff Group exercise and participatory workshop to measure effectiveness of program	Contractor staff	WSSC Office, Mardan	One day long training seminar including group exercise/workshop to be repeated as needed
Operation Phase STP Facility operator authorized representative or through 3rd Party	WSSC Mardan	Short seminars on Environmental risks associated with operation phase. Development of Environmental Performance Indicators/ Occupational Health and Safety (OHS) issues Group exercise and participatory workshop to measure effectiveness of program	Facility Operator, O&M contractors	WSSC Office, Mardan	One day long training seminar including group exercise/workshop to be repeated as needed

8.8 Environmental Management Costs

251. The Table 7.6 below provides cost estimates for 'Pre-Construction phase' monitoring while Tables 7.7 and 7.8providescost estimates for 'Construction phase' and 'Operation phase' monitoring of key environmental parameters.

252. The costs associated with implementation of the EMP and the necessary mitigation measures are provided as Table 7.6 below. The Table 7.10 below provides the 'Capacity development and training programmer' for project contractors for the proposed Rorya STP.

Table 8—6: Annual Cost Estimates for 'Pre-Construction Phase' Environmental Monitoring23

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NO_2, SO_2, O_3 and PM_{10}	8 (Once only at 4 locations both upwind and down wind)	240,000	8 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	3 (Once only at 3 locations)	90,000	3 readings @ PKR 30,000 per reading
Ground and Surface Water Quality	NEQS	6 (Once only at 6 locations)	180,000	6 readings @ PKR 30,000 per sample
Contingencies			25,500	5% of monitoring cost
Total (PKR)			**535,500**	

Table 8—7: Annual Cost Estimates for 'Construction Phase' Environmental Monitoring24

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NO_2, SO_2, O_3 and PM_{10}	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per reading
Contingencies			36,000	5% of monitoring cost
Total (PKR)			**756,000**	

[23] For air quality monitoring: 'Passive samplers' such as test tubes can be used or 'Active samplers' with sorbent turbes can also be used.
[29] For noise monitoring: sampling equipment with duration greater than 1 hour can be used.

Table 8—8: Annual Cost Estimates for 'Operation Phase' Environmental Monitoring

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NO_2, PM_{10}	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per sample
Sludge	NEQS	2 (bi-annual basis)	60,000	2 readings @ PKR 30,000 per sample
Wash water	NEQS	2 (bi-annual basis)	60,000	2 readings @ PKR 30,000 per sample
Contingencies			24,000	5% of monitoring cost
Total (PKR)			**504,000**	

Table 8—9: Estimated Costs for EMP Implementation

Item	Sub-Item	Estimated Total Cost (PKR)
Staff, audit and monitoring cost[25]	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.	**50,00,000**
(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 provide buffer	To plant vegetation all along the STP 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	20,00,000
Contingencies	5% of EMP implementation cost	320,000
Total Estimated Cost (PKR)		**7,720,000**

[25] To cover staff cost of expense of environmental specialist for contractor

Table 8—10: Cost of Capacity Development and Training Programme for Project Contractor(s)

Provided by	Organized by	Contents	No. of training events	Duration	Cost (PKR)
Pre-construction Phase 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
Construction Phase 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
Operation Phase Sewerage Treatment Plant Operator authorized representative or 3rd party trainer	WSSCM	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	400,000/Year
Total			**800,000** **(PKR 0.8 million)**		

9 Public Consultation and Information Disclosure

253. In this section the process and outcomes of the consultations has been described that was carried out with various groups of stakeholders as part of the environmental and social assessment of the proposed project. It includes a brief discussion about the concerns expressed by the various stakeholders during the meetings and responses provided in order to address the concerns through necessary mitigation measures in project design, environmental and social assessment document.

254. 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 (if any) 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.

255. Two rounds of comprehensive stakeholders' consultations were organized with different stakeholders consulted. The public consultations in the form of FGDs and one to one meetings were conducted in the month of February/March 2020 while the stakeholder consultation was conducted in August 2020. Information on positive and negative impacts associated with constructional and operational stage and proper mitigation of adverse impacts were shared during these consultations.

256. Details on the public consultations conducted are provided below with the pictorial evidences and list of persons consulted provided as **Annexure C**.

9.1 Identification of Stakeholders

257. There are three types of stakeholders for the construction of sewage treatment plant and sewerage network project as described below.

9.1.1 Primary Stakeholders

258. 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 sewage treatment plant and sewerage network in Mardan. 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. Since, the project is rehabilitation and reconstruction of existing, though not operative sewerage plant, therefore, limited primary stakeholders are available. No direct PAPs are available for the project.

9.1.2 Secondary Stakeholders

259. 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 STP site, the secondary stakeholders are as follows:

- Water and Sanitation Agency, Mardan (The Proponent)
- Irrigation and Agriculture Government of KP.
- Environment Protection Agency (EPA), Peshawar, Government of KP

- The ADB (The Financing Agency)
- Forest and Wildlife Departments, Government of KP
- Planning and Development (P&D) Department, Government of KP
- Representatives of local communities
- Tehsil Municipal Authority, Mardan
- Revenue Department, Government of KP
- Salik Development Foundation (SDF) Sheikhmalton
- Public at large

9.1.3 Key stakeholders

260. The stakeholders considered to possess 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 the context of the STP and sewerage networks these are considered to be local leaders, influential community members and other local representatives including Imams of mosques and teachers of local schools.

261. For the proposed project no direct effectees are there, thus immidate population was considered as the focus groups related with project.

1.

9.2 Information Disclosure and Consultation

9.2.1 Scope of Consultations

262. The consultations were conducted and recorded by Mr. Musaddiq Shah (Sociologist), Mr Zeeshan (Sociologist), Mr. Waji Ul Hasan (Sociologist) and Mr. Mehmood Amjad (Environmentalist), Mr. Ibrahim Atiq (Environmentalist), Mr. Sameer (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 feedbacks were recorded.

263. All consultations were carried out in accordance with the 'meaningful consultation' guidelines of ADB's SPS 2009 and their outcomes are discussed in the proceeding sections. Consultations were also held with the PMU, higher government officials, Local Government Board and the design consultants.

264. As part of the present environmental and social assessment, consultations with over 35 different stakeholders were conducted through local community meetings and focus group discussions (FGDs), 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, WSSC Mardan, 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.**

Figure 9-1: Map of Public Consultation Locations

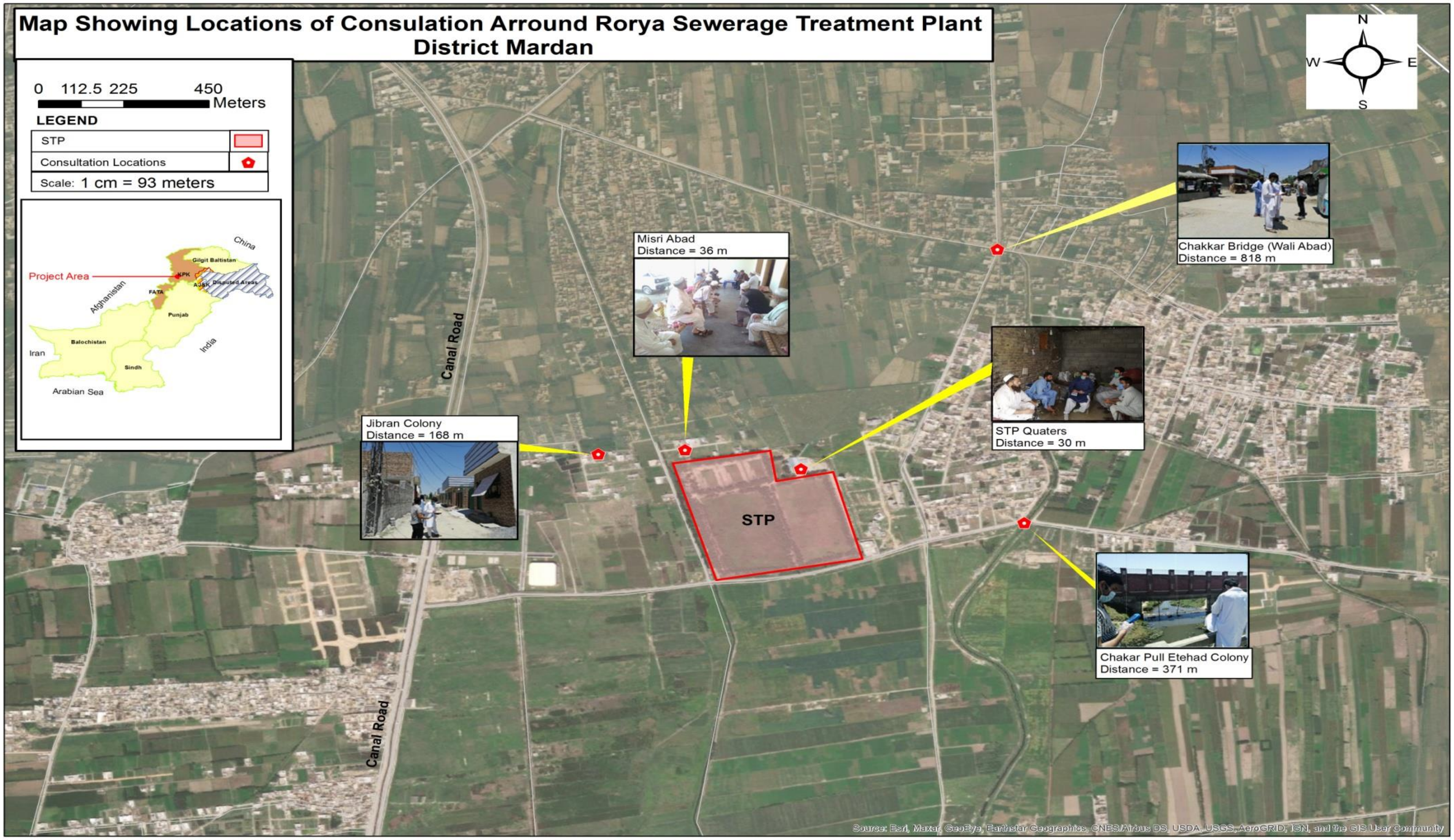


Table 9—1: List of Stakeholder Consultation and Concerns

Sr. No.	Date	Location of Consultation	Total No. of Participants	Comments/Concerns	Consultant Response
i	17/03/2020	Misri-Abad	11 (male)	The project was highly appreciated considering how effectively it will help in cleaning the sewage and in return cleaning the environment. This project shall be implemented as soon as possible and proper mitigation plan shall be drafted for it, to make it more environment-efficient.	The drainage network shall be replaced with new pipeline system keeping while following environmental principles. The residents of the surroundings were made sure that the project shall be started as soon as possible.
ii	17/03/2020	Shaamilat	05 (male)	The open drains of sewage system are becoming a source of spreading dangerous fatal diseases. Job opportunities shall be provided for the local community.	The new pipeline system shall not allow leakage of sewage whatsoever and efficiently transport the sewage water to the targeted sewerage treatment plant. Locals will be preferred for jobs in this project, as its socially and economically both very feasible
iii	17/03/2020	Hafiz-abad	09 (female)	Limited access to clean drinking water No schools in the nearby vicinity for girl’s education. There is high maternal mortality rate in the village.	Educating about the technologies that go into the proposed sewerage treatment plant which shall efficiently improve the drainage system in STP and eliminate the diseases caused by dirt. The women were motivated by this project as this could improve the city’s drainage infrastructure on a bigger scale and help improve health infrastructure as well.

Sr. No.	Date	Location of Consultation	Total No. of Participants	Comments/Concerns	Consultant Response
iv	17/03/2020	Misri-Abad	08 (female)	Maternal mortality is a huge issue in the village. A large number of women pass away during pregnancy. Most of the pregnant women are treated by tradition unskilled birth attendants. There is a lack of basic health facilities in the village. Poor communication system i.e. poor road infrastructure. Electric power load shedding throughout the day.	People were introduced to the new sewerage treatment process i.e. construction of Sewerage Treatment Plant and its positive impacts on the drainage system in the District. Road infrastructure along the proposed STP is also a part of this project and it will also be restructured. Concerns related to education/power will be communicated to relevant departments of the government.
v	17/03/2020	STP Site	05 (male)	Power supply was cut down to the servant quarters of STP Mardan, due to unavailability of funds with TMA. Open drainage system is causing serious health issues among the community.	The servant quarters inside STP Mardan will be facilitated with basic needs. A closed drainage system will be installed and replaced with current drainage network.

Table 9—2: Consultations with Government Stakeholders

Sr. No.	Date	Department of Consultation	Name/Designation of Person	Comments/Concerns	Consultant Response
1	07-08-20	EPA Head Office Peshawar	Waheed Khan (DD-EIA)	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 proponent will make a liaison with EPA for necessary applicable approval.
2	07-08-20	EPA Head Office Peshawar	Israr Khan (AD-EIA)	Ground water shall not be contaminated at any level due to construction /operational activities. Solid waste shall be dumped in the landfill under the monitoring of WSSC Mardan	All physical structures and road network assessment is also part of the feasibility and will be considered during the detail design and construction/operational activities.

Figure 9-2: Map Showing the Institutional Consultation Locations

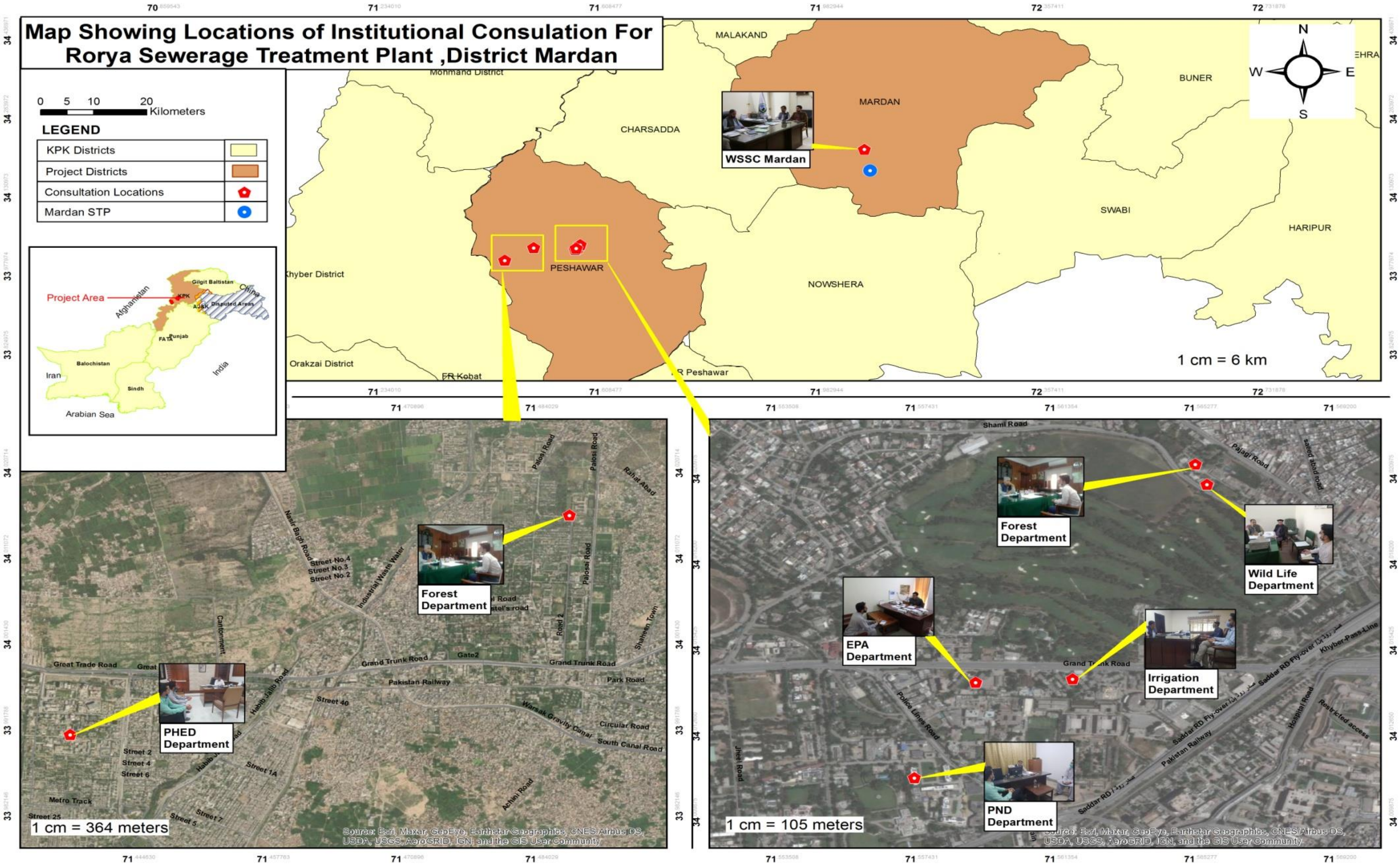


Figure 9-3: Consultations with Institutional Stakeholders

Chief Minister Khyber Pakhtunkhwa Mahmood Khan is being briefed regarding progress on "Citizen Improvement Project" at Peshawar.

EDCM/PMU Environmental and Social Safeguards experts meeting with WSSC-Mardan

PMU Environmental and Social Safeguards experts meeting with WSSC-Mardan

EDCM design team in consultation with Engr Khalil (CEO WSSCM) and assistant managers for discussing the proposed sewerage network of Rorya STP

ADB, EDCM and WSSCM officials joint visit to STP

EDCM design team in consultation with Engr Khalil (CEO WSSCM) and assistant managers for discussing the proposed sewerage network of Rorya STP

EDCM Environment Team in consultation with DD-EIA Waheed Khan, KP-EPA

EDCM Environment Team in consultation with AD-EIA Israr Khan, KP-EPA

9.3 Responses and Proposed Solutions:

265. The people living in the vicinity of the project area had major concerns related to the drainage system of the city. Odor issues and spread of diseases from open sewage system, was their major concern as it became a source of many diseases in the nearby population.

266. The poor drainage infrastructure may be replaced with new pipeline network to improve the sewerage system of the city. The road infrastructure along the route of proposed STP may be improved.

267. These issues were brought up in the public consultations that were held.

268. Residents in the site's vicinity were assured that the sewerage treatment plant will be built utilizing environment-friendly technologies and shall be socially and environmentally sustainable during operational phase. Moreover, roads shall be rehabilitated after laying of sewer lines and no potholes shall be left.

9.4 Consultation Plan for Construction and Operation Phase

269. Consultation plan for construction and operation phase of Mardan STP will be prepared in order to take response of project stakeholders and general public about the project. Periodic consultations and community feedback 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/WSSC Mardan offices and necessary changes in operational modalities will be introduced wihin the system in light of the response provided by the consultees.

10 Grievance Redressal Mechanism

10.1 General

270. 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 project -STP works.

271. 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 will 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.

272. 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.

273. 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.

274. 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.

275. 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 (WSSC), Mardan who will pass unresolved complaints upward to the Grievance Redress Committee (GRC). The GRC will be established by WSSC 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.

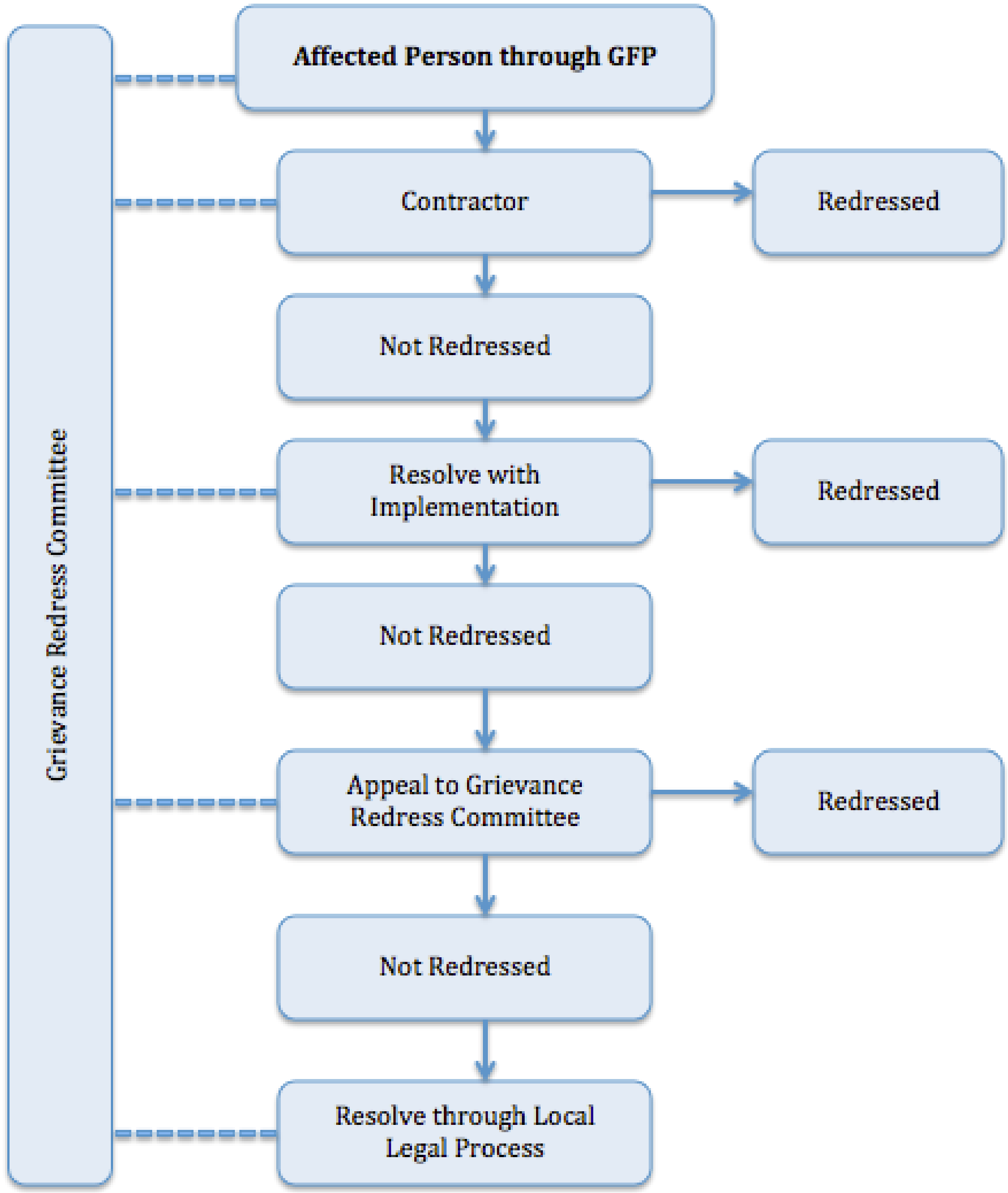
276. The functions of the local GRC are as follows: (i) resolve problems and provide support to affected persons arising from various environmental issues and including dust, noise, utilities, power and water supply, waste disposal, traffic interference and public safety as well as social issues and land acquisition (temporary or permanent if any); 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.

277. The WSSC Mardan 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.

278. **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).

279. In order to provide greater clarity, the pictoral description of the GRM is provided in **Figure 9.1** below.

Figure 10-1: Grievance Redressal Mechanism



11 Conclusion and Recommendations

280. This IEE report covers a detailed environmental and social impact assessment of the proposed project based on field assessments and public consultations with the communities that are likely to benefit or to be affected by the proposed project and other stakeholders in compliance with ADB SPS 2009 and KPEPA 2014 environment and social policy and standards.

281. The development of the proposed sewerage network and sewage treatment plant in Mardan is of high significance considering the urgent need for improving the sanitation situation of Mardan city.

282. 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.

283. 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, Attraction of Vermin and disease vector generation, generation of sludge and disposal, leaks and overflows from sewer lines etc., to name a few.

284. The implementation of mitigation measures during this period will be the responsibility of the operator i.e. WSSC Mardan. Therefore, the required environmental mitigation measures will have to be clearly defined in the standard operating procedures for operation of Sewerage Networks and STP and qualified environmental staff should supervise the implementation process. The EMP includes measures to minimize project impacts during design, construction and operation phases.

285. 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.

286. This project has been assigned environmental category ‘B’ in accordance with the ADB’s Safeguard Policy Statement (SPS) 2009 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/ KP Cities Improvement Project – (Mardan City)

Sector Division: Rorya Sewerage treatment plant of Mardan

Screening Questions	Yes	No	Remarks
B. Project Siting Is the project area…			
▪ Densely populated?		√	The proposed location is surrounded by the Rorya Union Coucil with distance of approximately 1.4km however new construction is going for residential societies/US of Bari cham, BicketGunj, Muslimabad, Hoti, Gulibagh and Rorya.
▪ Heavy with development activities?		√	No development activities presently being conducted in project area of the WWTP.
▪ Adjacent to or within any environmentally sensitive areas?		√	Not applicable for WWTP. (It needs to be assessed if the RoW of the sullage carrier will cross any such sensitive sites.)
• Cultural heritage site		√	Not applicable.

Screening Questions	Yes	No	Remarks
• Protected Area		√	Not applicable.
• Wetland		√	Not applicable.
• Mangrove		√	Not applicable.
• Estuarine		√	Not applicable.
• Buffer zone of protected area		√	Not applicable.
• Special area for protecting biodiversity		√	Not applicable.
• Bay		√	Not applicable.
A. Potential Environmental Impacts Will the Project cause…			
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	
▪ interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?	√		The design of the STP will ensure that odor nuisances, infestations and other contaminations are minimized by providing a buffer zone.
▪ dislocation or involuntary resettlement of people?		√	
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	However, mitigation measures will be incorporated
▪ impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		√	
▪ overflows and flooding of neighboring properties with raw sewage?		√	Not envisioned
▪ environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?	√		Mitigation measures will be incorporated in IEE. Need strict compliance
▪ noise and vibration due to blasting and other civil works?	√		Best management and safety practices should be adopted to protect environment such hazards and can be managed through engineering and administrative controls. No blasting activity would be carried out.

Screening Questions	Yes	No	Remarks
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?	√		However, these impacts would be mitigated by applying best management practices and engineering solutions.
▪ discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?	√		These impacts would be mitigated by applying best management practices and engineering solutions.
▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?	√		The nearest populated area is about approximately 350 meters away from the proposed site.
▪ road blocking and temporary flooding due to land excavation during the rainy season?		√	Strict implementation of safety measures by suggesting in the EMP will reduce these impacts
▪ noise and dust from construction activities?	√		Noise and dust from construction can be minimized and managed with adequate mitigation measures.
▪ traffic disturbances due to construction material transport and wastes?	√		Minor impact and would be mitigated by applying best administrative practices and engineering solutions.
▪ 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 overflow flooding, and groundwater pollution due to failure of sewerage system?	√		Appropriate mitigation measures will be adopted and design engineers will consider to mitigated by applying best administrative practices and engineering solutions.
▪ deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?	√		Would be manage through best engineering solutions.
▪ contamination of surface and ground waters due to sludge disposal on land?	√		Impact would be mitigated by applying best administrative practices and engineering solutions.
▪ health and safety hazards to workers from toxic gases and hazardous materials which maybe contained in confined areas, sewage flow and exposure to pathogens in untreated sewage and un-stabilized sludge?	√		Safety mitigation measures will be adopted to protect workers (as per IFC/EHS guidelines).
▪ large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?	√		Minor impact -However, the contractor shall ensure hiring of local labor and sustainable water usage.
▪ social conflicts between construction workers from other areas and community workers?		√	Not expected, though the contractor shall ensure to hire labors from local community.

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?	√		Strict implementation of safety measures by suggesting in the EMP will reduce these impacts
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components 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?	√		The installation of structural element should be the part of the project.

Expert Response:

Project fall in category: (A)__________(B)____√________(C)_____ ______(F)____________

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 RESETTLEMENT SURVEY FOR KPCIP SUB PROJECTS

Date: ____________

Sr 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	Marla
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 ☐ Leaser

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**

5.1 Specify the existing village/social organizations in your area and state their functional status?

Sr. No.	Name of Organization	Category	Registered/ Unregistered	Functions
1		Religious		
2		Educational		
3		Skill Development		
4		Social Welfare		
5		Women Organization		
6		Other		

6. Leadership Pattern

6.1 Which type of people is influential in village matters and how they decide these matters?

Sr.#	Person / Status	Decision Pattern
1	MPA / MNAs	
2	Head of Tribe	
3	Spiritual / Religious Leader	
4	Land Lord / Lumber Dar	
5	School Teacher	
6	Community Leader	
7	Government Official	
8	Retd. Government Official	
9	Any other (specify)	

6.2 Were their decisions considered final and implemented successfully? ☐ 1. Yes ☐ 2. No

i) Level of acceptability (%) ________ ii) Successful implementation (%) ___________

6.3 Are the general relationship among people in the locality essentially based upon?

1. Competition _______________ 2. Conflict _____________
3. Co–operation _______________ 4. Don't Know ___________

6.4 Were you involved in any dispute in the past 5 years? ☐ 1. Yes ☐ 2. No

6.5 If yes, what was the nature of dispute and how was it resolved

Nature of Dispute	Method of Resolution
1. ________________	________________________
2. ________________	________________________
3. ________________	________________________

7. **Credit**

7.1 Have you obtained credit during last year? Yes [ ], No. [ ], if yes, source of credit.

Formal [ ], Informal [ ]

7.2 Please write the name of relevant source

Formal source (s) ____

Informal source (s) ____

Percentage of interest ____

7.3 Purpose of Loan (Tick)

Purchase House [ ] Rs. ____

Business [ ] Rs. ____

Repair of House [ ] Rs. ____

Medicare of Family Member [ ] Rs. ____

Family/ Social matters [ ] Rs. ____

Farm inputs [ ] Rs. ____

Livestock [ ] Rs. ____

Other (specify) [ ] Rs. ____

7.4 Mode of repayment (Tick the relevant)

1) One time [ ] 2) Through installments [ ],

i) Quarterly installments [ ] ii) Six monthly [ ],

iii) Annual [ ] iv) Other (specify) ____

7.5 How much repayment has been made so far? a) 100%[ ], b)75% [ ], c) 50% [ ], d) 25% [ ], Less than 25 % [ ]

8. **Housing Conditions**

8.1 Do you have your own house?

1) Yes ____ 2) No. ____

If yes then

8.2 Total Area of the house: square ft. Present Value (Rs)________.

Type of Room	No. of Room	Katcha (tick)	Pacca (tick)	Semi Pacca (tick)
Living rooms				
Animal shed				
Other shed				
Bathroom				
Latrine				
- Open				
- Flush				

- 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	[ ]	[ ]
Farm/Crop activities	[ ]	[ ]
Livestock rearing	[ ]	[ ]
Sale & Purchase of properties	[ ]	[ ]
Social obligations (marriage, birthday & other functions)	[ ]	[ ]
Local representation (councilor/ political gathering)	[ ]	[ ]
Others	[ ]	[ ]

11.2 Women issues in the project area

____

____

11.3 Women views about the project

____

____

12. Perceptions of Respondents for Action Associated with the Project

	Increase	Decrease
Employment opportunities	[ ]	[ ]
Marketing facilities opportunities	[ ]	[ ]
Living standard	[ ]	[ ]
Unemployment	[ ]	[ ]
Income generating activities	[ ]	[ ]
Mobility (Access to Resources)	[ ]	[ ]
Quality of drinking water	[ ]	[ ]
Agriculture water	[ ]	[ ]
Trend of fish farm	[ ]	[ ]

Other specify____________________________

13. **General Remarks of the Respondents**

14. **Resettlement Part**

14.1 Do you feel any resettlement 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

If yes then Yes ______ No ______

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

If yes then Yes ______ No ______

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?

____

____

14.9 Miscellaneous Impacts of the Project

____

____

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: ________

Annexure C

Details of Public Consultations

Focal Group Discussion (FGDs)

Project Name: STP

Venue: Misri Abad (mardan)

Sr no ____

Date: 17-3-2020

Sr no	Name	Profession	CNIC	Moza/Village UC, Tehsil & District	Signature/Thumb
1	Bushra	House wife	16101-6682760-2	Mardan	
2	Hira	Hous wife	03345602056 —	Mardan	Hira
3	Nagin	Hous wife	16161-2608438-9	mardan	
4	Dil Agman	Hous wife	16101-6560603-0	Mardan	
5	Afshan	Hous wife	0312-8218213	Mardan	
6	Madina	Hous wife	16172118126	Mardan	Madina Imran
7	Nida	Hous wife	—	Mardan	Nida.
8	Marina khan	Hous wife	16102-9283756-6	Mardan.	Malina Khan
9					
10					
11					
12					

Focal Group Discussion (FGDs)

Project Name: STP

Venue: Hafiz Abad (M)ardan

Sr no ____

Date: 17-3-2020

Sr no	Name	Profession	CNIC	Moza/Village UC, Tehsil & District	Signature/Thumb
1	Shabina	Hous wife	16101-1252737-8	Marda-	
2	Mujamila	〃	16101-0136748-2	〃	
3	Bibi Nisa	〃		〃	
4	Seema	〃		〃	
5	Bakht Naz	〃		〃	
6	Rahat	〃	16101-0884713-0	〃	
7	Toheed	〃		〃	
8	Azra	〃		〃	
9	Aysha	〃		〃	
10					
11					
12					

Focal Group Discussion (FGDs)

Project Name:

Venue: Misree Abad Mardan STP

Sr no 01

Date: 17/3/2020

Sr no	Name	Profession	CNIC	Moza/Village UC, Tehsil & District	Signature/Thumb
1	Muhamad Tufail	class 4 University	16101-0967826-1	Misree Abad.	
2	Zeeshan Khan	operator Police dept	16101-9863061-9	" "	
3	Ibrar Ali	PST Education	16101-1526908-7	" "	
4	Abdul Malik	Govt Employ	0343-9152291	" "	Abdul Malik
5	Noor Rehman	labour	16101-9056536-9	" "	
6	Fazal Ghani	Business	16101-7529968-1		
7	Haji Mohmand	21106-4949709-9		" "	B.G
8	Shahid		16101-2386399-3	" "	
9	Saeed Rahim	Labour	16101-2655150-3	" "	
10	Kafoor Khan	Pratitioner	16101-2330422-3	" "	
11	Mursalin	Labour	16101-1373514	" "	
12					

~~LANDFILL~~ ~~STP~~ MARDAN.
STP

Focal Group Discussion (FGDs)

Project Name: KPCIP

Venue: Village Shamilat (Mardan)

Sr no 02

Date: 17-3-20

Sr no	Name	Profession	CNIC	Moza/Village UC, Tehsil & District	Signature/Thumb
1	Bakhtawar	Labor	16101-5037163-1	Shamilat UC Maho dheri	
2	Iftar	"	0340-9398394	"	افتار
3	Gul Faraz	//	16101-5037287-1	//	گل فراز
4	Karim Khan	//	16101-0623328-3	//	[illegible]
5	Rauf Khan	//	16101-0826912-3	//	رؤف
6					
7					
8					
9					
10					
11					
12					

Annexure D

Environmental Baseline Monitoring

Air Quality

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AMBIENT PARTICULATE MATTERS MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	08-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Air	**Monitoring Instrument:**	AQMS65, Serial # 1310
Location:	STP Quarters		
GPS Coordinates:	72.05346 E 34.16774 N		

Sr. No	Time	Parameters		Results (Average 24 Hrs)	
		$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
		Units			
	Hours	(μg/m^3)	(μg/m^3)		
1.	08:30 AM	18.15	58.65	13.05 (μg/m3)	46.14 (μg/m3)
2.	09:30 AM	10.05	60.95		
3.	10:30 AM	15.65	56.15		
4.	11:30 AM	16.95	57.45		
5.	12:30 PM	15.75	56.25		
6.	01:30 PM	13.55	67.75		
7.	02:30 PM	16.95	65.25		
8.	03:30 PM	18.05	59.45		
9.	04:30 PM	16.15	56.65		
10.	05:30 PM	13.75	54.25		
11.	06:30 PM	13.65	54.15		
12.	07:30 PM	10.95	51.45		
13.	08:30 PM	5.85	46.35		
14.	09:30 PM	2.75	43.25		
15.	10:30 PM	10.65	39.75		
16.	11:30 PM	9.15	38.15		
17.	12:30 AM	9.55	36.45		
18.	01:30 AM	13.95	33.25		
19.	02:30 AM	15.05	32.65		
20.	03:30 AM	15.85	26.35		
21.	04:30 AM	16.05	25.45		
22.	05:30 AM	12.95	27.75		
23.	06:30 AM	6.75	30.25		
24.	07:30 AM	14.95	29.25		
NEQSAA				35 (μg/m^3)	150 (μg/m^3)
WHO				25 (μg/m^3)	50 (μg/m^3)

NEQSAA: National Environmental Quality Standards for Ambient Air
WHO: World Health Organization
Note:

- Selected measurement units were μg/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.

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Signature of Analyst: Signature of Chief Chemist

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AMBIENT PARTICULATE MATTERS MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	09-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Air	**Monitoring Instrument:**	AQMS65, Serial # 1310
Location:	Mardan Sports Complex		
GPS Coordinates:	72.05082 E 34.16525 N		

Sr. No	Time	Parameters		Results (Average 24 Hrs)	
		$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
		Units			
	Hours	(μg/m³)	(μg/m³)		
1	09:30 AM	11.93	67.46	10.20 (μg/m³)	62.41 (μg/m³)
2	10:30 AM	10.8	66.33		
3	11:30 AM	14.39	49.78		
4	12:30 PM	12.54	68.07		
5	01:30 PM	5.99	61.52		
6	02:30 PM	12.98	47.81		
7	03:30 PM	11.75	67.28		
8	04:30 PM	11.02	59.55		
9	05:30 PM	10.2	45.84		
10	06:30 PM	10.79	66.32		
11	07:30 PM	10.06	57.59		
12	08:30 PM	11.54	67.07		
13	09:30 PM	11.82	67.35		
14	10:30 PM	0.09	55.62		
15	11:30 PM	11.57	67.1		
16	12:30 AM	11.84	67.37		
17	01:30 AM	12.31	67.84		
18	02:30 AM	11.6	67.13		
19	03:30 AM	12.03	67.56		
20	04:30 AM	12.34	67.87		
21	05:30 AM	7.72	63.25		
22	06:30 AM	14.3	50		
23	07:30 AM	12.38	67.91		
24	08:30 AM	8.8	64.33		
NEQSAA				35 (μg/m³)	150 (μg/m³)
WHO				25 (μg/m³)	50 (μg/m³)

NEQSAA: National Environmental Quality Standards for Ambient Air
WHO: World Health Organization
Note:

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Signature of Analyst: *Signature of Chief Chemist*

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ENVIRONMENTAL PROTECTION AGENCY Khyber Pakhtunkhwa EPA Accredited

AMBIENT PARTICULATE MATTERS MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	11-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Air	**Monitoring Instrument:**	AQMS65, Serial # 1310
Location:	New Police Line Near Chakkar Pull		
GPS Coordinates:	72.05813 E 34.16911 N		

Sr. No	Time	Parameters		Results (Average 24 Hrs)	
		$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
		Units			
	Hours	(µg/m^3)	(µg/m^3)		
1	10:00 AM	14.9	53.15	9.97 (µg/m^3)	51.11 (µg/m^3)
2	11:00 AM	6.8	59.65		
3	12:00 PM	12.4	62.75		
4	01:00 PM	13.7	64.45		
5	02:00 PM	12.5	65.35		
6	03:00 PM	10.3	66.85		
7	04:00 PM	13.7	65.05		
8	05:00 PM	14.8	55.15		
9	06:00 PM	12.9	62.55		
10	07:00 PM	10.5	66.25		
11	08:00 PM	10.4	63.65		
12	09:00 PM	9.7	59.95		
13	10:00 PM	10.6	58.35		
14	11:00 PM	8.7	51.75		
15	12:00 AM	7.4	49.45		
16	01:00 AM	5.9	44.75		
17	02:00 AM	6.3	43.25		
18	03:00 AM	10.7	40.75		
19	04:00 AM	11.8	38.85		
20	05:00 AM	12.6	31.75		
21	06:00 AM	12.8	29.75		
22	07:00 AM	9.7	26.95		
23	08:00 AM	3.5	31.98		
24	09:00 AM	11.7	34.25		
NEQSAA				35 (µg/m^3)	150 (µg/m^3)
WHO				25 (µg/m^3)	50 (µg/m^3)

NEQSAA: National Environmental Quality Standards for Ambient Air
WHO: World Health Organization
Note:

- Selected measurement units were µg/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.
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Signature of Analyst: Signature of Chief Chemist

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AMBIENT GASEOUS MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	08-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Air (Gaseous)	**Monitoring Instrument:**	AQMS65, Serial # 1310
Location:	STP Quarters		
GPS Coordinates:	72.05346 E 34.16774 N		

Sr. No	Time	CO	NO	NO_2	SO_2
		Parameters			
		Units			
	Hours	(mg/m³)	(µg/m³)	(µg/m³)	(µg/m³)
1.	08:30 AM	0.83	10.46	9.92	12.35
2.	09:30 AM	0.85	10.48	10.10	12.22
3.	10:30 AM	0.81	10.33	10.34	11.49
4.	11:30 AM	0.96	10.42	9.28	11.62
5.	12:30 PM	0.95	10.40	9.15	11.77
6.	01:30 PM	0.97	11.13	9.26	10.65
7.	02:30 PM	0.99	10.24	9.62	11.27
8.	03:30 PM	1.03	10.37	9.77	12.61
9.	04:30 PM	0.92	10.41	9.29	10.49
10.	05:30 PM	0.90	10.00	9.34	10.78
11.	06:30 PM	0.80	9.63	9.99	12.21
12.	07:30 PM	0.77	9.42	9.10	11.88
13.	08:30 PM	0.72	9.34	9.53	11.65
14.	09:30 PM	0.70	9.33	9.34	11.11
15.	10:30 PM	0.73	8.94	10.21	11.96
16.	11:30 PM	0.67	8.53	9.46	12.24
17.	12:30 AM	0.63	8.09	9.00	11.17
18.	01:30 AM	0.62	8.61	9.16	10.98
19.	02:30 AM	0.66	8.91	9.04	10.76
20.	03:30 AM	0.67	9.41	8.47	11.27
21.	04:30 AM	0.68	9.78	7.90	11.63
22.	05:30 AM	0.72	9.73	8.96	12.12
23.	06:30 AM	0.74	10.15	9.25	11.92
24.	07:30 AM	0.80	10.08	9.15	11.77
Average Concentration		**0.79**	**9.76**	**9.36**	**11.58**
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
WHO: World Health Organization
Note:

- Selected measurement units were mg/m³ and µg/m³ otherwise stated.
- Quality was assured through self calibration of the instrument.
- The values were representing of monitoring conditions prevailing during the monitoring hours.
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Signature of Analyst — Signature of Chief Chemist

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AMBIENT GASEOUS MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	09-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Air (Gaseous)	**Monitoring Instrument:**	AQMS65, Serial # 1310
Location:	Mardan Sports Complex		
GPS Coordinates:	72.05082 E 34.16525 N		

Sr. No	Time	Parameters			
		CO	NO	NO_2	SO_2
		Units			
	Hours	(mg/m^3)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)
1	09:30 AM	0.80	8.29	9.98	12.53
2	10:30 AM	0.83	9.14	10.16	12.40
3	11:30 AM	0.77	9.21	10.40	11.67
4	12:30 PM	0.83	9.96	9.34	11.80
5	01:30 PM	0.82	9.36	9.21	11.95
6	02:30 PM	0.80	9.54	9.32	10.83
7	03:30 PM	0.78	10.08	9.68	11.45
8	04:30 PM	0.73	9.22	9.83	12.79
9	05:30 PM	0.69	8.38	9.35	10.67
10	06:30 PM	0.75	8.15	9.40	10.96
11	07:30 PM	0.61	8.93	10.05	12.39
12	08:30 PM	0.67	9.26	9.16	12.06
13	09:30 PM	0.43	9.87	9.59	11.83
14	10:30 PM	0.48	8.15	9.40	11.29
15	11:30 PM	0.41	7.72	10.27	12.14
16	12:30 AM	0.53	8.90	9.52	12.42
17	01:30 AM	0.50	8.38	9.06	11.35
18	02:30 AM	0.57	8.22	9.22	11.16
19	03:30 AM	0.69	10.01	9.10	10.94
20	04:30 AM	0.70	9.22	8.53	11.45
21	05:30 A.M	0.75	8.98	7.96	11.81
22	06:30 A.M	0.73	8.71	9.02	12.30
23	07:30 A.M	0.55	9.26	9.31	12.10
24	08:30 A.M	0.78	8.50	9.21	11.95
Average Concentration		**0.67**	**8.98**	**9.42**	**11.76**
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

WHO: World Health Organization

Note:

- Selected measurement units were mg/m^3 and $\mu g/m^3$ 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.
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Signature of Analyst — Signature of Chief Chemist

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FOR ENVIRONMENTAL MONITORING, ANALYSIS & SURVEYS

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AMBIENT GASEOUS MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	11-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Air (Gaseous)	**Monitoring Instrument:**	AQMS65, Serial # 1310
Location:	New Police Line Near Chakkar Pull		
GPS Coordinates:	72.05813 E 34.16911 N		

Sr. No	Time	Parameters			
		CO	NO	NO_2	SO_2
		Units			
	Hours	(mg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)
1	10:00 AM	0.96	9.98	13.05	11.82
2	11:00 AM	0.91	10.29	12.82	11.59
3	12:00 PM	0.95	11.16	13.55	12.32
4	01:00 PM	0.94	11.11	14.09	12.86
5	02:00 PM	0.92	11.34	13.73	12.50
6	03:00 PM	0.90	10.10	12.89	11.66
7	04:00 PM	0.89	11.13	13.09	11.86
8	05:00 PM	0.92	11.01	13.47	12.24
9	06:00 PM	0.93	11.15	13.10	11.87
10	07:00 PM	0.91	10.20	12.69	11.46
11	08:00 PM	0.90	9.88	11.94	10.71
12	09:00 PM	0.69	10.09	10.85	9.62
13	10:00 PM	0.73	8.89	10.80	9.57
14	11:00 PM	0.82	8.97	10.62	9.39
15	12:00 AM	0.69	9.17	11.73	10.50
16	01:00 AM	0.64	9.33	11.42	10.19
17	02:00 AM	0.67	9.61	11.61	10.38
18	03:00 AM	0.61	9.95	11.87	10.64
19	04:00 AM	0.67	10.48	10.62	9.39
20	05:00 AM	0.69	10.17	11.45	10.22
21	06:00 AM	0.85	9.98	10.86	9.63
22	07:00 AM	0.86	10.26	10.09	8.86
23	08:00 AM	0.87	10.47	10.60	9.37
24	09:00 AM	0.95	10.33	10.41	9.18
Average Concentration		**0.82**	**10.21**	**11.97**	**10.74**
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
WHO: World Health Organization
Note:

- Selected measurement units were mg/m^3 and µg/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.
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Noise Level

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NOISE LEVEL MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	08-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Condition	**Monitoring Instrument:**	Noise Meter-IEC651-Type-2
Location:	STP Quarters		

Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq
1	08:30 AM	dB(A)	43.84	47.71	45.7
2	09:30 AM		43.64	47.51	45.5
3	10:30 AM		43.44	47.31	45.3
4	11:30 AM		43.24	47.11	45.1
5	12:30 PM		43.04	46.91	44.9
6	01:30 PM		42.84	46.61	44.7
7	02:30 PM		42.54	46.41	44.4
8	03:30 PM		42.34	46.21	44.2
9	04:30 PM		42.14	46.01	44.0
10	05:30 PM		41.94	45.81	43.8
11	06:30 PM		41.74	45.61	43.6
12	07:30 PM		41.54	45.31	43.4
13	08:30 PM		41.24	45.11	43.1
14	09:30 PM		41.04	44.91	42.9
15	10:30 PM		40.84	44.71	42.7
16	11:30 PM		40.64	44.51	42.5
17	12:30 AM		40.44	44.31	42.3
18	01:30 AM		40.24	44.11	42.1
19	02:30 AM		40.04	43.91	41.9
20	03:30 AM		39.84	43.61	41.7
21	04:30 AM		39.54	43.41	41.4
22	05:30 AM		39.34	43.21	41.2
23	06:30 AM		39.14	43.01	41.0
24	07:30 AM		38.94	42.81	40.8
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: 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: Signature of Chief Chemist

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NOISE LEVEL MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	09-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Condition	**Monitoring Instrument:**	Noise Meter-IEC651-Type-2
Location:	Mardan Sports omplex		

Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq
1	09:30 AM	dB(A)	57.61	61.51	59.56
2	10:30 AM		57.41	61.31	59.36
3	11:30 AM		57.21	61.11	59.16
4	12:30 PM		57.01	60.91	58.96
5	01:30 PM		56.81	60.71	58.76
6	02:30 PM		56.61	60.41	58.51
7	03:30 PM		56.31	60.21	58.26
8	04:30 PM		56.11	60.01	58.06
9	05:30 PM		55.91	59.81	57.86
10	06:30 PM		55.71	59.61	57.66
11	07:30 PM		55.51	59.41	57.46
12	08:30 PM		55.31	59.11	57.21
13	09:30 PM		55.01	58.91	56.96
14	10:30 PM		54.81	58.71	56.76
15	11:30 PM		54.61	58.51	56.56
16	12:30 AM		54.41	58.31	56.36
17	01:30 AM		54.21	58.11	56.16
18	02:30 AM		54.01	57.91	55.96
19	03:30 AM		53.81	57.71	55.76
20	04:30 AM		53.61	57.41	55.51
21	05:30 A.M		53.31	57.21	55.26
22	06:30 A.M		53.11	57.01	55.06
23	07:30 A.M		52.91	56.81	54.86
24	08:30 A.M		52.71	56.61	54.66

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: 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.
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NOISE LEVEL MONITORING REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Monitoring Date:	11-05-2020	**Reporting Date:**	18-05-2020
Source:	Ambient Condition	**Monitoring Instrument:**	Noise Meter-IEC651-Type-2
Location:	New Police Line Near Chakkar Pull		

Sr. No.	Monitoring Time	Unit	Minimum	Maximum	Leq
1	10:00 AM		53.41	57.31	55.36
2	11:00 AM		53.21	57.11	55.16
3	12:00 PM		53.01	56.91	54.96
4	01:00 PM		52.81	56.71	54.76
5	02:00 PM		52.61	56.51	54.56
6	03:00 PM		52.41	56.21	54.31
7	04:00 PM		52.11	56.01	54.06
8	05:00 PM		51.91	55.81	53.86
9	06:00 PM		51.71	55.61	53.66
10	07:00 PM		51.51	55.41	53.46
11	08:00 PM		51.31	55.21	53.26
12	09:00 PM		51.11	54.91	53.01
13	10:00 PM	dB(A)	50.81	54.71	52.76
14	11:00 PM		50.61	54.51	52.56
15	12:00 AM		50.41	54.31	52.36
16	01:00 AM		50.21	54.11	52.16
17	02:00 AM		50.01	53.91	51.96
18	03:00 AM		49.81	53.71	51.76
19	04:00 AM		49.61	53.51	51.56
20	05:00 AM		49.41	53.21	51.31
21	06:00 AM		49.11	53.01	51.06
22	07:00 AM		48.91	52.81	50.86
23	08:00 AM		48.71	52.61	50.66
24	09:00 AM		48.51	52.41	50.46

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: Equivalent Continuous Sound Level

Note:

- Selected measurement units were dB (A) otherwise stated.
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Ground Water

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WATER ANALYSIS REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project.	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Sampling Date:	08-05-2020	**Reporting Date:**	18-05-2020
Source:	Ground Water	**Sampling Done by:**	Analyst
Location:	Masjid Spin Jumaat	**Analysis Method:**	APHA/USEPA Standard Methods

Sr. No.	Parameters	Analysis Methods	Units	NDWQS	Results
1.	pH	APHA-4500H+ B	--	6.5-8.5	7.1
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.	E-Coli	APHA:9222 D	Number/100 mL	0 Number/100 mL	0
6.	Total Coliform	APHA:9222 B	Number/100 Ml	0 Number/100 mL	0
7.	Total Dissolved Solids (TDS)	APHA-2540 C	mg/L	<1000	180
8.	Total Hardness	APHA-2340 C	mg/L	<500	69
9.	Nitrate	APHA-4500NO3 B	mg/L	≤50	3.4
10.	Nitrite	APHA-4500NO2 B	mg/L	≤3	0.03
11.	Ammonia	APHA-4500-NH3-B	mg/L	-----	0.08
12.	Arsenic	APHA-3500As B	mg/L	≤0.05	N.D.
13.	Antimony	APHA-3500Sb B	mg/L	<0.005	N.D.
14.	Barium	APHA-3500Ba-B	mg/L	0.7	N.D
15.	Chloride	APHA-4500Cl- B	mg/L	<250	91
16.	Fluoride	APHA-4500F- C	mg/L	≤1.5	0.78
17.	Aluminum	APHA-3500 Al	mg/L	≤0.2	N.D.
18.	Manganese	APHA-3500 MN-B	mg/L	≤0.5	N.D.
19.	Mercury	APHA-3500 Hg-B	mg/L	≤0.001	N.D.
20.	Iodine		mg/L	-----	0.1
21.	Zinc	APHA- 3500 Zn B	mg/L	5.0	0.84
22.	Boron	APHA 4500 B- C	mg/L	0.3	N.D.
23.	Chromium	APHA 3500 cr B	mg/L	≤0.05	N.D
24.	Selenium	APHA- 3500 Se C	mg/L	0.01	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/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project.	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Sampling Date:	08-05-2020	**Reporting Date:**	18-05-2020
Source:	Ground Water	**Sampling Done by:**	Analyst
Location:	Special Branch Near STP Site	**Analysis Method:**	APHA/USEPA Standard Methods

Sr. No.	Parameters	Analysis Methods	Units	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	4
5.	E-Coli	APHA:9222 D	Number/100 mL	0 Number/100 mL	0
6.	Total Coliform	APHA:9222 B	Number/100 mL	0 Number/100 mL	0
7.	Total Dissolved Solids (TDS)	APHA-2540 C	mg/L	<1000	186
8.	Total Hardness	APHA-2340 C	mg/L	<500	61
9.	Nitrate	APHA-4500NO3 B	mg/L	≤50	4.1
10.	Nitrite	APHA-4500NO2 B	mg/L	≤3	0.06
11.	Ammonia	APHA-NH3-B	mg/L	-----	0.03
12.	Arsenic	APHA-3500As B	mg/L	≤0.05	N.D.
13.	Antimony	APHA-3500Sb B	mg/L	<0.005	N.D.
14.	Barium	APHA-3500 Ba B	mg/L	0.7	0.41
15.	Chloride	APHA-4500Cl- B	mg/L	<250	76
16.	Fluoride	APHA-4500F- C	mg/L	≤1.5	0.78
17.	Aluminum	APHA-3500 Al	mg/L	≤0.2	N.D.
18.	Manganese (Mn)	APHA-3500 MN-B	mg/L	≤0.5	N.D.
19.	Mercury (Hg)	APHA-3500 Hg-B	mg/L	≤0.001	N.D.
20.	Iodine		mg/L	-----	0.07
21.	Zinc (Zn)	APHA- 3500 Zn B	mg/L	5.0	1.6
22.	Boron (B)	APHA 4500 B- C	mg/L	0.3	N.D.
23.	Chromium (Cr)	APHA 3500 cr B	mg/L	≤0.05	N.D.
24.	Selenium (Se)	APHA- 3500 Se C	mg/L	0.01	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/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project.	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Sampling Date:	09-05-2020	**Reporting Date:**	18-05-2020
Source:	Ground Water	**Sampling Done by:**	Analyst
Location:	Chakkar Pull	**Analysis Method:**	APHA/USEPA Standard Methods

Sr. No.	Parameters	Analysis Methods	Units	NDWQS	Results
1	pH	APHA-4500H+ B	--	6.5-8.5	7.3
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	E-Coli	APHA:9222 D	Number/100 mL	0 Number/100 mL	0
6	Total Coliform	APHA:9222 B	Number/100 mL	0 Number/100 mL	0
7	Total Dissolved Solids (TDS)	APHA-2540 C	mg/L	<1000	183
8	Total Hardness	APHA-2340 C	mg/L	<500	279
9	Nitrate	APHA-4500NO3 B	mg/L	≤50	4.7
10	Nitrite	APHA-4500NO2 B	mg/L	≤3	0.0079
11	Ammonia	APHA-4500-NH3-B	mg/L	----	0.07
12	Arsenic	APHA-3500As B	mg/L	≤0.05	N.D.
13	Antimony	APHA-3500Sb B	mg/L	<0.005	N.D.
14	Barium	APHA-3500 Ba B	mg/L	0.7	0.3
15	Chloride	APHA-4500Cl- B	mg/L	<250	96
16	Fluoride	APHA-4500F- C	mg/L	≤1.5	0.89
17	Aluminum	APHA-3500 Al	mg/L	≤0.2	N.D.
18	Manganese	APHA-3500 MN-B	mg/L	≤0.5	N.D.
19	Mercury	APHA-3500 Hg-B	mg/L	≤0.001	N.D.
20	Iodine		mg/L	----	0.05
21	Zinc (Zn)	APHA- 3500 Zn B	mg/L	5.0	1.07
22	Boron (B)	APHA 4500 B- C	mg/L	0.3	N.D.
23	Chromium (Cr)	APHA 3500 cr B	mg/L	≤0.05	N.D.
24	Selenium (Se)	APHA- 3500 Se C	mg/L	0.01	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/93-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project.	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Sampling Date:	09-05-2020	**Reporting Date:**	18-05-2020
Source:	Ground Water	**Sampling Done by:**	Analyst
Location:	Masjid facing Bacha Khan Agriculture University, Mardan	**Analysis Method:**	APHA/USEPA Standard Methods

Sr. No.	Parameters	Analysis Methods	Units	NDWQS	Results
1	pH	APHA-4500H+ B	--	6.5-8.5	6.9
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	E-Coli	APHA:9222 D	Number/100 mL	0 Number/100 mL	0
6	Total Coliform	APHA:9222 B	Number/100 mL	0 Number/100 mL	0
7	Total Dissolved Solids (TDS)	APHA-2540 C	mg/L	<1000	149
8	Total Hardness	APHA-2340 C	mg/L	<500	68
9	Nitrate	APHA-4500NO3 B	mg/L	≤50	5.9
10	Nitrite	APHA-4500NO2 B	mg/L	≤3	0.0068
11	Ammonia	APHA-4500-NH3-B	mg/L	----	0.08
12	Arsenic	APHA-3500As B	mg/L	≤0.05	N.D.
13	Antimony	APHA-3500Sb B	mg/L	<0.005	N.D.
14	Barium	APHA-3500 Ba B	mg/L	0.7	0.2
15	Chloride	APHA-4500Cl- B	mg/L	<250	92
16	Fluoride	APHA-4500F- C	mg/L	≤1.5	0.73
17	Aluminum	APHA-3500 Al	mg/L	≤0.2	N.D.
18	Manganese	APHA-3500 MN-B	mg/L	≤0.5	N.D.
19	Mercury	APHA-3500 Hg-B	mg/L	≤0.001	N.D.
20	Iodine		mg/L	----	0.06
21	Zinc (Zn)	APHA- 3500 Zn B	mg/L	5.0	1.08
22	Boron (B)	APHA 4500 B- C	mg/L	0.3	N.D.
23	Chromium (Cr)	APHA 3500 cr B	mg/L	≤0.05	N.D.
24	Selenium (Se)	APHA- 3500 Se C	mg/L	0.01	N.D.

NDWQS: National Drinking Water Quality Standards

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Signature of Analyst: *Signature of Chief Chemist*

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Surface Water Quality Analysis

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Khyber Pakhtunkhwa
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SURFACE WATER ANALYSIS REPORT

Reference Number	KPCIP/ENV/95-2020		
Project Name:	Khyber Pakhtunkhwa Cities Improvement Project.	**Site Address:**	University Road, Mistriabad, STP Plant, District Mardan
Sampling Date:	08-05-2020	**Reporting Date:**	18-05-2020
Source:	Surface Water	**Sampling Done by:**	Analyst
Location:	Wali-abad residency	**Analysis Method:**	APHA/USEPA Standard Methods

Sr. No	Parameters	Analysis Method	Units	NEQS	Results
1	Temperature	-----	°C	40	29
2	pH	APHA-4500H+ B	---	6-9	6.8
3	Chemical Oxygen Demand (COD)	APHA-5220-D	mg/l	150	101
4	Biological Oxygen Demand (BOD_5) at 20 °C	APHA, 5210	mg/l	80	68
5	Total Dissolved Solids (TDS)	APHA-2540 C	mg/l	3500	1437
6	Total Suspended Solids (TSS)	APHA-2540 D	mg/l	200	146
7	Total Hardness	APHA-2340 C	mg/l	--	168
8	Oil & Grease	Separation Method	mg/l	10	2.7
9	Chromium	APHA-3500Cr B	mg/l	1.0	1.6
10	Total Iron	APHA-3500-Fe-B	mg/l	8.0	2.1
11	Chloride	APHA-4500Cl- B	mg/l	1000	139
12	Flouride	APHA-4500F- C	mg/l	10	3.7
13	Chlorine	APHA-4500 CL	mg/l	1.0	0.39
14	Ammonia	ASTM-D1426-15	mg/l	40	6.3
15	Cadmium	APHA-3500 Cd-B	mg/l	0.1	0.0
16	Lead	APHA-3500-Pb B	mg/l	0.5	0.07
17	Arsenic	APHA-3500As B	mg/l	1.0	0.03
18	Copper	APHA-3500Cu B	mg/l	1.0	0.01
19	Barium	APHA-3500Ba B	mg/l	1.5	0.4
20	Selenium	APHA- 3500 Se C	mg/l	0.5	N.D
21	Silver	APHA-3500Ag-B	mg/l	1.0	N.D
22	Manganese	APHA-3500-Mn B	mg/l	1.5	0.87
23	Zinc	APHA-3500-Zn B	mg/l	5.0	0.13
24	Nickel	ASTM E3047-16	mg/l	1.0	0.47
25	Boron	APHA-4500B-C	mg/l	6.0	N.D
26	Mercury	APHA-3500 Hg-B	mg/l	0.01	N.D
27	Sulphide	APHA-4500 S2	mg/l	1.0	0.47

FOR ENVIRONMENTAL MONITORING, ANALYSIS & SURVEYS

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Environmental Protection Agency (EPA-KPK) Certified

Integrated Environment Laboratory

ENVIRONMENTAL PROTECTION AGENCY Khyber Pakhtunkhwa
EPA Accredited

28	Sulphate	APHA-4500-SO4 C	mg/l	600	133
29	An Ionic Detergent (as MBAS)	----	mg/l	20	3.7
30	Phenolic Compound (as Phenol)	APHA-5530-D	mg/l	0.1	0.02
31	Cyanide (as CN) total	APHA 4500-CN	mg/l	1.0	N.D

NEQS: National Environmental Quality Standards for effluents
N.D: Not Detected

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 should be capable of supporting at least 6 times the maximum intended load applied or transmitted to that rope. Pole scaffolds over 60 feet in height shall be designed by a registered professional engineer and shall be constructed and loaded in accordance with that design. Where scaffolds are not provided, safety belts/safety nets shall be provided;

vii. Ensure that all ramps or walkways are at least 6 feet wide, having slip resistance threads and not inclined at more than a slope of 1 vertical and 3 horizontal.

viii. Stacking away all excavated earth at least 2 feet from the pit to avoid material such as loose rocks from falling back into the excavated area and injuring those working inside excavated sites.

ix. Constructing support systems, such as bracing to adjoining structures that may be endangered by excavation works nearby.

x. Only a trained electrician to construct, install and repair all electrical equipment to prevent risks of electrical shocks and electrocution.

xi. Install fire extinguishers and/or other fire-fighting equipment at every work site to prepare for any accidental fire hazards.

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 should be in place:

i. Provision of dispensaries by the individual EPC contractor.

ii. A vehicle shall be on standby from the Project Office so that emergency transportation can be arranged to take severely injured/sick workers to the nearest hospital for immediate medical attention.

iii. A designated Health Officer/worker for the Project will be identified as a focal person to attend to all health and safety related issues. This employee's contact number will be posted at all work sites for speedy delivery of emergency services. The focal person shall be well versed with the medical system and facilities available at the hospital.

iv. Communication arrangements, such a provision of radios or mobile communication for all work sites, for efficient handling of emergencies, will be made.

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 should 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 F.1** below.

Table F.1 Emergency Response Team

Action Group	Responsibility
Emergency Coordinator	Overall control of personnel and resources. The Emergency Coordinator will support and advise the Site Safety Supervision as necessary. Serves as public relations spokes persons, or delegates to some staff member the responsibility for working with news media regarding any disaster or emergency. Also assure proper coordination of news release with appropriate corporate staff or other designated people.
Site Safety Supervision (Emergency Commander)	Overall responsibility for activating emergency plan and for terminating emergency actions. Be alternative of emergency response chairpersons. Disseminates warnings and information as required to ensure all people in the immediate area have been warned and evacuated either by alarms or by word of mouth. Supervise the actions of the Emergency Response Team to ensure all persons are safe from the danger. Notify outside authorities if assistance is required. Carries the responsibility for coordinating actions including other organizations in accordance with the needs of the situation. Ensure maximum co-operation and assistance is provided to any outside groups called to respond to an emergency. Establish and appoint all emergency organization structure and team. Assures adequate delegation of responsibilities for all key positions of assistants on the Project to assist with any foreseeable emergency. Ensure resources available to purchase needed emergency response equipment and supplies. Assures that all persons on the Emergency Response Team aware and fully understand their individual responsibilities for implementing and supporting the emergency plan. Establish the emergency drill schedule of all identified emergency scenarios, track the status and evaluate the emergency.

Action Group	Responsibility
	The Emergency Commander shall ensure that senior management personnel have been reported of the emergency as soon as practical after the event.
Security Team	Ensure that the exit route is regularly tested and maintained in good working order. Maintain station at the security gate or most suitable location to secure the area during any emergency such that only authorized personnel and equipment may enter, prevent access to the site of unauthorized personnel. Assist with strong/activation of services during an emergency. Ensure vehicles and obstructions are moved to give incoming emergency vehicles access to the scene, if ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct any incoming emergency service to the site of emergency.
Rescue & Medical Team	Protect the injured from further danger and weather. Provide treatment to the victim(s) to the best of their ability by first aid and then transfer to hospital. Remain familiar with the rescue activities and rescue apparatus. Assist outside medical services personnel when they arrive
General Administration Team	Response to support any requested general facilities for assisting Emergency Response Team in their work.
Government Relation Team	Coordinate with local government on a matter of concerned in the emergency response plan to liaise with local officers in their affair for support Emergency Response Team. Coordinate emergency plan with the government authorities, local community.
Environment Team	In case of emergency related to the environmental pollution such as the chemical spill, oil spill into the ambient, the environment team will support the technical advice to control and mitigate the pollution until return to the normal situation.
Department Heads	Call up of personnel into the safe location for protective life and property.

Action Group	Responsibility
	Take immediate and appropriate action while Emergency Response Team is being mobilized. Keep in touch with the Emergency Commander Control and supervise operators and contractors on the implementation of this procedure, with consultation with Safety Team as necessary. Provide and maintain emergency equipment of their responsible areas.
Other Staff and Employees	All other staff and employees will remain at their workstations or assembly point unless directed otherwise from Emergency Response Team. Each supervisor will ensure that all members of his work group are accounted for and keep in touch with each of their Department Head.

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

FIRE

RESCUE
- Rescue any person in immediate danger if safe to do so

ALARM
- Raise the alarm by shouting to raise attention to others
- If confident and safe to do so, commence fighting the fire

EVACUATE
- If not practical to fight the fire, move to safe area ensuring all other personnel are warned along the way

REPORT
- Advice the Emergency coordinator of the reasons for the alarm and location of fire.

Fig

A

take the following action:

If a hazard exists consider your own safety then if possible remove the hazard or the injured person.

Assess the patient by checking for Airway, Breathing, Pulse and obvious

Report directly to First Aid or Security Centers, when raising the alarm you must clearly give the following in formation;
- Your name and the detail of accident
- The location of the injured person(s)
- The number of persons injured
- The extent of the injuries, if known
- What known hazards are in the area

Make the injured person as comfortable as possible

Treat the obvious injuries

Reassure the injured person

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 should also,

Provide treatment to the victim(s) to the best of his/her ability.

Ensure the safety of victims by ceasing any work activity in the area.

Protect the injured from further danger and weather.

Assist medical services personnel when they arrive.

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.

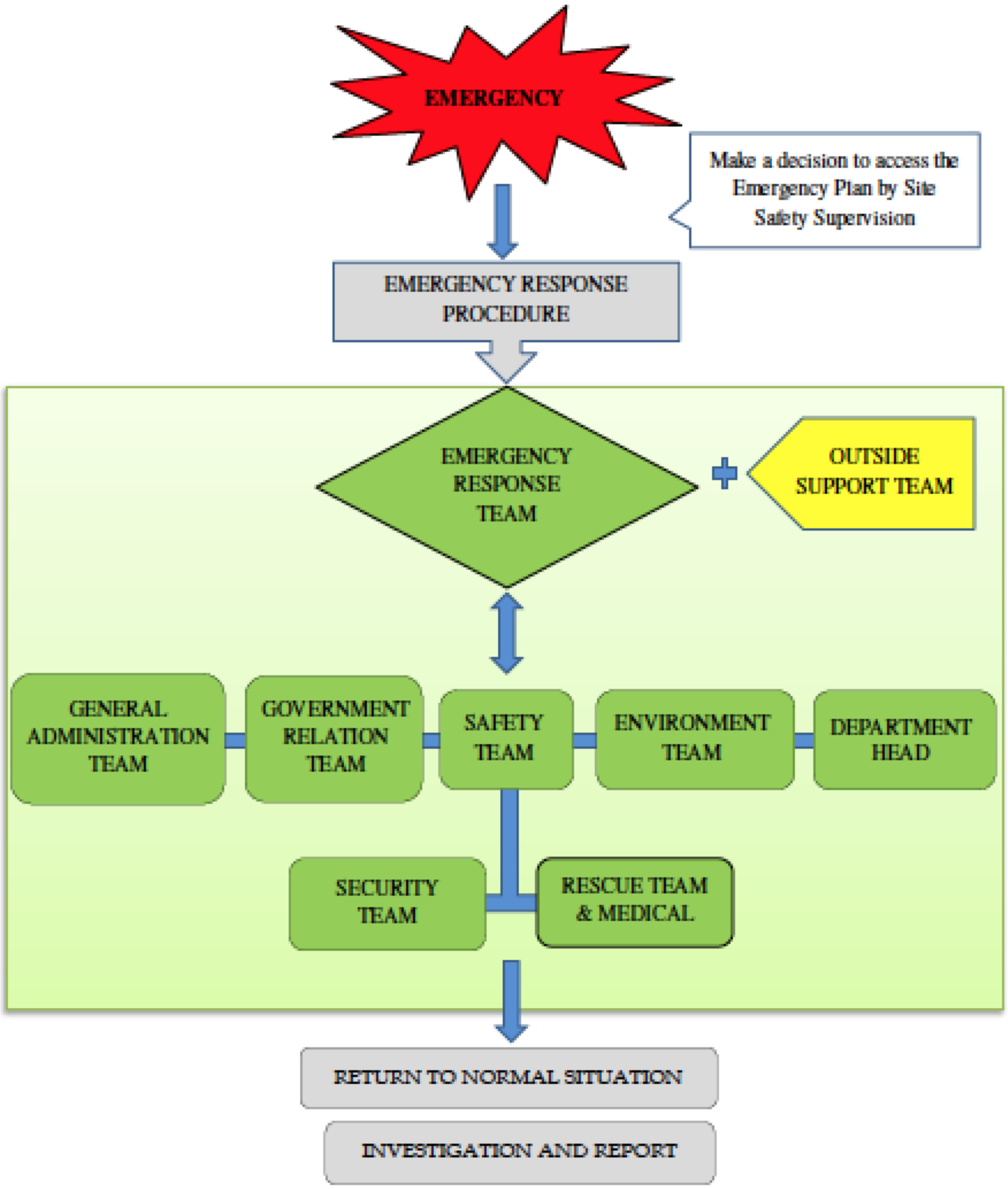
Prevent access to the site of unauthorized personnel (press, etc.).

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.



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

F.5 INCIDENT AND ACCIDENT REPORT

Section A: Identification Data

Report No:	Date of Reported:	Reporter:	Sign:
Job Title:		Company Name:	

Section B: Violence Rate

Accident Violence: ☐ 01-Death ☐ 02-Serious Injury ☐ 03-Lost Time Injury ☐ 04-First Aid ☐ 05- Not Injury ☐ 06-Near Miss

Property Damage Cost: ☐ 1-2,000 USD ☐ 2,001-10,000 USD ☐ 10,001-50,000 ☐ > 50,001

Section C: Environmental Impact

Affected area	☐ Construction area	☐ Public area	
Receptor	☐ None	☐ Workers	☐ Community
Type of pollution	☐ Physical	☐ Chemical	☐ Biological
Toxicity	☐ Non-toxic	☐ Low - toxic	☐ High - toxic
Return to Normal	☐ 1 day	☐ 1 day to 1 week	☐ ≥ 1 week
Cumulative impact	☐ Non-cumulative	☐ Cumulative	

Section D: Injured/Illness Employee

1.Name:	Sex:	Date of Birth:			Age:	Regular Job Title:	Experience:			
							In this job title		In this Project	
	☐ Male ☐ Female	Month	Day	Year			Years	Weeks	Years	Weeks

Site:	Company:	Reference:	Phone No:	Social Security Number

Part of Body Injured or Affected:

☐ Head ☐ Hands ☐ Face ☐ Nose
☐ Eyes ☐ Legs ☐ Teeth ☐ Neck
☐ Trunk ☐ Toes ☐ Elbow ☐ Shoulder
☐ Back ☐ Ankle ☐ Wrist ☐ Foot
☐ Arms ☐ Thump ☐ Fingers ☐ Internal

Remark: ………………………………………………

Nature of Injury or Illness:

☐ Laceration ☐ Amputation ☐ Puncture ☐ Fracture
☐ Strain & Sprain ☐ Burns ☐ Contusion ☐ Dry Heat Friction
☐ Hernia ☐ Foreign Body ☐ Chemical ☐ Contamination
☐ Skin (Occupationnel) ☐ Rash ☐ Irritation

Remark: ………………………………………………………………………………………

2.Name:	Sex:	Date of Birth:			Age:	Regular Job Title:	Experience:			
							In this job title		In this Project	
	☐ Male ☐ Female	Month	Day	Year			Years	Weeks	Years	Weeks

Site:	Company:	Reference:	Phone No:	Social Security Number

Part of Body Injured or Affected:

☐ Head ☐ Hands ☐ Face ☐ Nose
☐ Eyes ☐ Legs ☐ Teeth ☐ Neck
☐ Trunk ☐ Toes ☐ Elbow ☐ Shoulder
☐ Back ☐ Ankle ☐ Wrist ☐ Foot
☐ Arms ☐ Thump ☐ Fingers ☐ Internal

Remark: ………………………………………………

Nature of Injury or Illness:

☐ Laceration ☐ Amputation ☐ Puncture ☐ Fracture
☐ Strain & Sprain ☐ Burns ☐ Contusion ☐ Dry Heat Friction
☐ Hernia ☐ Foreign Body ☐ Contamination ☐ Chemical
☐ Skin (Occupationnel) ☐ Rash ☐ Irritation

Remark: ………………………………………………………………………………………

Section E: Accidents/incident Details

Date Accident/Incident Occurred:	Time Accident/Incident Occurred:	Exact Location of the Accident / Incident:

Details of the actual Job Being done at the time:

Details of Accident/Incident/What actually happened?

Section F: Accident Cause (Basic cause mark X / Contributing cause, if any mark O)

UNSAFE CONDITIONS		UNSAFE ACTS	
1	☐ Inadequately Guarded	1	☐ Operating Without Authority / Training
2	☐ Unguarded	2	☐ Operating at Unsafe Speed
3	☐ Defective Tools, Equipment, or Substance	3	☐ Marking SHE Device Inoperative
4	☐ Unsafe Design or Construction	4	☐ Using Unsafe Equipment or Equipment Unsafely
5	☐ Hazardous Arrangement	5	☐ Unsafe Loading, Placing, Mixing
6	☐ Unsafe Illumination	6	☐ Taking Unsafe Position
7	☐ Unsafe Ventilation	7	☐ Working on Moving or Dangerous Equipment
8	☐ Unsafe Clothing	8	☐ Distraction, Teasing, Horse Play
9	☐ Insufficient Instruction	9	☐ Failure to use Personal Protective Devices
10	☐ Lack of system of work	10	☐ Lack of effective instruction or supervision

Why was the unsafe act committed?________________ Why did the unsafe condition exist?________________

Section G: Guide to Corrective Action (Base on the cause checked above, I am taking the following corrective action)

UNSAFE ACT	UNSAFE CONDITION	If Supervisor can't handle, then recommend to
☐ Stop the Behaviour	☐ Remove	☐ Site Engineer, or
☐ Study the job	☐ Guard	☐ Site Manager, or
☐ Instruct (tell-show-try-check)	☐ Warn	☐ Project Manager, or
☐ Follow Up	☐ Supervisory Training	☐ Safety Committee
☐ Enforce		

Detail below any immediate remedial actions that have been taken:

Detail below any corrective and preventative actions that could be taken to prevent future re-occurrence:	Responsible	Completion Date

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

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 of reproduction taken or made shall be sold or offered for sale except by or with the consent of the owner of the object of which the photograph, copy or the reproduction has been taken or made.

Where substantial damage is caused to any property as a result of the inspection, the Director shall pay to the owner thereof reasonable compensation for the damage in consultation with the Advisory Committee.

If the Director after conducting an inquiry, has reasonable grounds to believe that any land contains any antiquity, he may approach the Government to direct the Revenue Department to acquire such land or any part thereof and the Revenue Department shall thereupon acquire such land or part 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

Haulage Routes, Vehicles and Asphalt/Concrete Batching Plant	
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.
Handling, Storage, Stockpiling and Spillage of Dusty materials	
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.
Storage of Materials	
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.
Storage of Stockpiles	

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	Where possible, stockpiles will be placed under sheeting. Dusty material will be damped down. Wind barriers (protective fences) of a similar height to the stockpile will be erected, if required.
Large and long term stockpiles	Long-term stockpiles will be vegetated and stabilized as soon as possible. Stock plies will be dampened down until stabilized, where necessary. Wind barriers (protective fences) of a similar height to the stockpile will be erected, if required.
Waste Material from Construction	
Disposal method	A dedicated lay-down area will be available for waste. Waste will not be allowed to build up and will be disposed off at the designated locations as per EMP.
Site Preparation and Restoration	
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.
Construction and Fabrication Process	
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 major damage to or movement required to archaeological or historical sites	3

Consequence	Definition	Score
	Occurrence may result in work being halted and a fine	
Moderate	No or minimal adverse environmental or social impacts e.g. no measurable or noticeable changes in stormwater quality. Water quality remains within tolerable limits little noticeable effect on ecosystems no or isolated community complaints no or unlikely damage to archaeological or historical sites no likelihood of being fined	2
Minor	No or minimal adverse environmental or social impacts e.g. no measurable or noticeable changes in stormwater quality. Water quality remains within tolerable limits little noticeable effect on ecosystems no or isolated community complaints no or unlikely damage to archaeological or historical sites no likelihood of being fined	1

Risk Score Table

	Consequence				
		Catastrophic	Major	Moderate	Minor
Likelihood	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 measuresare to be extracted from the EIA study for the project and should 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				
		Fuel spills				

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
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)[26]: 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 providedalong 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

Construction Activities

[26] ADB, Safeguards Unit for Central & West Asia Department, *Environmental Management for Construction Handbook.*

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

K.1 Need for Plan

The construction of the Rorya STP 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.

K.2 The plan

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

The TMP will advise and inform site Contractors and external suppliers of equipment and materials of access and entry points along with other key information such 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 Manangement 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.

K.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:

K.3.1 Public Access Routes

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

Vehicle size, width and type of load

Time limits

Parking

Pedestrian conflicts

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

K.3.2 Site Workers Traffic

Site personnel should 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.

K.3.3 Site Rules

Access to and from the site must be only via the specified entrance.

On leaving the site, vehicles must be directed to follow the directions given.

Drivers must adhere to the site speed limits.

All material deliveries to site must keep allocated time limits.

No material or rubbish should be left in the loading-unloading area.

Develop a map for alternate routes showing material delivery services.

Assign designated personnel on site to receive deliveries and to direct the vehicles.

Monitor vehicle movement to reduce the likelihood of queuing or causing congestion in and around the area.

Project vehicles should have a unanimous badge or logo on windscreen displaying that they belong to the STP project.

K.4 Contractor's Obligation

The traffic management plan of the Contractor should 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 should 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 should be placed from any diverting route or road marking.

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

ANNEXURE K

National Environmental Quality Standards

Parameter	Unit	Standards (maximum allowable limit)
Temperature increase	^{o}C	<3
pH value (acidity / basicity)	pH	6-9
5-day biochemical oxygen demand (BOD) AT 20 ^{O}C	mg/l	80
Chemical oxygen demand (COD)	mg/l	150
Total dissolved solids	mg/l	200
Total dissolved solids	mg/l	3,500
Grease and oil	mg/l	10
Phenolic compounds (as phenol)	mg/l	0.1
Chloride (as Cl)	mg/l	1.0
Fluoride (as F)	mg/l	10
Sulfate (SO_4)	mg/l	600
Ammonia (NH_3)	mg/l	40
Cadmium	mg/l	0.1
Chromium (trivalent and hexavalent)	mg/l	1.0
Copper	mg/l	1.0
Lead	mg/l	0.5
Mercury	mg/l	0.01
Selenium	mg/l	0.5
Nickel	mg/l	1.0
Silver	mg/l	1.0
Total toxic metals	mg/l	2.0
Zinc	mg/l	5
Arsenic	mg/l	1.0
Barium	mg/l	1.5
Iron	mg/l	8.0
Manganese	mg/l	1.5
Boron	mg/l	6.0
Chlorine	mg/l	1.0

Notes:

1. The standard assumes that dilution of 1:10 on discharge is available. That is, for each cubic meter of treated effluent, the recipient water body should have 10 m^3 of water for dilution of this effluent.

2. Toxic metals include cadmium, chromium, copper, lead, mercury, selenium, nickel and silver. The effluent should meet the individual standards for these metals as well as the standard for total toxic metal concentration.

Source: Government of Pakistan (2000) (SRO 549(I)/2000).

Pollutants	Time-Weighted Average	Concentration in Ambient Air		Method of Measurement
		Effective from 1st July 2010	Effective from 1st January 2013	
Sulfur Dioxide (SO_2)	Annual Average *	80 µg/m3	80 µg/m3	Ultraviolet Fluorescence
	24 hours**	120 µg/m3	120 µg/m3	
Oxides of Nitrogen as (NO)	Annual Average*	40 µg/m3	40 µg/m3	Gas Phase Chemiluminescence
	24 hours**	80 µg/m3	80 µg/m3	
Ozone (O_3)	1 hour	180 µg/m3	130 µg/m3	Non dispersive UV absorption
Suspended Particulate Matter (SPM)	Annual Average*	400 µg/m3	360 µg/m3	High Volume Sampling, (Average flow rate not less than 1.1 m3/minute).
	1 hour	180 µg/m3	130 µg/m3	
Respirable Particulate Matter. PM_{10}	Annual Average*	200 µg/m3	120 µg/m3	β Ray absorption
	24 hours**	250 µg/m3	150 µg/m3	
Respirable Particulate Matter. $PM_{2.5}$	Annual Average*	25 µg/m3	15 µg/m3	β Ray absorption
	24 hours**	40 µg/m3	35 µg/m3	
	1 hour	25 µg/m3	15 µg/m3	
Lead (Pb)	Annual Average*	1.5 µg/m3	1.0 µg/m3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2.0 µg/m3	1.5 µg/m3	
Carbon Monoxide (CO)	8 hours**	5 µg/m3	5 µg/m3	Non dispersive Infra-Red (NDIR)
	1 hour	10 µg/m3	10 µg/m3	

* Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

24 hourly / 8 hourly values should be met 98% of the in a year. 20% of the time, it may exceed but not on two consecutive days.

Source: Government of Pakistan (2010) (SRO 1062 (I)/ 2010).

National Environmental Quality Standards for Noise[1]

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 1st 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

(A) For In-use Vehicles

Sr. No.	Parameter	Standard (Maximum permissible Limit)	Measuring Method	Applicability
1	Smoke	40% or 2 on the Ringlemann Scale during engine acceleration mode	To be compared with Ringlemann Chart at a distance 6 or more.	Immediate effect
2	Carbon Monoxide	6%	Under idling conditions: Non-dispersive infrared detection through gas analyzer.	
3	Noise	85 db (A).	Sound meter at 7.5 meters from the source.	

(B) For New Vehicles

(i) Emission Standards for Diesel Vehicles

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

Type of Vehicle	Category/Class	Tiers	CO	HC+ NOX	PM	Measuring Method	Applicability
Passenger Cars	M 1: with reference mass (RW) upto 2500 kg. Cars with RW over 2500 kg to meets NI category standards.	Pak-II IDI	1.00	0.70	0.08	NEDC (ECE 15+ EUDCL)	All imported and local manufactured diesel vehicles with effect from 01-07-2012
		Pak-II DI	1.00	0.90	0.10		
Light Commercial Vehicles	NI-I (RW<1250 kg)	Pak-II IDI	1.00	0.70	0.08		
		Pak-II DI	1.00	0.90	0.10		
	NI-I (1250 kg< RW< 1700 kg0	Pak-II IDI	1.25	1.00	0.12		
		Pak-II DI	1.25	1.30	0.14		
	NI-III (RW>1700 kg)	Pak-II IDI	1.50	1.20	0.17		
		Pak-II DI	1.50	1.60	0.20		

Parameter	Standard **(maximum permissible limit**	Measuring **Method**
Noise	85 db (A)	Sound meter at 7.5 meters from the source.

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

Type of Vehicle	Category/Class	Tiers	CO	HC+ NOX	Measuring Method	Applicability
Passenger	M 1: with reference mass (RW) upto 2500 kg. Cars with RW over 2500 kg to meets NI category standards.	Pak-II	2.20	0.50	NEDC (ECE 15+ EUDCL)	All imported and new models* locally manufactured petrol vehicles with effect from 1st July, 2009**
Light Commercial Vehicles	NI-I (RW<1250 kg)	Pak-II	2.20	0.50		
	NI-I (1250 kg> RW< 1700 kg0	Pak-II	4.00	0.65		
	NI-III (RW>1700 kg)	Pak-II	5.00	0.80		
Motor Rickshaws and motor Cycles	2.4 strokes < 150 cc	Pak-II	5.50	1.50	ECER 40	
	2.4 strokes < 150 cc	Pak-II	5.50	1.30		
Parameter	**Standard (maximum** permissible **limit**				Measuring Method	
Noise	85 db (A)				Sound meter at 7.5 meters from the source.	

Explantations:

DI: Direct Injection
IDI: Indirect Injection
EUDCL: Extra Urban Driving Cycle
NEDC: New Urban Driving Cycle
M: Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.
N: Motor vehicles with at least four wheels designed and constructed for the carriages of goods.
* New model means both model and engine type change
** The existing models of petrol driven vehicles locally manufactured will immediately switch ever to Pak-II emission standards but not later than 30th June, 2012.

Source: Government of Pakistan (2009) (SRO 72 (KE)/ 2009).

National Standards for Drinking Water Quality

Properties/Parameters	Standard Values for Pakistan
Bacterial	
All water intended for drinking (E.Coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml samples
Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml samples
Treated water in the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml samples In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.
Physical	
Color	$\leq$ 15 TCU
Taste	Non objectionable/ Accept able
Odor	Non objectionable/Accept able
Turbidity	< 5 NTU
Total hardness as $CaCO_3$	< 500 mg/l
TDS	< 1000
pH	6.5-8.5
Chemical	
Essential Inorganic	*mg/Litre*
Aluminum (Al)	$\leq$ 0.005(P)
Antimony	$\leq$ 0.05(P)
Arsenic (As)	$\leq$ 0.05(P)
Barium (Ba)	0.7
Boron (B)	0.3
Cadmium (Cd)	0.01
Chloride (Cl)	<250
Chromium (Cr)	$\leq$ 0.05
Copper (Cu)	2
Toxic Inorganic	**Mg/Litre**
Cyanide (Cn)	$\leq$ 0.05
Fluoride (F)*	$\leq$ 1.5
Lead (Pb)	$\leq$ 0.05
Manganese (Mn)	$\leq$ 0.5
Mercury (Hg)	$\leq$ 0.001
Nickel (Ni)	$\leq$ 0.02
Nitrate (NO_3)*	$\leq$ 50
Nitrate (NO_2)*	$\leq$ 3 (P)
Selenium (Se)	0.01 (P)
Residual chlorine	0.2-0.5 at consumer end; 0.5-1.5 at source
Zinc (Zn)	5.0
Organic	
Pesticides mg/l	PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20-58 may be consulted.**
Phenolic compound (as phenols) mg/l	WHO standards: $\leq$ 0.002
Polynuclear Aromatic hydrocarbon (as PAH) g/L	WHO standards: $\leq$ 0.01v (by GC/MS method)
Radioactive	
Alpha Emitters bq/L or pCi	0.1
Beta Emitters	1

* Indicates priority health related inorganic constituents which need regular monitoring.

** PSQCA: Pakistan Standards Quality Control Authority.

Source: Government of Pakistan (2010) (SRO 1063(I)/2010).

ANNEXURE L

WHO Guidance on Laboratory Biosafety

Laboratory biosafety guidance related to coronavirus disease 2019 (COVID-19)

Interim guidance
12 February 2020

World Health Organization

1. Introduction

The purpose of this document is to provide interim guidance on laboratory biosafety related to the testing of clinical specimens of patients that meet the case definition of the novel pathogen identified in Wuhan, China, that is, 2019 novel coronavirus (2019-nCoV), now known as the virus responsible for coronavirus disease 2019 (COVID-19).

As our understanding of COVID-19 is limited but rapidly growing, the World Health Organization (WHO) continues to monitor developments and will revise these recommendations as necessary.

Highlights of COVID-19 laboratory biosafety

- All procedures must be performed based on risk assessment and only by personnel with demonstrated capability, in strict observance of any relevant protocols at all times.
- Initial processing (before inactivation) of all specimens should take place in a validated biological safety cabinet (BSC) or primary containment device.
- Non-propagative diagnostic laboratory work (for example, sequencing, nucleic acid amplification test [NAAT]) should be conducted at a facility using procedures equivalent to Biosafety Level 2 (BSL-2)
- Propagative work (for example, virus culture, isolation or neutralization assays) should be conducted at a containment laboratory with inward directional airflow (BSL-3).
- Appropriate disinfectants with proven activity against enveloped viruses should be used (for example, hypochlorite [bleach], alcohol, hydrogen peroxide, quaternary ammonium compounds and phenolic compounds).
- Patient specimens from suspected or confirmed cases should be transported as UN3373, "Biological Substance Category B". Viral cultures or isolates should be transported as Category A, UN2814, "infectious substance, affecting humans".

2. Laboratory biosafety

It is essential to ensure that health laboratories adhere to appropriate biosafety practices. Any testing for the presence of the virus responsible for COVID-19 or of clinical specimens from patients meeting the suspected case definition *(1)* should be performed in appropriately equipped laboratories, by staff trained in the relevant technical and safety procedures. National guidelines on the laboratory biosafety should be followed in all circumstances. For general information on laboratory biosafety guidelines, see the WHO *Laboratory biosafety manual*, 3rd edition *(2)* in the interim before the 4th edition is released.

Key points

- Each laboratory should conduct a local (that is, institutional) risk assessment to ensure it is competent to safely perform the intended testing with appropriate risk control measures in place.
- When handling and processing specimens, including blood for serological testing, laboratory practices and procedures that are basic to good microbiological practices and procedures (GMPP) should be followed.
- The handling and processing of specimens from cases with suspected or confirmed COVID-19 infection that are intended for additional laboratory tests, such as haematology or blood gas analysis, should follow local guidelines for processing potentially infectious material.
- Non-propagative diagnostic laboratory work, including sequencing and NAAT, on clinical specimens from patients who are suspected or confirmed to be infected with COVID-19, should be conducted adopting the practices and procedures of "core requirements",[1] as detailed in **Annex 1**, and an appropriate selection of "heightened control measures",[2] as informed by the local risk assessment. In the interim, BSL-2 in the WHO *Laboratory biosafety manual*, 3rd edition *(2)* remains appropriate until the 4th edition replaces it.
- Handling of material with high concentrations of live virus (such as when performing virus propagation, virus isolation or neutralization assays) or large volumes of infectious materials should be performed **only by**

[1] **Core requirements:** A set of minimum requirements defined in the 4th edition of the WHO *Laboratory biosafety manual* to describe a combination of risk control measures that are both the foundation for, and an integral part of, laboratory biosafety. These measures reflect international standards and best practice in biosafety that are necessary to work safely with biological agents, even where the associated risks are minimal.

[2] **Heightened control measures:** A set of risk control measures that may need to be applied in a laboratory facility because the outcome of a risk assessment indicates that the biological agents being handled and/or the activities to be performed with them are associated with a relatively high risk that cannot be acceptable solely with the core requirements.

properly trained and competent personnel in laboratories capable of meeting additional essential containment requirements and practices, that is, BSL-3.

- Initial processing (before inactivation) of all specimens, including those for sequencing and NAAT, should take place in an appropriately maintained and validated BSC or primary containment device.
- Appropriate disinfectants with proven activity against enveloped viruses should be used for the recommended contact time, at the correct dilution and within the expiry date after the working solution is prepared.
- All technical procedures should be performed in a way that minimizes the generation of aerosols and droplets.
- Appropriate personal protective equipment (PPE), as determined by a detailed risk assessment, should be worn by all laboratory personnel handling these specimens.
- Patient specimens from suspected or confirmed cases should be transported as UN3373, "Biological Substance Category B". Viral cultures or isolates should be transported as Category A UN2814, "infectious substance, affecting humans" *(3)*.

3. Recommendations addressing minimal/essential working conditions associated with specific manipulations in laboratory settings

The additional recommendations provided in this section address the minimal/essential working conditions associated with specific manipulations in laboratory settings.

a. Risk assessment

Risk assessment is a systematic process of gathering information and evaluating the likelihood and consequences of exposure to or release of workplace hazard(s) and determining the appropriate risk control measures to reduce the risk to an acceptable level. It is important to note that hazards alone do not pose a risk to humans or animals. Consideration therefore must also be given to the types of equipment used and the procedure(s) that will be performed with the biological agent.

It is highly recommended to start with performing a local risk assessment for each process step, that is, from sample collection, sample reception, clinical testing, polymerase chain reaction (PCR) to virus isolation (only when and where applicable). Certain hazards will then be considered for each process step, such as aerosol exposure during sample processing; eye splash during sample processing; infectious culture material spill; and leaking sample (in the case of sample reception), with an assessed grade of risk. For each identified risk, appropriate risk control measures, including but not limited to the following recommendations, should be selected and implemented, in order to mitigate the residual risks to an acceptable level.

A risk assessment template is provided in **Annex 2;** this is intended to serve as an example and to facilitate the process.

b. Routine laboratory procedures, including non-propagative diagnostic work and PCR analysis

Non-culture-based diagnostic laboratory work, and PCR analysis on clinical specimens from patients who are suspected or confirmed to be infected with the virus responsible for COVID-19, should be conducted adopting practices and procedures described for conventional clinical and microbiology laboratories as described in the "core requirements" (see **Annex 1**).

However, all manipulations of potentially infectious materials, including those that may cause splashes, droplets or aerosols of infectious materials (for example, loading and unloading of sealed centrifuge cups, grinding, blending, vigorous shaking or mixing, sonic disruption, opening of containers of infectious materials whose internal pressure may be different from the ambient pressure), should be performed in appropriately maintained and validated BSCs or primary containment devices, by personnel with demonstrated capability.

Examples of routine laboratory procedures include:

• diagnostic testing of serum; blood (including haematology and clinical chemistry); respiratory specimens such as nasopharyngeal and oropharyngeal swabs, sputum and/or endotracheal aspirate or bronchoalveolar lavage; stool; or other specimens;

• routine examination of mycotic and bacterial cultures developed from respiratory tract specimens. When handling and processing specimens, "core requirements" (see **Annex 1**), including GMPP, should be followed at all times, including but not limited to those under the following subheadings. More details are explained and demonstrated in the WHO Biosafety video series *(4)*.

c. Use of appropriate disinfectants

• While little is known about this novel virus, the comparable genetic characteristics between the virus responsible for COVID-19 and MERS-CoV suggest that the COVID-19 virus may be susceptible to disinfectants with proven activity against enveloped viruses, including sodium hypochlorite (bleach; for example, 1000 parts per million [ppm] (0.1%) for general surface disinfection and 10 000 ppm (1%) for disinfection of blood spills);

62–71% ethanol; 0.5% hydrogen peroxide; quaternary ammonium compounds; and phenolic compounds, if used according to the manufacturer's recommendations. Other biocidal agents such as 0.05–0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate can be less effective.

• Particular attention should be paid not only to the selection of the disinfectant but also the contact time (for example, 10 minutes), dilution (that is, concentration of the active ingredient) and expiry date after the working solution is prepared.

• Human coronaviruses in general are known to persist on inanimate surfaces such as metal, glass or plastic for up to 9 days *(5)*.

d. Viral isolation

Unless a country decides otherwise, considering the newly acquired knowledge and effective preventive measures described above, viral isolation on clinical specimens from patients who are suspected or confirmed to be infected with the virus responsible for COVID-19 should be performed only in laboratories capable of meeting the following additional containment criteria:

• a controlled ventilation system maintains inward directional airflow into the laboratory room;

• exhaust air from the laboratory room is not recirculated to other areas within the building. Air must be HEPA (high-efficiency particulate air) filtered, if reconditioned and recirculated within the laboratory. When exhaust air from the laboratory is discharged to the outdoors, it must be dispersed away from occupied buildings and air intakes. This air should be discharged through HEPA filters;

• a dedicated hand-wash sink is available in the laboratory;

• all manipulations of infectious or potentially infectious materials must be performed in appropriately maintained and validated BSCs;

• laboratory workers should wear protective equipment, including disposable gloves; solid-front or wrap-around gowns, scrub suits, or coveralls with sleeves that fully cover the forearms; head coverings; shoe covers or dedicated shoes; and eye protection (goggles or face shield). Risk assessment should inform the use of respiratory protection (fit-tested particulate respirator, for example, EU FFP2, US 6 NIOSH-certified N95 or equivalent, or higher protection);

• centrifugation of specimens should be performed using sealed centrifuge rotors or sample cups. These rotors or cups should be loaded and unloaded in a BSC.

e. Additional risks associated with virus isolation studies

Certain experimental procedures may carry additional risks of virus mutations with possible increased pathogenicity and/or transmissibility, or viruses with altered antigenicity or drug susceptibility. Specific risk assessments should be conducted, and specific risk-reduction measures adopted, before any of the following procedures are conducted:

• coinfection of cell cultures with different coronaviruses, or any procedures that may result in a coinfection;

• culture of viruses in the presence of antiviral drugs;

• deliberate genetic modification of viruses.

f. Work with animals infected with the virus responsible for COVID-19

The following activities require an animal facility – BSL-3 facilities and work practices, as detailed in the WHO ***Laboratory biosafety manual***, 3rd edition *(2)*:

• inoculation of animals for potential recovery of the agent from specimens of the virus responsible for COVID-19;

• any protocol involving animal inoculation for confirmation and/or characterization of putative agents of the COVID-19 virus.

g. Referral of specimens to laboratories with appropriate containment measures in place

Laboratories that are not able to meet the above biosafety recommendations should consider transferring specimens to national, regional or international referral laboratories with COVID-19-detection capacity that can meet the biosafety requirements.

4. Packaging and shipment

All materials transported within and between laboratories should be placed in a secondary container, to minimize the potential for breakage or a spill. An example includes transfer of materials from the BSC to an incubator and vice versa. Specimens leaving the BSC should be surface decontaminated. Detailed guidance is provided in the WHO Biosafety video series *(4)*, in particular *Good microbiological practices and procedures (GMPP) 7: transport*.

Transport of specimens within national borders should comply with applicable national regulations. Cross-boundary transport of specimens of the virus responsible for COVID-19 should follow the United Nations model regulations, *Technical instructions for the safe transport of* *dangerous goods by air (Doc 9284)* of the International Civil Aviation Organization *(6)*, for airlifted transport, and any other applicable regulations depending on the mode of transport being used. More information may be found in the WHO *Guidance on regulations for the transport of infectious substances 2019-2020* (applicable as from 1 January 2019) *(3)*. A summary on transport of infectious substances can also be found in Tool box 4 of the WHO handbook, *Managing epidemics: key facts about deadly diseases (7)*.

Patient specimens from suspected or confirmed cases should be transported as UN3373, "Biological Substance Category B", when they are transported for diagnostic or investigational purposes. Viral cultures or isolates should be transported as Category A UN2814, "infectious substance, affecting humans" *(3)*. All specimens being transported (whether UN3373 or UN2814) should have appropriate packaging, labelling and documentation, as described in the documents mentioned earlier.

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ANNEXURE M

WHO advice on Use of Masks for the COVID-19 Virus

masks away from those in health care who need them most, especially when masks are in short supply.

Persons with symptoms should:

- wear a medical mask, self-isolate, and seek medical advice as soon as they start to feel unwell. Symptoms can include fever, fatigue, cough, sore throat, and difficulty breathing. It is important to note that early symptoms for some people infected with COVID-19 may be very mild;
- follow instructions on how to put on, take off, and dispose of medical masks;
- follow all additional preventive measures, in particular, hand hygiene and maintaining physical distance from other persons.

All persons should:

- avoid groups of people and enclosed, crowded spaces;
- maintain physical distance of at least 1 m from other persons, in particular from those with respiratory symptoms (e.g., coughing, sneezing);
- perform hand hygiene frequently, using an alcohol-based hand rub if hands are not visibly dirty or soap and water when hands are visibly dirty;
- cover their nose and mouth with a bent elbow or paper tissue when coughing or sneezing, dispose of the tissue immediately after use, and perform hand hygiene;
- refrain from touching their mouth, nose, and eyes.

In some countries masks are worn in accordance with local customs or in accordance with advice by national authorities in the context of COVID-19. In these situations, best practices should be followed about how to wear, remove, and dispose of them, and for hand hygiene after removal.

Advice to decision makers on the use of masks for healthy people in community settings

As described above, the wide use of masks by healthy people in the community setting is not supported by current evidence and carries uncertainties and critical risks. WHO offers the following advice to decision makers so they apply a risk-based approach.

Decisions makers should consider the following:

1. **Purpose** of mask use: the rationale and reason for mask use should be clear– whether it is to be used for source control (used by infected persons) or prevention of COVID-19 (used by healthy persons)
2. Risk of **exposure** to the COVID-19 virus in the local context:
   - The population: current epidemiology about how widely the virus is circulating (e.g., clusters of cases versus community transmission), as well as local surveillance and testing capacity (e.g., contact tracing and follow up, ability to carry out testing).
   - The individual: working in close contact with public (e.g., community health worker, cashier)
3. **Vulnerability** of the person/population to develop severe disease or be at higher risk of death, e.g. people with comorbidities, such as cardiovascular disease or diabetes mellitus, and older people
4. **Setting** in which the population lives in terms of population density, the ability to carry out physical distancing (e.g. on a crowded bus), and risk of rapid spread (e.g. closed settings, slums, camps/camp-like settings).
5. **Feasibility**: availability and costs of the mask, and tolerability by individuals
6. **Type** of mask: medical mask versus nonmedical mask (see below)

In addition to these factors, potential advantages of the use of mask by healthy people in the community setting include reducing potential exposure risk from infected person during the "pre-symptomatic" period and stigmatization of individuals wearing mask for source control.

However, the following potential risks should be carefully taken into account in any decision-making process:

- self-contamination that can occur by touching and reusing contaminated mask
- depending on type of mask used, potential breathing difficulties
- false sense of security, leading to potentially less adherence to other preventive measures such as physical distancing and hand hygiene
- diversion of mask supplies and consequent shortage of mask for health care workers
- diversion of resources from effective public health measures, such as hand hygiene

Whatever approach is taken, it is important to develop a strong communication strategy to explain to the population the circumstances, criteria, and reasons for decisions. The population should receive clear instructions on what masks to wear, when and how (see mask management section), and on the importance of continuing to strictly follow all other IPC measures (e.g., hand hygiene, physical distancing, and others).

Type of Mask

WHO stresses that it is critical that medical masks and respirators be prioritized for health care workers.

The use of masks made of other materials (e.g., cotton fabric), also known as nonmedical masks, in the community setting has not been well evaluated. There is no current evidence to make a recommendation for or against their use in this setting.

WHO is collaborating with research and development partners to better understand the effectiveness and efficiency of nonmedical masks. WHO is also strongly encouraging countries that issue recommendations for the use of masks in healthy people in the community to conduct research on this critical topic. WHO will update its guidance when new evidence becomes available.

In the interim, decision makers may be moving ahead with advising the use of nonmedical masks. Where this is the case, the following features related to nonmedical masks should be taken into consideration:

- Numbers of layers of fabric/tissue
- Breathability of material used
- Water repellence/hydrophobic qualities
- Shape of mask
- Fit of mask

Home care

For COVID-19 patients with mild illness, hospitalization may not be required. All patients cared for outside hospital (i.e. at home or non-traditional settings) should be instructed to follow local/regional public health protocols for home isolation and return to designated COVID-19 hospital if they develop any worsening of illness.[7]

Home care may also be considered when inpatient care is unavailable or unsafe (e.g. capacity is limited, and resources are unable to meet the demand for health care services). Specific IPC guidance for home care should be followed.[3]

Persons with suspected COVID-19 or mild symptoms should:

- Self-isolate if isolation in a medical facility is not indicated or not possible
- Perform hand hygiene frequently, using an alcohol-based hand rub if hands are not visibly dirty or soap and water when hands are visibly dirty;
- Keep a distance of at least 1 m from other people;
- Wear a medical mask as much as possible; the mask should be changed at least once daily. Persons who cannot tolerate a medical mask should rigorously apply respiratory hygiene (i.e. cover mouth and nose with a disposable paper tissue when coughing or sneezing and dispose of it immediately after use or use a bent elbow procedure and then perform hand hygiene.)
- Avoid contaminating surfaces with saliva, phlegm, or respiratory secretions.
- Improve airflow and ventilation in their living space by opening windows and doors as much as possible.

Caregivers or those sharing living space with persons suspected of COVID-19 or with mild symptoms should:

- Perform hand hygiene frequently, using an alcohol-based hand rub if hands are not visibly dirty or soap and water when hands are visibly dirty;
- Keep a distance of at least 1 meter from the affected person when possible;
- Wear a medical mask when in the same room as the affected person;
- Dispose of any material contaminated with respiratory secretions (disposable tissues) immediately after use and then perform hand hygiene.
- Improve airflow and ventilation in the living space by opening windows as much as possible.

Health care settings

WHO provides guidance for the use of PPE, including masks, by health care workers in the guidance document: Rational use of PPE in the context of COVID-19.[24] Here we provide advice for people visiting a health care setting:

Symptomatic people visiting a health care setting should:

- Wear a medical mask while waiting in triage or other areas and during transportation within the facility;
- Not wear a medical mask when isolated in a single room, but cover their mouth and nose when coughing or sneezing with disposable paper tissues. Tissues must be disposed of appropriately, and hand hygiene should be performed immediately afterwards.

Health care workers should:

- Wear a medical mask when entering a room where patients with suspected or confirmed COVID-19 are admitted.
- Use a particulate respirator at least as protective as a US National Institute for Occupational Safety and Health-certified N95, European Union standard FFP2, or equivalent, when performing or working in settings where aerosol-generating procedures, such as tracheal intubation, non-invasive ventilation, tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation, and bronchoscopy are performed.
- Full infection prevention and control guidance for health care workers is provided here.

One study that evaluated the use of cloth masks in a health care facility found that health care workers using cotton cloth masks were at increased risk of infection compared with those who wore medical masks.[25] Therefore, cotton cloth masks are not considered appropriate for health care workers. As for other PPE items, if production of cloth masks for use in health care settings is proposed locally in situations of shortage or stock out, a local authority should assess the proposed PPE according to specific minimum standards and technical specifications.

Mask management

For any type of mask, appropriate use and disposal are essential to ensure that they are effective and to avoid any increase in transmission.

The following information on the correct use of masks is derived from practices in health care settings

- Place the mask carefully, ensuring it covers the mouth and nose, and tie it securely to minimize any gaps between the face and the mask.
- Avoid touching the mask while wearing it.
- Remove the mask using the appropriate technique: do not touch the front of the mask but untie it from behind.
- After removal or whenever a used mask is inadvertently touched, clean hands using an alcohol-based hand rub or soap and water if hands are visibly dirty.
- Replace masks as soon as they become damp with a new clean, dry mask.
- Do not re-use single-use masks.
- Discard single-use masks after each use and dispose of them immediately upon removal.

WHO continues to monitor the situation closely for any changes that may affect this interim guidance. Should any factors change, WHO will issue a further update. Otherwise, this interim guidance document will expire 2 years after the date of publication.

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ANNEXURE N

Solid Waste Management Framework

Framework for Solid Waste Management

1. INTRODUCTION

Framework Solid Waste Management Plan for the development Sewage Treatment Plant (STP) and associated sewerage network is provided. Construction contractors may use this framework as guiding document for preparation of site specific solid waste management plan. The purpose of this Framework Solid Waste Management Plan is to ensure that wastes arising from the proposed construction works at STP are managed, reused, recovered or disposed of by a method that ensures the provisions of the KP EPA Act, 2014 and Pakistan Environmental Protection, 1997 and ADB SPS, 2009. It also ensures that the optimum levels of waste reduction, re-use and recycling are achieved.

Waste management priorities for project are based on following waste management hierarchy.

- Prevent material wastage
- Minimize the quantity of waste
- Reuse of site materials
- Recycling of waste
- Energy recovery
- Disposal

2. WASTE MANAGEMENT POLICIES and GUIDELINES

2.1 National Level

Waste management of the project will be carried out as per national rules including:

- Solid Waste Management Policy, 2000
- Requirements of KP EPA, 2014
- Draft Guidelines on Solid Waste Management, 2005.
- Section 11 of PEPA, 1997 prohibits discharge of waste in amount that violates the NEQS.
- Draft Hazardous Substances rule of 1999
- Section 132 of Cantonment Act, 1942
- Provision Contains in the Local Government Ordinance, 2001

2.2 Regional Level

- Asian Development Bank (ADB) SPS, 2009
- IFC guidelines for Solid Waste Management
- Best practices of waste management on construction sites

3. DESCRIPTION OF THE PROJECT

The proposed location of STP is located about 2km Sheikhmaltoon town, near zarra Rorya, situated in Union Council Rorya of District Mardan. The total area of the STP is approximately 261 Kanals. The land is already owned by the WSSC Mardan. Site is accessible by a paved road and is located at a distance of 2.3km from Mardan bypass on N45, 6.5Km from Rashakai Interchange M1.

The proposed sewerage system for Mardan will be developed in six (6) urban union councils under jurisdiction of WSSC Mardan. These Six union councils i.e. Bari cham, Bicket Gunj, Muslimabad, Hoti, Guli bagh and Rorya are the major urban settlements in District Mardan. The proposed sewerage system shall be connected to Rorya Sewage treatment plant

The proposed corridor (1.0 -1.5 meters) for the sewerage system is based on the best available option as per the topographic survey. The corridor is mostly adopted at one edge of the exiting road carriageway keeping in mind the existing house ramps and utilities at both sides of the road carriageway. Road reinstatement cost is considered in the detailed Bill of Quantities (BOQ) of the project.

3.1 Details of the wastes to be produced

During construction/civil works potential sources of waste will include spoils generated during excavation of trenches for sewerage networks and rising main, excavation for other civil works including STP infrastructure and pumping station, domestic wastes (solid & wastewater), fuel or oil leakages or spills, onsite effluents from vehicle wash & cleaning, and cement spills. It is the responsibility of all personnel on site including Contractors, Sub-Contractors and their Employees to ensure compliance with this Waste Management Plan.

3.2 Main Waste Categories

Contractors are required to develop inventory of main waste categories that will be generated during construction phase of the project. Anticipated main waste categories include construction debris including spoil generated during excavation works, scarification, concrete waste, scrap wood, bricks, concrete, asphalt, plumping fixtures, piping, insulation (asbestos and non-asbestos), metal scraps, oil, electrical wiring and components, chemicals, paints, solvents.

3.3 Anticipated Hazardous Waste Arising

Fuels stored on site that will be used during the construction phase are classed as hazardous. There will be fuel stored on site for machinery and construction vehicles. All fuel tanks and draw off points will be bunded. If the fuel is correctly contained and bunded, it is not expected that there will be any fuel wastage at the site. Other sources of hazardous waste include used paints, used oil/lubricants, electrical waste and chemicals. Project contractors are required to develop SOPs for handling, storage and disposal of hazardous waste arising from the project.

4. ESTIMATED WASTE GENERATION

4.1 Construction Waste Generation

Project contractors are required to develop and maintain waste inventory clearly showing the type, amount and location of waste generated from different activities at the site. Waste record keeping is key to successful implementation of waste management plan.

4.2 Proposed Waste Management Options

Excavated material from trenches will be stored at site and it will be used as fill material after laying of sewers while access spoil shall be transported to spoil disposal site if required. Almost half of the spoil shall be used for backfilling while remaining shall be disposed of at designated disposal site. At construction site waste will be segregated on site. Contractor will ensure that sufficient number of waste drums are placed at site with appropriate color coding. All recyclable waste will be handed over to recycling contractor. The appointed waste contractor will collect and transfer the recyclable wastes as receptacles are filled. The non-recyclable waste will be transferred by an authorized waste collector to an appropriate facility. Project contractors will identify both recycling and non-recycling contractor working in the project area. Contractors through bidding documents will be bound to hire such waste contractors for efficient waste management at project sites. A successful Waste Management Plan is largely dependent on how readily it can be integrated in to normal site operations by the person responsible. It is recognized that the plan should not be obstructive to site operations and the construction program by placing the responsibility of construction waste management with the Manager, all reuse, recycling, wastage and necessary disposal can be monitored as close to the source as possible. An Environmental Representative from each Works Sub-Contractor will also be nominated responsible for all waste management in their own operations. In this way, it is possible to identify where the greatest material wastage occurs, with a view to implementing better management.

The site Construction Manager will be designated as the Responsible Person and have overall responsibility for the implementation of the on-site Waste Management Plan. The Responsible Person will be assigned the authority to instruct all site personnel to comply with the specific provisions of the plan. At the operational level, a nominated Environmental Representative from each sub-contractor company on the site shall be assigned the direct responsibility to ensure that the discrete operations stated in this framework for solid waste management are performed on an on-going basis.

4.3 Tracking and documentation procedures for off-site waste

The site construction Manager will maintain a copy of all waste collection permits. If waste (soil & stone) is being accepted on-site, a waste docket must be issued to the collector. If the waste is being transported to another site, a copy of the waste permit for that site must be provided to the manager. Record of waste collection docket, a receipt from the final destination of the material will be kept as part of the on-site waste management records. All information will be entered in a waste management system to be maintained on-site.

4.4 Disposal Waste

Contractors are required to develop SOP for disposal of recyclable, non-recyclable and hazardous waste generated at site. Food waste will be disposed at food waste pit which will be fenced. Recycling waste will be handed over to recycling waste contractor. Hazardous waste will be disposed through incineration facility available in close proximity of the project area. Workers on the site will be encouraged to recycle as much municipal waste as possible i.e. cardboard, plastic, metals and glass. Prior to removal, the municipal waste will be examined to determine if recyclable materials have been placed in other containers. If this is the case, effort will be made to determine the cause of the waste not being segregated correctly.

5. ESTIMATED COST OF WASTE MANAGEMENT

Contractors are required to estimate and budget cost for waste management through BOQ items. Such waste management cost should include cost of waste drums, cost of waste handling crew, cost of waste transportation, cost of EPA approved waste contractor services and associated incineration costs if any. By reusing materials on site, there will be reduction in transport and disposal costs for a waste contractor taking the material away.

6. TRAINING PROVISIONS FOR WASTE MANAGER AND SITE CREW

A waste manager will be appointed or designated by construction contractors to ensure commitment, operational efficiency and accountability during the project execution.

6.1 Site Manager Training and Responsibility

The waste manager will be given responsibility and authority to select a waste team if required i.e. members of the site crew that will aid him in the organization, operation and recording the waste management system implemented on-site. The waste manager will have overall responsibility to oversee record and provide feedback to the CSC on everyday waste management at the site. Authority will be given to the waste manager to delegate responsibility to sub-contractors where necessary and to co-ordinate with suppliers, service providers and sub-contractors to prioritize waste prevention and salvage. The waste manager will be trained in how to set up and maintain a record keeping system, how to perform an audit and how to establish targets for waste management on-site. He will also be trained in the best method for segregation and storage of recyclable materials, have information on the materials that can be reused on-site and know how to implement this Framework for Solid Waste Management.

6.2 Site Crew Waste Management Training

Training of the site crew is the responsibility of the waste manager and as such, a waste training program should be organized. A basic awareness course will be held for all crew to outline the construction waste management plan and to detail the segregation of waste at source. This may be incorporated with other training needs (e.g. general site induction, safety training etc.). This basic course will describe the materials to be segregated, the storage methods and the location of the waste storage areas. A subsection on hazardous wastes will be incorporated and the particular dangers of each hazardous waste will be explained.

7. RECORD KEEPING

Records will be kept for each waste material which leaves the site, either for reuse on another site, recovery, recycling or disposal. A system will be put in place to record the construction waste arising on-site. The waste manager or delegate will record the following:

- Waste taken off-site for reuse
- Waste taken off-site for recovery
- Waste taken off-site for recycling
- Waste taken off-site for disposal
- Waste (soil & stone) accepted on-site for recovery

For each movement of waste off-site, a signed waste collection docket will be obtained by the waste manager (or delegate) from the contractor. This will be carried out for each material type. This system will also be linked with the delivery records. A signed waste acceptance docket will be issued for each movement of waste on-site.

8. OUTLINE WASTE AUDIT PROCEDURE

Contractors are required to develop SOP for waste auditing at the construction sites. Such SOP should reflect frequency and types of waste audits, audit criteria and way forward to close non-compliances.

8.1 Responsibility for Waste Audit

The appointed waste manager will be responsible for conducting a waste audit at the site during project execution.

8.2 Review of Records and Identification of Corrective Actions

A review of all the records for the waste generated and transported off-site, as well as waste accepted, should be undertaken. If waste movements are not accounted for, the reasons for this should be established in order to see if and why the record keeping system has not been maintained. Each material type will be examined in order to see where the largest percentage waste generation is occurring. The waste management methods for each material type will be reviewed in order to highlight how the targets can be achieved. Waste management costs will also be reviewed. Upon completion of the construction phase a final report will be prepared summarizing the outcomes of waste management processes adopted and the total recycling/reuse/recovery figures for the development.

9. CONSULTATION WITH RELEVANT BODIES

9.1 Local Authority

Project contractors are required to maintain close coordination with PMU, WSSC Mardan and KP EPA to ensure that all available waste reduction, re-use and recycling opportunities are identified and utilized.

9.2 EPA Approved Waste Contractors

Companies that specialize waste management will be contacted to determine their suitability for engagement. If used, each company will be audited in order to ensure that relevant and up-to-date waste collection permits and/or license are held. In addition, information regarding individual materials will be obtained including the feasibility of recycling each material, the costs of recycling/reclamation and the means by which the wastes will be collected and transported off-site, and the recycling/reclamation process each material will undergo off-site.

ANNEXURE O

Environmental Audit Report of Existing Facility

Table 1: Env. Audit of Existing STP and Sewerage System at Mardan

S/No.	Component	Env. Audit Findings	Required Corrective Action
1	**Existing Treatment Plant**	▪ The existing treatment plant in Mardan was constructed in the year 1991 under SUDP. ▪ A treatment plant based on ponds was constructed in past however, for long time, it is not operational. ▪ The capacity of existing ponds is not adequate to treat the current as well as future flows from the Mardan City. As current ponds are not operational and does not have adequate capacity, therefore, the raw sewage is being directly discharged into nearby water bodies. ▪ Current practice is environmentally unsafe, a violation of Environmental Protection Act and could be a major cause of diseases in the area ▪ System is not serving the purpose and untreated waste water is being discharged directly to water bodies. ▪ Most of the pipelines within treatment plant are clogged and water is diverted ▪ Leaks and overflows from ponds is source of contamination of soil, groundwater, and surface water. ▪	▪ A new sewerage system is proposed to be constructed to fulfill present and next 25 years requirements of six union council of Mardan. ▪ The proposed wastewater treatment plant should serve the current as well as ultimate future flows from Mardan City. ▪ The design flow for the proposed wastewater treatment plant is 5.8 MGD (21,953 m3/day).). Three parallel streams, 1.93 MGD (7,318 m3/day) each, will be constructed to achieve flexibility in operation ▪ WTP should bring pollution parameters (BOD5, COD, TSS) within prevailing provincial environmental standards i.e. National Environmental Quality Standards (NEQS ▪ Various treatment technologies shall be compared during detailed design and most suitable biological treatment technology should be applied. ▪ There is need to rehabilitate/revamp the damaged and collapsed system in order to ensure efficient WTP operation ▪ Propose project should fix issues related to clogging and overflowing through revamping works wherever required.
2	**Catchment Network**	▪ The existing sewerage system in the project area was constructed in the year 1991 under SUDP. ▪ The existing sewerage system is catering to three urban union councils of Mardan i.e. Bari cham, Bicket Gunj and Guli bagh ▪ The total length of the existing sewerage network in the project area is approximately 14.8 kilometers, which is fully clogged, abandoned or damaged.	▪ The proposed sewerage system for Mardan will be developed in six (6) urban union councils under jurisdiction of WSSC Mardan. ▪ These Six union councils i.e. Bari cham, Bicket Gunj, Muslimabad, Hoti, Guli bagh and Rorya are the major urban settlements in District Mardan. ▪ The proposed sewerage system shall be connected to Rorya Sewage treatment plant.

S/No.	Component	Env. Audit Findings	Required Corrective Action
		▪ The tertiary network is mostly of 6 to 8 inches' diameter passing through the middle of the streets. ▪ The secondary sewer line is approximately 24 inches' diameter, while the primary sewerage network near the outfall/Rorya STP is of 36 inches diameter. ▪ The length of existing tertiary sewers is 8.5 kilometers, secondary sewers is 0.8 kilometer and primary sewer is 5 kilometers. ▪ The existing sewerage system in the project area is totally abandoned or dysfunctional ▪ The existing sewerage system has never been fully connected to the existing Rorya STP. ▪ Locals have disconnected their house connections from the existing sewerage system and connected them to the open drains in the streets. ▪ Some of the open drains have been diverted in to the primary sewer line which is passing near the Rorya sewage treatment plant. ▪ Leaks in gravity mains sometime allows ground water to enter in the sewer system ▪ Existing sewerage system during rainfall event become a source of water pollution in large area of the city ▪ Catchment of existing sewerage system is not planned/appropriate and proposed WTP will receive increased volume of water ▪ HSE issues related to damaged and collapsed manholes ▪ There is overall lack of maintenance and operational negligence by WSSC Mardan	▪ Collapsed and damaged tertiary network should be replaced with new one ▪ Periodic inspection is proposed to identify hot spots where clogging can occur ▪ Catchment network should be revamped with proper interception/connection works, manholes and other facilities ▪ Catchment area should be re-defined keeping in view the urban growth of township and capacity of existing collection network ▪ Maintenance interventions should be carried out on frequent basis ▪ SOPs should be developed and resources should be allocated within WSSC Mardan for repair and maintenance works of sewerage network. ▪ Proposed project should fix leaks and overflows to contribute improved aesthetics of the area and to reduce soil contamination ▪ There is need to compute the sewerage flows with peak flooding factor during rainy season and system should be constructed accordingly ▪ System should be designed to cater peak loads with minimum percolation of surface runoff ▪ Capacity building interventions of WSSC Mardan are proposed to fix existing system constraints ▪ New sewerage system should be designed on self-cleansing mechanism ▪ System should be inspected periodically to check for leaks and overflows and record of such inspections should be maintained ▪ SOPs should be developed and resources should be allocated within WSSC Mardan to fix system leaks and overflows ▪ The total length of the proposed conveyance network in Mardan is approximately 79.85 kms

S/No.	Component	Env. Audit Findings	Required Corrective Action
3	**Outfall Drains**	▪ There is no lining of such outfall drains which is source of soil contamination ▪ There is no proper embankments of such drains which trigger HSE issues ▪ There is no plantation along the drains creating poor aesthetics ▪ Such drains are source of odor and public nuisance ▪ Outfall drains are traversing the residential plots which can create social issues ▪ There is overall lack of maintenance and operational negligence by WSSC Mardan	▪ Lining of outfall drains should be carried out to avoid seepage in ground ▪ Embankment works on drains should be carried out to avoid HSE issues ▪ Plantation along the drains should be carried out to create buffer against bad nuisance and odor ▪ Drains traversing residential plot should be abandoned and sewer conveyance should be routed to planned drains ▪ SOPs should be developed and resources should be allocated within WSSC Mardan for maintenance works of drains