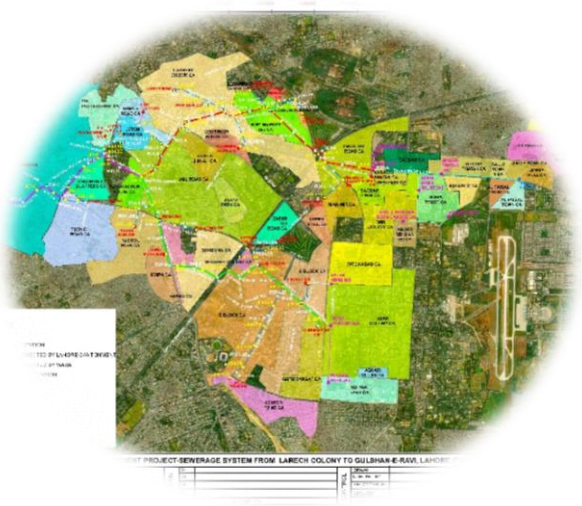
WATER AND SANITATION AGENCY LAHORE (LWASA),
LAHORE DEVELOPMENT AUTHORITY (LDA)



SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI IN LAHORE

(THROUGH TRENCHLESS TECHNOLOGY)

DRAFT ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

July 2025

Prepared by:

Water and Sanitation Agency, Lahore Development Authority, Government of Punjab

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
AIIB	Asian Infrastructure Investment Bank
ALGAS	Asia Least Cost Greenhouse Gases Abatement Strategy
AMSL	Above mean sea level
AP	Affected Person
BOD	Biochemical Oxygen Demand
BODs	Board of Directors
BoQ	Bills of Quantities
BOT	Build, Operate and Transfer
BRBD	Bambanwala Ravi Bedian Depalpur (Canal)
CBO	Community Based Organization
CDGL	City District Government Lahore
CDM	Clean Development Mechanism
CH_4	Methane
CMS	Complaint Management System
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
D/S	Disposal Station
dB	Decibels
DC	Design Consultant
DCR	District Census Report
DG	Directorate General/Director General
DNA	Designated National Authority
DO	Dissolved Oxygen
EC	Environmental Committee
EE	Environmental Engineer
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EPCCD	Environment Protection & Climate Change Department
EPCC	Engineering, Procurement & Construction Contractor
ES	Environmental and Social
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Mitigation and Monitoring Plan
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESS	Environmental and Social Standard
FGD	Focused Group Discussion

GT Road	Grand Trunk Road
GBV	Gender Based Violence
GHGs	Green House Gases
GPO	General Post Office
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GWP	Global Warming Potential
H_2S	Hydrogen Sulphide
HDPE	High Density Polyethylene
HSE	Health, Safety and Environment
HIV	Human Immunodeficiency Virus
HUD&PHED	Housing Urban Development and Public Health Engineering Department
IEE	Initial Environmental Examination
IPPF	Indigenous Peoples Planning Framework
JICA	Japan International Cooperation Agency
KP	Khyber Pakhtunkhwa
LAA	Land Acquisition Act
LAR	Land Acquisition and Resettlement
LBC	Lahore Branch Canal
LCC	LAR Coordination Committee
LESCO	Lahore Electric Supply Company
LPG	Liquefied Petroleum Gas
LRMTS	Lahore Rapid Mass Transit System
LRP	Livelihood Restoration Plan
LTC	Lahore Transport Company
WASA	Water and Sanitation Agency
LWMC	Lahore Waste Management Company
LWWMP	Lahore Water and Wastewater Management Project
MBT	Main Boundary Thrust
MDG	Millennium Development Goal
MSDS	Material Safety Data Sheet
MTBM	Micro Tunnel Boring Machines/Method
NCS	National Conservation Strategy
ND	Not Detectable
NDMA	National Disaster and Management Authority
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NESPAK	National Engineering Services Pakistan
NFPA	National Fire Protection Association

NGO	Non-Government Organization
NIC	National Identity Card
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NOB	Non-Objectionable
NOC	No Objection Certificate
NPZ	Noise Perimeter Zones
O&M	Operation and Maintenance
O_3	Ozone
OHSAS	Occupation Health and Safety Assessment Series
OHS	Occupation Health and Safety
OPC	Ordinary Portland Cement
PAHs	Polycyclic Aromatic Hydrocarbons
PAP	Project Affected Person
Pb	Lead
PCB	Polychlorinated Biphenyl
PCC	Plain Cement Concrete
PDHS	Pakistan Demographic and Health Survey
PDO	Planning and Development Officer
PESD	Punjab Emergency Services Department
PEPA	Punjab Environmental Protection Act/Pakistan Environmental Protection Act
PEPC	Punjab Environmental Protection Council/Pakistan Environmental Protection Council
PEQS	Punjab Environmental Quality Standards
PETSAC	Pakistan Electric and Telecommunication Safety Code
PGA	Peak Ground Acceleration
PHA	Parks and Horticulture Authority
PMTA	Punjab Mass Transit Authority
PMU	Project Management Unit
PMC	Project Management Consultants
PPE	Personal Protective Equipment
PPP	Public Private Partnership
PTCL	Pakistan Telecommunication Company Limited
RAR	Refined Activity Rate
RCC	Reinforced Cement Concrete
RE	Resident Engineer
RPF	Resettlement Planning Framework
SC	Supervision Consultant
SNGPL	Sui Northern Gas Pipelines Limited
SO_2	Sulfur Dioxide

SPM	Suspended Particulate Matter
SPT	Standard Penetration Test
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
STP	Sewerage Treatment Plant
TA	Technical Assistance
TBM	Tunnel Boring Machines/Method
TDS	Total Dissolved Solids
TMP	Traffic Management Plan
TPV	Third Party Validator/Third Party Validation
TSS	Total Suspended Solids
UAN	Universal Access Number
UCC	Upper Chenab Canal
UNDP	United Nation Development Program
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	Volatile Organic Compounds
WASA	Water And Sanitation Agency
WB	World Bank
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

Water and Sanitation Agency Lahore (LWASA) is responsible for provision of water supply, sewerage and drainage services within notified jurisdiction of Lahore, Pakistan. It has embarked on a project named "Sewerage System from Larech Colony to Gulshan-e-Ravi Lahore (Through Trenchless Technology). The Asian Infrastructure Investment Bank (AIIB) will provide financial support for the project. In order to comply with the provincial regulatory agency, Environment Protection Agency (EPA) and the AIIB Environmental and Social Policy (ESP), the instant document namely Environmental and Social Impacts Assessment (ESIA) report for the proposed project has been prepared.

Project Background and Context

Rapid urbanization and unplanned urban sprawl have resulted in various issues related to management of sewerage & drainage for Lahore, which is the provincial capital of Punjab Province. The overburden of the city's current sewage systems has led to inadequate infrastructure related to trunk sewer/conveyance system to address some of these issues, the Lahore Water and Wastewater Management Project (LWWMP) has been brought on board by LWASA. The project is to enhance Lahore's operational performance and wastewater services by improving trunk sewer infrastructure. One component of the LWWMP program is the projected trunk sewer project for improving infrastructure in Central Lahore through state-of-the-art Micro-tunneling technology.

Currently, the storm water drainage system is used to dispose of the majority of the city's sewage once it has been delivered to pumping stations. This system's open channels expose the city's residents to a variety of environmental risks that impair their health and sanitation. By providing specialized trunk sewers, this planned project will improve LWASA's ability to handle the wastewater generated in the city of Lahore and lessen the burden on the city's current storm water drainage system. Serving a population of 2.35 million people [i]over an area of roughly 64 square kilometers in central Lahore, this will safely convey household wastewater Diversion of wastewater from the storm water drains to trunk sewers will improve the capacity of the drainage system and help the affected localities to cope against flooding during monsoon.

Proposed Project Description

In the proposed project, approximately 32.37 km of trunk sewers using trenchless technology is to be laid. An additional pumping station with a capacity of roughly 688 cusecs (cubic feet per second) or approximately 20 cumecs (cubic meters per second) will be constructed next to the existing Gulshan-e-Ravi disposal station. The three segments that make up the proposed trunk sewer's entire length will be as follows:

- The first segment Line A measuring about 12.30 km (including 159m open cut) will be constructed from Karachi Phattak to Qartaba Chowk.
- The second segment Line B with a length of about 12.82 km from Guru Mangat to Qartaba Chowk and;
- The third segment Line C measuring 7.25 km from Qartaba Chowk to Gulshan-e-Ravi disposal station.

The project also involves installation of 450-KW of solar energy installation system that will generate electricity from sunlight to power a pump, Supervisory Control and Data Acquisition (SCADA), and lightening of the disposal station. This will be a small utility scale system. Three celled box conduits will also be constructed to convey wastewater from the existing and proposed disposal station to River Ravi; a smaller Escape channel with capacity of 350 cusecs (10 cumec approx.) that already exists near existing disposal station shall also be rehabilitated including outfall channel for proposed accommodation of 1040 (30 cumec approx.) cusec discharge from existing and proposed disposal station. About 7 km of surface drains will also

be rehabilitated and restored. The requirement for intermediate wastewater pumping at 22 distinct locations will be eliminated with the installation of a gravity-based wastewater transport infrastructure. Upon completion of the project, about 9 km of surface drains in the locality falling under WASA jurisdiction, freed from sewage disposal.

LWASA and Project Management Consultants (PMC) to review the design presented in the report and prepare preliminary design and tender documents on Engineering, Procurement, Construction (EPC) basis, as well as monitoring the project's construction.

Project Alternative

Regarding technical, environmental, social, and economic factors, the following options were taken into consideration for the project:

- No project option;
- Relief sewer providing necessary additional capacity;
- New sewerage of expanded capacity (trunk sewer) with Trenchless Technology.

The third option, which uses micro tunneling technology, has been chosen for this project in order to avoid the social and environmental problems that come with the other options. MTBM option is safer for workforce as it is remotely operated. It is also favored because it is more environmentally friendly that saves time and cost with reduced traffic disruption and minimum soil disturbance. Also, with this option there is minimal shifting of underground utilities and causes minimum visual pollution.

Type and Category of Project

As per the AIIB's Environmental and Social Policy, the project is classified as "A" and necessitates an ESIA study, meaning that there is a high probability of severe negative environmental and social repercussions that are irreversible, cumulative, diverse, or unprecedented. Likewise, in accordance with Pakistan Regulation-2022's Initial Environmental Examination (IEE)/Environmental Impact Assessment (EIA), the project under consideration falls under Schedule-II's Category "G" (Waste Disposal), which calls for an EIA due to the project's potential for negative environmental effects.

Policy, Legal and Administrative Framework

Before beginning any development project, it is required under the Punjab Environmental Protection (Amendment) Act, 2017 to conduct an environmental and social assessment study. In addition, the AIIB's Environmental and Social Policy (ESP) governs the planned project. The project is categorized as Category A under this policy, which indicates that there is a high chance of major negative environmental and social effects that could be irreversible, cumulative, varied, or unprecedented. Thus, in order to carry out the proposed project, Environmental and Social Standard (ESS) 1, which deals with Environmental and Social Assessment and Management, must be put into practice. Furthermore, ESS 2, which also addresses livelihood of commercial entities due to the construction of trunk sewers as part of involuntary resettlement, is relevant. These guidelines provide the careful evaluation and handling of environmental and social aspects associated with the project.

The AIIB has its ESP which is required to be fulfilled by their borrowers. The national legislation and ESP diverge on some key points which need to be identified and filled. National laws and regulations are more focused on environmental impact assessment and mitigation measures whereas; AIIB’s ESP covers labor influx, Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) aspects. National legislation entails compensation against land acquisition and land-based assets for title holders only, whereas, ESP covers compensation at market rates and even to non-titled holders. ESP also focuses on public consultation, information disclosure and grievance redressal mechanism. AIIB’S ESP shall prevail over the regional legislation in case of gaps.

Project Institutional Arrangements

The overall responsibility of ESMP monitoring and implementation lies with the Project Management Unit (PMU) established in LWASA. PMU will supervise the implementation of ESMP through its Environment and Social Staff for carrying out activities related to ESMP implementation. PMC will depute Environment & Social Safeguards, Gender Specialist and field-based Social Mobilizer for the implementation of ESMP. The Contractor will be responsible for the implementation of ESMP. Grievances will be redressed under the Project established Grievance Redress Mechanism**.** The whole process will be monitored and evaluated by a third party throughout the implementation cycle. Internal monitoring on Quarterly Basis and external monitoring on Semi-Annual Basis will be carried out during project implementation. Moreover, EPCCD will also monitor the implementation of E&S.

Current Status with Environmental Protection & Climate Change Department (EPCCD)

The No Objection Certificate (NOC) of the proposed project has already been secured from Environmental Protection & Climate Change Department (EPCCD) in February 2022 which was renewed up to February 2028.

Environmental and Social Baseline

The project is in the urban city of Lahore, a mega city which is highly urbanized. The sewer alignment runs along the main roads and shall be laid for the most part on the left side, facing towards downstream flow. These lines will pass through commercial and residential areas having green spaces and green belts between the roads. Some laterals are passing through congested commercial areas also.

Existing conditions in and around the project area have been studied with respect to the physical and socio-economic environment.

Physical Environment

The proposed project will employ underground tunneling method of construction, a trenchless technique which minimizes excavation. The total length of the proposed Trunk Sewer is divided into three segments.

The terrain of the project area is generally flat with few undulations present in the stretch while the general trend of the slope is towards River Ravi. The soil in the project area is cohesion less and the types of soil layers that are present below the ground level include: silt, silty clay, silty sand, poorly graded sand with silt and lean clay.

The project area has extreme climate conditions, with hot summers and cold winters. The summer starts from April and lasts till September, with mean maximum and minimum temperature ranges from 39.2 Celsius to 19.1 Celsius.

Ecological Environment

As the climate of Lahore is semi-arid and subtropical, the vegetation of the area falls under scrub, dry, tropical thorn forest type as per phyto-geographical classification of the area.

Flora

The proposed alignment is passing through urban areas and having ornamental plants, shrubs and herbs planted and managed by Parks and Horticulture Authority (PHA) for the purpose of beautification and urban ecological sustainability. These floral species also providing number of tangible and non-tangible benefits to the regional and local climate. 14 types of trees and various shrubs and herbs were observed during site visit.

Fauna

Mammals

Common mammals found in the study area are dogs, cats, house rats and bats. Small Indian Mongoose and Indian Palm Squirrel have also been reported.

Reptiles

Snakes such as cobra and kraits were once common in the tract, but now cases of snake bites are very rare, as these reptiles have been either killed by expanding urbanization, and they have moved away. Lizards such as Spiny Tailed Lizard (Uromastix hardwickii) and Fringed Toed Lizard (Acantho dactylus cantoris) are also reported by the residents of the study area.

Amphibians

Amphibians frequently seen in and around the project area, especially during rainy season, include common Frog (Rana tigrina) and Indus Valley Toad.

Birds

Birds that are observed in the study area during site visit are: House Sparrow (Passer domesticus), House Crow (Corvuss plendens), Hawk (Milvus migrans), Mynah (Acredothe restristis), Nightingale (Pycnon tuscafer), Parrot (Psittacu lakrameri), Pigeon (Columba livia), and Hoopoe (Upupa epops).

Endangered Species, Wetlands and Wildlife Sanctuaries

There exist no threatened or endangered species of flora and fauna as indicated by IUCN red list of the species in the project area. There are no wetlands, game reserve and wild sanctuaries present in the project area.

Socio-economic Environment

Lahore's political and administrative setup comprises five tehsils and 274 Union Councils. The demographic profile reveals a population of 13.9 million, with an annual growth rate of 2.65%. The city has a youthful population and is slightly male dominated. Islam is the predominant religion, with a mix of Sunni sects, while religious minorities account for 5%. Lahore is ethnically diverse, featuring major castes and artisans, and Punjabi is the primary language spoken.

The gender ratio slightly favors males, and marital trends indicate higher rates of never-married individuals among males and in urban areas. Migration is significant, with 16.4% being lifetime in-migrants, predominantly from other districts of Punjab. Economically, 21.8% of the population is active, with a substantial gender gap in labor force participation. Key occupations include manufacturing, trade, and services, while poverty affects 29.5% of residents, particularly in rural areas. Income distribution reflects moderate inequality with a Gini coefficient of 0.35.

Lahore boasts a literacy rate of 78%, higher than the national average, supported by an extensive network of educational institutions. Health facilities are well-established, with numerous public and private hospitals. The city features diverse housing and infrastructure, ranging from modern urban developments to traditional rural structures. Lahore is Pakistan's second-largest industrial hub, producing a variety of goods, from textiles to machinery. Agricultural land spans 316,000 acres, with wheat and vegetables as primary crops.

Lahore's cultural heritage is rich, with landmarks like the Lahore Fort, Badshahi Mosque, and Shalimar Gardens. Transportation infrastructure includes the Metro Bus and Orange Line Metro, along with extensive road and railway networks. Auto rickshaws, cabs, and ride-hailing services are integral to urban mobility. The city is also known for its handicrafts, including embroidery, jewelry, and hand-knotted carpets.

Despite its progress, gender disparities in education, employment, and resource access persist, necessitating targeted interventions to promote equality and empowerment. Overall, Lahore is a dynamic city with significant economic, cultural, and social diversity, albeit facing challenges in poverty and gender equality.

A separate document of LRP has been prepared along with this report which has elaborately narrated the socio-economic conditions of the project area.

Public Consultation

This section deals with the information disclosure to the public and consultation sessions held with the different stakeholder groups that are likely to be affected by the implementation of the proposed Project. The consultation process was carried out as per the guidelines of Punjab EPA and AIIB.

The following methods were used for public consultation with project stakeholders in the project area, to ascertain their stakes regarding execution of the proposed project: Focused Group Discussions (FGDs), Meetings and Consultation Sessions.

The consultation process was held with the objectives of sharing information with stakeholders on proposed Project and expected impacts on the physical, biological and socioeconomic environment of the project corridor; understanding stakeholder concerns regarding various aspects of the project; providing an opportunity to the public to influence project design in a positive manner; and creating a sense of ownership of the proposal in the mind of the stakeholders.

Groups of primary stakeholders, including residents around the project, shopkeepers and their staff, offices and their workers, vendors, pedestrians, students and business affectees etc. were contacted for consultation and discussions.

The communities falling in the vicinity of project area greatly favored the project and almost all the respondents expressed support towards this initiative believing that the project will improve the overall sanitation condition and environmental profile of the city. The major concerns shown by the respondents included dust, noise and vibration, air pollution, safety issues, access constraints, temporary loss of livelihood, structure stability, and traffic disruption during the construction phase of the project. In order to tackle these concerns and mitigate the severity of other negative impacts due to the project, a comprehensive Environmental and Social Management Plan (ESMP), encompassing all the EPA Punjab and AIIB guidelines, standards and regulations, has been developed.

E&S Impacts during Construction Phase

During construction negative impacts will be produced. They include visual intrusion due to placement of equipment and cordoning off the work site. There will be traffic congestion for the same reason. Traffic load on Canal Road, Main Boulevard Gulberg, Gurumangat Road, Allama Iqbal Road, Egerton Road, Infantry Road, Zafar Ali Road, McLeod Road, Gulshan-e-Ravi Road (Chauburji area) and connecting access roads would be increased due to the project activities, and movement of heavy machinery especially during construction phase.

The project will also have Occupational Health and Safety (OHS) of workers and Community Health and safety impacts arising due to the construction activities. Workers may be exposed to an unsafe and unfavorable working environment due to improper storage, handling and transport of hazardous construction material. The health and safety issues are also associated with the malfunctioning in the operation of construction machinery and equipment which may cause minor to severe injuries to workers.

Other impacts include visual intrusion, air quality deterioration due to dust emissions, soil disturbance, noise and vibrations and interference with underground utilities. The residents may be disturbed due to labor influx and night time construction activities.

There will be livelihood and loss of assets as well. The construction activity may disturb the business and livelihoods of the shopkeepers and workers doing their business along the trunk sewer route. In the congested roads the existing shopkeepers will be affected by the excavation activities at the shaft locations. In this respect, the most critical areas include Larech Colony Road connecting with Allama Iqbal Roadand Mushtaq Ahmed Gurmani Road. The main commercial activities in these areas include vegetables shops, meat shops, grocery

stores, hair salons, furniture shops, beauty parlors, roadside eateries, workshops and electronic shops.

E&S Impacts during Operation Phase

The 450-KW solar energy installation at the Gulshan e Ravi Disposal Station is also a part of the project that will significantly reduce carbon emissions by harnessing renewable energy to power the operations. The proposed project is expected to reduce the prevailing negative impacts – such as public health, hygiene, and odor – associated with flow of raw sewage in the open drains. The replacement of present system with Sewer trunk will consume less electricity and consequently, producing less Carbon Dioxide (CO_2) resulting in a net positive impact on Global Warming Potential (GWP). The project will decrease reliance on fossil fuels, lower greenhouse gas emissions by 127,612.936 tons of CO_2 in 25 years design life and contribute to a cleaner environment.

As compared to the present situation, the project will have high positive impacts on land use, aesthetics, employment and air. There will still be negative impacts in the operation phase, significantly low as compared to the present system. There will be emissions at ventilation points, odor control and disposal stations. The OHS is noted to be high negative for maintenance during operation. It is strongly recommended through this study that wastewater should be treated before its disposal. After, completion of this project, the overall project will have moderate to high positive impacts.

A wastewater treatment plant (WWTP) at Babu Sabu is planned by LWASA with the financial assistance of Agence Francaise de Development (AFD), the PC-I of which is in appraisal phase at P&D Board. In Phase I, the proposed wastewater treatment plant (WWTP) at Babu Sabu will have a capacity of 164 cusecs (400,000 m³/day) to treat 150 cusecs (367,000 m³/day) of dry weather flow from the Larech Project up to 2035. The expected dry weather flow from this project is 200 cusecs (489,000 m³/day) up to 2050. The additional 50 cusecs (122,000 m³/day) from the Larech Project will be addressed in Phase II of the WWTP project, for which the Babu Sabu WWTP capacity will be increased to 408 cusecs (1,000,000 m³/day). Through both these phases, 100 percent of dry weather flow from Gulshan-e-Ravi will be treated.

Environmental and Social Management Plan (ESMP)

The ESMP was prepared according to the envisaged impacts of the project. It summarizes project impacts and describes some doable mitigation measures and identifies the authorities responsible for implementing those mitigation measures. The ESMP includes check and balance framework to control and minimize the identified impacts and monitoring programs to oversee residual impacts, if any, before and after the construction phase of project. The ESMP describes procedures to be followed throughout the construction as well as the operational phase of said project.

The Project Management Unit (PMU) for the Project will be LWASA. The PMU supported by a dedicated team of environment and social specialists of consultants will assist LWASA in implementation of the project, support PMU in construction supervision, ESMP implementation and fulfilling requirements of AIIB and other stakeholders, including Government departments.

The contractor(s) will be responsible for implementation and adherence to all the mitigation measures and monitoring arrangements outlined in the ESMP associated with their respective activities. The contractors will be hired through proper bidding procedure. The contractors must have qualified environmental and social experts on a full-time basis to interpret and implement ESMP. The ESMP provides a mitigation plan, a monitoring plan and a training program with responsible parties and a budget.

The ESMP will become part of the construction contract agreement and will be strictly enforced during the implementation of the proposed project. In the event of design change the ESMP will be revised accordingly.

ESMP Budget

The Budget calculated for the implementation of ESMP is estimated to be **PKR 166,593,020/-** or **166.593 million PKR.**

Grievance Redress Mechanism (GRM)

The AIIB requires the establishment of a suitable project-level grievance redress mechanism to address the concerns and grievances of the project-affected persons and stakeholders. As per AIIB's Environment and Social Policy (ESP), a two-tier GRM for preparatory phase is already in place and the three-tier GRM will be notified prior to execution phase to provide a time-bound, early, transparent, and fair resolution for APs and other stakeholder grievances. As a first step, PMC and contractors will devise awareness-raising plans for carrying out sessions to provide information on the GRM to the APs and other stakeholders. A Grievance Redressal (GR) Cell will be established as the first tier of GRM at site. The second tier of the GRM will be at PMU level. LWASA Management level will be the third tier of the Grievance Redressal Mechanism (GRM). For this purpose, the committees will be constituted to redress grievances prior to the execution phase of the project. If unsatisfied with the decision, the existence of the GRC will not impede the complainant's access to the government's administrative or judicial remedies.

1 INTRODUCTION

Government of Punjab, through the LWASA, is planning to implement the project namely the "Lahore Water & Wastewater Management Project (LWMMP)" The project is being financed by the Asian Infrastructure Investment Bank (AIIB) through the Islamic Republic of Pakistan (GOP) and the Government of Punjab (GoPb). The project comprises two phases:
Phase I: Sewerage System from Larech Colony Gulshan-e-Ravi (Through Trenchless Technology) – Lahore Wastewater and Drainage Project and.
Phase II: Construction of Surface Water Treatment Plant at BRBD Canal Lahore – Lahore Water Supply Project.

1.1 BACKGROUND OF THE PROJECT

Lahore, being the hub of business activities of Punjab province, provides better job opportunities, healthcare, education, infrastructure etc. as compared to other cities. Owing to which residents from other cities are migrating here. This has resulted in rapid population influx, which is putting huge stress on the existing water supply and sewage infrastructures of Lahore, because such existing facilities cannot meet the growing needs and that is why it needs to be upgraded.

The prevailing situation therefore has necessitated provision of such facilities to additional areas, replacement, and augmentation of existing networks in various areas. There is a dire need to substantially improve both sewerages, as well as storm water drainage network, keeping in view of the growing population.

The Lahore Water and Sanitation Agency (LWASA) was established by Lahore Development Authority during the year 1976 for the planning, designing, development and maintenance of water supply, sewage and draining system in Lahore. Ever since its establishment, there has been continual improvement in the water supply, sewage, and storm water drainage of Lahore district. However, due to revenue shortfall, lack of political will to implement reasonable tariff to at least recover the cost spent on water and sewerage infrastructure and its operational cost, lack of planning in some areas of the city as well as lack of financial resources, most of the planned schemes could not be implemented. Moreover, due to revenue shortfall, LWASA always relies on either government funds or foreign loans/grant-aid projects for their development works. The implementation of these development projects needs feasibility studies and detailed design of each scheme to justify their economic and financial viability. In this regard, LWASA management has been forthcoming in proposing the new development schemes and has carried out various studies, prepared feasibilities and detailed designs, for the improvement in the water and sewerage networks by hiring both local and international consultants.

Numerous studies have been conducted by LWASA from time to time for attracting government funds as well as funds from various international banks like World Bank (WB), Asian Development Bank (ADB), Asian Infrastructure Investment Bank (AIIB), Agence Francaise de Development (AFD), Japanese International Cooperation Agency (JICA), etc. Some of these studies pertain to water and sewerage Network improvement which are discussed in this section of the report.

Some of the major existing sewerage projects in the Central Zone of Lahore convey the sewage effluent to the five existing disposal stations near the Ravi River which pump the sewage effluent into the river. Besides, many other localized sewerage schemes terminate into six disposal stations and 24 lift stations from which sewage effluent is being pumped into existing storm water drains terminating into the Ravi River. During rainy season, these disposal/lift stations also help in evacuating the storm water runoff from the low-lying areas of the city.

An estimated 540 MGD (1000 Cusec) of untreated domestic sewage is being disposed of into River Ravi, which is contaminating the groundwater source as well. Along the Ravi River, mixed water sewage is being used for growing vegetables; hence bacteria, virus and industrial discharges containing even metals are causing huge health issues among the population living along the Ravi River. The phenomenon of piece-meal implementation of sewerage projects has also led to huge operation and maintenance costs, putting extreme stress on the meager financial resources of LWASA, LDA.

1.2 AIMS & OBJECTIVES OF THE PROJECT

The main objective of the project is to provide an improved facility of sewage disposal system in the Central Zone of Lahore for proper collection, conveyance, and disposal of sewage effluent to the proposed disposal (lift) station in Gulshan-e-Ravi area by providing new trunk sewers.

Implementation of this project will result in:

i. Environmental improvement

ii. Elimination of intermediate disposal/lift stations

iii. Existing primary drains, which are presently being used as sullage carriers, will act as storm water channels, which is their primary purpose.

The project aims to improve the wastewater management system in Lahore, which currently relies on open drains meant for rainwater to transport bulk wastewater, polluting the nearby River Ravi. The project will assist LWASA in constructing a modern conveyance system by constructing trunk sewers through underground tunneling and the construction of an ultimate pumping and disposal station at Gulshan-e-Ravi in the vicinity of the existing disposal station, which will safely transport domestic sewage, serving a population of 2.35 million over an area of about 15,658.2 acres in central Lahore. The construction of a gravity-based transport of wastewater infrastructure will also eliminate the need for intermediate pumping of wastewater at 22 different locations, resulting in cost savings for LWASA in payment of electricity charges.

1.3 PROPOSED PROJECT DESCRIPTION

The project area lies within the Lahore district which is historical, cultural, and commercial hub of the Punjab Province of Pakistan. LWASA has divided Lahore district into six operational zones primarily based on the topographical features, and existing sewerage network for the city.

This proposed project caters to the Central Zone's sewage drainage requirements. This central zone is also a center for commercial activities and is densely populated with almost no open spaces left for horizontal growth. The central zone with respect to its present sewerage and drainage situation is also considered as a "critical zone".

The project includes laying of a Trunk Sewer that will carry the project area's sewage in an efficient manner, reducing stress on existing sewerage system and storm water drains. It is accompanied by the provision of various jacking pits as well as upgradation of disposal stations.

1.4 SCOPE OF PROJECT

The total length of the sewer to be constructed is about 32.3 kilometers, which is divided into three construction legs. The first trunk sewer measuring about 12.3 kilometers (including 159m open cut) will be constructed from Karachi Phattak to Qartaba Chowk, and the second trunk

sewer with a length of 12.8 kilometers (km) will cover the sewage flow from Guru Mangat Road to Qartaba Chowk and the third length of 7.2 km will cover from Qartaba Chowk to Gulshan-e-Ravi.

Component II involves construction of an ultimate pumping and disposal station with a capacity of 688 Cusecs at Gulshan-e-Ravi. The wastewater will flow out from the disposal station through an existing drainage channel of 1.5 km long falling into the 1040 cusec main drain that takes the sullage to River Ravi. About 7 km of surface drains will also be rehabilitated and restored.

Upon completion of the project, about 9 km of surface drains in the locality falling under LWASA jurisdiction, freed from sewage disposal. Another sub – component of the project is the installation of Solar PV system of 450 KW. It is a small utility scale project which will supplement only 5.7% out of total energy requirement of Disposal Station. Since it is an on-grid system, this energy is sufficient to bear the load equivalent to energy requirements of a pump (dry well), SCADA and lightning of Disposal Station.

The proposed route of trunk sewer is shown in **Figure 1-1.**

1.5 TYPE AND CATEGORY OF PROJECT

According to Environmental and Social Policy of AIIB, the project falls under category “A” that requires ESIA study (where the project is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented). Similarly, according to IEE/EIA Pakistan Regulation, 2000, the proposed project falls under Category “G” (Waste Disposal) of Schedule-II that requires Environmental Impact assessment (EIA) because proposed project is likely to have adverse impacts on environment.

1.6 NEED FOR UPDATION

1.6.1 Environmental & Social Impact Assessment

The purpose to update the study is that the Government of Punjab has taken the initiative to construct an Elevated Expressway (EEW) project connecting Gulberg to Babu Sabu interchange at M2 motorway. The original design of EEW had a 4-lane width, which made it possible to accommodate both the projects (Trunk Sewer and EEW) to run in parallel in the same corridor. However, the design of EEW was revised to a 10-lane width requiring a much wider corridor, making it impossible to accommodate both the projects in the same corridor. Therefore, to avoid conflict between the two projects, the proposed sewer tunnels alignment must be reviewed. LWASA has therefore advised Project Management Consultant (PMC) to identify feasible alternate routes for Lines B and C of the Trunk Sewer Project interfering with EEW. At the same time, the PMC is required to identify any other conflict with the planned future projects that may arise in the next five years.

The ESIA of the project has already been approved by EPCCD (Environmental Protection & Climate Change Department). Previous ESIA is complete in all respects, and a NOC/ Conditional approval to start construction on the project has been granted by the EPCCD **(Annex-XIII).** For updation purposes, EPCCD-Punjab was consulted on 5th August 2024 for the regulations and environmental legal requirements regarding the changes made in the final alignments. It was decided that as the construction NOC is still valid, there is no need to submit the updated ESIA to EPCCD and apply for new NOC. Also, the ESIA will be finally implemented by the contractors according to the final design.

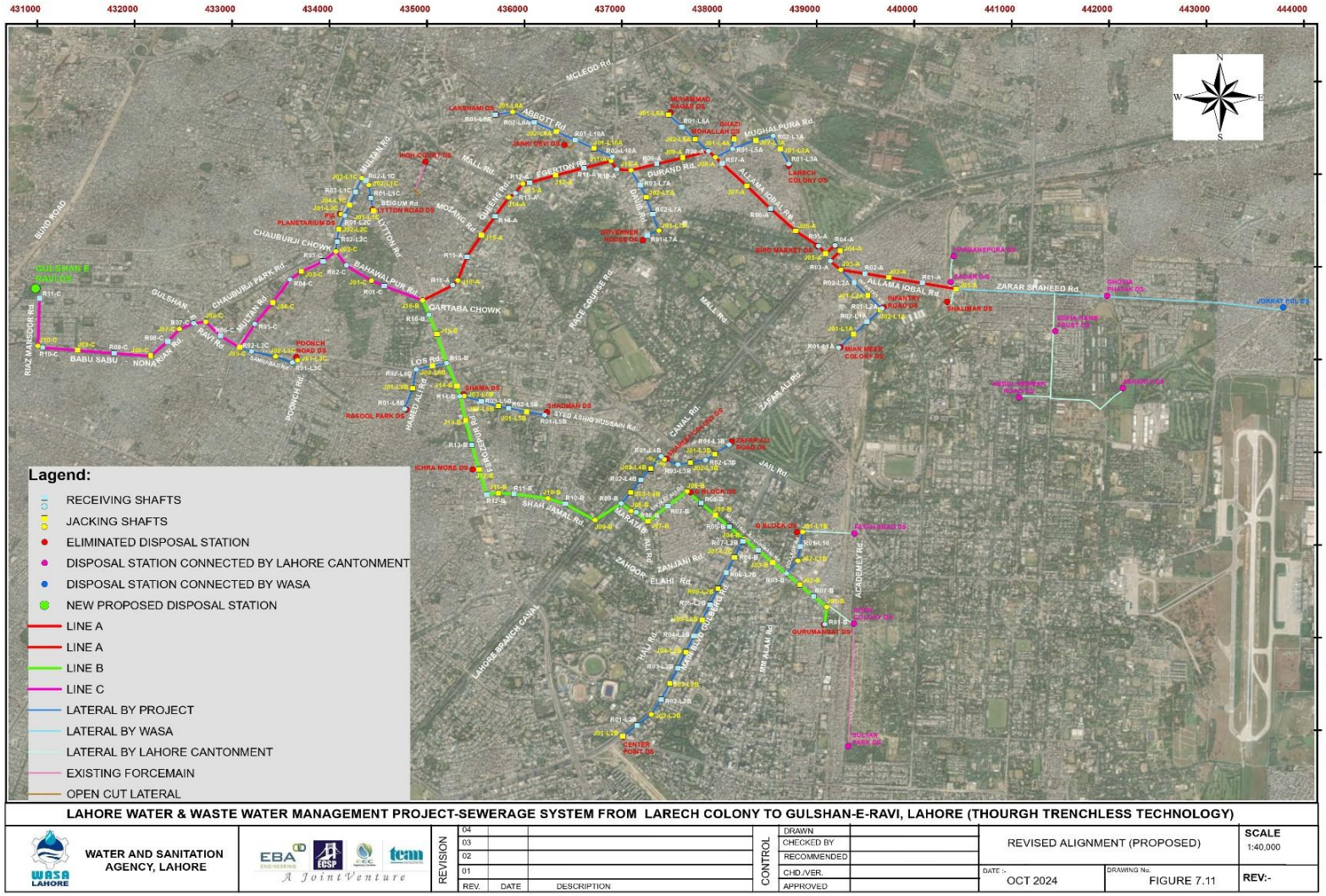


Figure 1-1: Proposed Route of Trunk Sewer

1.6.2 Area of influence (AoI)

The AoI of the impact assessment study is 150m on both sides of the alignment route. The major direct impacts due to project's construction activities include visual intrusion, noise and vibration, access/mobility problems, traffic congestion and dust emission.

1.6.3 Impact on Ground settlement due to micro tunneling

The ground surface settlement due to Micro tunneling was estimated using Attewell (1982). The ground surface settlement usually produces a trough (perpendicular to the tunnel alignment) with the maximum settlement along the centerline. The overall estimated ground settlement due to tunneling is less than 12mm (0.5 in.). The ground surface settlement was estimated based on the ground conditions described in, an assumed ground "volume loss" of 1% (typical for the ground conditions identified and with the use of MTBM with pressurized face). The zone of influence (ZOI) is expected to extend approximately 8.4 m (27.6 ft.) from the tunnel centerline, where settlement is estimated to be less than 1mm and 10 m from the tunnel centerline, where settlement is estimated to be 0 mm. **See Figure 1-1**:

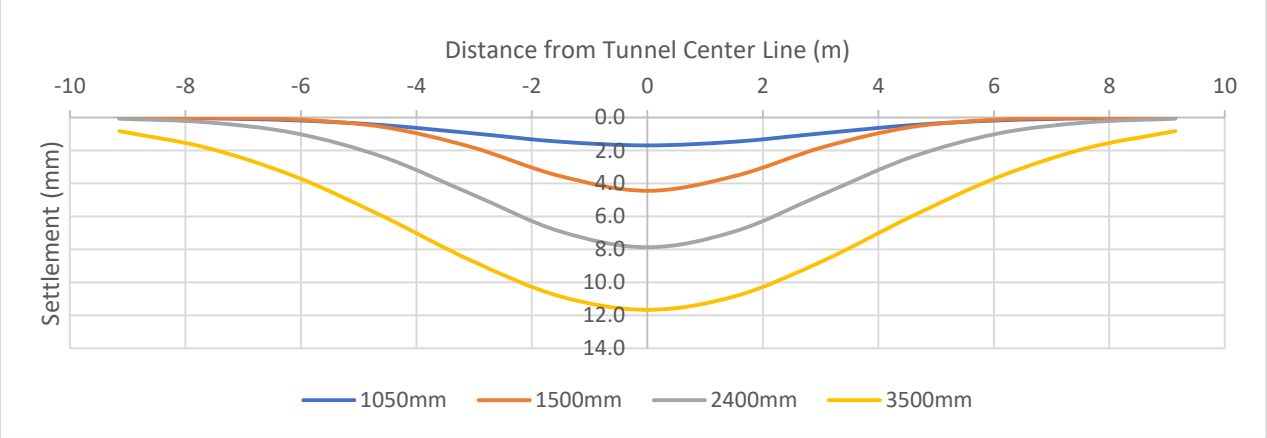


Figure 1-2: Ground Settlement Estimation

1.6.4 Impact of Vibration and Noise control

The tunnel cover varies from 8.51 m (27.9 Ft.) to 19.37 m (63.5 ft.) along the alignment. Based on the vibration historical data and the tunnel depth, the anticipated peak particle velocity (PPV) is expected to be less than 1 mm/sec (less than 0.04 in./sec), in accordance with similar soft ground case histories documented in the Transport Research Laboratory (TRL) Report 429. This value is estimated at the ground surface directly above the tunnel. The vibration is significantly reduced with increased distance from the source.

A typical value of 13 mm/sec is the threshold for building, where there is potential for damage. As indicated above, a list of critical structures/infrastructures will need to be identified and evaluated for potential damage due to vibration. Mitigation measures to protect these structures should be implemented. Buffer Zone of all tunnel sizes are given in the **Table 1-1**:

Table 1-1: Zone of Influence from Center Line of Tunnel

Inner Dia. of tunnel (mm)	Outer Dia. of tunnel (mm)	Standard Shaft width (m)	Center line of tunnel Distance from footpath (m)	Zone of Influence from center line of tunnel on both sides (m)
1050	1350	4.5	2.25	8.4
1500	1840	5	2.5	8.4
2400	2850	6	3	8.4
3500	4100	7	3.5	8.4

1.7 ESIA METHODOLOGY

Following steps were taken to draft ESIA.

1.7.1 Primary Data Collection

Environmental and social resource inventory has been prepared for all environmental and social features viz. terrain, land use, waterways/water bodies, roadside vegetation, sensitive receptors, common property resources, utilities, drainage, flooding/water logging, accident prone areas, information about income ranges of people, livelihood sources of people, conditions of civic facilities, education and employment status, data on indigenous population and cultural/historical sites, etc. within the area of influence of project. Social surveys were conducted along the trunk sewer line to collect the data of displaced people in the vicinity of the disposal station and business owners and their employees in case of temporary business. Information about this has been collected by trained staff under the supervision of an expert team. Similarly, physical environment and biodiversity surveys were also carried out. Baseline monitoring was conducted at the locations as per standards of AIIB and GoP.

An instrument was prepared for structured interviews of the Affected Persons of the project. Furthermore, inventory matrix was developed to assess the financial impact that might occur due to the project activities.

1.7.2 Secondary Data Collection

Secondary sources include published government reports, environmental impact assessments conducted in similar regions, government websites, recognized institutions and relevant government departments, Forest, Irrigation, Fisheries, Statistics, Environmental Protection Department, and Meteorological Department etc. Recent Google images have been captured to view environmental features at regional scale. The secondary data also enables to extract information regarding the demographic conditions of project areas such as age groups of people, population estimation, employment status, utilities provision etc. For livelihood restoration the bureau of statistics Pakistan (Census 2023), LAA 1894 and livelihood plan of similar other projects were consulted.

Pakistan's Legal Framework and AIIB Environmental and Social Policy (ESP) have been reviewed. It is essential to analyze the various permissions/clearances required for any developmental project. AIIB has established the ESP which encompasses mandatory

environmental and social requirements for every project. The ESP serves as a framework to incorporate robust environmental and social management practices into projects, facilitating the attainment of desired development outcomes. Two key standards within the ESP are ESS-1: Environmental and Social Assessment and Management, and ESS-2: Involuntary Resettlement. ESS-1 focuses on comprehensive assessment and effective management of environmental and social aspects throughout the project lifecycle. Through ESS-1, the AIIB aims to ensure that projects are designed, implemented, and operated in a manner that minimizes adverse environmental and social effects and maximizes positive outcomes. Furthermore, ESS 2 addresses livelihood of commercial entities due to the construction of trunk sewers as part of involuntary resettlement.

1.7.3 Public Consultation

Meaningful consultations were organized with the key stakeholders, local people/beneficiary population to know the level of project acceptability, understand their concerns, apprehensions, and overall opinions. Information was gathered about existing baseline environmental conditions viz. ambient levels and their effects on health, water resources, water logging/flooding, flora and fauna, socio-economic standing of local people, impact due to loss of land other assets and common property resources, accident risk during construction and operation stage, perceived benefits, and losses, etc. Information thus gathered was used to integrate it into project design and formulate mitigation measures and environmental management plan.

1.7.4 Assessment of Potential Impacts:

The assessment of the type, nature, intensity, and their significance to the physical, biological, and socio-economic aspects of the environment has been done to ascertain whether the project is environmentally and socially sustainable or not. Nature of impacts has been classified as significant, insignificant, short-term, long-term, reversible, irreversible etc. After identification of nature and extent of impacts, mitigation measures have been suggested.

1.8 PREPARATION OF THE ENVIRONMENT AND SOCIAL MANAGEMENT PLAN (ESMP)

The project specific Environment and Social Management Plan (ESMP) was formulated with an aim to avoid, reduce, mitigate, or compensate for adverse environmental impacts/risks and propose enhancement measures. This includes:

- Institutional arrangements and training
- Mitigation of potentially adverse impacts
- Monitoring of impacts and mitigation measures during project implementation and operation
- Compliance with statutory requirements
- Integration of ESMP with Project planning, design, construction and operation.
- Documentation and reporting

1.9 MONITORING AND EVALUATION

Monitoring and evaluation are critical activities in implementation of the project. Monitoring involves periodic checking to ascertain whether activities are going according to plan or not. It provides the necessary feedback for project management to ensure project objectives are met

and on schedule. The reporting system is based on accountability to ensure that environmental mitigation measures are implemented. Environmental monitoring program has the underlying objective to ensure that the intended environmental mitigations are realized and these result in desired benefits to the target population causing minimal deterioration to the environmental parameters.

The broad objectives of monitoring and evaluation are:

- To evaluate the adequacy of environmental and social assessment.
- To evaluate the performance of mitigation measures proposed in the ESMP
- To evaluate if the construction site after the completion of the project is restored to suggest ongoing improvements in management plan based on the monitoring
- To meet existing environmental regulatory framework and community obligations.

1.10 PERFORMANCE INDICATORS

The significant physical, biological and social aspects affecting the environment at critical locations serve as wider/overall performance Indicators. However, the following specific environmental parameters can be quantitatively measured and compared over a period of time and are, therefore, selected as key Performance Indicators for monitoring because of their regulatory importance and the availability of standardized procedures and relevant expertise.

Performance indicators requiring quantitative measurements are:

- Air quality with respect to $PM_{2.5}$, PM_{10}, NO_x and SO_2 at selected locations.
- Water quality as per Punjab Environmental Quality Standards
- Noise levels as per Punjab Environmental Quality Standards
- Survival rates of trees planted as compensatory plantation
- Awareness raising/information disclosure for APs and other stakeholders
- Compensation paid to APs
- Demand Notices paid to government departments
- Process of compensation payment
- Satisfaction level of APs on compensation payment
- Satisfaction certification of government departments over compensation payment
- Duration of compensation payment
- Grievances on their redressal on compensation payment
- Implementation of livelihood restoration measures and
- Functioning of grievance redress mechanism.

1.11 STUDY & IMPLEMENTATION TEAM(s)

The Environment and Resettlement study & Implementation team of proposed project is presented in **Table 1-2.**

Table 1-2: Roles and Responsibilities of ESIA Study & Design Team

Sr. No.	Name	Roles	Responsibilities
1	Mr. Amjad Ghafoor	Team Leader/ Environmental Specialist (for Design Phase)	He is responsible for liaison with the Client and relevant stakeholders, reconnaissance survey of the project site, technical guidance and input for preparing the updated ESIA report. The environmental specialist will be responsible for the Study of all environmental safeguards as per the requirements of LWASA and AIIB.
2	To be nominated (TBN)	Team Leader/ Environmental Specialist (for Implementation Phase)	He is responsible for liaison with the Client and relevant stakeholders, reconnaissance survey of the project site, technical guidance and updating the ESIA report in case of any changes during detailed design / implementation. The environmental specialist will be responsible for the updating and Implementation of all environmental safeguards as per the requirements of LWASA and AIIB.
3	Mr. Atif Hassan	Resettlement Specialist (for Design Phase)	He is responsible for identification of potential impacts on socio-economic environment, proposal for mitigation measures for adverse social impacts and updating of livelihood restoration plan.
4	To be nominated (TBN)	Resettlement Specialist for implementation phase	He is responsible for identification of potential impacts on socio-economic environment, proposal for mitigation measures for adverse social impacts and updating of livelihood restoration plan in case of design change.
5	To be nominated (TBN)	Health & Safety (HSE) Specialist (for Implementation Phase)	He is responsible for the identification of potential H&S risks and propose suitable mitigation measures in detailed design and at implementation phase.
3	Mr. Ali Salman Zafar	Environmental Engineer	Mr. Salman is responsible for the site survey and collection of baseline data, review of procedures, guidelines, legal and policy framework, identification & evaluation of potential significant impacts

Sr. No.	Name	Roles	Responsibilities
			of the project on the surrounding environment, proposal for mitigation measures for adverse impacts, and preparation of updated ESIA report. The Environmental Engineer assists Environmental Specialist in implementation of all environmental safeguards as per the requirements of LWASA and AIIB.
4	Mr. Muhammad Babar	Environmental Engineer	The Environmental Engineer assists Environmental Specialist in implementation of all environmental safeguards as per the requirements of WASA and AIIB.
5	Mr. Muneeb Hassan	Environmental Engineer	The Environmental Engineer assists Environmental Specialist in implementation of all environmental safeguards as per the requirements of LWASA and AIIB.
6	Mr. Syed Fahad Hussain	Environmental Engineer	The Environmental Engineer assists Environmental Specialist in implementation of all environmental safeguards as per the requirements of LWASA and AIIB.

1.12 DOCUMENT STRUCTURE

This ESIA report consists of eight (08) chapters:

Chapter-1 Introduction: covers an introduction of the proposed project;

Chapter-2 Policy, Legal and Administrative Framework: provides the country's environmental legislative requirements and AIIB framework applicable to the proposed project together with other relevant guidelines;

Chapter-3 Description of Project: presents detailed description of the project including project components and activities, design parameters, detail of technical facilities, alternatives, etc;

Chapter-4 Environment and Social Baseline Profile: describes in detail the existing environmental baseline conditions of the study area related to the physical, ecological and social domains of environment;

Chapter-5 Public Consultation and Information Disclosure: explains the public consultation mechanism and findings,

Chapter-6 Environmental and Social Impacts Assessment and Mitigation Measures:

exhibits the assessment of the impact at construction and operational phases of the proposed project along with their mitigation measures,

Chapter-7 Environmental and Social Management Plan: outlines ESMP along with institutional framework required for effective implementation and monitoring;

Chapter-8 Institutional Arrangements: overall responsibility of ESMP monitoring and implementation lies with the Project Management Unit (PMU)

Chapter-9 Grievance Redress Mechanism: elaborates the effective GRM and its implementation framework.

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 NATIONAL POLICY AND LEGAL FRAMEWORK

The Ministry of Climate Change is the authority responsible for environmental protection policy making in Pakistan. 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.

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. Subsequently, the Punjab government amended PEPA, 1997 as Punjab Environmental Protection Act (Amended), 2012, and now Punjab Environment Protection Agency (Punjab-EPA) is responsible for ensuring the implementation of provisions of the Act in Punjab territorial jurisdiction and assuring compliance of the PEQS, and in establishing monitoring and evaluation systems.

For the proposed project, Lahore Water and Sanitation Agency (LWASA), as implementing agency ensure the execution of Punjab Environmental Protection Act (Amended) 2012 and AIIB Environmental and Social Framework (Amended), 2016 during design construction and operational phases of the project.

2.1.1 Punjab Environmental Protection (Amendment) Act (PEPA), 2012

Punjab Environmental Protection (Amendment) Act, 2017 under Clause 12 entails the provision of filing an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) and obtaining environmental approval from the Agency, in respect thereof before the construction of the proposed project.

2.1.2 Pakistan Climate Change Act, 2017

This act aims to meet obligations under international conventions relating to climate change and to provide for adoption of comprehensive adaptation and mitigation policies, plans, programmes, projects and other measures required to address the effects of climate change and for matters connected herewith and ancillary thereto. This act will not accelerate because the proposed project will abridge the emission of hydrogen sulphide and greenhouse gases from the open drains present in the proposed project area.

2.1.3 Land Acquisition Act (LLA), 1894

The project has no land acquisition or involuntary resettlement therefore, the Act LAA 1894 is not applicable to our project

2.1.4 Canal and Drainage Act, 1873

This act entails provisions for the prevention of pollution of natural or man-made water bodies. This act provides the provision that prohibits the discharge of any solid or liquid matter or combination of both from any source into any river, canal and drainage including natural

Channel (Sec 59 A (4), save disposal of discharges without harming the natural environment of receiving water body as well as corrupting and fouling of water channel so as to render it unfit for the purpose for which it is ordinarily used (Sec 70 (8)). Any person who fails to contravene with the provisions will be incurred with the penalty provided under the act. This act will trigger if construction waste (liquid and solid) disposed of into nearby canal and open drains directly.

2.1.5 Punjab Municipal Water Act, 2014

The basic aim of the act is to recognize, regulate and manage present and future municipal water supply and sanitation services and to establish rights of access to basic water supply and basic sanitation, and to ensure conservation of water resources in the province. This act is in draft stage. This act will elicit if there is misappropriation of water supply during construction activities.

2.1.6 Fisheries Act, 1897

This act aims at the protection of fish in water bodies by rules of the State Government. This act will not trigger as no species of fish is present in the water bodies of the proposed project area.

2.1.7 Protection of Trees and Brushwood Act, 1949

This act prohibits cutting or lopping of trees and brushwood without permission of the Forest Department. The Forest Department will be approached for permission to cut trees along the proposed project site.

2.1.8 Cutting of Trees (Prohibition) Act, 1975

This act forbids cutting of trees without acquiescence by the Forest Department. The acts mentioned in section g, and h will stimulate if tree cutting is involved during construction phase of the proposed project.

2.1.9 Punjab Forest Act (Amended), 2010

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. The proposed project is urban in nature and thus no protected forest is situated in and around the Project area.

2.1.10 Punjab Wildlife (Protection, Preservation, Conservation & Management) Act, 1974

This act provides for the protection, preservation, conservation, and management of wildlife in the Province of Punjab. This act defines the wildlife sanctuary, game reserves, protected areas and national parks. It also defines the rules and responsibilities of the relevant authorities and the relevant personnel to protect the ecological resources. It also describes the penalties and punishments on offenses against the sections given in the act. This act will not be violated because no wildlife species exist in the proposed project area.

2.1.11 Antiquities Act, 1975

Antiquities Act, 1975, administered by the Provincial Government, is aimed at safeguarding the preservation of cultural heritage, destruction, damage or defacement of antiquities is an offence under the act.

2.1.12 Punjab Heritage Foundation Act, 2005

This act entails preservation, conservation, maintenance and rehabilitation of the Punjab Heritage through various means, including technical or financial assistance and to create awareness among the people for preservation of the Punjab Heritage.

2.1.13 National Clean Air Act, 2000

The act aims to control vehicular emissions, pollution from industry, and indoor air pollution in rural and urban areas. This act will trigger if vehicles and machinery used for construction activities emanate air pollutants above the permissible limit.

2.1.14 Seismic Building Code of Pakistan 2007

This code stipulates the minimum requirements for seismic safety of building and structures and the provisions of the Building Code of Pakistan (Seismic Provisions-2007) will apply for engineering design of buildings, like structures and related components.

Construction of buildings in defilement of the Building Code will be considered as violation of professional engineering work specified under clause (XXV) of section 2 of the act. This Code is applicable to the proposed project as it includes the formation of structures.

2.1.15 Parks and Horticulture Authority Act, 2012

This act entails regulation, development, and maintenance of public parks, green belts and green areas in the Punjab; regulation of billboards, sky signs and outdoor advertisements; to promote open and unrestricted views of the Punjab. This act will antedate if green belts along the proposed project route affected during construction phase.

2.1.16 Handling of Hazardous Substances, PEPA, 2000

Subject to the provisions of this act, no person will generate, collect, consign, transport, treat, dispose of, store, handle or import any hazardous substance except under a license issued by the Federal Agency and in such manner as may be prescribed; or in accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party customary under sub- clause (a) and (b) of clause 13. This act will trigger during construction and operation phases for handling, management and disposal of hazardous waste.

2.1.17 Punjab Environmental Protection (Motor Vehicles) Rules, 2013

Subject to the provisions of this act, and the rules and regulations, no person will operate a motor vehicle from which air pollutants and noise are being emitted in an amount, concentration or level which is in excess of the Punjab Environmental Quality Standards, or where applicable the standards established under clause (g) of subsection (1) of section 6 of the act. This act will elicit during construction phase due to use of motor vehicles that produce air pollutants and noise.

2.1.18 Alternative and Renewable Energy (ARE) Policy 2019

The ARE Policy 2019 sets Pakistan's strategic direction for achieving energy security and

environmental sustainability through renewable energy. It targets a 30% share of renewable energy in the energy mix by 2030, promotes solar PV deployment, and supports private sector participation through net metering, competitive bidding, and incentives.

2.1.19 Labor and Health and Safety Legislation

The Constitution of Pakistan contains a range of provisions with regards to labor rights, in particular:

a. Article 11 of the Constitution prohibits all forms of slavery, forced labor and child labor;

b. Article 17 provides for a fundamental right to exercise the freedom of association and the right to form unions;

c. Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone; and

d. Article 37(e) makes provision for securing just and humane conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment.

Labor law is controlled at both provincial and national levels with compulsory employment agreements containing the terms set out by the labor laws. There are various laws containing health and safety requirements including: International Labor Law 1998, Mines Act 1923; Factories Act 1934; Factories Rules; Hazardous Occupations Rules 1963; Provincial Employees Social Security Ordinance 1965; and Workmen's Compensation Act 1923. This legislation will trigger during project implementation stage as project involves hiring of labors.

2.1.20 Punjab Occupational Safety and Health Act, 2019

This act entails provision of occupational safety and health of the workers at workplace and to protect them against risks arising out of the occupational hazards; to promote safe and healthy working environment catering to the physiological and psychological needs of the employees at workplace. The act will trigger during construction and operational phase to ensure health and safety of workers at workplace associated with the project activities.

2.1.21 Punjab Restriction on Employment of Children Act, 2016

According to the sub-section 11(a) of this act, an occupier who employs or permits a child (person under the age of 15 years) to work in an establishment will be liable to punishment with imprisonment for a term which may extend to six months, but which will not be less than seven days, and a mandatory fine between 10,000 and 50,000 rupees. This act will trigger if contract higher skilled and unskilled labor under age 15.

2.1.22 Punjab Protection of Women against Violence Act, 2016

This act counters gender-based discrimination, violence against women, and economic and social empowerment of women. This act will entail gender-based violence observed in the project area during construction phase.

2.1.23 Disaster Management Act, 2010

The act is administered by the federal government which provides guidelines for the provision of disaster management plans, offer necessary technical assistance to the Provincial

Governments and Provincial Authorities as well for preparing their disaster management plans in case of any mishap. This act is valid to the subject project in case of any unseen situation.

2.1.24 National Environmental Policy (NEP), 2005

NEP is the primary policy of Government of Pakistan addressing environmental issues. The broad Goal of NEP is, "to protect, conserve and restore Pakistan environment in order to improve the quality of life of the citizens through sustainable development". The NEP identifies a set of sectoral and cross-sectoral guidelines to achieve its goal of sustainable development. It also suggests various policy instruments to overcome the environmental problems throughout the country.

2.1.25 National Climate Change Policy (NCCP), 2021

The Policy puts forward comprehensive policy objectives of sustained economic growth, integration of climate change into inter-related national policies, pro-poor gender sensitive adaptation and cost-effective mitigation, water, food and energy security, Disaster and Risk Reduction (DRR), effective decision making and coordination, creating awareness, building capacities, and conservation of natural resources and long-term sustainability. It also emphasizes the promotion of renewable energy technologies, including solar, to reduce GHG emissions and enhance climate resilience. It aligns national development with global climate commitments and encourages solar adoption in residential, commercial, and industrial sectors.

2.1.26 National Energy Efficiency and Conservation Act, 2023

This act mandates energy efficiency standards and promotes the adoption of clean and renewable technologies like solar systems. It complements the transition to sustainable energy under national and provincial frameworks.

2.1.27 NEPRA Regulations (Distributed Generation and Net Metering) 2015

These regulations facilitate the connection of solar PV systems to the national grid through net metering, encouraging small- and large-scale users to install solar systems and contribute to the energy mix.

2.1.28 National Water Policy

National Water Policy aims at efficient management and conservation of existing water resources, optimal development of potential water resources, steps to minimize time and cost overruns in completion of water sector projects, improving urban water management by increasing system efficiency and reducing non-revenue water through adequate investments to address drinking water demand, sewage disposal, handling of wastewater and industrial effluents; equitable water distribution in various areas and canal commands, measures to reverse rapidly declining groundwater levels in low-recharge areas, increased groundwater exploitation in high-recharge areas, effective drainage interventions to maximize crop production, improved flood control and protective measures, steps to ensure acceptable and safe quality of water, minimization of salt build-up and other environmental hazards in irrigated areas, institutional reforms to make the managing organizations more dynamic and responsive.

2.1.29 National Drinking Water Policy

National Drinking Water Policy provides a framework for addressing the key issues and challenges facing Pakistan in the provision of safe drinking water to the people. Drinking water is the constitutional responsibility of the provincial governments and the specific provision function has been devolved to specially created agencies in cities and Town and Tehsil Municipal Administrations under the Local Government Ordinance 2001.

2.1.30 Guidelines for Environmental Assessment, Pakistan EPA

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 project are listed below:

- Guidelines for the Preparation and Review of Environmental Reports, Pakistan, EPA 1997
- Guidelines for Public Consultations; Pakistan EPA May 1997

2.1.31 National Environmental Quality Standards (NEQS), 2010

Pakistan Environmental Protection Council (PEPC) first approved these standards in 1993. They were later revised in 1995, 2000 and 2010. They endow information on the permissible limits for discharges of municipal and industrial effluent parameters and industrial gaseous emissions to regulate environmental pollution. However, after 18th amendment in the Constitution of Pakistan, Punjab Environmental Quality Standards (PEQS) 2016 will be applicable for this project.

2.1.32 Punjab Environmental Quality Standards (PEQS), 2016

In exercise of the powers conferred under clause (c) of sub-section (1) of section 4 of the Punjab Environmental Protection Act, 1997 (XXXIV of 1997), the Environmental Protection Council has approved the Punjab Environmental Quality Standards (PEQS), 2016. They endow information on the permissible limits for discharges of municipal and industrial effluent parameters and industrial gaseous emissions to regulate environmental pollution. The quality standards for Ambient Air, Noise, Drinking Water and Discharge of Municipal Effluents into Inland Waters and Sewage Treatment are discussed in **Table 2-1, Table 2-2, Table 2-3 and**

2.1.33

Table 2-4**.**

Table 2-1: Ambient Air Quality Standards

Sr. No.	Pollutant	PEQS, 2016	
		Time-Weighted Average	**Concentration Standard**
1	Sulfur Dioxide (SO_2)	Annual Average	80 µg/m^3
		24 Hours	120 µg/m^3
2	Nitrogen Oxide (NO)	Annual Average	40 µg/m^3
		24 Hours	40 µg/m^3
3	Nitrogen Dioxide (NO_2)	Annual Average	40 µg/m^3
		24 Hours	80 µg/m^3
4	Ozone (O_3)	1 Hour	130 µg/m^3
5	Suspended Particulate Matters (SPM)	Annual Average	360µg/m^3
		24 Hours	500 µg/m^3
6	PM_{10}	Annual Average	120 µg/m^3
		24 Hours	150 µg/m^3
7	$PM_{2.5}$	Annual Average	15 µg/m^3
		24 Hours	35 µg/m^3
		1 Hour	15 µg/m^3
8	Lead (Pb)	Annual Average	1 µg/m^3
		24 Hours	1.5 µg/m^3
9	Carbon Monoxide (CO)	8 Hours	5 mg/m^3
		1 Hour	10 mg/m^3

Table 2-2: Noise Quality Standards

Sr. No.	Category of Area	PEQS, 2016	
		Day Time	**Night Time**

		(db)	**(db)**
1	Residential Area	55	45
2	Commercial Area	65	55
3	Industrial Area	75	65
4	Silence Zone	50	45

Table 2-3: Drinking Water Quality Standards

Sr. No.	**Parameters**	**PEQS, 2016**	**WHO (World Health Organization)**
		(mg/l)	**(mg/l)**
A)	**CHEMICAL PARAMETERS**		
1	Aluminum (Al)	≤ 0.2	0.2
2	Ammonium (NH_3)	-	1.5
3	Antimony (Sb)	≤ 0.005	0.02
4	Arsenic (As)	≤ 0.05	0.01
5	Barium (Ba)	0.7	0.7
6	Boron (B)	0.3	0.3
7	Cadmium (Cd)	0.01	0.003
8	Chloride (Cl)	< 250	250
9	Chromium (Cr)	≤ 0.05	0.05
10	Copper (Cu)	2	2
11	Cyanide (CN)	≤ 0.05	0.07
12	Fluoride (F)	≤ 1.5	1.5
13	Iron (Fe)	-	0.3
14	Lead (Pb)	≤ 0.05	0.01
15	Manganese (Mn)	≤ 0.5	0.5
16	Mercury (Hg)	≤ 0.001	0.001
17	Molybdenum (Mo)	-	0.07

Sr. No.	Parameters	PEQS, 2016	WHO (World Health Organization)
		(mg/l)	(mg/l)
18	Nickel (Ni)	≤ 0.02	0.02
19	Nitrate (NO_3)	≤ 50	50
20	Nitrite (NO_2)	≤ 3	3
21	Selenium (Se)	0.01	0.01
22	Residual Chlorine	0.2-0.5	-
23	Zinc (Zn)	5.0	3.0
B)	**PHYSICAL PARAMETERS**		
24	Color	≤ 15 TCU	≤ 15 TCU
25	Taste	Non-Objectionable/ Acceptable	Non-Objectionable/ Acceptable
26	Odour	Non-Objectionable/ Acceptable	Non-Objectionable/ Acceptable
27	Turbidity	< 5 NTU	< 5 NTU
28	Total hardness	< 500 mg/l	-
29	TDS	< 1000	< 1000
30	pH	6.5-8.5	6.5-8.5
C)	**BIOLOGICAL PARAMETERS**		
31	E-Coli	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample
32	Total Coliforms	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample

Table 2-4: Standards for Discharge of Municipal Effluents into Inland Waters and Sewage Treatment

Sr. No.	Parameters	Discharge into Inland Waters	Discharge into Sewage Treatment
		PEQS, 2016	PEQS, 2016
		(mg/l)	(mg/l)
1	Temperature	$\leq 3^0$C	$\leq 3^0$C
2	pH value (H^+)	6-9	6-9
3	Biochemical Oxygen Demand (BOD_5)	80	250
4	Chemical Oxygen Demand (COD)	150	400
5	Total Suspended Solids (TSS)	200	400
6	Total Dissolved Solids (TDS)	3500	3500
7	Oil & Grease	10	10
8	Phenolic Compounds (as Phenols)	0.1	0.3
9	Chloride (as Cl^-)	1000	1000
10	Fluoride (as F^-)	10	10
11	Cyanide (as CN^-)	1.0	1.0
12	Anionic detergents (as MBAS)	20	20
13	Sulphate (as SO_4^{2-})	600	1000
14	Sulphide (as S^{2-})	1.0	1.0
15	Ammonia (NH_3)	40	40
16	Pesticides	0.15	0.15
17	Cadmium	0.1	0.1
18	Chromium (trivalent and hexavalent)	1.0	1.0
19	Copper	1.0	1.0
20	Lead	0.5	0.5
21	Mercury	0.01	0.01
22	Selenium	0.5	0.5
23	Nickel	1.0	1.0
24	Silver	1.0	1.0
25	Total Toxic Metals	2.0	2.0
26	Zinc	5.0	5.0
27	Arsenic	1.0	1.0
28	Barium	1.5	1.5
29	Iron	8.0	8.0
30	Manganese	1.5	1.5
31	Boron	6.0	6.0
32	Chlorine	1.0	1.0

2.1.35 Hazardous Substance Rules, 2003

Hazardous Substance Rules, 2003 deals with handling, storage, transportation and health & safety procedures to be followed in the workplace. These rules deal with generation and handling of any kind of hazardous substance (solid, liquid & gas) as listed in Schedule I of the rules. These Rules provide Safety plan, waste management plan, transportation of hazardous materials procedures as well as reporting mechanisms in case of any accident. Under these rules a license has to be taken from the Federal/Provincial Agency for handling and transportation of hazardous material (Schedule II of Rules).

The contractor for handling hazardous waste will be the licensed contractor. Contravene to any of these rules may cause cancellation of the license by Federal/Provincial Agency as the case may be.

2.1.36 Solid Waste Management Guidelines, 2005

Guidelines for Solid Waste Management have been issued as a draft by the Pakistan Environmental Protection Agency in coordination with JICA and UNDP. These guidelines explain waste generation, discharge and composition. The handling, transportation and final disposal of waste generated during construction and operation phase of the project will be done in view of these guidelines.

2.1.37 Operational Strategy for Clean Development Mechanism (CDM), 2006

Operational Strategy for CDM has been developed to fulfill the requirements of establishing a Designated National Authority (DNA) and ensuring transparent, participatory and effective management of CDM process in the country. The strategy describes the functions and powers of the DNA and the national approval process. It builds on preliminary studies for initial projects including Asia Least Cost Greenhouse Gases Abatement Strategy (ALGAS) and Pakistan's Initial Communication on Climate Change which provides a general framework for operating CDM in Pakistan.

2.2 ADMINISTRATIVE FRAMEWORK

2.2.1 Lahore Water & Sanitation Agency

LWASA is responsible for ensuring that the project complies with laws and regulations controlling the environmental concerns of sewerage system construction and operation and that all preconstruction requisites, such as permits, and clearance are met.

2.2.2 Environmental Protection & Climate Change Department Punjab

Pakistan Environmental Protection Council is the apex inter-ministerial and multi-stakeholder's decision-making body, which is headed by Prime Minister. While Pakistan Environmental Protection Agency is meant for the enforcement of environmental laws in Pakistan. They have delegated powers to provincial environmental protection agencies for review, approval and monitoring of environmental examination/assessment projects. As regards the proposed Project, EPCCD will be responsible for reviewing the report, issuing No Objection Certificate (NOC) and overall/broad based monitoring of the proposed project activities.

2.3 INTERNATIONAL CONVENTIONS

2.3.1 United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate Change (UNFCCC) sets the framework for global efforts to combat climate change. Its ultimate goal is to stabilize greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system. The UNFCCC aims to achieve this goal by promoting cooperation among countries to reduce greenhouse gas emissions, adapt to the impacts of climate change, and provide financial and technological support to developing countries. The Convention has near-universal membership, with 198 parties, and is the parent treaty of the Kyoto Protocol and the Paris Agreement.

The objective of the Convention is to stabilize greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system." Such a level will be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

2.3.2 Kyoto Protocol (Amended), 2012

Kyoto Protocol aimed to reduce carbon dioxide (CO_2) emissions and the presence of greenhouse gases (GHG) in the atmosphere.

2.3.3 Paris Agreement, 2015

The Paris Agreements central goal is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below two degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even. Further to one and half degrees Celsius. Additionally, the agreement aims to increase the ability of countries to deal with the impacts of climate change, and at making finance flows consistent with a low GHG emissions and climate-resilient pathway.

The implementation of the proposed project will reduce the emission of greenhouse gases (GHG) and hydrogen sulphide in the atmosphere form the open drains which is present in the proposed project area due to absence of sewerage system.

2.3.4 Convention on Conservation of Migratory Species of Wild Animals

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 Project area.

2.3.5 Basel Convention, 1994

In 1994, Pakistan signed Basel Convention that restricts trans-boundary movements of “Hazardous Waste and their Disposal with aim to protect human health and surrounding environment by minimizing the use of hazardous waste production. The proposed project will not necessitate the endowment of this convention.

2.3.6 International Union for Conservation of Nature and Natural Resources Red List, 2000

This enlists 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. However, no wildlife species experiencing various levels of threats are present in and around the surroundings of project area.

2.3.7 Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are a set of 17 interconnected global goals adopted by the United Nations in 2015 to address pressing environmental, social, and economic challenges. The SDGs aim to promote peace, prosperity, and dignity for all people, while protecting the planet and its resources. They cover a wide range of issues, including poverty, inequality, climate change, education, healthcare, and sustainable infrastructure, and are designed to be achieved by 2030. The SDGs provide a shared framework for countries, organizations, and individuals to work together towards a more sustainable and equitable future. The proposed project aligns with several SDGs, of which the most relevant are enlisted below:

- ***SDG 3 (Good Health and Well-being):*** Adequate sanitation and sewerage management are crucial for preventing water-borne diseases and promoting public health.
- ***SDG 6 (Clean Water and Sanitation):*** The project aims to enhance sewerage management and sanitation capacity, directly contributing to this goal.
- ***SDG 9 (Industry, Innovation, and Infrastructure):*** The project involves upgrading infrastructure, which is essential for supporting economic growth and development.
- ***SDG 11 (Sustainable Cities and Communities):*** By improving sanitation infrastructure, the project supports the development of sustainable and resilient cities.

2.3.8 International Renewable Energy Agency (IRENA) Guidelines

IRENA supports member countries, including Pakistan, in policy formulation and capacity building for renewable energy. Its technical guidelines for solar systems, grid integration, and energy access support sustainable deployment.

2.3.9 SAARC Framework Agreement on Energy Cooperation (Electricity)

This regional framework promotes cooperation among South Asian nations for cross-border electricity trade, including renewable energy. It lays the groundwork for policy harmonization in the region and encourages solar energy development as a regional priority.

2.4 ENVIRONMENTAL & SOCIAL FRAMEWORK AND POLICY OF AIIB

2.4.1 Environmental and Social Framework of AIIB

The main objectives of the Environmental and Social Framework of AIIB are to:

- Reflect institutional aims to address environmental and social risks, and impacts in Projects;
- Provide a robust structure for managing operational and reputational risks of the Bank and its shareholders in relation to Projects‟ environmental and social risks and impacts;
- Ensure the environmental and social soundness and sustainability of the Project;
- Support integration of environmental and social aspects of Project into the decision-making process by all parties;
- Provide a mechanism for addressing environmental and social risks and impacts in Project identification, preparation and implementation;
- Enable Clients to identify and manage environmental and social risks and impacts of Project, including those of climate change;

- Provide a framework for public consultation and disclosure of environmental and social information in relation to Project;
- Improve development effectiveness and impact to increase results on the ground, both short- and long-term;
- Support Clients, through Bank financing of Project, to implement their obligations under national environmental and social legislation (including under international agreements adopted by the member) governing this Project; and
- Facilitate cooperation on environmental and social matters with development partners.

2.4.2 Project Screening and Categorization

The Bank screens and categorizes each proposed Project to determine the nature and level of the required environmental and social review, type of information disclosure and stakeholder engagement for the Project. The categorization takes into consideration the nature, location, sensitivity, and scale of the Project, and is proportional to the significance of its potential environmental and social risks and impacts.

The Bank determines the Projects category by the category of the Project component presenting the highest environmental or social risk, including direct, indirect, cumulative and induced impacts, as relevant, in the Project area. Bank categorizes proposed project into following four categories:

Table 2-5: Bank Project Categories

Category	Description
A	A Project is categorized "A" if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works and may be temporary or permanent in nature. The Bank requires the Client to conduct an environmental and social impact assessment (ESIA) or equivalent environmental and social assessment, for each Category A Project and to prepare an ESMP or ESMPF, which is included in the ESIA report for the Project. The ESIA for a Category A Project examines the Project's potentially negative and positive environmental and social impacts, compares them with those of feasible alternatives (including the "without Project" situation), and recommends any measures needed to avoid, minimize, mitigate, or compensate for adverse impacts and improve environmental and social performance of the Project.
B	A Project is categorized "B" when: it has a limited number of potentially adverse environmental and social impacts; the impacts are not unprecedented; few if any of them are irreversible or cumulative; they are limited to the Project area; and can be successfully managed using good practice in an operational setting. The Bank requires the Client to conduct an initial review of the environmental and social implications of the Project. On the basis of this review, the Bank, in consultation with the Client, determines the appropriate instrument for the Client to assess the Project environmental and social risks and impacts, on a case-by-case basis. The Bank may determine whether an environmental and social assessment or another similar instrument is appropriate for the Project. The scope of the assessment may vary from Project to Project, but it is narrower than that of Category A ESIA.

C	Project is categorized "C" when it is likely to have minimal or no adverse environmental and social impacts. The Bank does not require an environmental and social assessment but does require the Client to conduct a review of the environmental and social implications of the Project.
F-I	A Project is categorized "F-I" if the financing structure involves the provision of funds to or through a financial intermediary (F-I) for the Project, whereby the Bank delegates to the F-I the decision-making on the use of the Bank funds, including the selection, appraisal, approval and monitoring of Bank-financed subprojects. The Bank requires the F-I Client, through the implementation of appropriate environmental and social policies and procedures, to screen and categorize subprojects as Category A, B or C, review, conduct due diligence on, and monitor the environmental and social risks and impacts associated with the Bank- financed subprojects, all in a manner consistent with this ESP. A Project categorized as F-I is also subject to: (a) the Environmental and Social Exclusion List and applicable host country national laws for all the Bank- financed subprojects; and (b) the applicable ESSs for the Bank-financed subprojects that are classified as Category A subprojects (and if the Bank so determines, some or all of the Bank-financed subprojects that are classified as Category B subprojects).

In the light of discussion in above sections; it is analyzed that according to Environmental and Social Policy of AIIB; project falls under category "A" that requires ESIA study (where the project is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented). Similarly, according to IEE/EIA Pakistan Regulation, 2022 projects fall under Schedule-II that requires Environmental Impact assessment (EIA) because proposed project is likely to have adverse impacts on environment.

2.4.3 Environmental and Social Standards (ESSs) of AIIB

When the Bank has determined, in consultation with the Client, that the Project has potentially adverse environmental and social risks and impacts, it requires the Client:

- To conduct an environmental and social assessment relating to these risks and impacts, and design appropriate measures to avoid, minimize, mitigate, offset or compensate for them, all as required under ESS 1 – Environmental and Social Assessment and Management.
- If the Project results in Involuntary Resettlement, the Client covers Involuntary Resettlement in a resettlement plan or resettlement planning framework (RPF), which is provided to the Bank as a freestanding document, an annex to the assessment report, or incorporated into the report as a recognizable element. The resettlement plan or RPF complements the broader coverage of social risks and impacts in the environmental and social assessment and provides specialized guidance to address the specific issues associated with Involuntary Resettlement, including land acquisition, changes in land use rights, displacement and need for livelihood restoration, all as required under ESS 2 – Involuntary Resettlement; and
- If the Project would affect Indigenous Peoples, the Client covers impacts on Indigenous Peoples in an Indigenous Peoples plan or Indigenous Peoples planning framework (IPPF), which is as a freestanding document, an annex to the assessment report, or incorporated into the report as a recognizable element. The Indigenous Peoples plan complements the broader coverage of social risks and impacts in the environmental and social assessment and provides specialized guidance to address specific issues

associated with the needs of affected Indigenous Peoples, all as required under ESS 3 – Indigenous Peoples.

The proposed project requires application of Environmental and Social Standard (ESS) 1 – Environmental and Social Assessment and Management and ESS 2 – Involuntary Resettlement.

2.4.4 Measures for Climate Change

The Bank supports the three aims of the Paris Agreement of December 2015 to strengthen the global response to the threat of climate change, which are related to mitigation, adaptation and the redirection of financial flows. In the context of sustainable development, the Bank stands ready, through its financings, to assist its clients in achieving their nationally determined contributions, including through mitigation, adaptation, finance, technology transfer and capacity-building. The Bank recognizes the challenges presented by climate change and the need to support both mitigation and adaptation measures in a Project facing such challenges. The Bank supports its clients in their evaluation of both the potential impacts of the Project on climate change and the implications of climate change on the Project.

2.4.5 Conserving Biodiversity

The Bank recognizes that protecting and conserving biodiversity, sustainably managing terrestrial and aquatic natural resources and maintaining core ecological functions and services are fundamental to sustainable development. Through the Projects it finances, the Bank assists its clients in protecting and conserving biodiversity and promoting the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

2.4.6 Comparison of National Legislations and Policies with AIIB's Policy

AIIB has its ESP which is required to be fulfilled by the borrower. The national legislation and ESP diverge on some key points which need to be identified and filled. National laws and regulations are more focused on environmental impact assessment and mitigation measures whereas, AIIB's ESP covers labor influx, GBV, SEA aspects. National legislation entails compensation against land acquisition and land-based assets for title holders, whereas ESP covers compensation at market rates and even to non-titled holders. ESP also focuses on public consultation, information disclosure and grievance redressal mechanism. The gaps between the AIIB ESP and National legislation and measures to bridge the gaps between the two are tabulated below.

Table 2-6: Gap Analysis between National and AIIB ES Requirements

Relevant ESS	National & Provincial Laws	Identification of Gaps	Gaps addressed in ESIA
ESS-1: Environmental and Social Assessment and Management	The Punjab Environmental Protection (Amendment) Act, (PEPA) 2017 and Review of IEE and EIA Regulations, 2000. Punjab Environment Policy (PEP), 2015 National Environment Policy (NEP), 2005 National Climate Change	The criteria mentioned in the Acts for classifying environmental and social risk is different than in the ESP. Moreover, AIIB does not fund Environmental and Social Exclusion Listed (ESEL) projects. The Punjab Environmental Protection (Amendment) Act, 2017 and Review of IEE and EIA Regulations, 2000 mainly focus	As the proposed Project is funded by AIIB, hence, environmental and social risk classifying criteria mentioned in ESP is being followed. As environmental and social assessment will be/is carried out as per ESS-1 for the proposed project. Additional, mitigation measures for environmental and social impacts will be implemented as part of various

Relevant ESS	National & Provincial Laws	Identification of Gaps	Gaps addressed in ESIA
	Policy (NCCP), 2012. Punjab Irrigation Drainage and rivers act, 2020.	on environmental assessment and management through Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) whereas social assessment is cursory. Similarly, NEP and NCCP are environment specific. They barely cover the social aspects. The different methods and tools (ESIA, environmental and social audit, commutative impact assessment, ESMP, ESMPF etc.) for environmental and social impact assessments, referenced in the ESP, are not part of the National and Provincial legislation. Third party monitoring is not covered in the national or provincial legislation.	plans prepared bythe Contractor based on the guidelines provided in this ESMP (guidelines for Tree Plantation / Reforestation Plan, Occupational Health and Safety Plan (OHS), Emergency Response Plan, Restoration and Rehabilitation Plan, Waste Management Plan, Traffic Management Plan, Gender Based Violence (GBV) Action Framework etc. has been prepared as a part of this ESMP to mitigate the environmental and social risks). ESMP is inclusive of Third Party/ External Monitoring Agency (EMA)
ESS-1: Labor and Working Conditions Community Health and Safety	The major labor laws applicable to Punjab province are listed below: The Punjab Occupational Safety and Health Act, 2019; The Punjab Minimum Wages Act, 2019; Punjab Restriction of Employment of Children Act, 2016; Punjab Protection of Women Against Violence Act, 2016; The Factories (Amendment) Act 2012, the Protection against harassment of women in the workplace(Amendment) Act 2022.	National and Provincial laws address most of these requirements of the ESS-2. However, the implementation of these laws and the management of certain issues addressed under ESS-1, such as OHS, GBV, SEA and Child and forced labor, prohibition of children in hazardous work in general and protection against discrimination of religious minorities (many formal sector workers belong to religious minority groups) are not done effectively as detailed coverage of certain requirements is partial.	ESHS clauses as well as GBV, SEA obligations will be made a part of the contract agreement of the contractor. Contractor will provide code of conduct under this agreement and OHS Plan based on the guidelines provided in this ESMP to mitigate construction related health and safety issues for labor/community such as: the exposure to project-related traffic, machinery and material movements, handling of hazardous material, excessive noise/dust etc. and will further ensure prevention of disease spread (including as appropriate, measures to avoid or minimize exposure to communicable and non-communicable diseases, including pandemics). Apply the relevant health and safety provisions of internationally recognized standards, such as the World Bank Group EHSGs, adherence of most updated SOPs/ guidelines issued by the Government / WHO. Also, Assess and appropriately manage the risks of adverse impacts on communities that may result from temporary Project-induced labor influx. Child labor will be strictly

Relevant ESS	National & Provincial Laws	Identification of Gaps	Gaps addressed in ESIA
			prohibited on all the work sites as envisaged in the ESMP.
ESS-1 Resource Efficiency and Pollution Prevention	National Energy Efficiency and Conservation Act, 2015, The Punjab Environmental Protection Act, amended 2012; The Punjab Agriculture Pesticides (Amendment) Act, Pakistan Penal Code, 1860 address the pollution aspect only.	National laws address most of the requirements of the ESS-1, particularly on pollution prevention	Resource efficiency requirements are incorporated in the ESMP and in other relevant instruments. Keeping in view the proposed project, Greenhouse Gases (GHGs) emissions are likely to be reduced significantly; therefore, the global warming potential in terms of CO_2 equivalent is determined.
ESS-1 Stakeholder Engagement and Information Disclosure	The Punjab Environmental Protection (Amendment) Act, 2017; Review of IEE and EIA Regulations, 2000; and Punjab Transparency and Right to Information Act, 2013	Stakeholder engagement in public sector development projects is not carried out throughout the project lifecycle on issues that could potentially affect relevant parties. Also, there is no proper mechanism to record the grievances.	The ESMP follows a structured approach to stakeholder engagement and public outreach that is based upon meaningful consultation and disclosure of appropriate information. The SEP and GRM have been developed as a part of this ESIA.
ESS-1 Cultural Heritage	Punjab Antiquities (Amendment)Act, 2012	All aspects of ESP are not covered under provincial law. Major identified gaps are as below: The provincial legislation is silent regarding the Development of Cultural Heritage Management Plan. There is no provision for the protection of tangible and intangible cultural properties. Provincial legislation is silent about the disclosure of information regarding cultural heritage.	Miani Sahib Graveyard, Shrine of Baba Shah Jamal, and Monument of Chauburji are in close vicinity of the project. However, since the construction is underground, technology used has no impact on these sites. This ESMP however, has developed "Chance Find Procedure" to be followed during project implementation in case of any chance find physical culture resource.
ESS- 1 Financial intermediaries.	NA	NA	Project does not involve any activities with financial intermediaries.
ESS-2 Land Acquisition and Involuntary Resettlement Resettlement Plan (RP)	Land Acquisition Act (LAA), 1894 addresses the land acquisition and compensation by the Government	Pakistan does not have any legal preview for preparation and approval of resettlement related documents e.g. Resettlement Plan (RP) / Abbreviated Resettlement Plan (ARAP). Scope of the LAA, 1894 in comparison to the requirements of ESP only partially takes into account the resettlement of	Construction of the project is in the state-owned land; therefore, no land acquisition will be involved. Furthermore, relevance of this ESS will be reassessed during the detailed design stage at specific site levels when more information is available and

Relevant ESS	National & Provincial Laws	Identification of Gaps	Gaps addressed in ESIA
Livelihood Restoration Plan (LRP)		displaced populations. Coverage of LAA, 1894 also does not provide any assistance for the poor and vulnerable PAPs, livelihood losses or resettlement costs for rehabilitation. Generally, it covers cash compensation policy for the acquisition of land and built-up property, and damage to other assets such as crops, trees, and infrastructure. LAA, 1894, does not require adequate consultation with affected parties; it simply requires that declaration and notice to be given about temporary use of land or acquisition and the purposes for which it is required and provide an opportunity for filing of objections. Nor does it require preparation of a RP/ ARP. In Pakistan there is no Government body / organization who own the resettlement related documents. Compensation for land and other assets is based on average values and schedule unit rates that do not ensure replacement market value of the property acquired. However, LAA, 1894 requires that a 15 percent compulsory acquisition surcharge supplement the assessed compensation. According to LAA, 1894, only title holders can get compensation of their lands, while tenants and squatters who are considered as illegal occupants are forcefully removed overnight and project is started without considering the loss of livelihoods and means of livelihoods of the affected peoples neither any compensation of their losses in terms of properties is paid There is no convenient GRM except recourse of appeal to formal administrative jurisdiction or the court of law.	upon the finalization of Project design. Although, the proposed project does not involve any private land acquisition, however, there will be resettlement and economic/ livelihood impacts. LRP is developed to provide compensation to the displaced persons at market rates along with applicable allowances including severity and shifting allowances. GRM is developed for the project to deal with the grievances to resettlement and livelihood restoration. Public consultation was carried out with directly and indirectly affected persons for the purpose of information disclosure.
ESS- 3 Indigenous Peoples/Sub-Saharan African	There is no law on indigenous people.	Since there is no law on indigenous people hence there is not gap.	It is not applicable to the project as there are no indigenous people in the project area

Relevant ESS	National & Provincial Laws	Identification of Gaps	Gaps addressed in ESIA
Historically Underserved Traditional Local Communities			

3 DESCRIPTION OF PROJECT

3.1 PROPOSED PROJECT DESCRIPTION

The proposed project aims to improve the wastewater management system in Lahore, which currently relies on open drains meant for rainwater to transport bulk wastewater, polluting the nearby River Ravi. The project will assist LWASA in constructing a modern conveyance system by constructing trunk sewers through underground tunneling and the construction of an ultimate pumping and disposal station at Gulshan-e-Ravi in the vicinity of the existing disposal station, which will safely transport domestic sewage, serving a population of 2.35 million over an area of about 15658.2 acres in central Lahore. The construction of a gravity-based transport of wastewater infrastructure will also eliminate the need for intermediate pumping of wastewater at different locations, resulting in cost and environment savings for LWASA in lieu of electricity consumption. The total length of the sewer to be constructed is about 32.37 kilometers, which is divided into three construction legs. The first trunk sewer measuring about 12.30 kilometers (including 159m open cut) will be constructed from Karachi Phattak to Qartaba Chowk, and the second trunk sewer with a length of 12.82 kilometers (km) will cover the sewage flow from Guru Mangant Road to Qartaba Chowk and the third length of 7.25 kilometers (km) will cover from Qartaba Chowk to Gulshan-e-Ravi.

The Project consists of; i) sewage collecting system, ii) sewage conveyance system and iii) sewage disposal system. Sewage collection system will contain intake structures at twenty-two (22) disposal stations to be closed after completion of this project and Seven (7) number intake structures for storm water to provide relief in inundation area. Intake structures at disposal stations consist of inlet chamber, screen chamber, outlet chamber, drop structure, de-aeration chamber, adit and odor control system. Odor control equipment will be housed in a room constructed close to drop structure. Intakes structures will be constructed after installation of steel sheet piles around the required space and excavation of earth material to foundation level. In addition to new structures, a number of existing structures at 22 disposal stations may be dismantled and reconstructed to accommodate new structures due to space limitation.

These shafts may be circular or rectangular depending upon site requirement and be constructed with installation of steel sheet piles around the periphery with internal bracing by steel sections as the excavation progress toward foundation. Manholes will be circular and constructed in reinforced concrete. Manholes are provided for inspection and maintenance by men and machinery. Total of 91 manholes will be provided along conveyance system. In addition to intake structure, odor control system will be installed at selected manholes along sewage conveyance system.

Sewage disposal system consists of disposal stations (intake, screen chamber, wet well, dry well), concrete channel, distribution chamber, concrete conduit, outfall disposal channel and spill channel. Distribution chamber and concrete conduit channel will be designed for 29.74 m^3/s and outfall channel will be remodeled also for 29.74 m^3/s coming from old and new disposal station. Sixteen (16) pumps will be installed with 13 in operation and 3 as standby. The disposal station will be equipped with electrical and mechanical equipment required for robust operation. Steel gates will be provided at the distribution chamber and head regulator of the outfall channel and spill channel for regulation of flows. Disposal station will be constructed by installation of secant piles around the required space. Excavation and dewatering will go side by side. An electricity grid of 132 kV is part of the project. A solar PV system of 450 KW will also be installed at the roof top of Disposal station. It is a small utility scale project which will supplement only 5.7% out of total energy requirement of Disposal Station. Since it is an on-grid system, this energy is sufficient to bear the load equivalent to energy requirements of a pump (dry well), SCADA and lightning of Disposal Station.

A comprehensive SCADA system is planned for acquisition of data, processing and monitoring of

operation of all components. Discharge and gases measurement along the collection, conveyance and disposal system will be monitored through SCADA system. Two control rooms, one at Disposal Station and another at WASA Head office, are also part of the SCADA System.

The proposed alignments of the sewers and their brief description are given in **Table 3-1.**

Table 3-1: Detail of Jacking & Receiving Shafts

Pipe ID	Jacking Shaft (m)			Receiving Shaft (m)			Recommended Drive Length
	Rectangular		Circular	Rectangular		Circular	
mm	Width	Length	Diameter	Width	Length	Diameter	m
1050	4.5	7.6	9.0	2.5	3.5	5.0	190
1500	5.0	8.2	10.0	2.5	4.5	6.0	250
2400	6.0	8.8	11.0	3.5	5.5	7.0	350
3500	7.0	8.8	12.0	4.0	6.5	8.0	500

3.2 PROPOSED ROUTE DESCRIPTION

LWASA carried out the feasibility of the realigned trunk sewer lines. The realignment study aims to avoid conflict with the upcoming development projects and to find a new route for the sewer tunnels to carry the sewage from project areas with minimum disturbance to the originally proposed alignment. The routes are evaluated for constructability and economy along with environmental considerations. The following changes are finalized for the Trunk Sewer Lines.

Trunk Sewer **Line-A**, 12.30 km long, having 450-, 1050-, 1500- and 2400- mm internal diameter, will start from Karachi Phatak (Sadar Lahore) and end at Qartaba Chowk. On its way, it collects sewage effluent from the disposal stations at Mian Mir Colony, Infantry Road, Bird Market, Larech Colony, Ghazi Muhallah, Muhammad Nagar, Governor House, Lakshmi Chowk and Janki Devi. Provision has been made regarding the size of the Trunk Sewer Line-A for accommodating the sewage effluent from certain disposal stations, which are to be connected to the Trunk Sewer in future. These disposal stations include the ones located at Harbanspura and Jorray Pul which are in WASA jurisdiction, and the ones located at Ghosia Colony, Askari IX, Abdur Rehman Road, Sofia Trust, and Shalimar Colony which are under jurisdiction of Lahore Cantonment Board. Length of the Trunk Sewer Line-A will be 12.30 km out of which the sewer with internal diameter of 450 mm will be 159 m, sewer with 1050 mm internal diameter will be 3.755 km, sewer with 1500 mm internal diameter will be 1.361 km long and the sewer with 2400 mm will be 7.025 km long.

Trunk Sewer **Line-B,** 12.82 km long, starts from Gurumangat Disposal Station with an internal diameter of 1500 mm. From Gulberg G-Block Disposal Station, the internal diameter of the Sewer increases to 2400 mm till its end at Qartaba Chowk along Ferozpur Road. On its way it collects the sewage effluent from disposal stations located at Gulberg Q-Block, Center Point, Gulberg G-Block, Zafar Ali Road, Sharif Colony, Ichra, Shadman, Shama and Rasool Park, all of which fall under jurisdiction of WASA Lahore. In future sewage effluent from disposal stations, namely Fatehabad, Khan Colony, Askari Villa and Sultan Park under Lahore and Walton Cantonment Boards will also flow into the Trunk Sewer Line-B. Accordingly the capacity of the Trunk Sewer Line-B has been selected to accommodate the discharges from these Disposal Stations as well. Length of the Trunk Sewer Line-B will be 12.82 km out of which a sewer with internal diameter 1050 mm will be 5.41 km, sewer with 1500 mm internal diameter will be 2.85 km, and 2400 mm internal diameter sewer will be 4.56 km long.

Line-C, 7.25 km starts from Qartaba Chowk, follows Bahawalpur Road, Multan Road, Gulshan-e-Ravi Main Boulevard, Noonarian Road, Riaz Mansuri Road and end at the proposed Ultimate Disposal Station to be located within the premises of the existing Disposal Station at Gulshan-e-

Ravi. Trunk Sewer Line-C will pass the combined flow from Line-A and Line-B. On the way it also carries flows from Disposal Station Lytton Road, PIA Planetarium and Poonch Road. Length of the Trunk Sewer Line-C will be 7.25 km out of which sewer with an internal diameter 1050 mm will be 1.26 km, sewer with 1500 mm internal diameter will be 0.64 km, and 3500 mm internal diameter sewer will be 5.35 km long. There will be approximately eighty-three (83) Receiving Shafts, and eight-two (82) Jacking Shafts will be constructed from start of the project to the end at the proposed Ultimate Disposal Station at Gulshan-e-Ravi to lay the Trunk Sewer by MTBM. The receiving and jacking shafts will be circular as well as rectangular and will be constructed by installing steel sheet piles around the periphery.

3.3 EXISTING SEWERAGE SYSTEM IN CENTRAL ZONE

The existing sewerage system of Central zone of Lahore (the project area) was laid during the past 25 to 60 years and consists of 233 km of existing trunk sewers and 1,092 km of lateral sewers, making a total length of 1,325 km. There are six (6) major sewage pumping stations, two (2) drainage pumping stations and twenty-seven (27) Local Disposal stations. The Local Disposal stations deliver the effluent into five (5) major existing disposal stations, which ultimately pump the whole effluent into disposal outfall channels connected to the Ravi River.

The existing sewerage system mainly consists of reinforced concrete sewer pipes while in some areas older brick masonry sewers also exist. Salient features of the existing disposal stations near the Ravi River are shown in **Table 3-2.**

Table 3-2: Salient Features of Existing Outfall Disposal Stations in the Central Zone*

Sr. No.	Disposal Station	Location	Year of Commissioning	Total Capacity in cusecs (ft^3/s)	No. of Pumps & Their Capacity (number of pumps X Individual Pump Capacity)
1	Bhati Gate	Near Data Darbar	2000	100	4 (4x25)
2	Main Outfall-1	Near Bund Road Saggian Bridge	1945	181	10 (4x25, 1x8, 1x40, 1x15, 1x6, 2x2)
3	Main Outfall-2	-do-	1977	102	4 (2x25, 2x26)
4	Main Outfall-3	-do-	1985	87	5 (3x25, 2x6)
5	Gulshan-e-Ravi	G-Block, Gulshan-e-Ravi	1992	560	14 (14x40)
6	Multan Road	Sabzazar Scheme	1982	240	6 (6x40)
Total Flow (Cusecs)				1270	

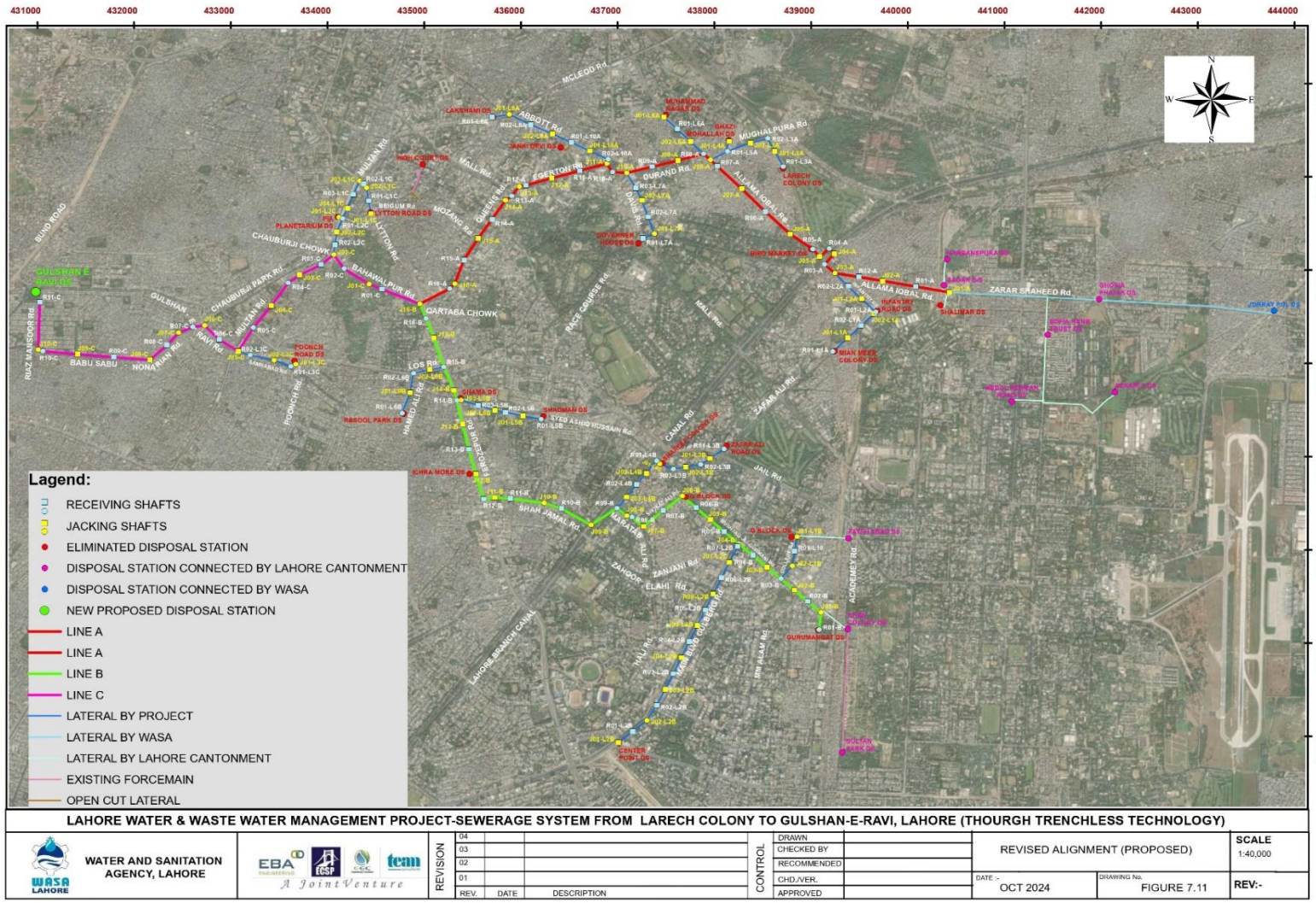


Figure 3-1: Updated Areas of Line-A, B, C

3.4 DESIGN OF PUMP STATION

The construction of an ultimate pumping and disposal station with a capacity of 688 Cusecs at Gulshan-e-Ravi, along with allied works, such as the installation of a SCADA system for gas concentration and flow monitoring in trunk sewers, electromagnetic/ ultrasonic flow rate monitoring system, construction of concrete disposal channel, distribution chamber, concrete conduits and construction and restoration of outfall disposal drain. Further, an outfall channel, restoration and brick-lining of Cantonment Drain and Gulberg Drain, and installation of a rider sewer along Cantonment Drain. The drainage channel required rehabilitation within the channel, while the second drainage channel will be constructed to increase the capacity of flow.

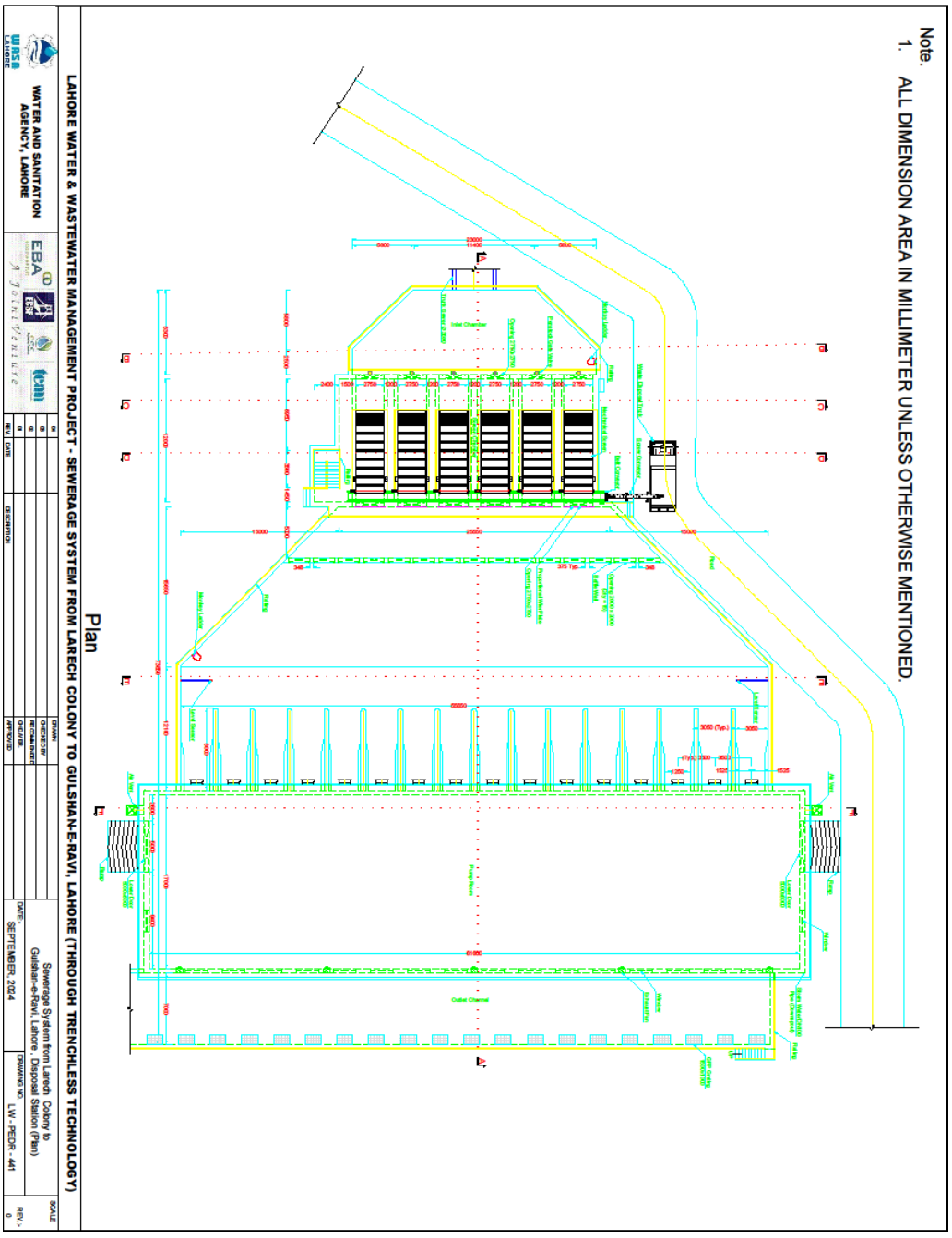


Figure 3-2: Layout of Pumping Station

3.4.1 Type of Pumps

Vertical Cardon shaft non-clogging pumps were proposed with a maximum efficiency of 80% at Peak sewage flow conditions. Enquiries from the local market have revealed that these pumps are locally available and hence the problem of spare parts & subsequent O&M is not envisaged.

3.4.2 Pumping Head

The total pumping head of proposed pumps is 23 m. The static head from wet well to the disposal point is 20.6 m. Total dynamic head loss due to fitting and bends is 15.7 m.

3.4.3 Screening Chamber

A screen chamber is provided between intake chambers and wet well. It is equipped with automatic mechanical screens. Six mechanical bar screens made of stainless steel are provided (five operational and one standby) for the removal of large, suspended objects (solid waste).

Level sensors are also provided in the screen chamber upstream and downstream of the mechanical screen for automatic operation and flow measurement. For the collection and automatic transfer of screening material, a conveyor belt will be provided. The screening material will automatically be transferred from the screens to the top of the conveyor belt, which will then transfer the material to the screening container or disposal truck. The screening material must be transferred to the landfill site daily. At the end and start of wet well a proportional weir is provided to maintain the velocity in the screen chamber to avoid deposition of suspended solids at the bottom of screen chamber. Steel railing is provided at the top of retaining walls for safety purposes.

3.4.4 Solar Energy

The 450-KW solar energy installation at the Gulshan e Ravi Disposal Station will significantly reduce carbon emissions by harnessing renewable energy to power the operations. It will decrease reliance on fossil fuels, lowering greenhouse gas emissions and contributing to a cleaner environment. Additionally, solar energy will reduce operating costs by minimizing energy expenses providing long-term savings and enhancing the station's sustainability. This initiative showcases a commitment to environmental stewardship and efficient resource management. The specifications of Solar Energy system are provided in Annexure-XXVII.

3.4.4.1 PV Solar System Technology Procurement

The procurement of PV Solar System technology can occur through one of the two possible pathways:

1. Direct acquisition from manufacturers or certified wholesalers, or
2. Through intermediary/local vendors or EPC contractors who manage procurement.

3.4.4.2 Operational Mechanism of Solar System

The operational system of the solar PV setup at the disposal station is designed to function as a grid-tied hybrid system with battery backup, ensuring continuous power supply for critical operations such as a pump Supervisory Control and Data Acquisition (SCADA) and lighting. During daylight hours, solar panels convert sunlight into direct current (DC) electricity, which

is then converted into alternating current (AC) through an inverter to power the disposal station's equipment. Excess electricity generated is used to charge the battery bank, which serves as a backup power source in case of grid outages or low solar output. A smart charge controller manages the charging and discharging cycles of the batteries to prevent overcharging or deep discharge, thereby extending battery life. The system is integrated with the existing WAPDA grid, allowing automatic switchovers between solar, battery, and grid power based on demand and availability. Additionally, a remote monitoring system is installed to track energy production, consumption, system efficiency, and to detect faults or failures in real time, ensuring high reliability and operational efficiency of the solar-powered disposal station.

3.4.5 Labor and Working Conditions of Supply Chain of Solar PV System

The 450 kW Solar PV system will be a small scale system and will engage a mix of skilled and unskilled labor during construction and a small number of technical personnel during operation. As this component falls under the scope of the Engineering, Procurement, and Construction (EPC) contractor, the contractor will be fully responsible for ensuring compliance with applicable national labor laws and international standards on fair wages, working hours, occupational health and safety, and non-discrimination. Risks such as child labor, forced labor, wage disparities, and lack of grievance mechanisms will be actively assessed and properly managed at the time of procurement and during the installation of works. The project will adopt clear labor management practices to ensure safe, equitable, and rights-based working conditions throughout its lifecycle.

3.4.5.1 Guidelines/Measures for Mitigation of Potential Supply Chain Risks

3.4.5.2 *For Direct Procurement:*

- Supply chain due diligence on Tier 1 and known Tier 2 suppliers will be conducted.
- Evidence of certifications, compliance history, and audit reports will be required from all relevant suppliers.
- A Supplier Code of Conduct aligned with AIIB ESP will be established and shared as part of the procurement process.
- Rights to conduct spot-checks, audits, or request compliance evidence during delivery will be included in contractual agreements.
-

3.4.5.3 *For Procurement via Intermediary Vendors/EPC Contractors:*

- Contractual obligations for vendors to procure only from suppliers who meet ethical, labor, and environmental standards will be included.
- Vendors will be required to submit supplier declarations or certifications as part of their delivery documentation.
- Penalty clauses for breach of supply chain compliance will be incorporated into all relevant contracts.
- A compliance focal person from the contractor/vendor team will be appointed to liaise on ESG verification matters.
- Flow-down clauses to ensure all subcontractors and sub-suppliers comply with the same standards will be included in contracts and subcontracts.

3.4.6 Outfall Structure

The collected wastewater will be pumped in a nearby sullage carrier across the Bund Road which will dispose it off into the river Ravi. **Figure 3-2 and**

Figure 3-3 shows the layout plan of the proposed Disposal Station and the sullage carrier.

3.4.7 Sullage Carrier/Outfall Drain

The condition of the existing sullage carrier, 350 cusecs, across the Bund Road is quite deteriorated and requires de-silting and remodeling/rehabilitation for enhancing it carrying capacity to 1040 cusec to cater additional flow from the proposed system. The topographic survey showed that the width of the existing carrier is enough to accommodate 1040 cusec drain. The depth would be increased to cover the additional load; therefore, no additional land is required thereby no need for land acquisition.

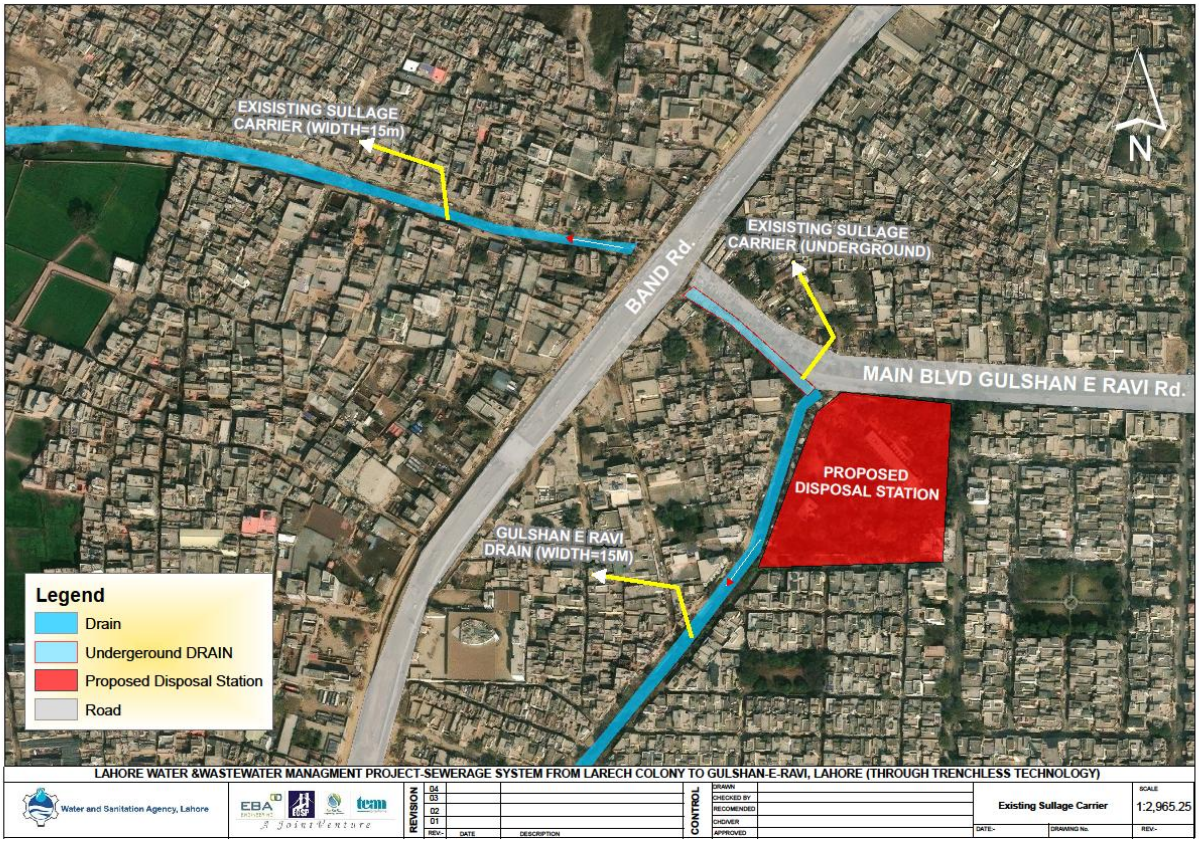


Figure 3-3: Layout Plan of Proposed Outfall / Structure and Sullage Carrier

3.5 COMPONENTS OF THE OUTFALL STRUCTURE

The proposed outfall structures will mainly include the following components.

1) Collection Sump

This structure will be built close to the existing outfall drain which will receive sewage from pump houses and dispose of the same into the river under submerged condition in the outfall drain. This will eliminate the risk of formation of gases and nuisance of odor in the area.

2) Outfall Drain

The old drain, being in deteriorated condition and inadequate to meet the additional sewage flows, will be remodeled/rehabilitated/replaced with suitable structures to meet the project requirements. A topographic survey of its existing route was carried out, keeping in view the following important features:

- Topographic levels on both sides of the existing drain
- Existing bed elevations
- Location of encroachments, if any on both sides of the existing route due to current developments on the ground
- Locations of road crossings
- Locations of buried utilities on both sides of drain if any
- Existing outfall structure details if any.

The topographic survey of existing drain reveals the following parameters. The Cross Section of Outfall Drain is attached as **Annexure XX.**

3) Outfall Structure

A proper outfall structure will be constructed at the final disposal point of the outfall drain.

4) Survey of Proposed Drain Route

A topographic survey of its existing route was carried out, keeping in view the following important features:

- Topographic levels on both sides of the existing drain.
- Existing bed elevations
- Location of encroachments, if any on both sides of the existing route due to current developments on the ground
- Locations of road crossings
- Locations of buried utilities on both sides of drain if any
- Existing outfall structure details if any.

3.5.1 Provision of Mechanical Screens at Lift /Disposal Stations

During the survey of existing lift/disposal stations, it was observed that no proper system of screening exists. The currently installed screens are all manual (hand cleaned) and are not operational, which can lead to the high maintenance cost of mechanical equipment (pumps), clogging, and lower efficiency. Currently, manual bar screens are not installed up to the finished ground level. So, the worker has to go to the lower level for screen cleaning operations. With this design, the whole process of screening, including cleaning, removal, and transfer of screening from lower level to higher ground level is difficult. Practically this is not recommended for such high flows due to labor-intensive operations.

Screening operations before the trunk sewer will help avoid frequent maintenance and cleaning operations. Accumulation of screened material inside the trunk sewer will reduce the area of flow which will reduce the carrying capacity of the sewer.

It is recommended to install new mechanical screens at each disposal station with level sensors for automatic operation of screens. Similarly, belt/shaftless screw conveyor will be provided along with the screens for automatic transfer of screenings to the disposal truck.

3.6 CONSTRUCTION MATERIAL AND MACHINERY

Most of the construction material is expected to be procured from Punjab and Khyber Pakhtunkhwa (KP) Provinces of Pakistan. The construction material that will be used for construction activities are Cement; Sand; Aggregate; Bentonite; High Density Polyethylene (HDPE) Pipes; Stainless Steel; Bricks; and Water.

The construction machinery that will be used for construction activities are Tunnel Boring Machine comprising Slurry pumps; Excavators; Batching Plant; Cranes; Lubrication System; Slurry Machine; Tractors; Trolley; Vibratory Roller; and Water Tankers. The Screening System, Microtunnelling Boring Machines, Vertical Spinning Machine, Sheet Piles, Pumps will be imported by the EPC contractor as per the specifications.

3.6.1 Construction Camp (Temporary Facility)

There will be two campsites located at the disposal station and a pipe manufacturing facility. The camp site will be selected, keeping in view the availability of an adequate area inclusive of parking areas for machinery, stores and workshops, access to communication and local markets. It will be at an appropriate distance away from sensitive areas of the vicinity. The site location will be selected by the finalized after approval from the proponent. Contractor will submit a Contractor`s Workers Accommodation Plan as a part of Site-Specific Environmental & Social Management Plan, before the start of construction. This plan will ensure incorporation of all the requirements set under the AIIB Policy.

3.6.2 Workforce Requirements

The estimated number of workers (including skilled and semi-skilled labor) required for the whole construction period is approximately 750.

3.6.3 Power Requirement and Source

The main source of electricity/electric power during the construction phase will be diesel generators. The electric power will be supplied by the Lahore Electric Supply Company (LESCO) during operational phase.

3.6.4 Water Requirement

According to LWASA Average Daily Per Capita Water Consumption (50 gallons/day) the water consumption is estimated to be 37,500 gallons per day for 750 construction workers and it is anticipated that about 25 tankers (approx. 37,500 gallons) per day will be required during construction phase of the project.

3.6.5 Wastewater Generation

The wastewater generation is estimated to be 30,000 gallons per day for 750 construction workers during the construction phase of the proposed project.

(*Source: Design Criteria of Public Health Engineering for Water Supply, Sewerage and Storm Water Drain)

3.6.6 Solid Waste Estimation

The solid waste generation is estimated to be 450 kilograms per day for 750 construction workers during the construction phase of the proposed project.

3.7 KEY CONSTRUCTION ACTIVITIES

As per the Feasibility Study trunk sewer design, there are 165 pits points of which 82 are jacking pits and 83 are recipient pits. Pits will be constructed before the tunnel starts boring. This will entail excavation, slurry management, material handling etc. Activities, their anticipated risks and mitigation measures are detailed in "Health and Safety" section in Chapter 6. The section also covers the community health risks as well. A pipeline is constructed by consecutively pushing pipes and the MTBM through the ground, using a jacking system for thrust. Continuous pressure is provided to the face of the excavation to balance groundwater and earth pressures.

3.8 MICROTUNNELING OVERVIEW

According to American Society of Civil Engineers/Construction Institute (ASCE/CI) 36-15, Standard Design and Construction Guidelines for Micro tunneling provides a general description of micro tunneling. According to ASCE/CI 36-15, micro tunneling must have the following criteria:

- Remote control: The (MTBM) is operated from a control panel, normally located on the surface. The system simultaneously installs pipe as the ground is excavated and removed. Personnel entry is not required for routine operation.

- Guidance: The guidance system usually consists of a laser beam projected onto a target in the MTBM. With this system, the MTBM is capable of installing gravity sewers or other types of pipelines to the required tolerance for line and grade.

- Pipe jacking: A pipeline is constructed by consecutively pushing pipes and the MTBM through the ground, using a jacking system for thrust.

- Continuous support: Continuous pressure is provided to the face of the excavation to balance groundwater and earth pressures.

The main component of a micro tunneling drive consists of a launching/jacking shaft, a micro tunneling drive, and a receiving shaft. The micro-tunnel boring machine (MTBM) will start from the launching shaft with the pipe continuously jacked behind the MTBM. The MTBM is guided by a guidance system to keep the machine within line and grade, typically, to a tight tolerance. A jacking frame is installed at the launching shaft to propel the machine by jacking the pipe behind the MTBM. A seal ring will be installed at the shaft wall where the MTBM penetrates the shaft wall (breakout) to keep the soil and groundwater from entering the shaft. Ground improvement behind the shaft wall may be required to contain the soil and groundwater as well. Similarly, a sealing ring is also required at the receiving shaft to prevent soil/groundwater from entering the shaft during MTBM wall penetration.

The construction cycle includes 2 stages, excavation stage and pipe setup stage. The excavation stage commences with the MTBM excavating the soil while the pipe jacked behind the MTBM. Once a pipe is jacked in place, the MTBM is stopped, and the next pipe section is set up in the launching machine (pipe setup stage). During this stage, all utility lines such as power, hydraulic, slurry etc. will be augmented. A schematic of a typical micro tunneling component is shown in **Figure 3-4** below.

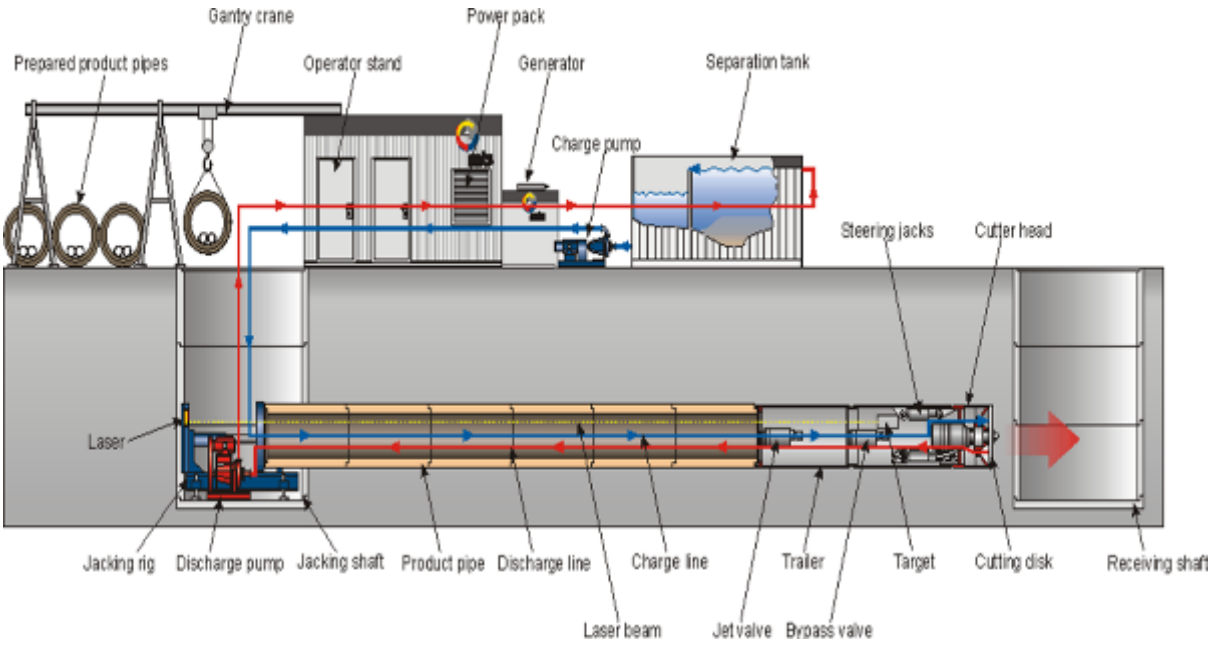


Figure 3-4: Micro-Tunneling Schematic

3.8.1 Tunneling Technique Selection

Project will use the guidelines provided in ASCE/CI 36-15 to determine the most suitable tunneling technique along the project alignment. The tunnel will be mainly constructed in silty sand, sand, and silt. Based on the selection criteria provided in **Figure 3-5** below, it is suggested that slurry micro tunneling technique is the most suitable tunneling technique.

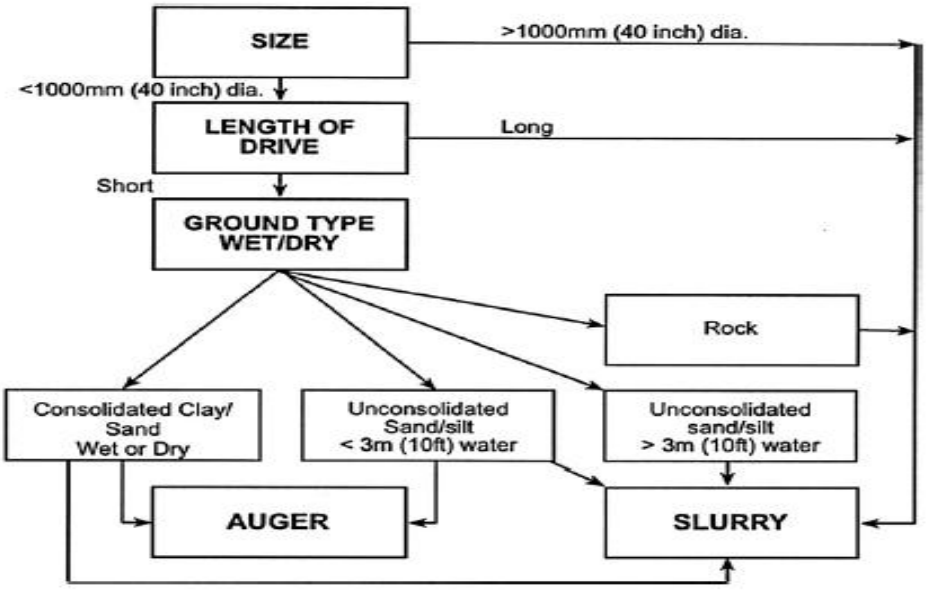


Figure 3-5: Determination of Tunneling Technique (from ASCE/CI 36-15)

Based on the guidelines presented in ASCE 36-15, the slurry micro-tunneling technique is most suitable based on the existing ground conditions, pipe sizes, depths, and proposed alignment. Specifically, ASCE 36-15 recommended the following micro-tunneling requirements

- "It must be capable of providing positive face support (both earth and water pressure)."
- "It must be articulated in such a way as to enable controlled steering in both the vertical and the horizontal direction, to a tolerance of plus or minus 3 percent of the MTBM diameter on grade or 25 mm (1 in.), whichever is greater, and 6 percent of the MTBM diameter on line or 50 mm (2 in.), whichever is greater, and from the design grade and line."
- "All MTBM functions must be controlled remotely, typically from a surface control unit."
- "The MTBM's rotation must be capable of being controlled. The cutter wheel must be capable of a bidirectional drive. Antiroll fins or grippers may also be installed, but not as the primary method of rotation control."
- "It must be possible to inject lubricant around the exterior of the jacked pipe at the back of the MTBM."
- "With proper operation of the MTBM, it must be possible to control heave and settlement to acceptable tolerances, as indicated in the contract documents."

The contractor shall follow the micro-tunneling operational guidelines provided in ASCE 36-15, where applicable.

3.8.2 Slurry Micro tunneling Machine Component

Micro tunnel Boring Machine (MTBM)

MTBM consists of a cutter disk, extraction chamber, crusher chamber, articulating shield, steering cylinders, laser target, and slurry supply and return lines. **Figure 3-6** provides a section view of a typical MTBM.

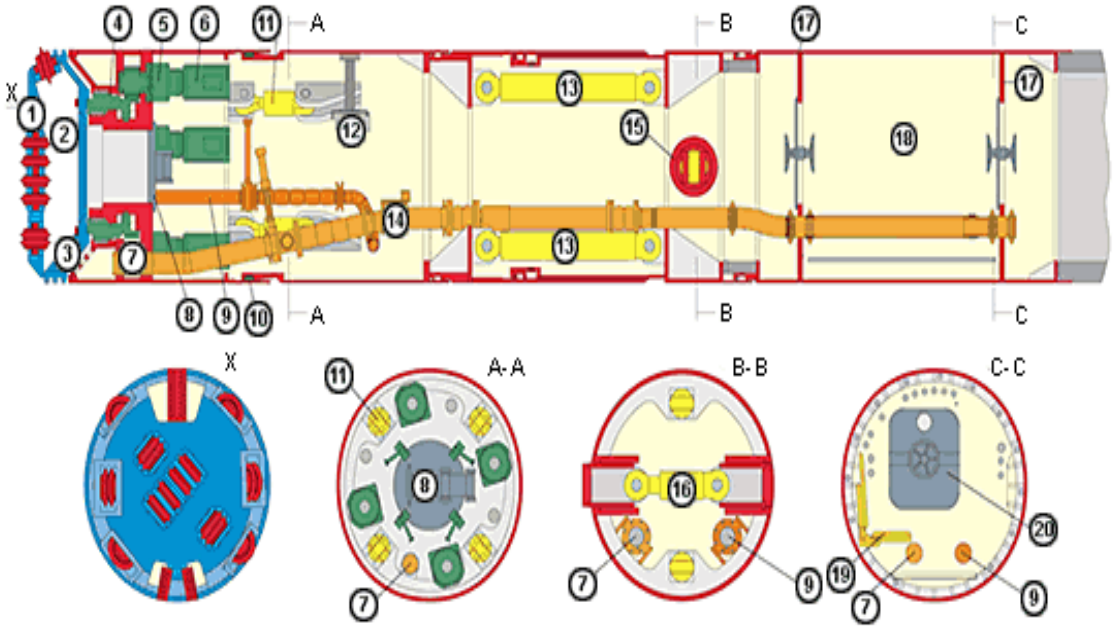
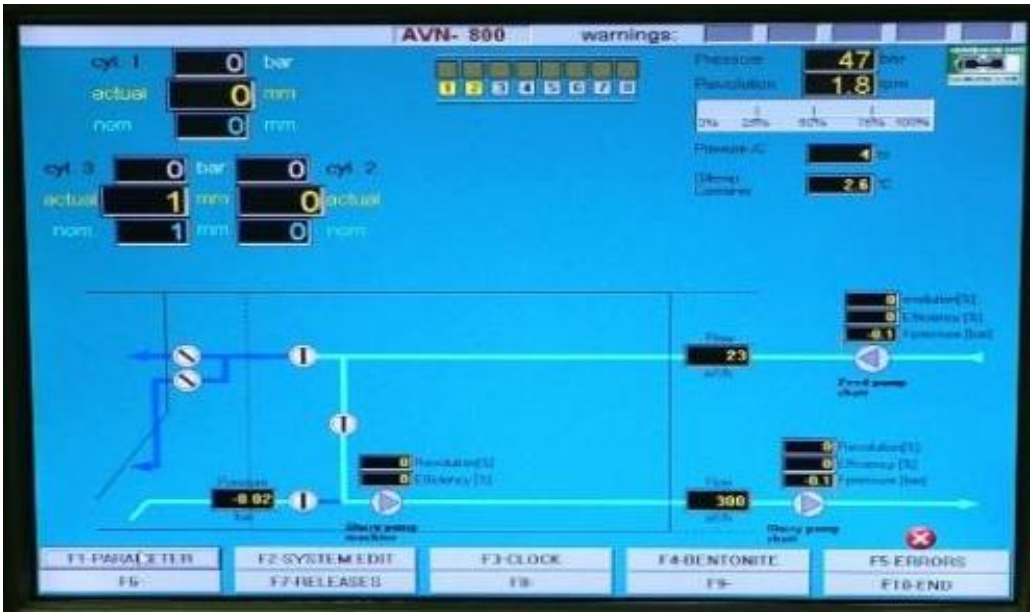


Figure 3-6: MTBM Component

3.8.3 Control System

A control unit is supplied with the machine. The control unit has instruments to control face pressure, and steering, and to provide information about the machine status and the guidance system. **Figure 3-7** shows typical control unit screens.



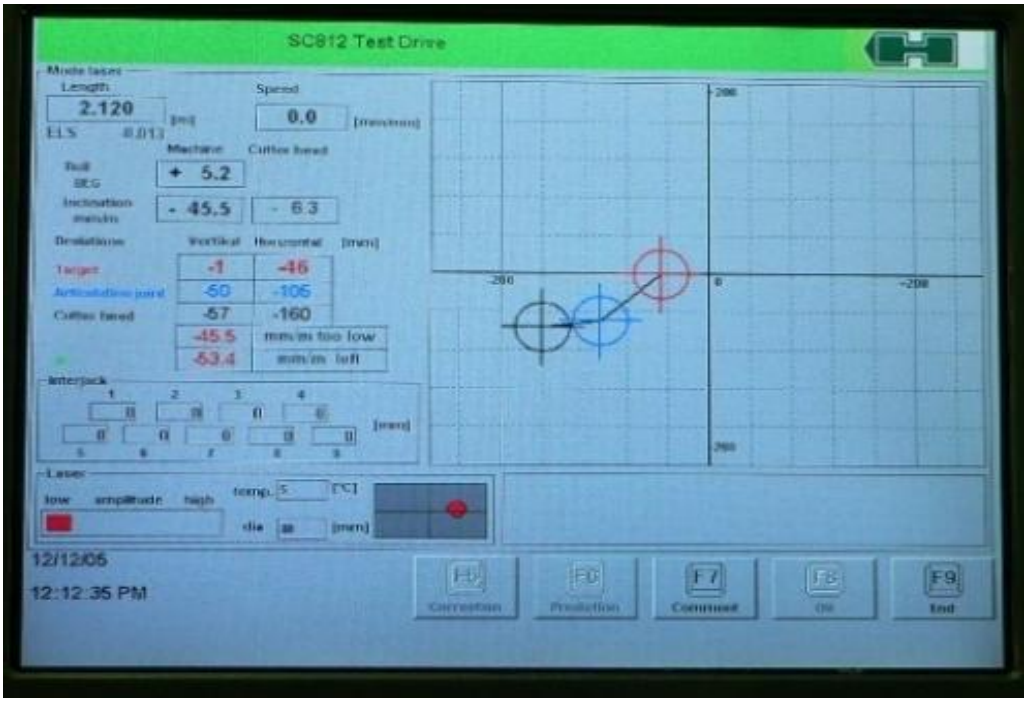


Figure 3-7: Typical Control Unit Screens

3.8.4 Spoil Handling System

For slurry machines, slurry is the main conduit to extract the soil cuttings. The slurry is injected into the face under pressure to provide face support (support ground and groundwater

pressure). The slurry then mixes with the soil cuttings and is extracted back to launching shaft/surface to a slurry separation plant. At the separation plant, the slurry is separated from the soils through shaker screens (for granular soil) or hydro cyclone (for fine grain soil). **Figure 3-8** provides an example of a slurry separation plant.

Figure 3-8: Slurry Separation Plant

3.8.5 Jacking System

The MTBM is advanced by means of jacking. A jacking frame is required to advance the pipe. The jacking frame is usually supported against the launching shaft wall via thrust block. **Figure 3-9** shows a typical jacking frame.

Figure 3-9: Typical Jacking Frame

3.8.6 Pipe Lubrication

The MTBM and the pipe are jacked into place throughout the micro tunneling operation. The jacking operation is required to overcome the face pressure and skin friction along the pipe. To reduce the required jacking forces, lubrication is required along the pipe/soil interface to reduce the skin friction resistance. Bentonite is injected through the MTBM tail shield to

partially keep the space between the pipe and the ground open and to reduce skin friction. Additional bentonite injections may be performed through grouting ports along the pipe.

3.8.7 Drop Structure

The primary function of the drop structure is to carry the flow from the surface sewer system to the deeper tunnel sewer to control the velocity and energy of water as it flows from high to lower elevation to avoid turbulence and odor control. As the flow falls, air mixes with the flow, and tremendous forces can be generated, resulting in a variety of hydraulic and structural design issues. The primary objective of drop structure design is to minimize the effects of falling flow by:

- Dissipating energy from the falling flow,
- Minimizing the amount of air that is entrained from the falling flow and transported into the main tunnel.

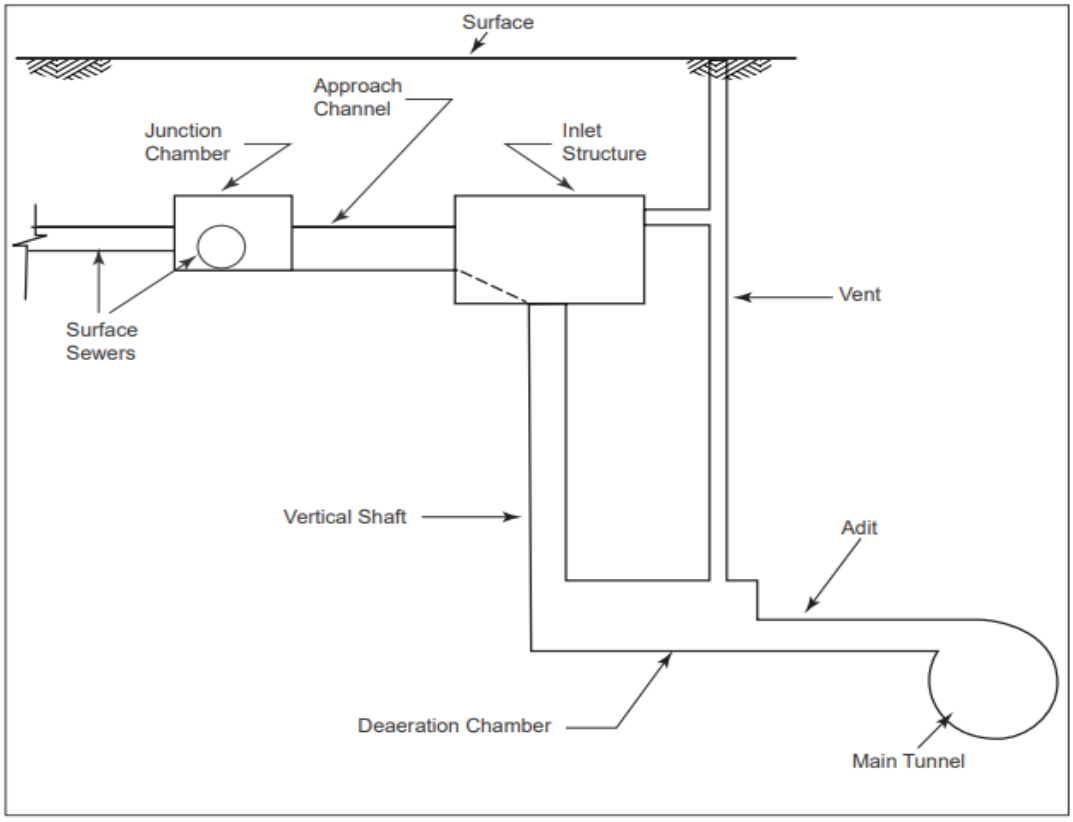


Figure 3-10: Drop Structure Design

3.8.8 Odor Control System

The turbulence caused by falling wastewater flow at drop structures is the primary factor contributing to the release of gases from the wastewater and consequent odor and corrosive conditions in the vicinity of the drop structure. In this project, the drop structures are located at the downstream end of the outlet chamber of the Intake sewage system, so it is assumed that dissolved oxygen levels are substantially depleted by the time the flow reaches the drop structures. Moreover, warm sewage temperatures and climate suggest that favorable conditions are present for the production of odorous gases, so odor control systems are proposed for each drop structure.

The odor control system is comprised of high-pressure fans for the extraction of contaminated air from the drop structure vent and activated carbon vessels.

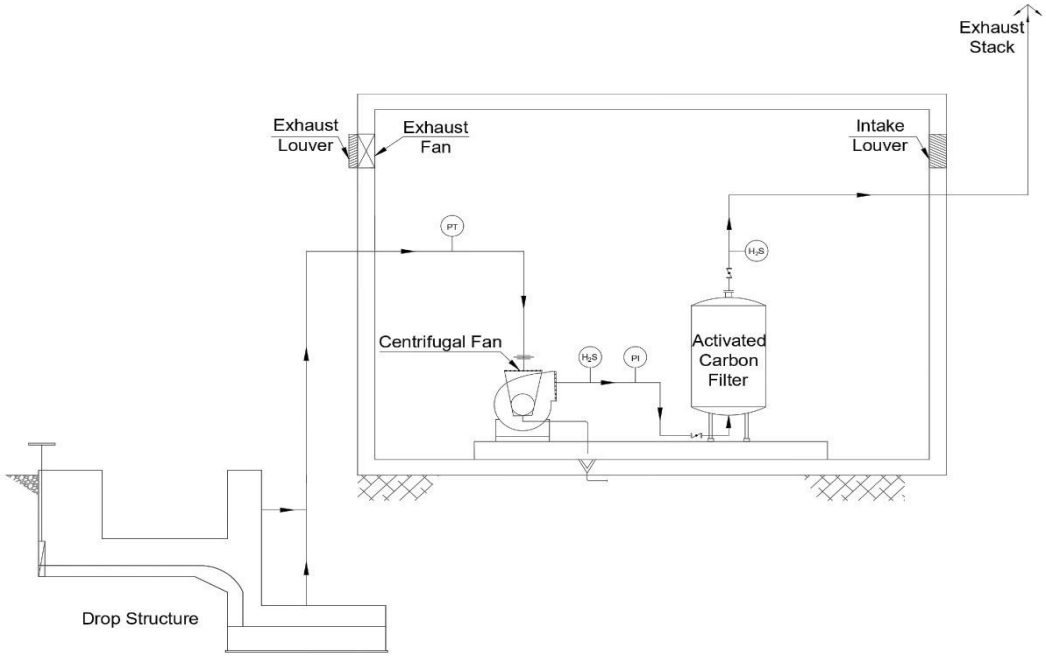


Figure 3-11: Schematic Diagram of Odor Control Systems

3.8.9 Ventilation System

The organic matter in sewage decomposes anaerobically and produces a variety of gases that are unpleasant in nature, harmful to human health, and corrosive to sewers. Sulfides are produced which can cause H_2S to be discharged into the headspaces if the oxygen transfer is insufficient to maintain sewage aerobics. The ventilation system is important to reduce the production of harmful gases and to effectively remove the produced gases to control the problem of odor, pressurization of sewer, health considerations due to toxic gases CH_4 and H_2S, and the build-up of explosive gases. Ventilation systems are used to promote air movement in sewer systems. Sewers must be ventilated properly because of the following reasons:

- To release gases in the atmosphere in a controlled way to avoid odor problems.
- Providing air release to avoid pressurization of the sewer and prevent system blockages that might arise from inadequate or nonexistent ventilation.
- To reduce hazards to maintenance personnel by countering the development of a toxic and/or explosive atmosphere.
- To promote aerobic conditions and reduce septicity in the sewer by maintaining a supply of oxygen.
- To reduce H_2S concentration in the sewer atmosphere.

3.8.10 Power Supply

At each jacking location, power supply shall be provided to operate the machine and the hydraulic units. Power supply should be made available continuously for MTBM operations. It is preferred that the generator set of required capacity be installed at each Jacking Shaft till completion MTBM Process.

3.9 OPERATION AND MAINTENANCE (O&M)

The contractor will be responsible for the preparation of operation and maintenance manuals of the proposed project and will be responsible for performing the following activities during operation and maintenance phase:

- Visual Inspection
- ND Testing;
- Infiltration and Exfiltration Test;
- Obstruction and Debris Removal;
- Leakage test for Manholes and Pipes;
- Smoke Test;
- Monitoring and Environmental Inspection;
- Noise Level;
- Energy Consumption;
- Hydraulic Capacity;
- SCADA System for Monitoring of CH_4 and H_2S gas concentration in sewer tunnels;
- Operational Staff Training of LWASA Staff
- Quality Control Monitoring; and
- Auditing.

However, the supervision consultant will be responsible for frequent site visits to ensure operation and maintenance of the proposed project in coordination with LWASA staff. If LWASA needs to ensure compliance of operation and maintenance activities, they can hire third party consultant or contractor for validation of these tasks.

3.9.1 Electrical and SCADA Systems

To realize the objectives of the project, the proposed Sewage Disposal Station as well as Sewerage / Trunk or allied Equipment to be installed and commissioned at site will be furnished with the Supervisory Control and Data Acquisition (SCADA) System. A small utility scale installation of Solar PV System of 450 KW will also be installed at Disposal Station of Gulshan-e- Ravi for the smooth working of SCADA and light load. Monitoring and Control System in the form of SCADA system is proposed for installation as per following:

- SCADA at Disposal Pumping Station at Gulshan-Ravi
- Data Acquisition for SCADA at various Sewerage Collection / Trunk points
- SCADA Central Control Room (CCR)

3.9.2 Main Disposal Station; Electrical Sizing and the Source of Power Supply

Certainly, it is a known step but needs special attention. Being the heart of the project, the pumping station would require the utmost care from the electrical designer.

Coming to the source of power supply, it is imperative to bring in power from two independent sources of Lahore Electric Supply Company (LESCO) power called as “Dual-Source Supply”, this means that dedicated 11 kV feeders from two different LESCO grid stations will be brought to the site, to supply this Main Disposal Station. Each of these two feeders will be capable of supplying the entire facility on its own. Resultantly, these two feeders will complement each

other. In case of suspension/ load shedding of electricity, a solar PV system of 450 KW will be installed at the Disposal station for the functioning of SCADA and Light load. The EPC contractor will finalize the design of this double source; hence the contractor will assess E&S impacts during the detailed design and updation of ESIA.

In addition to the above-mentioned LESCO 11 kV feeders, the emergency generator sets will be needed too, as a backup, in case the LESCO feeders fail. Having stated everything regarding the LESCO feeders as sources of power supply, we must mention here the LESCO rule that in case the power demand of any project exceeds 5 Megawatts, a 132/11 kV grid is required to be established by the Customer inside his premises.

3.9.3 Control through SCADA

Communication between the components of the entire system will be established through SCADA. While the SCADA substations will be placed at various disposal stations and other strategic locations, the Main Control Desk will be established at the Main Disposal Station. We expect that a maximum of 15 kW of power, including the room air-conditioning, will be needed for this Main Control Desk.

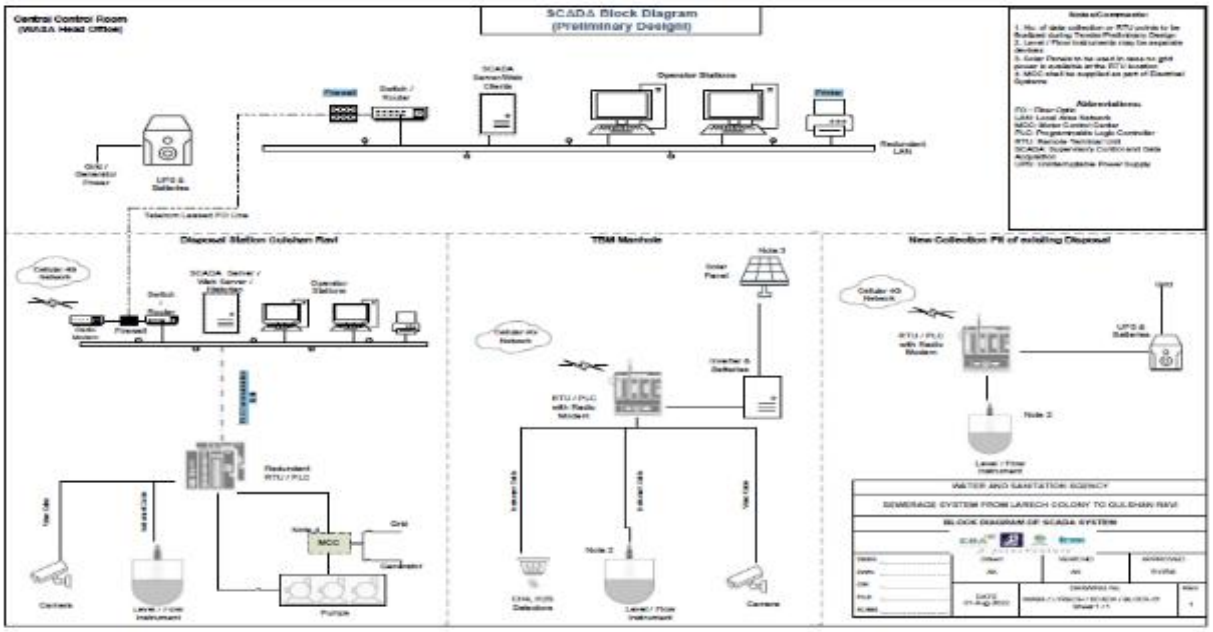


Figure 3-12: SCADA Mechanism

For each of the locations on the way, requiring SCADA components (sensors etc.), we would prefer to have single phase connections from LESCO, with back-up by very small single-phase UPS. This will ensure the availability of a continuous power supply. The total demand at each of these locations will be of the order of 500 Watts. The entire (power supply-related) assembly can be accommodated in well-ventilated weather-proof enclosure.

3.10 SLURRY DISPOSAL SITE

Slurry produced during the tunneling will be transported to a LWASA's designated site. The location of the site is shown in **Figure 3-13.** The site is a sizeable walled chunk of 836.4 acres, owned by LWASA and is under its control. The land required for slurry disposal / management is around 51 acres. Thus, the available land is sufficient for this purpose. Currently it is vacant land and has grass and bushes. LWASA in its other project, AFD funded, plans to install a wastewater treatment plant at this location. The treatment plant shall also receive the wastewater discharge of Gulshan-e-Ravi disposal station; therefore, its due diligence was

carried out as per AIIB policy of allied facilities. It turns out that LWASA may use this land for future projects as well. This land is important for LWASA, but it has a downside as well. It is in the flood plan of River Ravi. The Irrigation department has built spurs in the area, but the site would need one or more spurs to be safe from flooding. Since both projects are administered by LWASA and if properly planned, then perhaps the best use of the slurry could be building a spur.

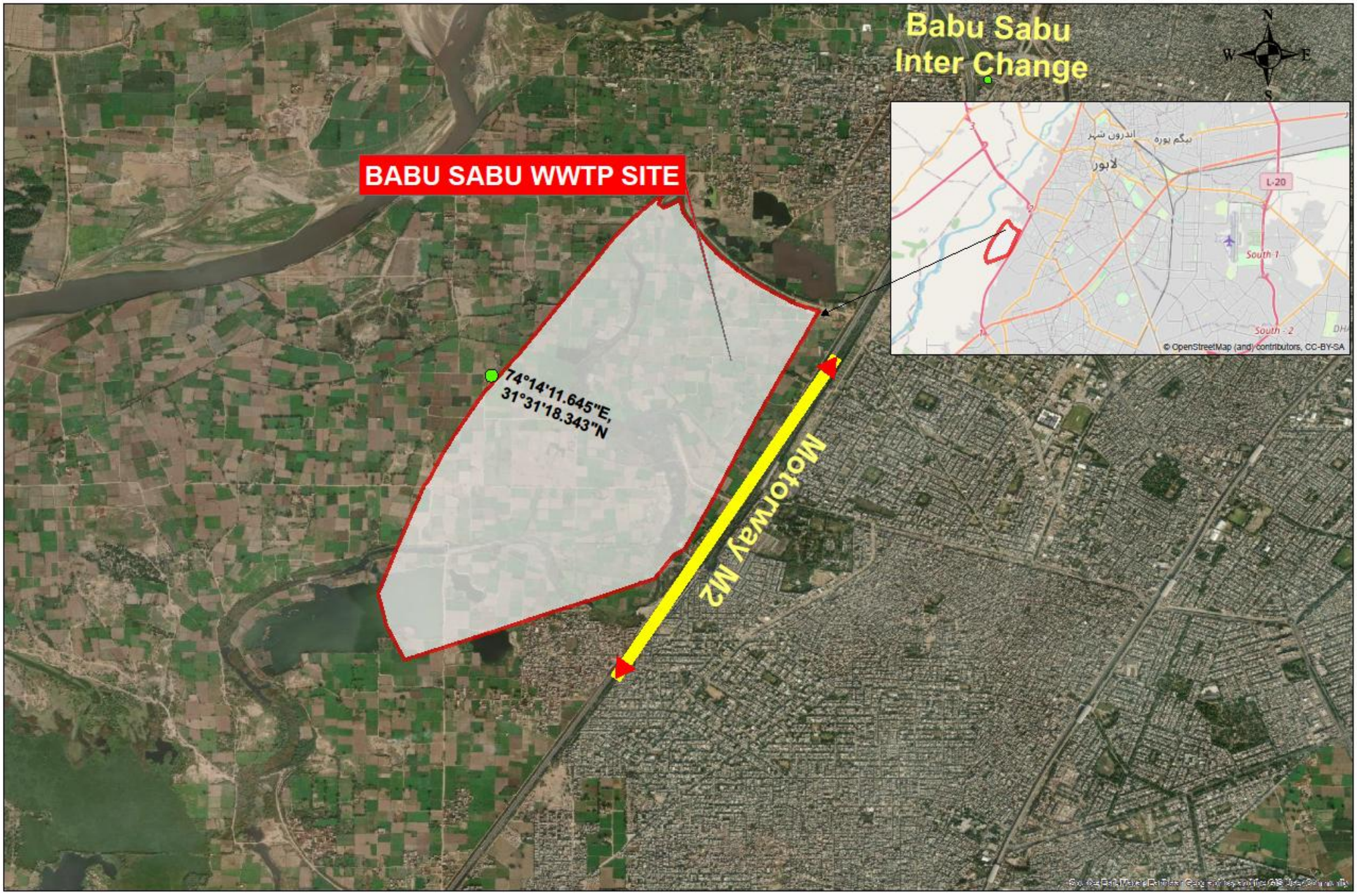


Figure 3-13: Slurry dumpsite

3.11 ANALYSIS OF ALTERNATIVES

Different alternatives were considered for the current project based on technical, technological, economic, financial, environmental and social parameters. Each alternative was further studied in detail and the best suitable option for the local conditions was selected. The alternatives are discussed in brief below:

- Option One: No Project
- Option Two: New sewerage of expanded capacity (trunk sewer) with Open-Trench Method; and
- Option Three: New sewerage of expanded capacity (trunk sewer) with Trenchless Technology.

3.11.1 Option-One: No Project

It means no project will be implemented to resolve the issues arising due to the absence of adequate sewerage system in the central zone to meet the present needs of overflowing sewers, therefore; this option is not feasible in terms of environmental and social economic aspects.

3.11.2 Option-Two: Relief Sewer

Under this option, a relief sewer is proposed that will take care of additional - excess flow from the existing sewage. The relief sewer will be laid parallel to the existing sewer and during excess flow over and above the existing capacity is encountered, this sewer will come-up for relief and excess - overflows will be taken care of by this relief sewer.

The size of the trunk sewer will be almost half of the existing sewer size and will be laid at shallower depths. The cost so involved is assessed as 1/3rd. of the new sewerage facilities. Therefore, this option is also not feasible in terms of environmental and social economic aspects.

3.11.3 Option-Three: Trunk Sewerage through Micro-Tunneling (Proposed Project)

As per the feasibility studies and detailed new design report prepared by M/s Project Management Consultancy (PMC), new Trunk Sewer has been proposed in the area along with construction of a new Disposal Station at Gulshan-e-Ravi to care for sewage disposal as well as storm water and reduce the flooding in the area during intense rainfall events. Therefore, this option is feasible in terms of environmental and social economic aspects.

a. **Laterals**

The total length of the project is 32.37 km with the length of proposed laterals is 13.37 km. In the built-up urban environment, open cut excavations for lying of infrastructure facilities including sewerage is considered inappropriate, mainly incontinence to traffic and public. For deeper sewerage, deeper excavations may endanger the urban - private property along the route of the sewer and may even become impossible to lay in some of the cases. Moreover, relatively longer periods involved in construction discourage the use of open-cut methodology for lying of sewer. Therefore, the Micro Tunnel Boring Machine will be deployed for laying of 13.21 km of laterals while only 159 m of lateral will be installed through open cut where the deployment of MTBM is not possible.

The sections include the following.

- Mian Mir DS to Infantry Road
- Infantry Road DS to Infantry / Allama Iqbal Road crossing

- Larech Colony to Garhi Shahu Bazar
- Ghazi Mohallah DS to Garhi Shahu Bazar
- Garhi shahu Bazar to Mughalpura / Allama Iqbal Road crossing
- Muhammad Nagar to Durand Road Crossing
- Governor House to Davis / Durand Road crossing
- Lakshami Chowk DS to Abbott Road
- Janki Devi DS to Abbott Road
- Abbott Road to Egerton Road / Shimla Hill
- Q Block Gulberg DS to College Road / Q Block link Rd Crossing
- Center Point DS to Gulberg Drain along main boulevard
- Zafar Ali Road DS to Shareef Colony
- Shareef Colony to Canal Crossing
- Shadman DS to Shama DS Shama/Ferozepur Road intersection
- Rasool Park DS to LOS junction with Ferozepur
- Lytton Road DS to Lake Road
- PIA Planetarium DS to Lake Road to Chauburj Chowk
- Poonch Road DS to Samanabad Morr

b. Horizontal Boring/ Pipe Jacking Machine

Trenchless technology offers an alternative to the traditional open-cut method of pipeline installation. A pipe jack is defined as a system of directly installing pipe behind an open-face tunnel boring machine (TBM). The pipe is then hydraulically jacked from a launch shaft, so that it forms a continuous string in the ground. The pipe, which is specially designed to withstand the jacking forces likely to be encountered during installation, forms the final pipeline once the excavation operation is completed.

Table 3-3 shows the comparison of Open Cut Method & Trenchless Technology.

Table 3-3: Comparison of Open Cut Method & Trenchless Technology

Open Cut Method	Trenchless Technology
Open cut methods often have demerits and risks such as chances of workforce getting injured are higher, health and safety issues for workers, traffic disruptions, temporary disturbance in daily life activities, social backlashes and failure of equipment, etc.	Pipe jacking is a safer method of working because the risks as compared to open cutting are minimized.
Dismantling of road takes place throughout the pipe path.	Dismantling of road only requires launch and reception shafts for entrance of pipe jacking machine. Substantial cost saving.
Slow Construction, often takes more time	Speedy Construction
Public Inconvenience.	Limited inconvenience to public.

More Traffic disturbance.	Traffic disruptions are reduced, Mobility above ground is less affected.
More environmental effects, soil disturbance.	Minimum environmental effects, less soil is disturbed and excavated.
Shifting of all underground utilities.	Minimum shifting of underground utilities, services, cost effective.
More Transportation & Re-handling of materials.	Reduce the quantities of incoming and outgoing materials.
Maximum visual impact on the local population.	Minimal visual impact to the local population and weather-proof construction.
Less reliability.	High degree of reliability.
Higher cost	Cost effective.

The project alternatives for laying of new trunk sewer from Larech Colony to Gulshan-e-Ravi in terms of economic, environmental, and social aspects are discussed in detailed in **Table 3-4.** The proposed system is based on following methods and technologies.

Table 3-4: Alternative Analysis

Impacts of Project Options on Parameters	**Types of Alternatives**		
	No Project Option	**Relief Sewer**	**New Sewerage**
Environmental and Engineering Consideration	• Climate change issues will arise due to the emissions of greenhouse gases (GHS) and hydrogen sulphide (H_2S) from the nearby drains due to the absence of sewer system, as observed during site visit. • Urban flooding will increase in central zone during intense rainfall events due to the overflow drains in absence of adequate sewer system.	• Existing - temporary sewage pumping stations located at various locations will not be eliminated under the option and hence the issue of their O&M will persist, and the pumping stations may remain blocked.	• Existing - temporary sewage pumping stations located at various locations will be eliminated under the option. • The capacity of sewer system will be enhanced that will eradicate microbial corrosion and seepage in groundwater. • Climate change issues will be reduced due to the elimination of existing disposal stations and intermediate stations, and it will reduce GHG emissions

Impacts of Project Options on Parameters	Types of Alternatives		
	No Project Option	**Relief Sewer**	**New Sewerage**
	• Eutrophic issues will arise in nearby drains, nullahs and canals. • Hepatitis-C, polio and other sewage related diseases	• The existing sewer is reportedly blocked under capacitated or failed due to microbiologically Induced Corrosion" which will result in seepage of wastewater to the groundwater table, hence deteriorating the groundwater quality. • Climate change issues will arise due to the emissions of greenhouse gases (GHS), • Enhancement in storm water carrying capacity of central and cantonment drain due to elimination of sewage and wastewater flows during intense rain events. • Extensive tree cutting will be involved along excavation sites. • Due to deep excavation, it disturbs ground which may be home to small animals and insects, resulting in the disturbance of local ecosystem, and habitat of the species in the immediate vicinity.	• Enhancement in storm water carrying capacity of central and cantonment drain due to elimination of sewage and wastewater flows during intense rain events. • Eutrophic issues will be reduced in nearby nullahs and canals due adequate sewerage system and an elimination of disposal and intermediate stations. • Significantly reduced the volume of excavation, trenchless technology disturbs less ground which may be home to small animals and insects. This reduces the impact of the new pipe and tunnel on the local ecosystem and maintains the habitat of the species in the immediate vicinity. • Improved topography by abandoning open drains for conveyance of sewage.

Impacts of Project Options on Parameters	Types of Alternatives		
	No Project Option	**Relief Sewer**	**New Sewerage**
Social	• Local population of the proposed project area will suffer from dengue, malaria, asthma, hepatitis and gastrointestinal diseases.	• Traffic jams will arise due to use of open cut technology for relief sewer because project is located in densely populated area. • Local population of the proposed project area will suffer from dengue, malaria, asthma, hepatitis and gastrointestinal diseases due to existing disposal stations. • Land of local people will be required for laying relief sewer pipe nearby existing ones. • Cultural heritage property present in project area will be damaged due to deep excavations. • Utilities present near the project area will require shifting.	• Less traffic jam as excavation is required near launching and recipient stations. • Local population of the proposed project area will not suffer from health and safety issues due to elimination of existing disposal stations. • No land of local people will be required for laying sewer pipe, as it will replace existing one using TBM method that requires less excavation. • Utilities present near the project area will require no shifting. • Cultural heritage property present in project area will be not damaged, as this project option involves superficial excavations.
Economic	• Cost will be required to mitigate the climate change issues, urban flooding and health problems. • No job opportunities for skilled and unskilled laborer.	• Cost will be required to mitigate the climate change issues, health problems, and operation and maintenance of non-eliminated disposal stations and intermediate lift stations. • Job opportunities for skilled and unskilled laborer.	• Huge initial investment will be required for purchase and import of pipe jacking Machinery from international firm.

Impacts of Project Options on Parameters	Types of Alternatives		
	No Project Option	**Relief Sewer**	**New Sewerage**
		• Compensation cost will be incurred for purchasing land from local masses. • Cost will be required for shifting utilities. • Cost required for the construction will be less in comparison to option one and two.	• No cost will be required to mitigate health problems, compensation cost, and operation and maintenance of non-eliminated disposal stations and intermediate lift stations. • Decline in loss of income due to vandalization of electrical appliances due to emissions of methane and hydrogen sulphide from nearby open drains.

4 ENVIRONMENTAL AND SOCIAL BASELINE PROFILE

4.1 GENERAL

Prior to the initial stages of planning, designing, and executing any development project, it is crucial to assess the current environmental conditions. This assessment involves identifying the physical, ecological, and social aspects of the environment and gathering relevant data. Such evaluation is essential for understanding the potential impacts and suggesting appropriate measures to mitigate them, which forms the foundation of the Environmental and Social Impact Assessment (ESIA) implementation. In the case of the proposed project, the existing environmental conditions within a 250-meter radius (considered as the area of influence) have been thoroughly examined in terms of physical, biological, and socio-economic factors. Information has been obtained from various sources, including published literature, on-site observations, and surveys specifically conducted for this project. Additionally, consultations were conducted with the general public and stakeholders in the project area to gather their opinions on the implementation of the proposed project.

4.2 PHYSICAL RESOURCES

4.2.1 Topography

Lahore is generally flat and slopy[1] towards south and south-west at an average gradient of 1:3000. The general height varies from 150 to 200 meters above mean sea level (amsl) it is divided into two parts i.e. the low-lying area along River Ravi and the comparatively upland area in the east away from Ravi. The lowlands are generally inundated by the river water during intense rainfall events.

The terrain of the project area is generally flat with few undulations present in the stretch while the general trend of the slope is towards River Ravi. The elevations in the proposed alignment of the sewerage network vary from 208.21 meter to 216.192 meter with an average grade of 0.1 percent and an average elevation of 212.17 meter[2].

4.2.2 Geology

Lahore lies on the alluvial plain called Bari Doab[3]. Doab is a local word for area between rivers. Bari Doab is a part of the Indo-Gangetic alluvial plain formed by the Indus River and its tributaries. It is bounded by Ravi and Chenab rivers in the northwest and west, and Sutlej River in the Southeast. A northeastern boundary of Doab lies near the foothills of the Himalayan Ranges.

The Bari Doab is covered by quaternary alluvium which overlies semi-consolidated tertiary rocks or metamorphic and igneous rocks of Precambrian age. Except for a small area in the northeastern art of Doab where basement rock was encountered no information is available at present regarding the distribution of tertiary and Precambrian rocks in the Doab.

The thickness of alluvial deposits in Lahore is reported to be more than 300 meters. These alluvial deposits are underlain by the basement rocks of the Indian shield. The alluvial deposits mainly consist of sands, with intercalation of silt and clay layers of varying thickness. Geological map of the Study Area is given in **Figure 4-1** Project site is located in meander belt deposits.

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1 Kazmi, A.H. & Jan, M.Q (1997), "Geology and Tectonics of Pakistan", Graphic Publishers, Karachi

2 Geotechnical Investigation Report of Larech Colony to Gul-e-Shan Ravi, January, 2016

3 Kadwai, S.U. and Siraj, A. (1964), "The Geology of Bari Doab, West Pakistan", WAPDA Water and Soil Investigation Division (Bulletin No. 8)

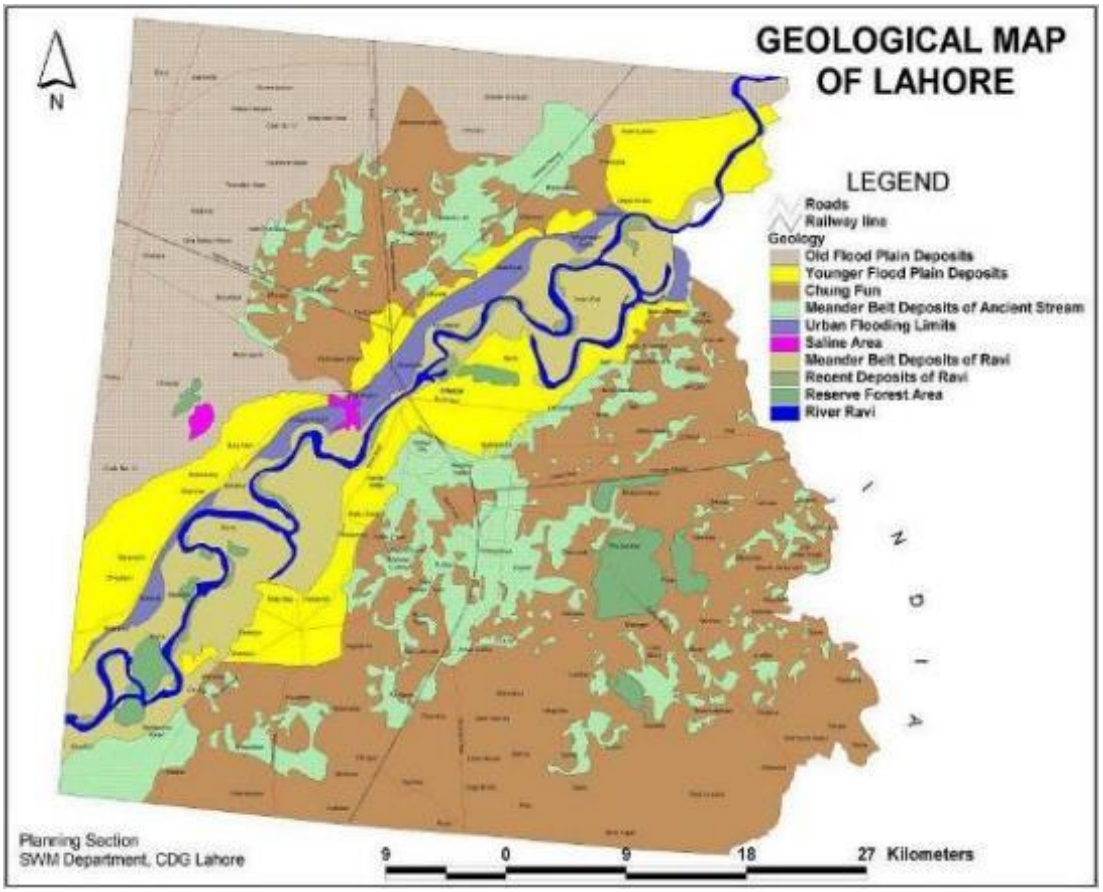


Figure 4-1: Geological Map of the Study Area

The only minerals worth to value are kallar and kankar[4] in the district Lahore. Kallar is the grey powdery substance collected and taken out from the old village sites and other deserted abodes in the district. It is used for the manufacture of crude saltpeter and also as manure for the top dressing of young cotton and tobacco plants (no longer in the line of extensive cultivation). With the passage of time the demand for Kallar has diminished and its use as a trading commodity is on the decline. Kankar is used for metaling roads and its smaller particulars are burnt for lime. It is a kind of limestone gravel and is found, after being dug out at a depth varying from one to eight feet, in many parts of the district particularly the uplands. However, the project area does not have any valuable minerals.

4.2.3 Soil

The soil in the project area is cohesion less and is of alluvial type deposited by Ravi River. The types of soil layers that are present below the ground level include: silt, silty clay, silty sand, poorly graded sand with silt and lean clay.

Four soil samples obtained around the proposed alignment elevations were tested for pH, chlorides, and sulfates. Results of the tests indicated that the soil at the project site is moderately corrosive to metal pipes, and as indicated by the chloride and sulfate concentrations, the soil is considered non-corrosive to concrete pipes. However, due to the gravity sewer, the Hydrogen Sulfide emission and oxidation at the pipe ceiling will cause

4 4 Malik, A. (2015). Geotechnical statistical evaluation of Lahore Site Data and Deep Excavation Design

Hydrogen Sulphate production, which will cause deterioration of concrete pipes. It is therefore recommended to provide protection coating against the Hydrogen Sulfide reaction at pipes internal surfaces[5].

4.2.4 Geotechnical Investigations

During preliminary investigation, Drilling of fifteen (15) boreholes, seven (7) up to a depth of 30.0 m and remaining eight (8) extended down to 40 m depth below the existing ground level has been carried out. PMC hired M/s Pioneer Associates Lahore to execute confirmatory geotechnical investigations of 15 boreholes. The geotechnical investigation was carried out in February 2024.

During detailed investigation, Drilling of hundred (100) boreholes at designated locations along the proposed sewer lines, out of which 29 boreholes are along Line-A, 31 along Line-B and 40 along Line-C.

The location of these boreholes is given in **Table 4-1** below:

Table 4-1: List of Boreholes

Description	Easting	Northing	Elevation	Continuous Sampling Zone	
				From (m)	To (m)
R1-A	440427.09	3490759.03	214.47	8.49	14.01
J1-A	440151.23	3490817.1	214.66	8.79	14.31
J2-A	439545.77	3490927.44	214.64	9.00	14.52
R3-A	439149.14	3491079.54	215.06	7.75	16.33
J5-A	439101.39	3491147.62	214.95	8.17	16.75
J6-A	438762.34	3491434.92	214.03	7.61	16.19
R6-A	438479.55	3491707.72	213.74	7.62	16.20
J7-A	438236.52	3491943.55	212.95	7.13	15.71
R7-A	437991.29	3492174.24	212.61	7.19	15.77
J8-A	437894.09	3492241.27	212.67	7.43	16.01
R8-A	437665.28	3492188.69	212.97	7.94	16.52
J9-A	437364.42	3492108.6	212.94	8.18	16.76
J10-A	436887.68	3492139.43	213.38	9.39	17.97
R10-A	436675.93	3492072.66	214.14	10.47	19.05
J11-A	436376.12	3491996.02	213.27	10.17	18.75
R11-A	435997.66	3491911.19	213.35	10.83	19.41
J12-A	435866.91	3491777.85	213.1	10.89	19.47
R12-A	435673.13	3491506.94	211.96	10.29	18.87

5 5 Geotechnical Investigation Report of Larech Colony to Gul-e-Shan Ravi , January, 2016

Description	Easting	Northing	Elevation	Continuous Sampling Zone	
				From (m)	To (m)
J13-A	435558.21	3491350.83	213.96	12.70	21.28
J14-A	435286.22	3490819.6	210.54	10.26	18.84
J01-L8	435883.78	3492673.76	209.94	5.04	10.56
J02-L8	436317.32	3492462.63	212.77	8.60	14.12
R02-L8	436115.32	3492553.06	211.41	6.88	12.40
R01-L8	435697.83	3492637.04	209.99	4.83	10.35
R03-L8	436562.24	3492344.72	213.17	9.37	14.89
J03-L8	436797.8	3492236.98	213.53	10.63	16.15
R01-L2	439683.26	3490537.25	214.78	7.80	13.32
J01-L2	439528.91	3490685.43	214.51	7.72	13.24
R02-L2	439416.64	3490803.66	214.41	7.80	13.32
R1-B	438720.39	3487708.43	214.47	7.44	12.96
J1-B	438493.99	3487533.10	213.74	7.21	12.73
R2-B	438248.11	3487498.10	213.59	7.56	13.08
J2-B	437973.56	3487572.98	213.50	7.52	13.04
R3-B	437748.54	3487665.71	213.55	7.62	13.14
J3-B	437479.08	3487707.90	213.61	7.73	13.25
J4B	437347.77	3487720.39	213.11	7.2766	12.7966
R5-B	437325.01	3487961.63	212.84	5.4666	14.0466
J1-2	438546.69	3487883.04	213.56	7.03	12.55
J2-2	438292.67	3488101.59	213.49	7.51	13.03
R3-2	438252.42	3488078.33	213.76	7.83	13.35
J4-2	437945.77	3487874.15	213.18	7.3466	12.8666
J5-2	437711.09	3488351.16	212.55	7.6766	13.1966
J4-3	437687.22	3487783.4	213.08	7.2466	12.7666
J5-B	437279.25	3488223.23	212.53	5.6766	14.2566
J6-B	437132.79	3488324.91	211.82	5.2666	13.8466
R6-B	436997.50	3488446.09	212.26	6.0666	14.6466
J7-B	436868.26	3488437.37	211.98	6.0066	14.5866
R7-B	436700.33	3488268.86	213.07	7.5966	16.1766
J8-B	436499.10	3488397.73	211.62	6.6466	15.2266
R8-B	436252.21	3488486.41	211.31	6.8366	15.4166
J9-B	436005.66	3488524.84	211.09	7.1166	15.6966

Description	Easting	Northing	Elevation	Continuous Sampling Zone	
				From (m)	To (m)
R9-B	435797.42	3488548.47	211.04	7.5266	16.1066
J10-B	435603.35	3488550.60	211.80	8.6066	17.1866
R10-B	435523.33	3488856.95	212.44	9.9466	18.5266
J11-B	435432.89	3489178.52	212.91	11.1166	19.6966
J12-B	435197.68	3489939.65	208.99	8.65	17.23
R12-B	435088.96	3490298.38	210.37	10.75	19.33
R01-L15	434772.44	3489473.08	208.87	6.59	12.11
R02-L15	434862.97	3489725.26	209.36	7.747739	13.26774
R03-L15	435146.64	3489648.64	210.64	9.610567	15.13057
R01-C	434500.87	3490821.09	213.28	12.67	24.97
J02-C	433937.33	3491181.93	208.63	8.56	20.86
R03-C	433680.75	3491022.67	208.01	8.25	20.55
J03-C	433371.33	3490836.30	208.05	8.61	20.91
R4A-C	432766.79	3490474.85	208.28	9.18	21.48
J4-C	432613.72	3490390.21	208.41	9.64	21.94
R5-C	432469.80	3490302.53	208.61	9.94	22.24
R5-A-C	432332.22	3490193.44	208.41	9.87	22.17
J5-C	432067.42	3490024.59	208.93	10.52	22.82
R6-C	431835.47	3490059.90	209.41	11.20	23.50
R6A-C	431606.05	3490079.16	209.37	11.30	23.60
J6-C	431424.10	3490095.69	208.86	10.92	23.22
J6A-C	431187.71	3490113.04	208.52	10.79	23.09
J7C-1	431020.85	3490370.88	207.18	9.65	21.95
J8C-1	430955.23	3490661.57	207.60	10.28	22.58
J7-C	430849.22	3490191.50	207.35	10.23	22.53
J7-A-C	430746.38	3490185.92	207.25	10.34	22.64
R8-C	430472.14	3490146.47	208.16	11.45	23.75
R8A-C	430391.09	3489882.38	207.53	11.03	23.33
J8-C	430344.26	3489673.41	207.29	10.99	23.29
R9-C	430423.72	3489500.65	209.70	13.60	25.90
J9-C	430422.34	3489289.73	207.13	11.24	23.54
J9A-C	430245.14	3489200.83	207.02	11.33	23.63
R10-C	430018.11	3489052.68	207.25	11.77	24.07

Description	Easting	Northing	Elevation	Continuous Sampling Zone	
				From (m)	To (m)
R10A-C	429912.98	3488830.41	207.56	12.28	24.58
J10-C	429783.53	3488615.39	206.24	11.17	23.47
J10A-C	429675.40	3488417.23	206.47	11.60	23.90
R11-C	429534.68	3488158.33	206.18	11.52	23.82
R11A-C	429426.53	3487949.16	204.87	10.41	22.71
J11-C	429302.29	3487723.47	205.52	11.27	23.57
J11A-C	429217.49	3487552.77	205.86	11.81	24.11
R12-C	429064.35	3487288.28	205.63	11.79	24.09
R12A-C	428908.34	3486993.81	205.59	11.95	24.25
R13-C	428662.64	3486804.78	204.68	11.24	23.54
R01-L19	433736.95	3490003.86	208.49	7.06	12.58
J01-L19	433751.97	3490207.90	208.63	7.44	12.96
R02-L19	433773.24	3490452.08	208.79	7.83	13.35
J02-L19	433784.77	3490629.60	208.86	8.12	13.64
R03-L19	433829.33	3490728.22	208.83	8.24	13.76
R04-L19	433781.87	3490840.81	208.88	8.46	13.98

- Performance of field testing including Standard Penetration Test (SPT) and Permeability test.
- Collection of disturbed, undisturbed soil samples and groundwater samples.
- Installation of piezometer in case groundwater encountered.
- Carry out laboratory tests on selected soil samples from boreholes to determine the engineering characteristics and chemical properties.
- Report the Engineering analysis of field and laboratory findings. Conclusions and recommendations to develop the design parameters required for the TBM expert.

The comprehensive soil and geotechnical report, which provides detailed information, is appended as **Annexure XVI**.

The borings indicate the subsurface conditions at the locations, dates, and depths indicated and it is not warranted that they are strictly representative of the materials and conditions at other locations, times, and greater depths.

4.2.5 Seismology

The project site falls in the Punjab plain, which has low to moderate level of seismicity. The project region has been subjected to severe shaking in the past due to earthquakes in the Himalayas. The known main active fault of the Himalayas is the Main Boundary Thrust (MBT), which passes at about 180 kilometers from Lahore towards northeast along the Himalayan front. The epicenters of low to moderate magnitude earthquakes, recorded in the Punjab plain,

are associated with the subsurface fractures in the basement rocks, which are concealed by thick alluvial deposits.

According to Building code of Pakistan, 2007, the project area falls in Seismic Zone 2A of Pakistan (Lower limit of moderate damage), and peak ground acceleration (PGA) from 0.08 to 0.16 gram.

4.2.6 Soil Liquefaction

Cohesion-less soils existing under submerged conditions are prone to liquefaction under earthquake or dynamic loading conditions. The resistance of the cohesion-less soil to liquefaction will depend on the density of the soil, confining stresses, soil structure (fabric, age and cementation), the magnitude and duration of the cyclic loading, and the extent to which shear stress reversal occurs.

Soil liquefaction describes the behavior of soils that, when loaded, suddenly go from a solid state to a liquefied state or having the consistency of a heavy liquid. Liquefaction is more likely to occur in loose to moderate saturated granular soils with poor drainage, such as silty sands or sands and gravels capped or containing seams of impermeable sediments. During loading, usually cyclic un-drained loading, e.g. earthquake loading, loose sands tend to decrease in volume, which produces an increase in their pore-water pressures and consequently a decrease in shear strength, i.e. reduction in effective stress.

Deposits most susceptible to liquefaction are young (Holocene-age, deposited within the last 10,000 years), sands and silts of similar grain size (well-sorted), in beds at least several feet thick, and saturated with water. Such deposits are often found along riverbeds, beaches, dunes, and areas where windblown silt (loess) and sand have accumulated.

The soils profile in the study area contains layers of cohesion-less material below groundwater table. These layers exist at medium dense to dense state of compactness and the soil deposits are not likely to liquefy during earthquakes. Various studies in the area show that the soils at the study area are safe against liquefaction failure for a PGA of 0.16 gram.

4.2.7 Climate Vulnerability and Risk Assessment

Pakistan is among the countries most vulnerable to climate change and affected by extreme events on a recurrent basis.[6] Since large cities like Lahore with poor infrastructure are among the regions of the maximum vulnerability, extreme events are expected to be more severe for the people living in such cities. Multiple stresses caused by rapid urbanization, industrialization, and economic development will be compounded by climate change, resulting in widespread adverse impacts. Climate change projections estimate Pakistan's temperature increase – in the range of 3^{o}C to 5^{o}C – to be higher than the global average, which will be accompanied with prolonged droughts and erratic precipitation, with more intense summer monsoon rainfall. These major changes in the weather patterns add to vulnerability of project areas, usually emerging as a result of heat waves, monsoon-induced heavy precipitation and subsequent urban flooding.

Climate change impacts on the project areas were assessed using different models, the impact of projected changes in temperature and precipitation on all subcomponents of the project were evaluated, and adaptation measures have been incorporated in the design of the respective subprojects. These measures cater for the expected increase in water demand, decrease in ground and surface water availability, performance of materials used in

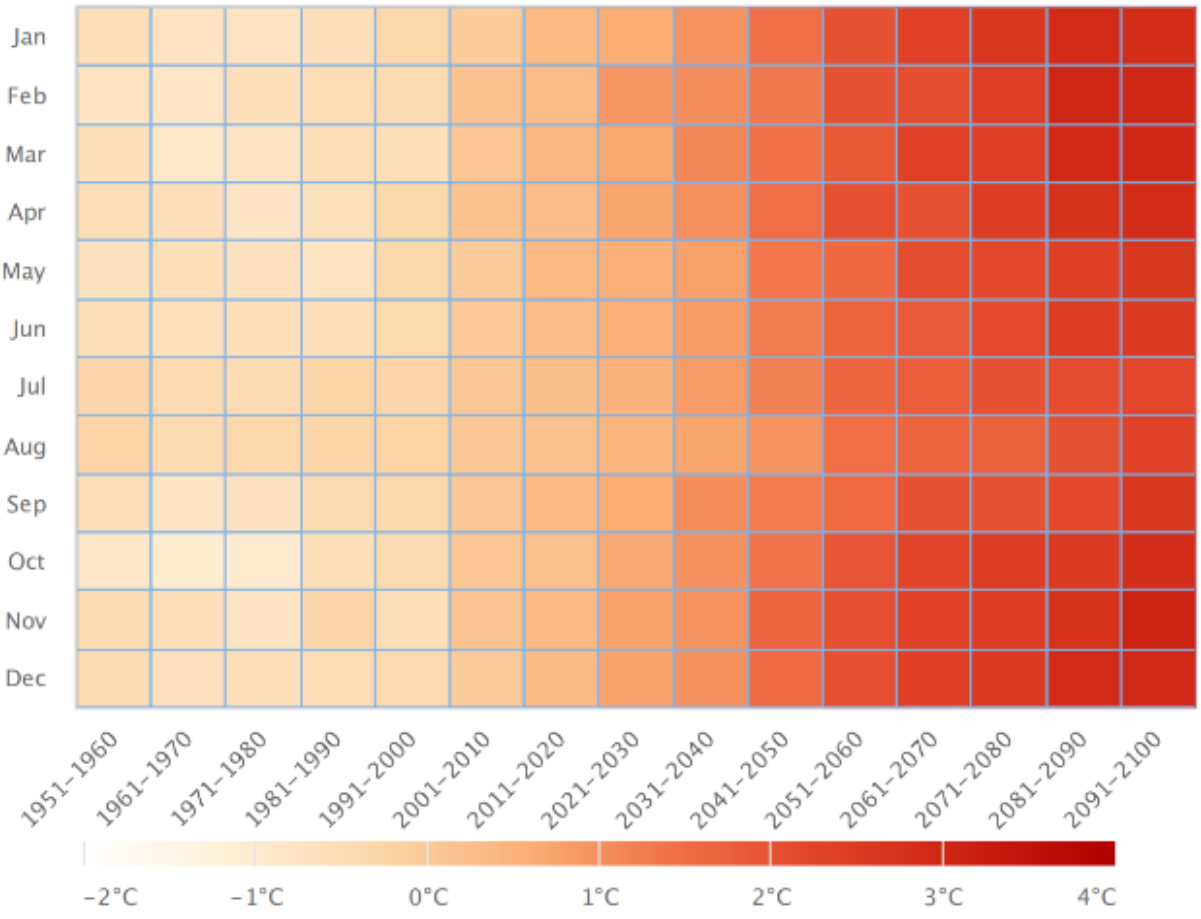
6 Global Climate Risk 2021. The GCRI Index has assessed Pakistan as eight most affected country in its annual report for 2021 due to climate induced extreme events for the period 2000-2019.
https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_2.pdf

construction, and increase in urban flooding. The climate assessment report (prepared separately and available with LWASA carries out climate risk assessment and management plan, based on design review and recommendations for climate inclusiveness. The project also contributes to net reduction in GHG emissions. The project investments are estimated to reduce 250,312 CO_2-equivalent tons of GHG emission in the project areas.

A total of 31 Global Climate Models (GCMs) Coupled Model Inter-comparison Project Phase 6 (CMIP6) data performance have been assessed using the bias-corrected climate dataset, using different statistical methods. Out of these 31 models, seven models performed relatively better in capturing the annual variations as well as absolute deviations in precipitation compared to the observations. The performance of all the models to capture the variability in temperature was found satisfactory. Due to the limited availability of variables at the daily resolution, five out of these seven models were finally selected for further analysis. For each of the five models, the dataset was obtained for the middle of the road scenario (SSP245) and extreme scenario (SSP585) for the assessment of the projected climate over the study area.

The monthly precipitation is expected to rise with a maximum of 3mm/month during 2041-2050 compared to 1985-2014 under SSP245. The overall increase in precipitation occurs during August with a maximum increase of about 60mm during 2040-2059 compared to 1985-2014 under SSP 245 scenario. However, the ensemble mean shows a meager increase in precipitation during the same period and month. A similar increase is noticeable under scenario SSP 585.

Mean temperature data has also been analyzed for the current project. The mean temperature shows a consistent but variable increase during different months of the year and decades. An expected increase of about 1.5°C to 1.6°C during July and August 2041-2050 compared to 1985-2014 under SSP 245 scenario has been observed. This trend can also be attested by below Figure, which shows projections during 2040-2059 compared to base period under SSP 245 scenario.



Mean Temperature monthly projected decadal variation compared to base period (1985-2014) using ensemble of 31 GCMs for SSP245 scenario. (Source: based on World Bank Knowledge Portal)

The mean temperature under SSP 585 shows similar projections. The mean temperature is likely to rise by about 1.6°C to 1.7°C during 2040-2050 compared to 1985-2014.

Considering the scope of the project, the above changes may result in more water supply demand and enhanced sewerage flow and treatment. The precipitation rise may slightly increase groundwater recharge, whereas the rise in temperature is likely to raise 13.5% water supply demand and about 11% increase in wastewater treatment. Adequate demand-based adaptation measures are recommended to be accounted in the design of water supply and sewerage treatment sub-project. The adaptation and mitigation measures for wastewater treatment sub-project are sizing of pipes, additional excavation, additional capacity of pumps, and additional treatment of water together with plantation.

Similarly, the adaptation and mitigation measures for water supply sub-project are additional water treatment, additional storage, sizing of pipes, additional excavation, placement of pumps, spreading awareness in water users, additional capacity of pumps, SCADA and water metering and plantation. The estimated cost for both adaptation and mitigation measures has also been segregated and provided in the main report.

The seasonal climatic conditions must be considered for the design and execution of the developmental projects. The climate including air, temperature, precipitation, humidity and evaporation are an influencing factor, affecting the construction of engineering structures. However, to determine the overall effect of the climatic stresses, daily and seasonal temperature changes, site altitude, direct solar radiation, and precipitation must be considered.

4.2.8 Climate and Meteorology

The project area has extreme climate conditions, with hot summers and cold winters. The summer starts from April and lasts till September, with mean maximum and minimum temperature ranges from 39.2 Celsius to 19.1 Celsius. The winter season lasts from November to March, with mean maximum and mean minimum temperature ranges from 27.3 Celsius to 6.4 Celsius.

The project area receives rain in all the seasons, but monsoon rain is pronounced and constitutes a definite rainy season between the month of July and September. The highest wind speed is observed in the month of June i.e. 7 mph. **Table 4-2** summarizes month-wise temperature, precipitation, relative humidity, and wind speed.

Table 4-2: Average Monthly Temperature, Precipitation, Relative Humidity and Wind Speed (1991-2021) Lahore, Punjab

Month	Mean Temperature		Precipitation (millimeters)	Relative Humidity (Percentage)	Wind Speed (mph)
	Maximum	Minimum			
January	18.3	6.4	28	70	3
February	21.3	8.9	46	66	5
March	27.3	13.6	36	55	5

April	34.4	19.1	29	36	6
May	39.2	24	20	30	6
June	38.88	27	68	43	7
July	34.9	26.7	166	70	6
August	33.7	26.1	145	76	5
September	33.5	24.1	64	69	4
October	31.7	19	14	55	3
November	26.1	13	7	58	3
December	20.7	7.9	13	64	3

Source: *Climate-Data.org*

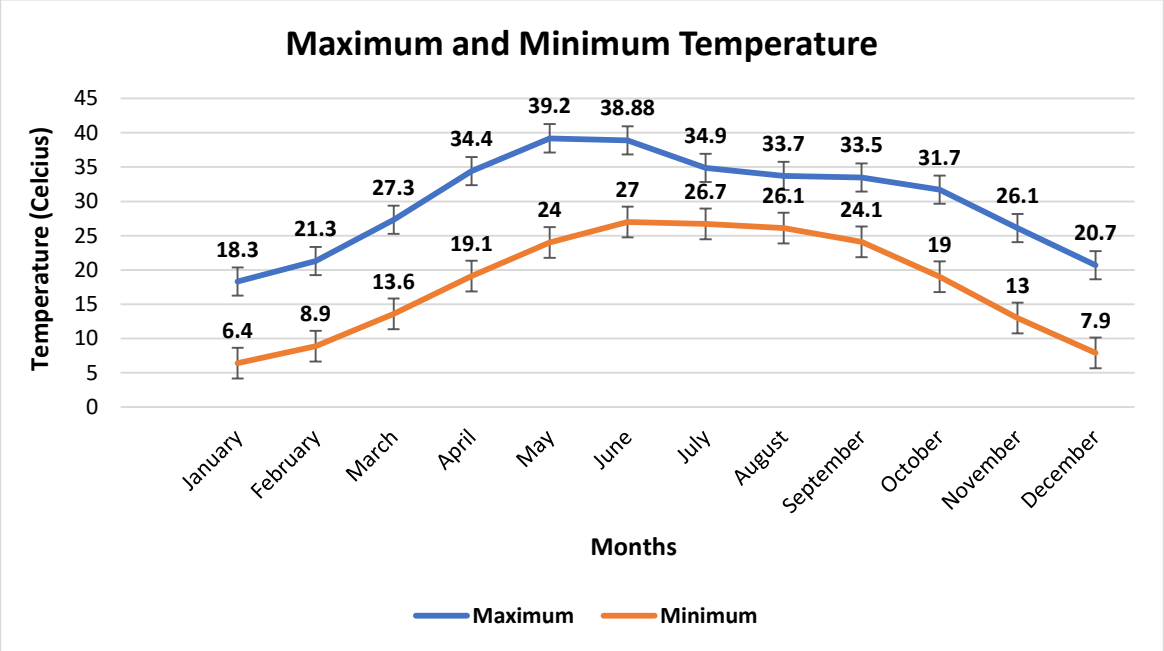


Figure 4-2: Mean Maximum and Minimum Temperature in the Project Area (1991-2021)

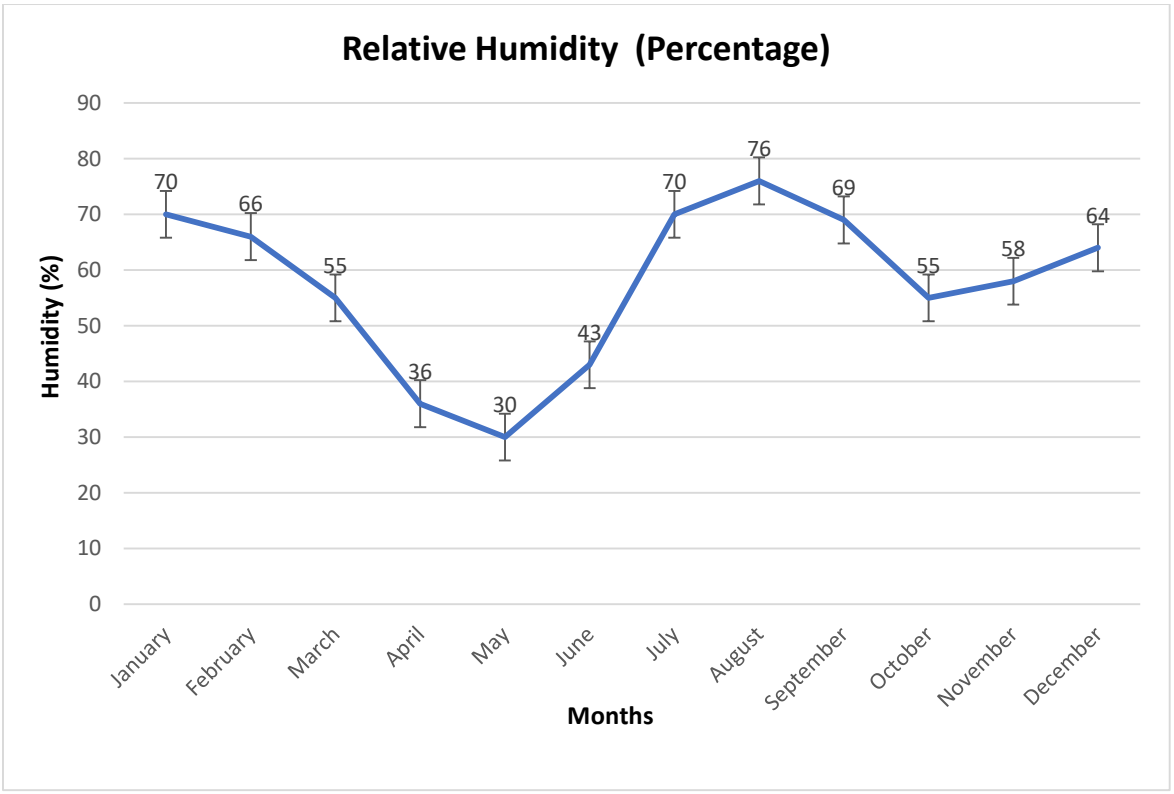


Figure 4-3: Relative Humidity in the Study Area (1991-2021)

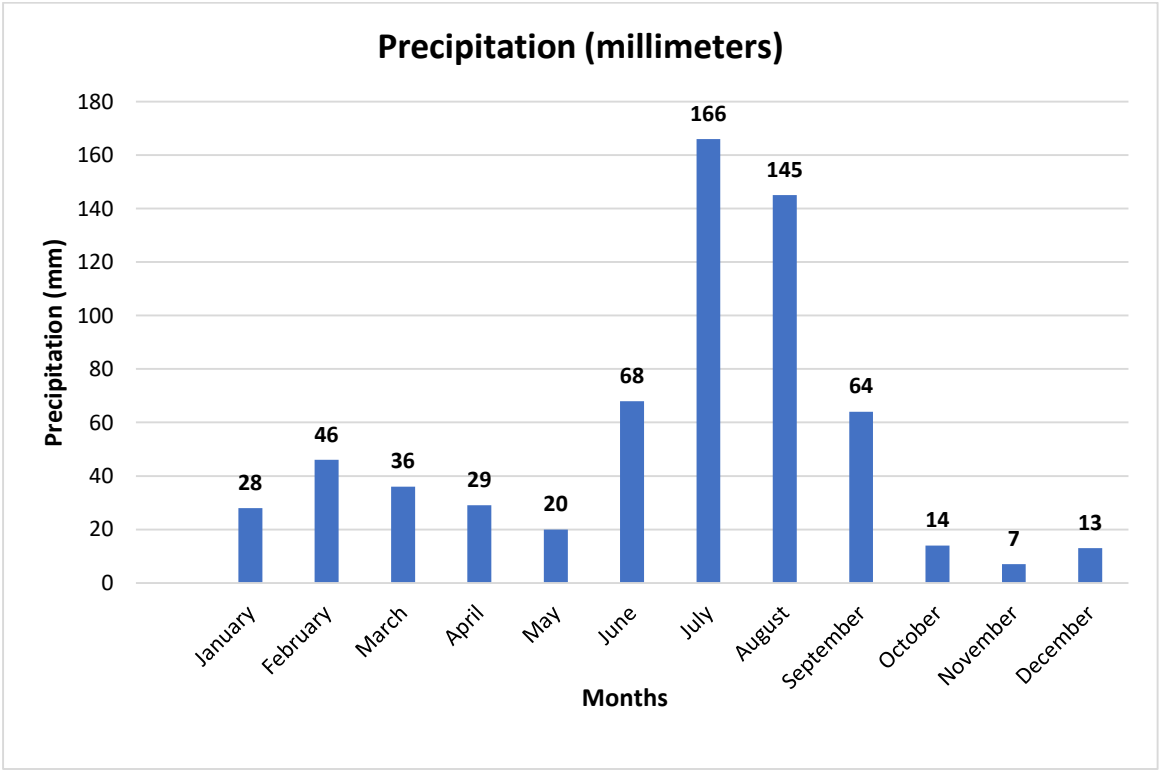


Figure 4-4: Average Rainfall in the Project Area (1991-2021)

Based on climatic elements, five seasons are recognized in the project area:

4.2.8.1 PRE-MONSOON SEASON

Pre-monsoon refers to the period from April to June prior to the setting in of the monsoon. This is the hottest and driest season, with persistent dry and hot winds. Day time temperature rises to 40 Celsius. The flows in the river begin to rise simultaneously due to snow-melt water in the high mountains. The water table falls to the maximum depth.

4.2.8.2 MONSOON SEASON

Monsoon is the main rainy period, which starts at the beginning of July, reaches its climax in August and gradually subsides in September. The intense rainfall events cause soil erosion, which is a function of erosivity and erodibility. The cool monsoon winds followed by heavy showers lower the temperature to a great extent. The part of rain percolates into the soil and is conserved in the subsoil and adds to the groundwater. The conserved moisture in the soil is generally sufficient to rejuvenate the vegetation. All plants grow rapidly and mature towards the end of the season. With the start of monsoon season, the rivers flow at their peak level. The groundwater level gets improved toward the end of the season in September and October.

4.2.8.3 POST-MONSOON SEASON

Post monsoon season refers to autumn (October-November). The temperature starts falling but the extreme aridity prevents plants from flowering early and set seed toward mid-seasons. Groundwater level rises as a result of infiltration from rainfall.

4.2.8.4 WINTER SEASON

Winter refers to the period from December to January. The lowest temperature is less than two degrees Celsius, and cold winds characterize this season. The plants become dormant and most of them dry out. Most of the trees shed their leaves and few remain green or partly green. Sometimes this season becomes severe due to cold Siberian winds. Groundwater level declines in this season due to low flows in the rivers, and no or little rains which usually fall in light showers causing little soil erosion.

4.2.8.5 SPRING SEASON

Spring refers to the period from February to March. Temperatures become pleasant. The mean maximum temperature is 27 Celsius with the highest precipitation of 41.2 millimeters and relative humidity of 57.6 percent. Some light showers of rain may also fall without generating run-off. The vegetation sprouts again because of conserved moisture from winter and spring rains (if any), and the water table starts falling.

4.2.9 Ground Water Hydrology

Presently the main clean water source in Lahore is ground water that meets all the requirements including domestic, industrial and commercial, which is being extracted through 585 tube wells installed in the city and later pumped to distribution system operated by LWASA. The groundwater extraction by LWASA is 2.45 million meter cubic per day (540 million gallon per day).

The River Ravi, which has been the main recharge source to Lahore's shallow aquifer, has changed the ground water regime. There are several dug boreholes in the central city pumping groundwater for domestic usage. Due to control of river flow by India, the recharge has decreased and at present, it is of negligible amount. In addition, the decrease in cultivated

areas due to urbanization is another reason for the decline of aquifer recharge. Current groundwater loss of Lahore is 304 million cubic meters per year, resulting in the lowering of the water table by one meter every year. As discussed above, due to population growth and urbanization and excessive pumping, the groundwater balance of the Lahore aquifer is facing an increasingly negative trend since the 1970's.

The uneven groundwater development has resulted in a major groundwater depression, with maximum depth of groundwater up to 47 meters in areas such as Shadman, Shah Jamal, and Gulberg. Thus, the ground water source does not appear dependable source in future and alternate source from surface water needs to be adopted, to reduce the stress on groundwater.[7]

During the geotechnical investigations, the groundwater level in the investigated depth and soil stratum were also monitored. It was generally observed the groundwater lies below the 20-meter depth in all holes, even the area near to surface water crossings and nullahs (i.e. Lahore Canal and various other surface drains), however, appearance of water from these surface channels and local perched groundwater may encounter in the tunnel.[8]

4.2.10 Surface Water Availability

The main sources of surface water that can be used as alternative to groundwater in Lahore are Ravi River, Lahore Branch Canal, Khaira Distributary and the BRBD canal.

4.2.11 Ravi River

Ravi River is a trans-boundary river crossing northwestern India and eastern Pakistan. It is one of six rivers of the Indus system in the Punjab region. The Ravi River has a total length of about 720-kilometer flows across the city of Lahore. However, besides monsoon season the river is mostly dry due to the fact that water is diverted in India for irrigation and domestic purposes. In the past, River Ravi was the main source for recharge of groundwater aquifer, but due to increasing water demand and diversion of its water in India, it can no longer meet the required aquifer recharge of Lahore. The quality of water of Ravi River has a direct impact on quality of water present in the adjacent aquifer.

4.2.12 BRBD Canal

BRBD canal flows in the east of Lahore, from North to South. It crosses Grand Trunk Road, at a distance of about 6 kilometers, from Lahore Ring Road. The Canal takes off from Upper Chenab Canal (UCC) at Bambanwala, itself off takes from Marala Barrage with full discharge. The BRBD is about 175 kilometers long. It is an earthen channel except a short lined central segment. Although design capacity at head is 7,260 cusecs (205 cumec approx.), the maximum discharge is around 4,600 cusecs (130 cumec approx.). Among others, one of the reasons for limiting discharge to 4,600 cusecs is the limited design capacity of Syphon for crossing of River Ravi. This means that water from BRBD canal is a better and dependable source as compared to Ravi River that can be used to supply water to residents of Lahore after treatment in future. The Canal is brick lined from RD 260 to RD 373 and crosses the River Ravi and GT road at RDs 281 and 325[9] respectively.

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7 Final Feasibility Study Report of LWWMP Project-Feb, 2019

8 Geotechnical Investigation Report Larech Colony to Gulshan-e-Ravi, Lahore, 2016

9 Final Feasibility Study Report on Lahore Water and Wastewater Management Project-February, 2019

4.2.13 Lahore Branch Canal

The other surface water source is the Lahore Branch Canal (LBC), which takes off from BRBD canal at about RD 230. It is an open channel with lining at both sides, due to its limited discharge of about 400 cusecs, this canal cannot be considered as surface water source for Lahore, even to draw 100 cusec discharge.

4.2.14 Khaira Distributary

This water source lies in the south of Lahore, and it also takes off from BRBD canal, and flows from east to west, its flow is even less than the Lahore Branch Canal and hence cannot be utilized for the supply of water to 100 cusecs water treatment plant.

4.2.15 Drainage

The wastewater generated from all sources, i.e. domestic, commercial and industrial, drains ultimately to River Ravi. The River Ravi receives huge amount of wastewater from the city of Lahore and other industrial discharges from different sources especially Hudiara Drain, a natural drain which carries pollution loads from both Pakistan and India. Most wastewater discharge reaches Ravi River in the 60 kilometer stretch between Balloki and Lahore. These wastewater discharges, along with reduction in available water in River Ravi for dilution, have greatly deteriorated the quality of river water. River Ravi runs merely as a sullage carrier near Lahore during low flow season. Besides, there are 76 minor drains, which finally fall in eight major drains namely Satto Katla Drain, Lakshimi Drain, Suk Neher Drain, Upper Chota Ravi Drain, Lower Chota Ravi Drain, Siddique Pura Drain, Cantonment Drain and Shahdara Drain. Nowadays, all these drains collect wastewater from different areas of Lahore and ultimately discharge into River Ravi. The location map of major drains in Lahore is shown in **Figure 4-5.**

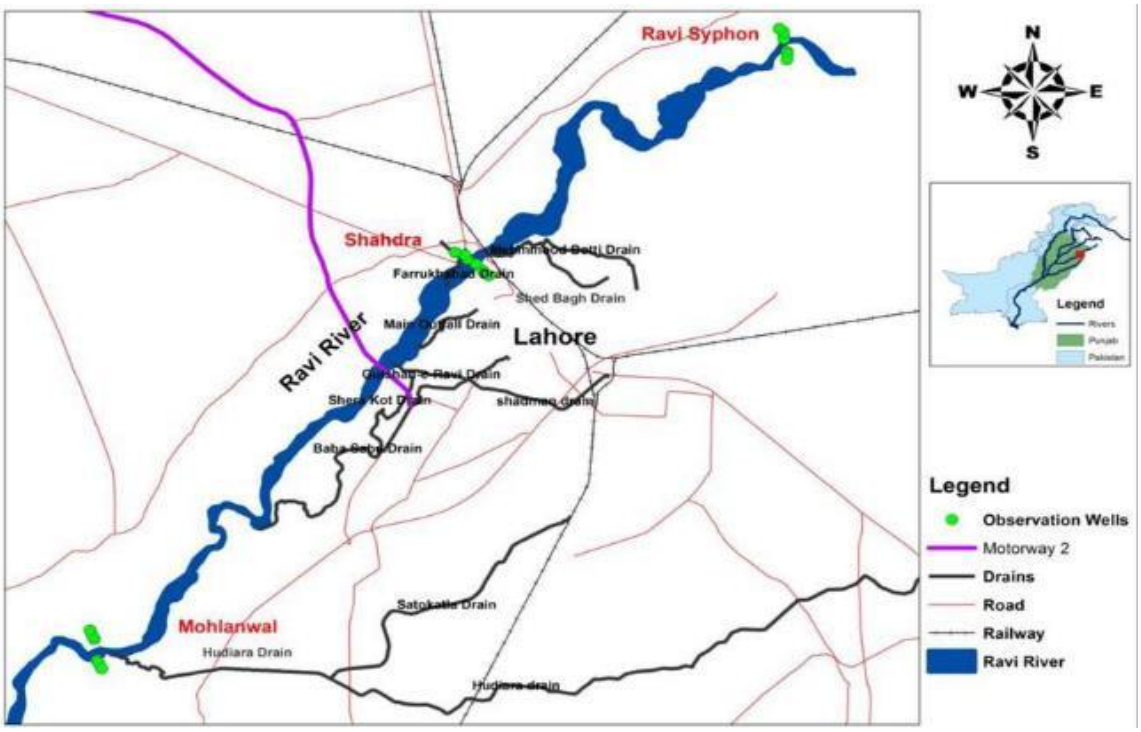


Figure 4-5: Location Map of Major Drains in Lahore

Source: *Hassan, G. Z., Hassan, F. R., & Akhtar, S. (2016). Environmental Issues and concerns of Groundwater in Lahore, Proceedings of the Pakistan Academy of Sciences, Life and Environmental Science, 53(3), 163-178.*

4.2.16 Solid Waste Management

Lahore Waste Management Company (LWMC) is responsible to ensure efficient collection, transportation, recovery, treatment and disposal of waste generated in Lahore. For this purpose, the LWMC divided the city into nine towns which include: Ravi Town, Shalimar Town, Wahga Town, Aziz Bhatti Town, Data Ganj Baksh Town, Samanabad Town, Gulberg Town, Allama Iqbal Town and Nishtar Town.

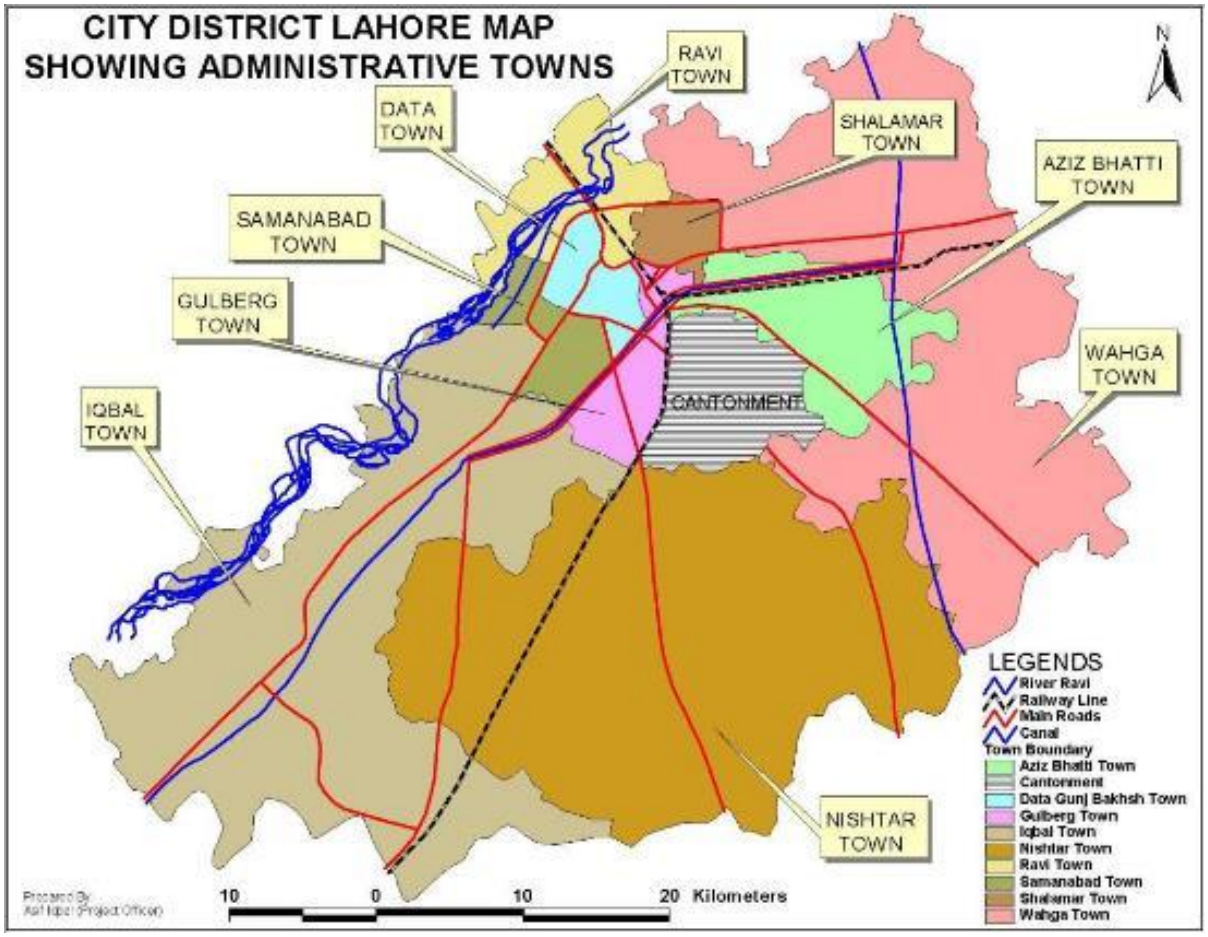


Figure 4-6: Administrative Zone Map for the collection of Solid Waste

The total waste generated in Lahore is about 7,510 tons/day[10], with a population of approximately 11.13 million[11], and an estimated capacity of waste generation rate of 0.65 kilogram per capita per day. The lifting capacity of the LWMC is about 4,500 tons per day, and around 350-450 tons of organic waste is utilized for compost preparation by private contractors on build, operate and transfer (BOT) basis under public-private partnership contracts. Currently, 60 percent of the Municipal Solid Waste is stored, collected, transported and disposed in open dumps (on dumping sites of Saggian, Bagarian, Kahna Kacha and Mehmood Booti) while 40 percent remains uncollected and lies along roadsides, streets, railway lines, depressions, vacant plots, drains, storm drains, in or around waste containers (where available), open heaps at road sides, informal collection points and open sewers.

10 https://www.export.gov/article?id=Pakistan-Waste-Management

11 District Census Lahore, 2023, Pakistan Statistics of Bureau

From the field survey, it was observed that the workers of LWMC collect and transport waste daily from the waste bins present near the proposed sewerage line route i.e. Garhi Shahu, Durand Road, Shimla Hill, Cooper Road, Queens Road, Bahawalpur Road, Chauburji Chowk, Infantry Road, Mustafabad, Basti Saddian Shah, Mian Mir Colony, Gulberg, Shadman, Shah Jamal, Shama, Rasool Park, Samanabad, and adjoining localities. Lahore Waste Management Company (LWMC) is working in Lahore and waste collection containers are placed at different locations. However, in Larech Colony and Gulshan-e-Ravi site, due to lack of awareness and sense of responsibility waste is being dumped on road sides, and in nearby open drains by residents as shown in **Plate 4.1.**

Dumping of Waste in Drain near Gulshan-e- Ravi

Dumping of Waste on Roadside near Larech Colony

Plate 4.1: A view of Waste Dumping

4.3 ENVIRONMENTAL MONITORING

The environmental parameters like ambient air quality, noise level, surface water, and ground water were monitored at ten different locations of the proposed project site for analyzing the quality of air, ground water, surface water, and level of noise, for establishing the baseline profile of the area as shown in **Table 4-3.** Moreover, wastewater quality analysis has been provided in section 6.4.6 (Table 6.5 & 6.6).

Table 4-3: Detail of Environmental Monitoring Parameters and Locations

Sr. No.	Parameters	Total Sampling Points	Sampling Locations
1.	Ambient Air	3	• Garhi Shahu • Shama Stop • Main Boulevard Gulshan-e-Ravi near Disposal Station
2.	Noise Level		
3.	Ground Water		

4.3.1 Air Quality

The ambient air quality monitoring for Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), and Particulate Matter (PM_{10} and $PM_{2.5}$) were carried out at three different locations of the proposed project site. The sampling was conducted for 24 hours period for SO_2, NO_2, PM_{10} and CO etc. $PM_{2.5}$, PM_{10} and SPM were out of limit at the sampling point. The reason for exceeding parameters is due to heavy traffic and commercial activities in the area. The results of selected points are discussed in **Table 4-4, Table 4-5 & Table 4-6.** The completed result report of the ambient air quality is attached as **Annexure XVII.**

Table 4-4: Ambient Air at Garhi Shahu

Sr. No.	Parameter	Concentration	Unit	Remarks
1	**Carbon Monoxide (CO)**	2.3	mg/m^3	Within Limits
2	**Sulfur Dioxide**	18.2	$\mu g/m^3$	Within Limits
3	**Ozone (O_3)**	8.0	$\mu g/m^3$	Within Limits
4	**Oxides of Nitrogen (NO)**	16.3	$\mu g/m^3$	Within Limits
5	**Oxides of Nitrogen (NO_2)**	22.9	$\mu g/m^3$	Within Limits
6	**Particulate Matter ($PM_{2.5}$)**	39.4	$\mu g/m^3$	Exceeding Limits
7	**Particulate Matter (PM_{10})**	156	$\mu g/m^3$	Exceeding Limits
8	**Suspended Particulate Matter**	528	$\mu g/m^3$	Exceeding Limits

Table 4-5: Ambient Air at Shama Stop

Sr. No.	Parameter	Concentration	Unit	Remarks
1	**Carbon Monoxide (CO)**	3.3	mg/m^3	Within Limits
2	**Sulfur Dioxide**	19.2	$\mu g/m^3$	Within Limits
3	**Ozone (O_3)**	9.0	$\mu g/m^3$	Within Limits
4	**Oxides of Nitrogen (NO)**	17.4	$\mu g/m^3$	Within Limits
5	**Oxides of Nitrogen (NO_2)**	28.7	$\mu g/m^3$	Within Limits
6	**Particulate Matter ($PM_{2.5}$)**	42.2	$\mu g/m^3$	Exceeding Limits
7	**Particulate Matter (PM_{10})**	154	$\mu g/m^3$	Exceeding Limits
8	**Suspended Particulate Matter**	578	$\mu g/m^3$	Exceeding Limits

Table 4-6: Ambient Air at Gulshan e Ravi

Sr. No.	Parameter	Concentration	Unit	Remarks
1	**Carbon Monoxide (CO)**	3.3	mg/m^3	Within Limits
2	**Sulfur Dioxide**	19.2	$\mu g/m^3$	Within Limits
3	**Ozone (O_3)**	9.0	$\mu g/m^3$	Within Limits
4	**Oxides of Nitrogen (NO)**	17.4	$\mu g/m^3$	Within Limits
5	**Oxides of Nitrogen (NO_2)**	28.7	$\mu g/m^3$	Within Limits
6	**Particulate Matter ($PM_{2.5}$)**	42.2	$\mu g/m^3$	Exceeding Limits
7	**Particulate Matter (PM_{10})**	154	$\mu g/m^3$	Exceeding Limits
8	**Suspended Particulate Matter**	578	$\mu g/m^3$	Exceeding Limits

4.3.2 Noise

Noise level monitoring was carried out at the same location where ambient air quality was monitored. Noise levels were monitored with the help of a potable digital sound meter at the project site for 24 hours. The average monitored values of noise taken are given in **Table 4-7, Table 4-8 &**

Table 4-9**.** Completed monitoring reports are attached as **Annexure XVII**.

Table 4-7: Noise Level at Main Blvd Gulshan e Ravi

Sr.	Measurement Point	Limit Values (PEQS)	Noise Levels in dB(A)	Remarks
1	Main Blvd Gulshan-e-Ravi Point-3 (GPS: 31.549978°, 74.28123°) Day Time	65 dB(A)	68 dB(A)	Within Prescribed Limits
2	Main Blvd Gulshan-e-Ravi Point-3 (GPS: 31.549978°, 74.28123°) Night Time	55 dB(A)	58 dB(A)	Within Prescribed Limits

Table 4-8: Noise Level at Garhi Shahu

Sr.	Measurement Point	Limit Values (PEQS)	Noise Levels in dB(A)	Remarks
1	Garhi Shahu Point-1 (GPS: 31.55552°, 74.355452°) Day Time	65 dB(A)	73 dB(A)	Exceeding Limits
2	Garhi Shahu Point-1 (GPS: 31.55552°, 74.355452°) Night Time	55 dB(A)	68 dB(A)	Exceeding Limits

Table 4-9: Noise Level at Shama Stop

Sr.	Measurement Point	Limit Values (PEQS)	Noise Levels in dB(A)	Remarks
1	Near Shama Stop Point-2 (GPS: 31.541991°, 74.312906°) Day Time	65 dB(A)	72 dB(A)	Exceeding Limits
2	Near Shama Stop Point-2 (GPS: 31.541991°, 74.312906°) Night Time	55 dB(A)	65 dB(A)	Exceeding Limits

The results indicate that the noise levels are higher at Garhi Shahu and Shama Stop locations during both day and nighttime, as the selected locations is along the busy roads and crossings. The traffic is always on the go on these roads, which contributes to the higher levels of noise.

4.3.3 Ground Water Quality

The major source of drinking water supplied to Lahore is through ground water reservoirs. Thus, quality of groundwater is very important in terms of public health. The groundwater sampling is done at three different locations, and subsequently analysis is done for the parameters specified in PEQS, 2016. **Table 4-10** gives groundwater quality monitoring results. Completed monitoring reports are attached as **Annexure XVII**.

Table 4-10: Ground Water Monitoring Results

Sr. No	Parameters	Result
Garhi Shahu		
All 31 parameters are within PEQS limit.		
Shama Stop		
1.	Fecal Coliform Bacteria	Exceeding Limits
2.	E. Coli	Exceeding Limits
3.	TDS	Exceeding Limits
Gulshan e Ravi		
1.	Fecal Coliform Bacteria	Exceeding Limits
2.	E. Coli	Exceeding Limits

4.4 LAND USE PATTERN

The land use of the project area is mainly residential, commercial, and studied by educational institutions, health facilities, religious sites, cultural heritage, recreational amenities, surface water bodies and roadside green belt. **Plate 4.2** shows pictorial view of land use.

Plate 4.2: A view of the Land Use of the Proposed Project Area

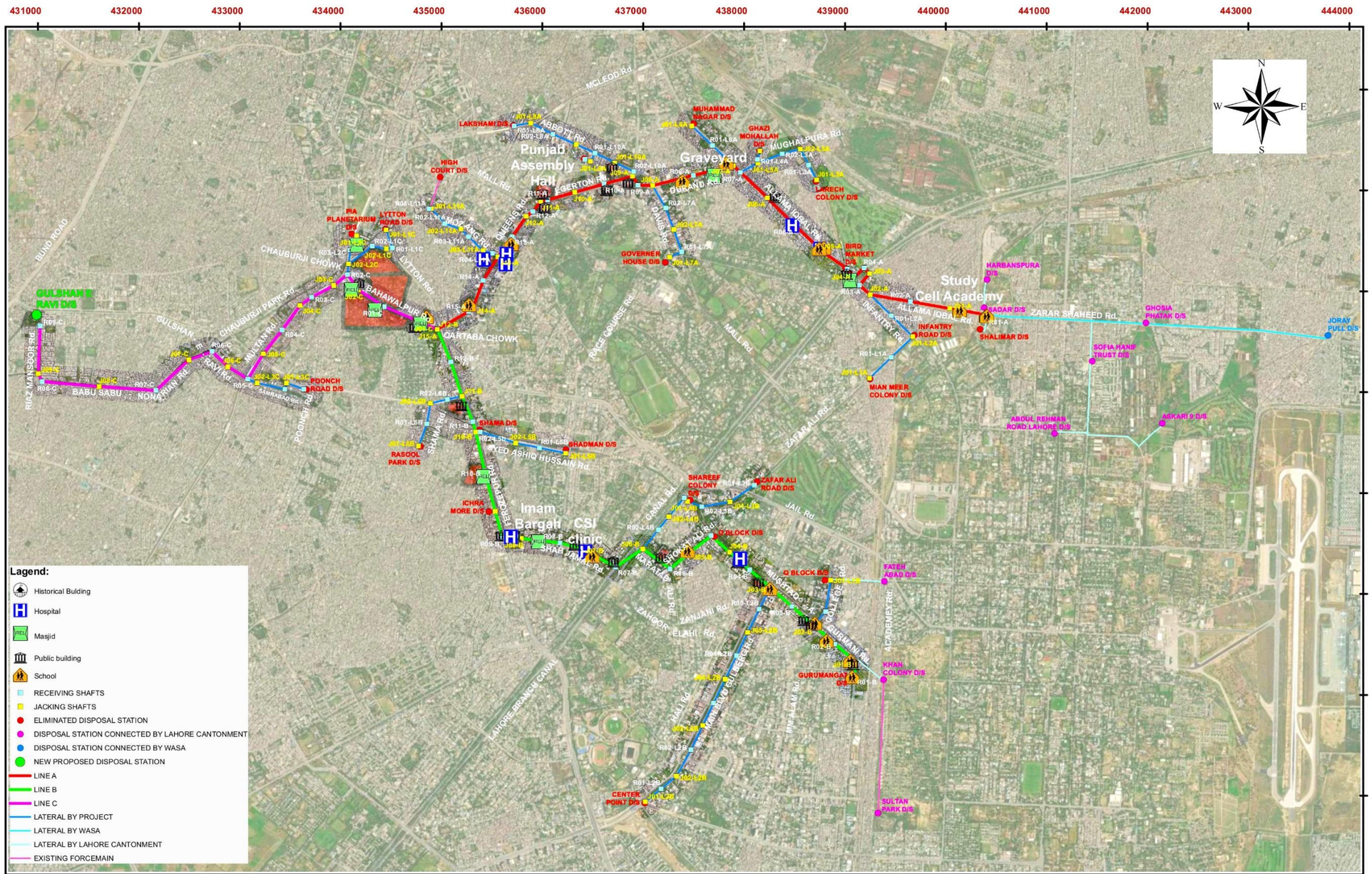
4.4.1 Sensitive Receptors

Sensitive receptors are mainly people or other organisms that may have a significantly increased sensitivity and exposure to the pollutants and social disturbance, due to the developmental projects. Thus, sensitive receptors are necessary to be identified, to evaluate the potential impacts of the proposed project on social, public health and the environment. The sensitive receptors identified for the proposed project within 250-meter radius are: Residential Areas; Educational Institutions; Health Facilities; Religious Places; and Culture Heritage. They are prone to sensitivity during construction phase, due to emission of air pollutants, noise and vibration, traffic jams, temporary edifice of construction camps, and mobilization issues. The detailed maps of sensitive receptors for line A, B and line C of the proposed project are attached as **Figure 4-7.** The detailed section maps are attached in **Annexure XXI.**

Complete list of sensitive receptors is given as **Annexure XXII**

Table 4-11: List of Sensitive Receptors

Line A	**Line B**	**Line C**
20 (Total Sensitive Receptors – Line A)	**8 (Total Sensitive Receptors – Line B)**	**11 (Total Sensitive Receptors – Line C)**
Steps Prep evening coaching, Kangroo kids' school	Pioneer Public School	Graveyard
Study Cell Academy	Orphanage (Mother Terresa Charity), PAC College	Graveyard
Astana Aliya, Civil Defense Organization	Family INN Hotel	Shafi Mehshar Mosque, Suraiya Azeem Hospital
Siddique Science Academy, Amina medical and gynae center, Tanveer academy of commerce,	JS Bank,	Orange line station, Poonch House Staff Colony
Fida Dental Clinic	Coca Cola (CCI) Office, Les Anges Montessori Academy	Directorate general of Mines and Minerals
Garhi Shao Police station	Iran Consulate	Pakistan Post Model Girls High School
Sir Ganga Ram hospital Fatima Jinnah College	American Lyceum School	Graveyard and Jamia Mosque Aqsa. Masjid Madina
Govt. Abu Alkhiar Girls middle school		
Graveyard		
Queen Marry Girls School.		
Falleti's hotel.		
Punjab Assembly Hall		
Cathedral school system,		
Govt. Jinnah Degree College for women		



LAHORE WATER & WASTE WATER MANAGEMENT PROJECT-SEWERAGE SYSTEM FROM LARECH COLONY TO GULSHAN-E-RAVI, LAHORE (THOURGH TRENCHLESS TECHNOLOGY)								
WATER AND SANITATION AGENCY, LAHORE	EBA ENGINEERING, EGSP, CCC, team — A JointVenture	REVISION	04			CONTROL	DRAWN	
			03				CHECKED BY	
			02				RECOMMENDED	
			01				CHD./VER.	
			REV.	DATE	DESCRIPTION		APPROVED	

REVISED ALIGNMENT (PROPOSED) | SCALE 1:40,000 | DATE :- AUG 2024 | DRAWING No. FIGURE 7.11 | REV:-

Figure 4-7: Sensitive Receptor Map of the Proposed Project

4.5 ECOLOGICAL RESOURCES

As climate of Lahore is semi-arid and subtropical, the vegetation of the area falls under scrub, dry, tropical thorn forest type as per phyto-geographical classification of the area. The alignment in which our project area falls, was once covered with native vegetation. Due to rapid increase in the population of the city, and to cater for its housing and commercial requirements, these agricultural lands were converted into public buildings, business centers, educational and health institutions, and housing colonies.

4.5.1 Flora

The proposed alignment is passing through urban areas and having ornamental plants, shrubs and herbs planted and managed by Parks and Horticulture Authority (PHA) for the purpose of beautification and urban ecological sustainability. These floral species also providing number of tangible and non-tangible benefits to the regional and local climate. Several types of trees, shrubs and herbs that observed during site visit are given below in **Table 4-12**, which illustrates their nomenclature including local names, English names and botanical names.

Table 4-12: Inventory of Flora

Sr. No.	Common Name	Scientific Name
1.	Alstonia	Alstonia scholaris
2.	Neem	Azadirachta indica
3.	Eucalyptus	Eucalyptus camaldulensis
4.	Jaman	Syzygiu mcumini
5.	Shisham	Dalbergia sissoo
6.	Sirris	Albizzia lebbek
7.	Bakain	Meliaaz edarach
8.	Pipal (Sacred Fig)	Ficus religiosa
9.	Banyan	Ficus bengalensis
10.	Toot (Mulberry)	Morus alba
11.	Molsary	Mimusopse lengi
12.	Bottle Palm	Cocos species
13.	Bottle Brush	Callistemon lanceolatus
14.	Palm	Cocos species

Source: Field Visit of the Study Area, July, 2024

4.5.2 Trees

The study area has a variety of trees, along the roadsides, center media in the lawns of administrative buildings, educational institutions and parks, consisting of the different ornamental and fruit species. These trees are mostly of medium size with the girth of two to four inches. **Plate 4.3** shows tree species observed in the study area.

Plate 4.3: A view of Tree Species in the Study Area

4.5.3 Natural Shrubs and Herbs

Shrubs and herbs raised along the roadside, compounds of educational institutions, office buildings, parks and lawns of houses for beautification of the landscape, and to improve the aesthetics in the study area includes: Calatropis (*calatropis procera*), Bhang (*cannabis sativa*), Bathu (*Chenopodium species*), and Molesary.

4.5.4 Grasses

The study area is at present covered with mostly Khabbal grass, while Kana grass (Saccharum munja) also exists, along with the depressions, where water accumulation occurs.

4.5.5 Fauna

Mammals

Common mammals found in the study area are dogs, cats, house rats and bats. Small Indian Mongoose and Indian Palm Squirrel have also been reported. These are mostly seen in areas where houses have already been constructed or are under construction.

Reptiles

Snakes such as cobra and kraits were once common in the tract, but now cases of snake bites are very rare, as these reptiles have been either killed by expanding urbanization, and they have moved away. Lizards such as Spiny Tailed Lizard (Uromastix hardwickii) and Fringed Toed Lizard (Acantho dactylus cantoris) are also reported by the residents of the study area.

Amphibians

Amphibians frequently seen in and around the project area, especially during rainy season, include common Frog (Rana tigrina) and Indus Valley Toad.

Birds

Birds that are observed in the study area during site visit are: House Sparrow (Passer domesticus), House Crow (Corvuss plendens), Mynah (Acredothe restristis), Nightingale (Pycnon tuscafer), Parrot (Psittacu lakrameri), Pigeon (Columba livia), and Hoopoe (Upupa epops).

Endangered Species, Wetlands and Wildlife Sanctuaries

There exist no threatened or endangered species of flora and fauna as indicated by IUCN red list of the species in the project area. There are no wetlands, game reserve and wild sanctuaries present in the project area.

4.6 SOCIO-ECONOMIC BASELINE

This section deals with the existing socio-economic conditions of Lahore and the project area. To appraise the prevailing socio-economic conditions, and to assess the impacts of the proposed project on the local settlements, and their livelihoods, the available reports and documents were comprehensively reviewed during the desk study, and detailed field surveys comprising structured interviews, stakeholders' consultations and Focus Group Discussions (FGDs) were conducted on socio-economic conditions. Livelihood and gender aspects. The results are presented in the ensuing paragraphs.

4.6.1 Socio-economic Profile of Lahore

The project will be implemented in Lahore, primarily catering to the sewerage requirements of central Lahore, which consists of Aziz Bhatti Town, Gulberg Town, Gunj Bakhash Town, and

Allama Iqbal Town. This section describes the socio-economic conditions of Lahore.

4.6.2 Political and Administrative Setup

The project site is situated within Lahore, part of the Lahore in Punjab Province, Pakistan. The highest-ranking administrative authority in the district is the District Commissioner. For revenue collection and administrative purposes, the Lahore District is divided into five tehsils: Lahore Cantt, Lahore district, Model Town, Raiwind, and Shalimar. Local governance is further managed through 274 Union Councils. The total land area of the Lahore District covers 1,772 square kilometers.

4.6.3 Demographic Characteristics

Lahore, located in Punjab Province, Pakistan, is bordered by Sheikhupura District to the north and west, the Wagha border to the east, and Kasur District to the south. The northern boundary of the city is marked by the River Ravi. Lahore spans a total land area of 404 square kilometers. According to the 2023 Census, Lahore has a population of 13.9 million, having experienced an average annual growth rate of 2.65% from 2017 to 2023. The city has an average household size of 6.3 people and a population density of 7,339 persons per square kilometer. The population is slightly male dominated, with males comprising 52.9% and females 47.1%. Additionally, Lahore has a youthful demographic, with over 40% of its residents under the age of 15.[12]

Lahore is bounded on the North and West by Sheikhupura district, on the east by India, on the south Kasur district and River Ravi flows on the northern side of Lahore. The district comprises five sub-administrative units (Tehsils). According to the census 2023, the overall population of the district was 13,004,135 and among them, males were 52.9 percent and 47.1 percent were females. The sex ratio is measured as 112.47. The area of the Lahore is 1,772 square kilometers, which gives a population density of 7,339 persons per square kilometer as compared to 3,566 persons observed in 1998. The average annual growth rate of the population in the district during the inter-census period 2017-2023 is 2.65%[13].

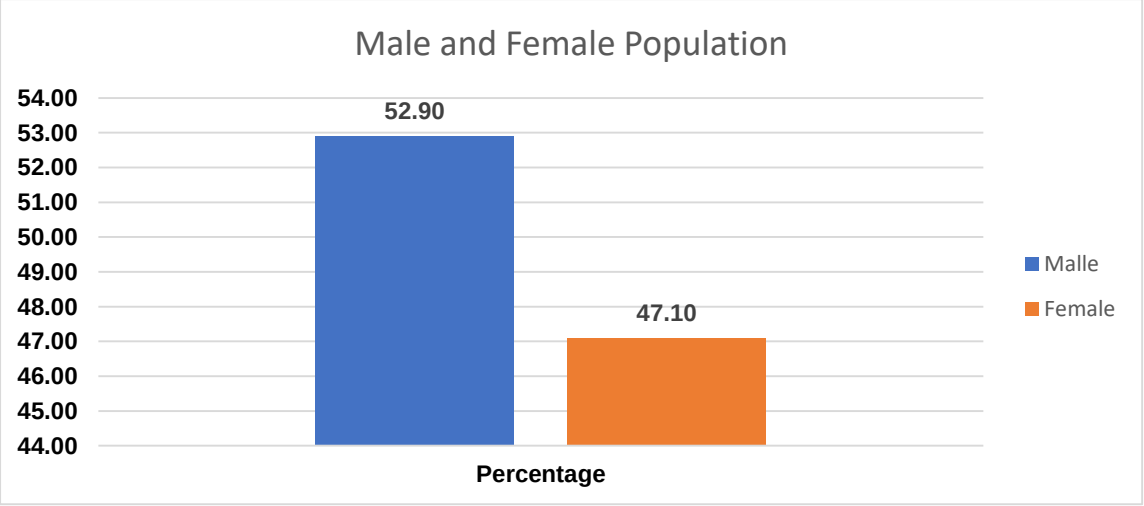


Figure 4-8: Male and Female Population

[12] **Punjab Development Statistics 2023, Bureau of Statistics, Planning and Development Board.**

[13] **Population Census, 2023, Pakistan Bureau of Statistics**

4.6.4 Religion

The majority of the population in Lahore practices Islam, accounting for 95% of residents. Among them, 50% follow the Barelvi sect, 25% are Deobandi, and 10% belong to the Ahl-e-Hadith and Ahl-e-Tashi sects. The remaining 5% of the population consists of religious minorities, including Christians, Ahmadis, Hindus, Sikhs, and others. The graph below provides a breakdown of the religious and sectarian composition in the district.

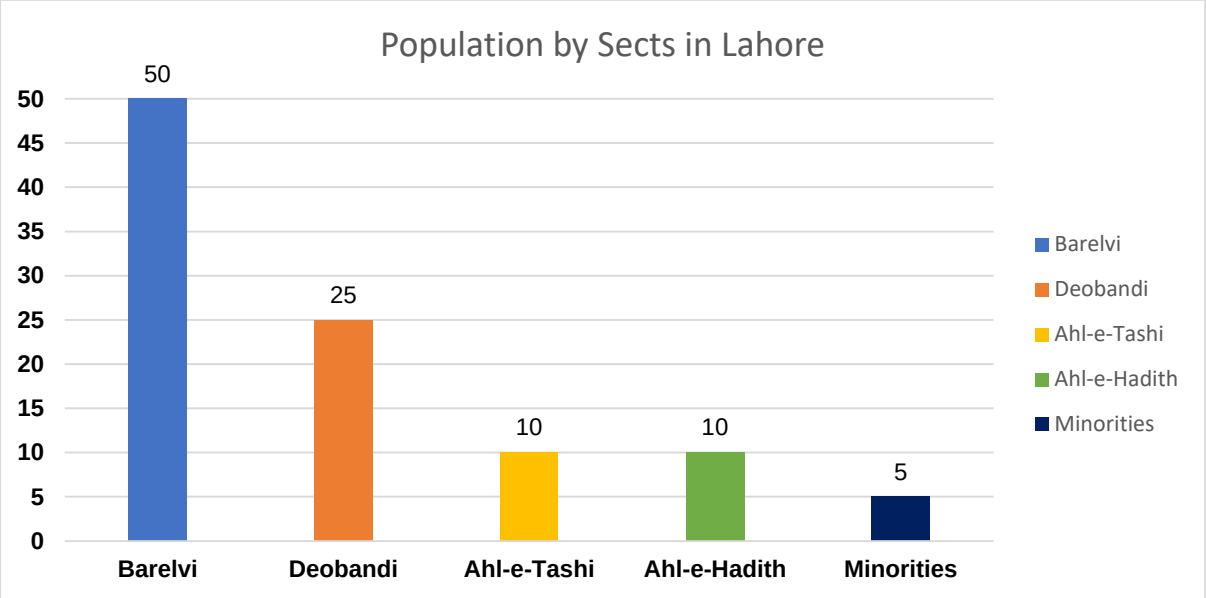


Figure 4-9: Population by Sects in Lahore

4.6.5 Ethnic Structure

Lahore is home to a variety of major castes and communities, including Arain, Jutt, Rajput, Malik, Pathan, Mughal, Sheikh, Komboh, and Gujjar. In addition to these groups, the district also features traditional village artisans such as Lohars (blacksmiths), Tarkhans (carpenters), Kumhars (potters), Mochis (cobblers), Machhis (water carriers), barbers, and weavers. Together, these communities play a vital role in shaping the district's diverse socio-economic fabric.

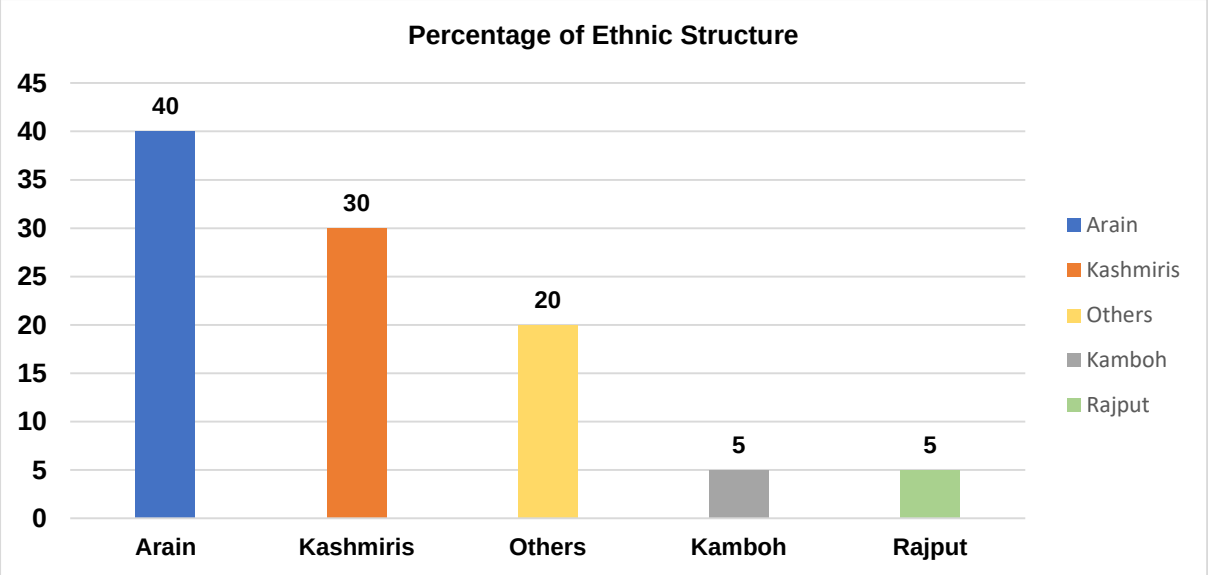


Figure 4-10: Population per Castes for Lahore

4.6.6 Language

Punjabi is the predominant language in the Lahore, spoken by approximately 74% of the population. Other languages spoken by smaller segments of the population include Urdu, Pashto, Saraiki, and Sindhi. In educational and governmental contexts, Urdu and English serve as the official languages.

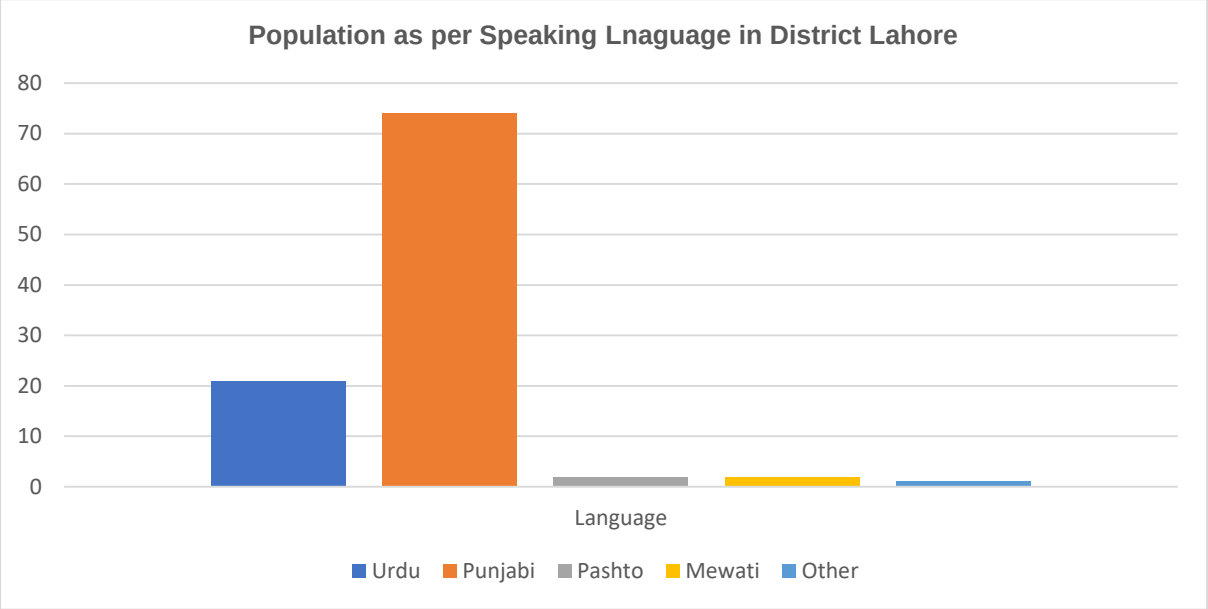


Figure 4-11: Population as Per Speaking Languages in Lahore

4.6.7 Gender Ratio

In Lahore, there are 111 males for every 100 females, indicating a slightly higher gender ratio. This imbalance is more pronounced in rural areas compared to urban regions.

4.6.8 Marital Status

Among the population aged 15 and older, 36.2% have never been married, 58.6% are married, 4.9% are widowed, and 0.3% are divorced. The proportion of never-married individuals is higher among males than females. Moreover, the percentage of never-married females is greater in urban areas compared to rural areas.

Table 4-13: Marital Status

Lahore				
Marital Status	**Detail**	**All Areas**	**Rural**	**Urban**
Never Married	Both Sexes	36.2	31.5	37.1
	Male	41.3	36.8	42.2
	Female	30.3	25.4	31.2
Married	Both Sexes	58.6	63.2	57.7
	Male	55.5	59.3	54.8

	Female	62.1	67.6	61.1
Widowed	Both Sexes	4.9	5.1	4.9
	Male	2.9	3.7	2.8
	Female	7.2	6.7	7.3
Divorced	Both Sexes	0.3	0.2	0.3
	Male	0.2	0.2	0.2
	Female	0.4	0.3	0.4

4.6.9 Migration

A total of 1,034,848 individuals, representing 16.4% of the population, were recorded as lifetime in-migrants in the Lahore. Of these, 890,427 chose to settle in urban areas. Among the lifetime immigrants, 71.7% originated from other districts within Punjab, while 10.1% came from Sindh, Khyber Pakhtunkhwa, and Baluchistan. Additionally, 1.3% were from Azad Kashmir and the Northern Areas, and the remaining 16.9% were repatriated Pakistanis from other countries. Notably, there were only 11 migrants whose birthplace was not reported. **Table 4-14** provides a detailed breakdown of lifetime in-migrants by their place of origin and settlement in the district's rural and urban areas.

Table 4-14: Migration Status

Migrants by Residence			
Description	**All Areas**	**Rural**	**Urban**
Total in-migrants	100	100	100
Migrants from the same province	71.7	79.4	70.5
Migrants from other provinces	10.1	6.1	10.7
Migrants from AK/ NA	1.3	0.8	1.4
Migrants from other countries	16.9	13.7	17.4

4.6.10 Economically Active Population

In Lahore, 21.8% of the population is economically active, including those employed in both the formal and informal sectors. The labor force participation rate is considerably higher among males, at 54.2%, compared to just 12.1% for females.

4.6.11 Occupational Structure

In the project area, key occupations cover a wide range of sectors, including industry, trade, services, and government positions. The urban population is engaged in various professions, with the service sector being particularly significant, employing a large share of the workforce and playing a crucial role in the district's economy. The percentage of the population associated with different types of occupations is shown in the **Table 4-15.**

Table 4-15: Occupational Structure

Occupation	Population
Agriculture with its Allied Livestock Breeding, Fishing, Forestry	5.70%
Manufacture	9.60%
Construction	30%
Wholesale/ Retail, Hotel/ Restaurant	15.60%
Transport, Storage & Communication	6.70%
Community, Social & Personal Services	17.10%
Financing, Insurance, Real Estate etc.	5.40%
Activities not Adequately Defined	9.40%
Electricity, Gas & Water	0.50%

4.6.12 Income Distribution

Income distribution in Lahore is markedly uneven, with a considerable disparity between high and low-income groups. The Gini coefficient, which quantifies income inequality, stands at 0.35, indicating moderate inequality. Most of the population falls into lower-income brackets, while a smaller portion enjoys higher incomes.

4.6.13 Poverty

The Lahore faces significant challenges with poverty, impacting around 29.5% of its population. Poverty is particularly pronounced in rural areas compared to urban regions. To address this issue and improve living conditions for vulnerable residents, various government initiatives and social welfare programs have been implemented.

4.6.14 Literacy and Education

Lahore has achieved significant progress in education, with a literacy rate of 78%, surpassing the national average. The literacy rate for males is 81%, while females have a literacy rate of 74%. The district hosts a wide range of educational institutions, including schools, colleges, and universities, reinforcing its status as a prominent educational hub.

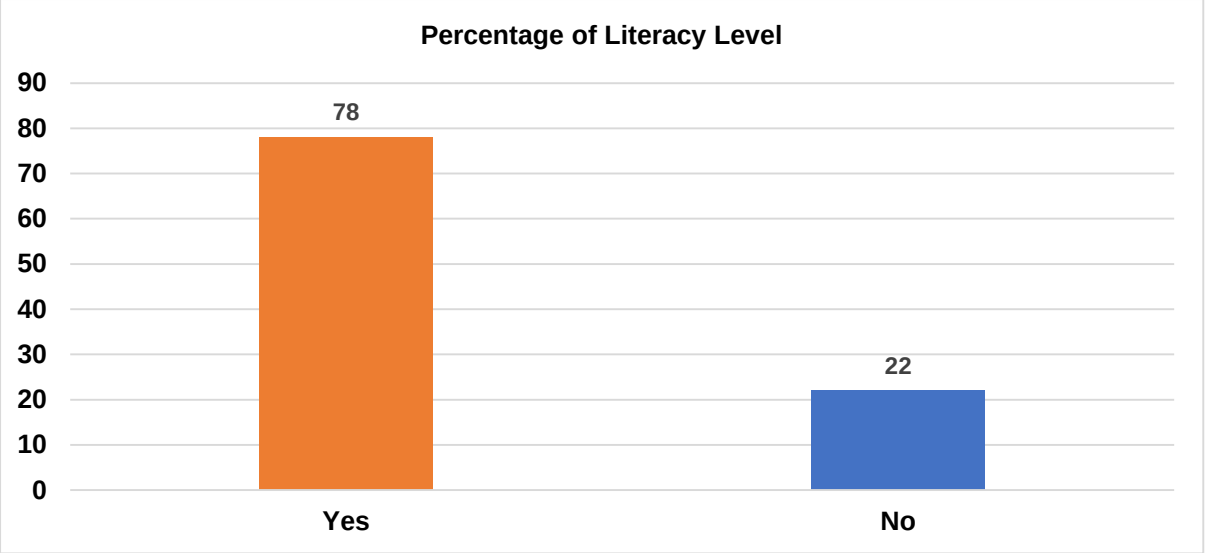


Figure 4-12: Literacy Level of Lahore

4.6.15 Educational Facilities

Educational facilities in Lahore are primarily managed by the Government of Punjab, the city government, the private sector, and various voluntary organizations. Additionally, the Federal Government oversees a few institutes in the cantonment area, providing limited high school education.

The educational attainment levels of Lahore's population are as follows: 12.6% have less than primary education, 23.2% have completed primary education, 22.5% have middle school education, 18.2% have matriculation (secondary) education, 9.3% have intermediate education, 7.2% are graduates, 2.6% are post-graduates, and 0.6% hold certificates. Lahore is served by 409 government schools, including 223 boys' schools and 186 girls' schools, with a total enrollment of 121,417 students (46,625 boys and 74,792 girls). Additionally, the Municipal Corporation manages 103 schools—44 for boys and 59 for girls—enrolling 4,575 boys and 9,606 girls. The city also boasts a substantial number of colleges and universities offering a diverse range of programs in science and the arts.

4.6.16 Health Facilities

Lahore Metropolitan Corporation and its urban areas offer an extensive array of medical and health facilities to meet the needs of the local population. Key hospitals in the city include Shaukat Khanum Memorial Cancer Hospital, Pakistan Kidney and Liver Institute, King Saud Bin Abdulaziz Hospital, General Hospital, Lady Willingdon Hospital, Mayo Hospital, Fatima Jinnah Hospital, The Children's Hospital, Services Hospital, and Ganga Ram Hospital. Additionally, several voluntary organizations operate hospitals that contribute to the healthcare services available to the public. Graph below shows the detail of medical facilities operated by Health Departments.

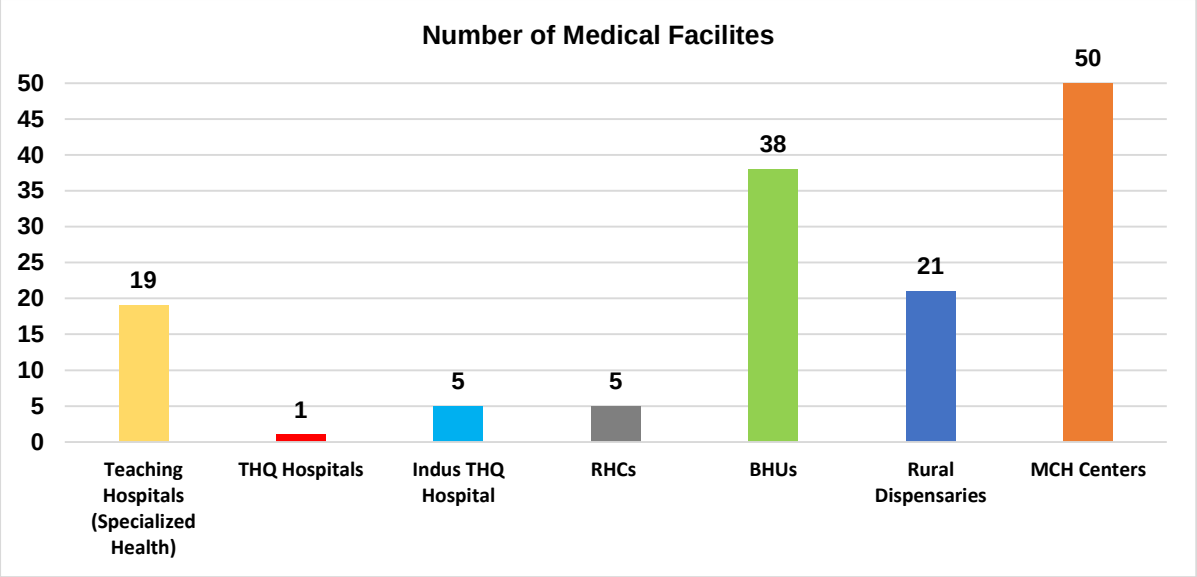


Figure 4-13: Number of Medical Facilities in Lahore

4.6.17 Housing and Infrastructure

Housing conditions in Lahore exhibit significant variation. Urban areas are marked by well-planned housing societies, apartment complexes, and residential colonies. In contrast, rural areas predominantly feature traditional housing structures. The majority of households in the district own their homes, with only a small percentage residing in rented accommodations.

4.6.18 Industry

Lahore is the second-largest industrial hub in Pakistan, following Karachi. Since independence, the city has experienced continuous industrial growth. The district hosts a diverse range of large industrial units that produce a wide array of products, including cotton, woolen, and silk fabrics; carpets and rugs; textile goods; leather and rubber footwear; clothing; pharmaceuticals; soap; iron and steel products; heating, plumbing, and lighting equipment; hardware; various fabricated items; agricultural machinery; engines and turbines; textile and printing machinery; metalworking machinery; pumps and compressors; household appliances; water generators; motor generators; transformers; electric fans; communication equipment; bicycles; and rickshaws.

Table 4-16: Industry in the Project Area

Name of Industry	No.
ICI Soda Ash	1
Pakistan Tobacco Company	1
Cement	2
Mari Petroleum	1
OGDCL	1
Brick Kilns	80
Flour Mills	16
Total	**102**

4.6.19 Land Utilization

Lahore covers an area of 858,000 acres, with 316,000 acres designated as cultivated land. Of this, 33,882 acres are irrigated, representing 10% of the cultivated area[14]. The primary agricultural crops include wheat, vegetables, fodder, and fruit from orchards. Grazing also constitutes a significant land use. For detailed land utilization statistics for Lahore in the year 2017, refer to the **Table 4-17.**

Table 4-17: Land Utilization

Particulars	Area (acres)
Cultivated Area	316,815
Irrigated Area	33,832
Rain Fed	282,983
Uncultivated Area	541,952
Forest	110,491
Culturable Waste	149,971
Not Available for Cultivation	281,490
Total Area	**858,767**

4.6.20 Archeological and Cultural Property

Lahore is a city renowned for its rich archaeological and historical heritage, featuring a diverse array of iconic sites. Among its treasures are the majestic Lahore Fort, the landmark Minar-e-Pakistan, the grand Badshahi Mosque, Shahi Fort, Chauburji and the distinguished Lahore Museum. Visitors can also explore the revered Shrine of Data Ganj Bakhsh, the sacred Shrine of Madhu Lal Hussain, the impressive Shah Jahan Monument, and the enchanting Shalimar Gardens. Additionally, the historic seven gates of Lahore stand as enduring symbols of the city's past. These sites collectively offer a profound insight into Lahore's cultural legacy and storied history.

4.6.21 Transportation

Lahore's public transportation is primarily managed by the Lahore Transport Company (LTC) and the Punjab Mass Transit Authority (PMTA). The PMTA operates the Lahore Metro Bus and the forthcoming Orange Line Metro, which form the core of the city's transit network. To support these services, LTC and PMTA run an extensive bus network that connects different parts of the city and serves as a feeder system for the Metro Bus. Additionally, the Punjab government has built numerous underpasses to reduce traffic congestion and prevent jams, making Lahore the city with the highest number of underpasses in Pakistan, according to official data.

Lahore Junction Station is the city's main railway hub and a key center for Pakistan Railway services in northern Pakistan. It provides essential connections to major destinations including Peshawar, Islamabad-Rawalpindi (the national capital), as well as long-distance routes to Karachi and Quetta. Additionally, Lahore Cantonment Station handles a selection of trains,

[14] **Punjab Development Statistics 2023, Bureau of Statistics, Planning and Development Board.**

further enhancing the city's extensive railway network.

Auto rickshaws and cabs are essential modes of public transportation in Lahore. The city is home to approximately 246,458 auto rickshaws, often called "autos," which are a prevalent choice for local travel. Additionally, motorcycle rickshaws, known as "chand gari" or "chingchi," are widely used for short-distance commuting. In recent years, private ride-hailing services such as IN drive and Yango have become increasingly popular in Lahore. These services offer radio cabs that can be booked in advance via mobile apps or phone calls and have become a favored transportation option for many city residents.

4.6.22 Handicrafts; Lahore

Lahore is renowned for its diverse arts and crafts, including intricate embroidery, exquisite silver and gold jewelry, and detailed brass and ivory inlay work. The city is also famous for its block and screen printing on textiles. Additionally, Lahore is a major center for hand-knotted carpet production. These carpets are among Pakistan’s top export items and represent the second largest sector in the cottage and small industry. Local artisans in Lahore create a wide range of handmade carpets, featuring a variety of traditional motifs.

4.6.23 Gender Situation

Gender disparities continue to affect access to education, employment, decision-making, and resource control in the city. To address these challenges, it is crucial to implement targeted interventions and awareness programs that promote gender equality and empower women across the project.

4.7 SOCIO-ECONOMIC PROFILE OF PROJECT AREAS

Comprehensive socio-economic investigations were carried out in the project area to assess the socio-economic conditions of the affected persons and women consulted for the project's gender action plan. The study involved a mixed-methods approach, utilizing structured questionnaires, stakeholder consultations and Focus group Discussions (FGDs). A general overview for the three (03) main lines is as follows:

4.7.1 Socio Economic Profile for Line A

Karachi Phattak, where line A starts from, passes under the canal to join with Allama Iqbal Road is semi old, developed area where there are shops along the main road. There are few mosques, hospitals, schools and a shrine of Mian Mir Sahib; however, there will be no impacts on the traffic, local businesses or communities. Most of the residents belong to the low and middle class. The locals mostly speak Punjabi, and a few Sikhs shops have also been seen. The local population is mostly divided into Brelvi and Shia sects. Then line A continues from Allama Iqbal Road to Shimla Pahari, which is also semi old, developed area. The population speaks Punjabi and Urdu and belongs to middle class. The Allama Iqbal Road is a two-way road which is around 25m wide. There will be no impacts of traffic or business loss. Two laterals starting from Ghazi Mohalla and Larech Colony disposal station, pass through Garhi Shahu Bazar to join line A at Allama Iqbal Road. It passes through a narrow commercial area which would have temporary losses for businesses.

These business operators have been contacted by the Social Safeguard team to calculate their compensation. From Shimla Pahari the line moves along Agerton Road and passes In front of Faletti’s Hotel and curves towards Qartaba Chowk, Queen’s Road. This segment is mostly commercial and has wide roads around that can easily accommodate the construction activities. There could be a conflict point close to the Faletti’s Hotel which may cause access problems. This will be resolved through engineering design. The area population speaks both Urdu and Panjabi and has many shops run by Patthans. This segment has some green spots

and has Jinnah Garden close by. The main sensitive receptors include WAPDA house, Faletti's Hotel and Punjab Assembly Hall. Qartaba Chowk where line A ends a commercial area that is famous for home appliances shops.

4.7.2 Socio Economic Profile for Line B

The line B starts from a highly commercial and an old industrial area of Guru Mangat Road and connects to Syed Gurmani Road. The area is considered a posh area, highly developed with a lot of greenery. There are shopping malls, brand shops, international food chains like McDonald, KFC and Hardees. The locals belong to the middle to high class. Most of the population speaks Urdu. There are a few sensitive receptors that include Mother Tareesa Orphanage and Home Economics College for Women. The Gurmani Road runs along a stormwater/wastewater drain. The construction will be done on the left side of the road, away from the drain. This side has houses and the green belts In front of the houses will be sacrificed and rehabilitated after the completion of the works.

The line from there connects to Shah Jamal Road via less than a half Km junction of Syed Maratab Ali Road and passing under the canal. The Shah Jamal Rd is a single road which is about 13m wide. It is residential and commercial area where we find schools, hospitals, shrine of Baba Shah Jamal and Iran Consulate. There could be a point that could cause access issues, but it can be easily avoided through engineering solutions and by moving the pit point a few meters. Line B then continues to Ferozepur Road to Qartaba Chowk which is two way 4 lanes each side and 33 meters wide. This is the main artery of the city and has commercial plazas on it. There is no impact as plenty of space will be available for construction activities. Laterals from Shama, Maulana Shaukat Ali Road and Shadman also join line B.

4.7.3 Socio Economic Profile for Line C

Line C, which starts from Qartaba Chawk to Gulshan-e-Ravi disposal station is in old, developed area that has narrow roads, small houses, shops, hospitals and hotels. The population belongs to the low-income class and mostly speaks Panjabi. The line passes through a single road, Bahawalpur Road which is 8 meters wide, and it will be closed for construction and require a diversion. Lahore's largest graveyard, Miani Sahib is situated on this road. From Bahawalpur Road the line continues to Multan Road, about 20 meters away from the historical monument of Chauburji. It runs along the Multan Road till it reaches the Gulshan-e-Ravi Road from where it turns left on to Babu Sabu Nonarian Road and then it terminates at Gulshan-e-Ravi disposal station.

The Babu Sabu Nonarian road is a congested single road having a width of just 8 meters. Also, Cantonment drain runs along the Nonarian road, and the construction will be done on its left bank. There are a few shops and a house that might face access issues. The road will be closed and require diversion. The access issue has been discussed with the design team, and they are considering providing temporary bridges to cater for the access issue. Since the road is narrow and has a drain by its side, it is prone to more accidents and conflicts with the local community. Rigorous OHS and CHS plans will be developed for this section of the alignment. Other sensitive receptors along the line C include Department of minerals and mines, Fisheries and wildlife department, Government Girls High School and a mosque.

5 STAKEHOLDER CONSULTATION AND INFORMATION DISCLOSURE

As per requirements of AIIB's Environment and Social Policy (ESP), consultations were carried out with stakeholders including business runners, residents, and Affected Persons (APs) and relevant government departments and authorities to inform them about the project components and probable impacts the project would generate. The opinions, views, and suggestions for the minimization and mitigation of project impacts were recorded. A Stakeholder Engagement Plan (SEP) has been prepared as a standalone document wherein the stakeholder engagement activities are outlined.

This consultation process had the following objectives:

- Share information with stakeholders on proposed improvement works and expected impacts on the physical, biological and socio-economic environment of the proposed project corridor (area of influence);
- Understand stakeholders' concerns regarding various aspects of the project, including the existing condition of the sewerage, upgrading requirements, and the likely impacts of construction related activities, and operation of the improved sewerage system;
- Provide an opportunity for the public to influence and execute project design in a positive manner;
- Obtain local and traditional knowledge, before decision making;
- Increase public confidence about the proponent, reviewers and decision makers;
- Reduce conflict through the early identification of controversial issues, and work through them to find acceptable solutions;
- Create a sense of ownership of the proposed project or proposal in the mind of the stakeholders; and
- Develop the proposal which is truly sustainable.

5.1 IDENTIFICATION OF MAIN STAKEHOLDERS

Stakeholder analysis and identification is a way of determining who among the stakeholders can have the most positive and negative impacts, and who is likely to be most affected by the project. The stakeholders are local population, groups, non- governmental organizations (NGOs), community-based organizations (CBOs), institutions, government organizations, and line departments, working in the area with the same nature of projects, and directly affected by the execution of the proposed project.

During the field survey, significant efforts were made to identify the possible categories of stakeholders and their stakes. The stakeholders identified were the local residents, government officials, shop owners, public representative, NGO's and public. All those stakeholders had different types of stakes according to their professions. Thus, consultations were conducted at two levels:

- Community level; and
- Institutional and Departmental level.

The findings of consultations are presented in the ensuing paragraphs.

5.2 CONSULTATION WITH AFFECTED PERSONS AND COMMUNITY

The concerns and issues raised by residents and APs have been adequately considered in the provision of livelihood restoration assistance in safeguards documents. The concerns relating to compensation for the loss of income will be catered to by PMU-LWASA. The compensation equaling 04 months of income of APs from their businesses is considered enough by the APs. The concerns related to disturbance of access, and environmental issues were recorded, and it was informed that mitigation measures such as traffic management and control of air and noise pollution will be mitigated. Necessary safety measures with cautionary signs including health, safety, road safety, and pedestrian crossing will be displayed during the construction and operational phase of the project. The APs will be provided with opportunities by the Contractor to work during the construction phase and opportunities will also be explored for the employment of APs in the operational phase of the Project. However, they suggested in time project completion and provision of adequate compensation to the APs.

Gender consultation sessions were held along the project sites. The participants of these sessions revealed that women had limited awareness of the proposed project and its potential impacts. It was essential to enhance their understanding to enable informed participation. Women expressed concerns about potential health risks associated with construction activities, including dust, noise, and exposure to hazardous materials. They also raised safety concerns, particularly about construction sites near residential areas. Women indicated a strong interest in employment opportunities related to the project. However, they also highlighted barriers such as a lack of relevant skills and training, which could limit their participation. Women reported challenges in accessing information about the project, often due to cultural norms and literacy levels. This underscored the need for targeted communication strategies that consider these barriers. There was a lack of awareness among women about existing grievance redress mechanisms. Women emphasized the need for a gender-sensitive grievance mechanism to access safely and confidently. The summary of consultations is given in the **Table 5-1** below.

Table 5-1: Summary of Consultation with APs and Community

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
Trunk Sewer Line Route					
17-09-2022	Q Chowk, College Road Gulbarga-III, Lahore	8	The project is good for the benefit of residents of Lahore and local people as it will clean the drains which are spreading foul smell and are a cause of accidents. The tunneling technology is also good as it will lead to less impact on businesses and road users.	- Project abandoned due to frequent changes in governments. - Businesses that will be impacted and need adequate compensation - Businesses interruption can be avoided by changing the location of pits to the other side of the road	- The project is fully funded by the Asian Infrastructure Investment Bank (AIIB) hence will be implemented and will not stop on want of funds or change of government. - Requests will be forwarded to the contractor who will look into it at the time of detailed engineering design.
17-09-2022	Q Chowk, College Road Gulberg-III, Lahore	5	The project is in favor of local people. The cleaning of drains will clean the area, and the lives of children and adults will be saved which is threatened as incidents of falling in the drain occur.	- Project may not be implemented as many projects are suspended after the change of government. - The project should not disturb the businesses and access of local people.	- The project is fully funded by the Asian Infrastructure Investment Bank (AIIB) hence will be implemented and will not be suspended. - The business interruption will be compensated, and access will be ensured by providing alternative routes.
18-09-2022	Hamza Hospital, Shama Road	2	The project is beneficial for the local population and the coming generations. The project will help in cleaning the environment. The lives of children will be saved. Our business should be protected during construction. Additionally, construction activity should not harm the environment.	- Businesses should be protected during construction. - Construction activity should not harm the environment. - Cash compensation should be provided for the disruption of our business. -The compensation should be enough to meet the expenses of APs for a couple of months.	- Efforts are made to reduce business losses in the design. The same will be followed by the contractor. - Mitigation measures will be adopted for environmental protection during construction - The project will affect businesses for one month;

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
			Cash compensation should be provided for the disruption of our business. The compensation should be enough to meet expenses for a couple of months.		however, compensation will be for about 03 months.
21-09-2022	Sikandar Road, Cantt Drain Mian Mir Colony	1	The project is designed by the government, and hopefully, it will benefit. The project should be for the benefit of local people. The drain is open and people dump solid waste in it. Once a child also drowned in this drain. If the sewer line is laid, we support the project. The open drain causes disease. It also justifies the machines like Air Conditioners and other machinery getting rotten.	None	Not Applicable
08-02-2023	Shama Metro Bus Station	2	Tunneling is a good technique.	- Business should not be affected. - The construction should take place away from the business. - The road should not be destroyed as this leads to business interruption	- Affected businesses will be compensated. - The destroyed part of the road will be repaired.
08-02-2023	Shama Chowk	8	At this time of high inflation, we cannot see any advantage of such a project as it will affect already deteriorated businesses badly.	- Project will cause loss of businesses that are already in the doldrums. - The government should protect businesses first and give second priority to such projects.	- Businesses will be interrupted temporarily against which compensation will be paid.

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
08-02-2023	Abbot Road Shops	7	The benefit is that the issues arising from the mismanagement of liquid waste will be reduced. Water will not accumulate in the streets.	- Businesses will be badly affected. - Government should take care of inflation at present rather than initiating such projects.	- Business interruption will be well-compensated - Development projects contribute to the local economy.
08-02-2023	Main Chauburji Park	7	There is no need for such projects in the present high inflation period.	- The life and business of common men will be destroyed by this project. - People don't have money to feed their children, and the government is putting a burden on common men by building such projects	- Business interruption will be well compensated - Development projects play a vital role in economic development.
8-02-2023	Bahawal Pur Road	9	There is no need for such a project in the present high inflation period.	- Roads will be closed which will destroy the businesses. - People are already under stress due to inflation. They need flour, not a sewer.	- Access will be ensured by providing alternative routes - Development projects should also take place along with the welfare of local people.
05-04,2023	WASA Disposal Station-Gulshan Ravi	9	The government should focus on such projects	The dwellers fear their livelihood will be impacted	Livelihood losses will be compensated.
10-04-2023	Mehr Nazir Park	10	The project is beneficial for local people as the sewerage is blocked off and on	None	Not Applicable
10-04-2023	Ganda Nala Bund Road, Gulshan Ravi	8	The project is beneficial for local people as the sewerage is blocked off and on	None	Not Applicable
23-08-2024	Babu Nonarian Road	6	The project will be greatly beneficial to the public.	- The construction works will disrupt all the business activities temporarily.	The suggestion of participants to shift the construction area to the right bank of the Cantonment

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
				- Access to Transportation goods will be restricted. They showed satisfaction with the construction of the project and stated that the project would be beneficial for the public. - Previously construction of road projects also affected their business activities. - They showed concern that construction activities should be completed within the stipulated time of 02-03 months as communicated by the survey team. They also expressed that if there is a delay in construction activities in the specified time, their business will be disrupted, which will cause income loss. - Minimal time will be utilized for the completion of construction activities in the area. - They also highlighted that construction material would not be placed/kept in front of the door/gates of shops/houses. - They also said that their stock/goods arise at the shop/store once a week on an average basis on vehicles, and there should be no hindrance to the transportation of goods/stock.	Drain to avert livelihood impact is forwarded to the concerned authorities. This shifting has been made in the design accordingly

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
				- They pointed out that the construction of a sewer line towards the right side of the nullah will reduce resettlement/income displacement impacts as well as reduce the impacts on traffic mobility in the area.	
23-08-2024	Mustafabad	6	The benefit is that the issues arising from the mismanagement of liquid waste will be reduced.	- Businesses in this reach will be affected due to construction activities. - Access to customers will be restricted during the construction period. - Mobility of the Public will be affected and alternate access roads should be provided for mobility. - They suggested that an alternate site towards the right side of the nullah may be considered for the installation/placement of a sewer pipeline.	Access to shops will be ensured.
23-08-2024	Allama Iqbal Road, Bird Market	4	The project is good for the people living in the area	- Road closures will negatively impact local businesses, potentially causing significant disruptions. - With inflation already putting people under financial strain, their immediate concern is access to necessities like flour,	Access to shops will be ensured

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
				rather than new sewer infrastructure.	
23-08-2024	Railway Stadium, Mughalpura Road	5	The project is good for the future developments.	- Business operations in this area will be impacted by the construction of this project. - They expressed their concern that construction activities will impact in reduction of Customers. - They suggested that shifting the jacking pit point at a distance of around 200ft to 250ft will avoid business disruption/income displacement/loss as there are shops at that place. However, the construction of the project is good for the future developments.	The suggestion of participants to shift the construction area backward in front of the wall of the railway stadium to avert livelihood impact will be forwarded to the concerned authorities. The design is changed to avert impacts accordingly
23-08-2024	Mozang Road	5	The project is beneficial for the area as the sewerage is blocked off and on.	- They raised the issue of rainwater and highlighted that the rainwater penetrates their shops during the rainy season. - They expressed concern that construction activities should be completed within the stipulated timeframe of 2-3 months, as communicated by the survey team. They also indicated that any delays in the construction process beyond this period could disrupt their business	- Contractor will be bound by LWASA to complete the civil works in the stipulated time. - The compensation will be paid to the business holders whose business will disrupt due to construction of sewer line

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
				operations and result in a loss of income. - Customer access will be limited during the construction period. - Previously construction of road projects also affected their business activities. - It will take more than 3 months we do not support it. - They recommended considering an alternative site on the right side of the nullah for the installation or placement of the sewer pipeline. - Minimal time will be utilized for the completion of construction activities in the area. - They expressed the concern that the construction activities will take more than 3 months, causing income loss due to disturbance of business, and therefore do not support it. They also added that the department should consider an alternate site /route to save the loss of their businesses. - They also emphasized if there is no alternate site or route available the department should try to minimize the construction period by doing day and night work.	

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
				- They also pointed out that the local contractor should not deployed/engaged in this project as they have no less resources and capability of machinery and equipment. - They also express their concern that shop operators will not allow the construction activities of the project in this area. They also insisted that the survey team may contact the market union president in this regard.	
10-12-2024	Nusrat Colony, Mian Meer, Cantt	19	The project is good for the benefit of residents of Lahore and local people as it will clean the drains which are spreading foul smell and are a cause of accidents.	- The project should be completed swiftly. Project delays may cause disturbance for the public. - Construction areas should be restored. - Cleanliness should be maintained.	The project is being financed by AIIB. Such projects are time-bound and hence will be completed in time. The contractor will restore the site to its original after completion of construction.
10-12-2024	Infantry Road	11	The project is good for local people	- It is requested to complete the project as soon as possible. - Site restoration to its original form after construction and cleanliness should be maintained.	The project is being financed by AIIB. Such projects are time-bound and hence will be completed in time. The contractor will restore the site to its original after completion of construction.
11-12-2024	Samanabad	10	The project will be greatly beneficial to the public.	- The project should be completed as early as possible.	The project is being financed by AIIB. Such projects are time-bound and hence will be completed in time.

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
11-12-2024	LOS Road	10	The project will be greatly beneficial to the public.	- During such projects, most of the time incompetent contractors are hired who don't work properly. - Usually, the workforce deployed during the construction of such projects is incompetent.	The contractor will be bound to hire skilled labor and complete the work in time.
11-12-2024	Saadi Park, Mozang Chungi	10	The project will be beneficial to the public.	- The construction activities may generate air and noise pollution. - The construction activities may cause traffic disturbances and inconvenience to locals. - Competent workforce should be hired.	- Transportation of construction materials will be avoided during the night and a strict schedule of construction material transport will be observed; - Water sprinkling at sites will be ensured where dust will be emitted; - Proper traffic management plan will be implemented to avoid traffic jams
12-12-2024	Qila Gujjar Singh	10	The project will be greatly beneficial to the public.	- The project should not end up like conventional government schemes (i.e., incomplete, delayed, troublesome for the public, etc.)	The project is being financed by AIIB. Such projects are time-bound and hence will be completed in time with the least disturbance to local people.
12-12-2024	Shah Jamal, Ichra	10		Concerns regarding the timely completion of the project. Site restoration should be duly observed. Competent contractors and labor should be hired.	The project is being financed by AIIB. Such projects are time-bound and hence will be completed in time with the least disturbance to local people.

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
				Public disturbance should be avoided as much as possible.	
12-12-2024	Shera Kot, Nonarian Road	10		- No concerns or apprehension were put forth by the participants. This is due to the high acceptance of the project by the locals of the area because of utterly poor sanitation, sewerage disposal, and hygiene conditions in the area.	Not Applicable
Disposal Station Site					
13-4-2023	Disposal Station Gulshan-e-Ravi	6	The staff of the Metropolitan Corporation Lahore (MCL) and Revenue Department consulted. They appreciated the project.	- They showed concern that their offices will be demolished for the construction of the disposal station. The departments do not have any building in the area to house their offices	A new building block will be constructed as part of the disposal station. The staff of both MCL and the Revenue Department will be adjusted/moved in temporary arrangements e.g: containerized offices etc. Construction work of new building block will be carried out alongside the temporary relocation of the current offices.
Gender Consultation					
18-9-2024	J Block Gulshan-e-Ravi	10	The project appears to be beneficial for the local population	None	Not Applicable
18-9-2024	Ghari Shahu Market	10	If the sewer line is laid, we support the project.	Usually, that kind of project takes a lot of time to complete. We request the authority complete this project as soon as possible.	This is a funded project that is time-bound. Hence the construction works will be completed within the stipulated

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
					time.
18-9-2024	Larex Colony, Ghari Shahu	10	The project is beneficial for the local population	Not much to say we will just pray for this project completed as soon as possible, as construction work may disturb our daily business life routine. The population of the city is increasing day by day need of this project, it should be done as soon as possible.	The contractor will be bound to take all measures to avoid disturbance to the local population.
18-9-2024	H 973+F&V, Mughalpura	10	The project is designed by the government, and hopefully, it will benefit. The project should be for the benefit of local people. The drain is open, and people dump solid waste in it. Once a child also drowned in this drain. If the sewer line is laid, we support the project. The open drain causes disease. It also justifies the machines like Air Conditioners and other machinery getting rotten.	Not much to say we will just pray for this project completed as soon as possible, as construction work may disturb our daily business life routine. The population of the city is increasing day by day need of this project, it should be done as soon as possible.	The contractor will be bound to take all measures to avoid disturbance to the local population.
18-9-2024	Shera Kot, Ghulshan Ravi	7	The project will be greatly beneficial to the public.	Nothing to say. All the best for the project	Not Applicable
17-9-2024	Muhallah Urdu Nagar, Ghulshan Ravi	10	The project will be greatly beneficial to the public.	This project disturbs the daily routine of life. Govt should improve health benefits	The contractor will be bound to take all measures to avoid disturbance to the local population.

Date of Consultation	Venue of Consultation	Number of Participants	AP's General Perceptions of the Project	Issues and Concerns Raised During Consultation	Response from the Project
17-9-2024	Rasool Park Shama	10	The project will be greatly beneficial for the public.	They showed concern that construction activities should be completed within the stipulated time of 3 months as communicated by the survey team. They also expressed that if there is a delay in constriction activities in the specified time, it will lead to impacts on livelihood and access. They also highlighted that construction material would not be placed/kept in front of the doors/gates of houses.	This is a funded project that is time-bound. Hence the construction works will be completed within the stipulated time. The contractor will be bound not to store material in front of doors/gates of houses.
17-9-2024	Mouza Nawa Kot, Shera Kot Samnabad,	17	The government should focus on such projects	They fear their livelihood will be impacted	Livelihood losses will be compensated.
September 17, 2024	Ichra, Shama	17	The project will be greatly beneficial for the public	It should be done as soon as possible.	This is a funded project that is time-bound. Hence the construction works will be completed within the stipulated time. The contractor will be bound not to store material in front of doors/gates of houses.
September 17, 2024	Park Street, Gulberg II	9	The project is beneficial for local people as the sewage is blocked off and on	None	Not Applicable
September 17, 2024	Mozang chuangi, Chaburji	4	The project is beneficial for local people as the sewage is blocked off and on	None	Not Applicable

5.3 CONSULTATION WITH GOVERNMENT DEPARTMENTS AND AUTHORITIES

Three stakeholder consultation meetings were held with representatives from relevant government departments and authorities. The purpose of the meeting was to provide an overview of the project titled “Sewerage System from Larech Colony to Gulshan-Ravi Using Trenchless Technology” and to gather views, opinions, and suggestions from the concerned departments regarding project planning and engagement during the planning and execution phases. The participants were apprised of “Lahore Water and Wastewater Management Project (LWMMP)”, which is being implemented by LWASA with financial assistance from the Asian Infrastructure Investment Bank (AIIB). A key component of this project is the construction of a Sewerage System from Larech Colony to Gulshan-e-Ravi using trenchless technology. Micro-Tunneling Boring System (MTBS) will be deployed for the construction of the project to eliminate the need for open-cut excavation. Instead, pits/shafts at distant locations (250 to 500 m approximately) will be made and a Micro tunnelling Boring Machine (MTBM) will be employed to lay the sewer pipes.

EPC contractor will be hired who would require clearance of the site and working space otherwise it may result in a delay in meeting project timelines which are not acceptable in EPC Contract as it may lead to claims from the contractor, therefore, we need to collectively work together to ensure well-prepared project to avoid any such nuisance in future. In this regard, detailed visits are requested to be carried out with multiple utilities. Accordingly, any demand notice for shifting services may urgently be prepared and shared with PMU. He further added that the EPC contractor will prepare detailed designs which may result in some variations at the site, therefore quick response will be required from each organization at the time of execution of the project.

Environmental and Social Impact Assessment (ESIA), Resettlement Plan (RP), Livelihood Restoration Plan (LRP), Gender Action Plan (GAP), and Stakeholder Engagement Plan (SEP) have been prepared for the project. The construction phase is expected to result in minor to moderate environmental and social impacts, such as traffic disruptions, temporary business interruptions, displacement of informal settlers, and air and noise pollution. He explained that each pit may take about 3 months for construction at the site. To address these impacts, compensation has been proposed for business losses. Additionally, mitigation measures have been developed to manage traffic and control air and noise pollution. All these strategies are integrated into safeguard documents.

Participants expressed their satisfaction with the sewerage project, emphasizing its critical importance for Lahore. They acknowledged that effective sewage management is essential for improving public health and environmental conditions. Overall, the consensus was that this project addresses a significant need for the community. A task force comprising Focal persons/representatives from all stakeholder departments is suggested to be notified to seek swift and amicable resolutions to the conflicts occurring during the construction phase. The key findings from this stakeholder consultation are outlined in the **Table 5-2** below.

Table 5-2: Summary of Consultation with Government Departments

Sr. No.	Name / Department	Observation/ Clarifications	PMU (LWWMP) WASA Lahore Response
1.	Punjab Mass Transit Authority (PMA)	The project conflicts with existing and proposed Mass transit Lines in Lahore. The project consultants must share the details for better facilitation of the public at this stage. The project needs to obtain NOCs from the key Stakeholders. The alignment of the proposed project needs more attention or improvement. Coordination with key stakeholders is very important.	It was apprised during the meeting that WASA will share the design layouts with the PMA. Conflicts can be effectively resolved through a combined session with the Mass Transit Authority. PMU will request concerned departments to provide NOCs. Key stakeholders will be contacted throughout the project cycle.
2.	Lahore Electric Supply Company (LESCO)	Each department should depute the concerned Focal person. Weekly meetings can be arranged to address particular aspects of the project that need more attention or improvement.	The PMU will depute a focal person to make liaisons with the concerned departments.
3.	Pakistan Telecommunication Company Limited (PTCL)	The project will contribute positive impacts to the community. Email Newsletters will be the preferred method for receiving updates and information about the project. Weekly meetings can be arranged to address particular aspects of the project that need more attention or improvement.	Key stakeholders will be contacted throughout the project cycle.
4	Sui Northern Gas Pipe Line (SNGPL)	Close coordination and meetings between departments will be effective execution of the project. Impacts on Local Livelihoods could be the primary social concerns regarding the project.	Close coordination and meetings between departments will be held throughout the project cycle. It will be the project's priority to avoid any kind of livelihood impact on the locals and if it becomes inevitable at some point, the project has prepared a detailed livelihood restoration plan in order to minimize and rehabilitate the impacts of the livelihood of locals.

Sr. No.	Name / Department	Observation/ Clarifications	PMU (LWWMP) WASA Lahore Response
5	Fisheries Department, Government of Punjab	Health and Safety Risks could be the Primary Social concerns regarding the project. Contamination of water quality could be the primary environmental concern regarding the sewerage project and disposal station. Email NEWS letters will be the preferred method for receiving updates and information about the project. Weekly meetings can be arranged to address particular aspects of the project that need more attention or improvement.	A detailed Environmental Social Management Plan (ESMP) has been prepared for the project in order to mitigate any health and safety risks. Three sewage water treatment plants are also planned, which will positively impact the ground water. Close coordination and meetings between departments will be made throughout the project cycle.
6	Punjab Safe City Authority	The primary social concerns regarding the project could be Traffic Congestion and Police Operations & Security. Health and Safety Risks could be the Primary Social concerns regarding the project. Contamination of air quality could be the primary environmental concern regarding the sewerage project and disposal station.	The Traffic Management Plan has been prepared by the project and it has already been shared with PSCAfor endorsement/information. A detailed Environmental Social Management Plan (ESMP) has been prepared for the project to mitigate any health and safety risks. Air quality monitoring will be made throughout the project cycle and necessary measures will be taken to avoid air quality contamination.
7	Punjab Safe City Authority	Air Quality, Water Quality, Noise Pollution, Waste Management, and Impact on Local Wildlife and Vegetation and Land use changes could be the primary environmental concerns regarding the sewerage project and disposal station. Displacement or Relocation, Impact on Livelihoods, Health and Safety Risks, Impact on Local Infrastructure, Social Cohesion and Community Relations, Public Access and Services could be the primary social concerns regarding the project. Biweekly meetings could make effective communication between the project and the concerned department.	A detailed Environmental Social Management Plan (ESMP) has been prepared for the project to mitigate all these environmental risks. It will be the project's priority to avoid any kind of livelihood impacts on the locals and if it becomes inevitable at some point, the project has prepared a detailed livelihood restoration plan to minimize and compensate for all these social issues of locals. Close coordination and meetings between departments will be made throughout the project cycle.

Sr. No.	Name / Department	Observation/ Clarifications	PMU (LWWMP) WASA Lahore Response
8	Traffic Engineering and Transport Planning Agency (TEPA)	Project The use of technology that is yet to be used in Pakistan may bring new challenges. Services shifting could be a particular aspect of this project. Proper traffic diversion plans need to be prepared.	It is challenging but the project design has been synchronized with the local dynamics and all precautionary measures have already been taken by the experts. Services shifting will be made by following all the protocols issued by the concerned department. Traffic Management plan has been prepared and shared with TEPA.
9	Lahore Waste Management Company (LWMC)	Site restoration is an important matter during this project's activities. If the slurry is not disposed of properly, it will adversely disturb the Environment Close coordination and meetings between departments will be essential related to the disposal of slurry.	The Project Director agreed that close coordination and cooperation with LWMC will save time and impact environmental conditions. PD said to make a cell in all the departments and assign a focal person in each department for better coordination with LWASA.
10	Metropolitan Corporation Lahore (MCL)	What is the depth of the trunk sewer? There is a 132 KVA WAPDA underground line near Shimla Hills. It will damage the existing infrastructure/roads and services of different departments for pit excavation. What about the pits if it will conflict with the main Roads and public area? Zonal Officer MCL asked what is plan of the outfall drain.	It was explained that Safe City and other department services must be protected, as the construction work will be 9 meters deep. The PMU will make every effort in designing the project to minimize the conflict between the main roads and public areas. Assistant Project Director LWASA explained we have a separate project for wastewater treatment at Babu Sabu. The Project Director highlighted that after the project's completion, the nullahs/drains in the project area will primarily carry rainwater, alleviating their burden. Three sewage water treatment plants are also planned, which will positively impact the River Ravi.

Sr. No.	Name / Department	Observation/ Clarifications	PMU (LWWMP) WASA Lahore Response
11	City Traffic Police Punjab	Project Director LWASA asked DSP if the Chinese delegation visit is expected in the next few days and what their security plan. He also highlighted that WASA has written a letter to SP Cantt as well for security. Traffic diversion will be necessary.	DSP said the city traffic police will appoint focal persons for Chinese delegation security during the visit to different sites in Lahore. Traffic diversion management will be coordinated with the city traffic police. A traffic management plan has already been shared with the Chief Traffic Officer of Lahore.

5.4 MARGINALIZED COMMUNITIES AND DISABLES PERSONS

During the survey, no individuals with disabilities, transgender individuals, marginalized communities, or minority groups were identified within the corridor of impact (CoI) of the project. As a result, the AIIB policy regarding persons with disabilities, transgender individuals, marginalized communities, and minorities is not applicable to this project. Consequently, there is no requirement to propose special measures, such as training and awareness sessions for them.

However, it will be ensured to maintain ongoing monitoring and engagement with the affected individuals and communities to ensure that any changes in demographics or project impacts are addressed in accordance with the AIIB policies and guidelines for marginalized communities. If members of these groups are later identified within the CoI of the project, appropriate measures will be implemented to comply with AIIB's policies for inclusiveness and equality.

6 ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT

6.1 GENERAL

This section presents the overall impacts (both beneficial and adverse) of pre-construction, construction and operation phases of the proposed project on the physical, ecological and socio- economic environment of the area of influence. In addition to this, it also covers the mitigation measures of the potential adverse environmental and social impacts.

6.2 IDENTIFICATION OF IMPACTS

A field checklist was prepared for the identification of potential environmental and social impacts. Based on the findings of literature review, field visits, and compilation of baseline information, the screening checklist was filled to screen out the impacts of the proposed project during the preconstruction, construction and operation stage.

The categories and characterization of impact matrices are mentioned below **Table 6-1**.

Table 6-1: Categories and Characterization of Impact Matrix

Sr. No.	Categories	Characterization
1	Nature/Type	Positive Negative
2	Intensity	Negligible: Minute to no impact Low: Impact of very light intensity Moderate: Normal impact High: Considerable impact Very High: Impact on an alarming/prominent level

Intensity refers to the severity or degree of change caused by an impact, relative to the existing environmental conditions whereas magnitude refers to the size or extent of the environmental impact.

The Impact screening checklist or project impact evaluation matrix has been developed to evaluate the potential impacts of the proposed Project based on set procedures of environmental guidelines of AIIB and Punjab-EPCCD. The impact screening checklist is developed to screen out the potentially insignificant environmental and social impacts from the potentially significant adverse environmental and social impacts during the construction and operational phases of the proposed project. The objective of the impact screening process is to assess the significance of the issues related to the air, water, noise, soil, transportation, infrastructure, communication, hazards, and external limits of the proposed project.

Table 6-2: Characterization Key

Negative	-
Negligible	1
Low	2
Moderate	3
High	4
Very High	5

Table 6-3: Impacts Matrix during Construction Phase

COMPONENTS	Description	Activity				
		Excavation Operations (Tunnel Boring and Construction of Shafts)	**Transportation of Construction Materials and Equipment's**	**Open Storage of Construction Materials and Fuel**	**Functioning of Power Generators and Construction Machinery and Equipment's**	**Solid and Liquid Waste Generation and Management**
		Impact Score (IS)	**IS**	**IS**	**IS**	**IS**
BIOPHYSICAL ENVIRONMENT	Visual Intrusion	-4	-3	-4	-4	-2
	Air Quality, Dust and Climate Change	-4	-4	-3	-4	-4
	Soil	-4	-2	-3	-2	-4
	Water Quality	-2	-1	-3	-1	-1
	Noise and Vibration	-3	-3	-1	-4	-1
	Traffic Disruption	-5	-3	-3	-2	-1
	Interference with Utilities	-4	-1	-1	-1	-1
	Resource Conservation	-4	-3	-1	-4	-2
	Flora	-3	-1	-1	-1	-1
	Fauna	-2	-1	-1	-1	-1

COMPONENTS	Description	Activity				
		Excavation Operations (Tunnel Boring and Construction of Shafts)	**Transportation of Construction Materials and Equipment's**	**Open Storage of Construction Materials and Fuel**	**Functioning of Power Generators and Construction Machinery and Equipment's**	**Solid and Liquid Waste Generation and Management**
		Impact Score (IS)	**IS**	**IS**	**IS**	**IS**
SOCIOECONOMIC ENVIRONMENT	Historical, Cultural and Archaeological Sites	-1	-1	-1	-1	-1
	Occupational Health and Safety	-4	-3	-4	-2	-2
	Disturbance to the Residents	-5	-3	-3	-4	-3
	Social and Cultural Conflicts	-3	-1	-3	-3	-2
	Employment	+4	+3	+2	+3	+3
	Impacts on Livelihood	-5	-1	-3	-3	-3
	Influx of Labor	-4	-1	-1	-1	-2
	Child Labor	-1	-2	-2	-1	-1

The excavation activities of shaft construction and tunnel boring will cause most of the negative impacts on air, labor, OHS residents, business holders and traffic. The impact would be high negative and after the completion of the project most of these will have positive and permanent impact.

Table 6-4: Impacts Matrix during Operation Phase

COMPONENTS	Description	Action						
		Conveyance of Wastewater	**Screening of Wastewater**	**Disposal of Wastewater**	**Maintenance of Drainage System**	**Functioning of Power Generators and Operation Machinery and Equipment's**	**Waste Generation, Storage, Transportation and Disposal**	**Open Storage of Operational Materials and Fuel**
		Impact Score (IS)	**IS**	**IS**	**IS**	**IS**	**IS**	**IS**
BIOPHYSICAL ENVIRONMENT	Land Use	+4	-3	+5	+4	+3	+3	+3
	Air quality, dust and climate change	+4	+2	+1	+4	+4	+3	+3
	Water Quality	+2	+2	-5	+3	+3	+3	+2
	Noise and Vibration	+3	-2	-1	+3	-2	-2	+1
	Flora	+3	+1	+1	+1	+1	+1	+1
SOCIOECONOMIC ENVIRONMENT	Aesthetic Value	+5	+1	+1	+4	+2	+2	+3
	Employment	+4	+4	+2	+3	+3	+3	+2
	Occupational Health & Safety	+4	+4	-1	-4	-2	-1	+3
	Natural and manmade disasters	-4	-1	-1	-4	-2	-2	-2

As compared to the present situation, the project will have high positive impacts on land use, aesthetics, employment and air. There will still be negative impacts in the operation phase, significantly low as compared to the present system. There will be emissions at ventilation points, odor control and disposal stations. The OHS is noted to be high negative for maintenance during operation. It is strongly recommended through this study that wastewater should be treated before its disposal into the river. After completion of this project, the overall project will have a moderate to high positive impact.

6.3 ANTICIPATED IMPACTS DURING PRE-CONSTRUCTION (DESIGN) PHASE

Impacts envisaged during pre-construction (design) phase, and the recommended mitigation measures have been described under physical, ecological and socio-economic categories.

6.4 IMPACTS ON PHYSICAL PARAMETERS

6.4.1 Selection of Appropriate Technology (Positive Impacts)

The proposed project aims to cater for the sewage flow of the project area. Tunnel Boring Method will significantly reduce potential environmental impacts like noise, dust and visual on sensitive receptors and restrict the impacts to the receivers located near the launching and receptor station. Compared with the cut-and-cover approach, disturbance to local traffic and associated environmental impacts would be much reduced; and quantity of spoil generated would also be reduced.

6.4.2 Layout Planning and Design (visual and aesthetic pollution)

Incompatible layout plans and engineering designs of the proposed project can undermine the overall aesthetic beauty and ambience of the project area creating visual pollution. Utilization of the available spaces and designing the layout without considering the prospective and futuristic needs may result in design with low social acceptability and functionality. This impact will be permanent and moderately adverse in nature.

6.4.3 Odor from Pump Stations and Sewer Pipes

In the suction wells, the sewage emits gases, which accumulate in the air above water surface. The gas may include odorous compounds like hydrogen sulfide (H_2S), amines, fatty acids, aldehydes, ketones and other volatile organic compounds (VOCs). As the water level rises before the pumping cycle, it physically displaces the air, along with the odorous gas compounds. H_2S is the most dominant odor causing compound and therefore can cause nuisance to nearby households. When sewage becomes stagnant, H_2S is generated in anaerobic conditions. The quantum of H_2S generation depends on the quantity of accumulated sewage and sewage retention time that create anaerobic conditions. Both the increase in quantity of sewage accumulation and retention time will increase the H_2S generation.

From the geotechnical investigations results, it is indicated that the soil at the proposed project site is moderately corrosive to metal pipes, and as indicated by the chloride and sulfate concentrations, the soil is considered non-corrosive to concrete pipes. However, due to the gravity sewer, the Hydrogen Sulfide emission and oxidation at the pipe ceiling will cause Hydrogen Sulphate production, which will cause deterioration of concrete pipes.

Mitigation Measures

- Internal surfaces of pipes will be designed in such a way that it provides protection against Hydrogen Sulfide (H_2S) reactions.
- Proposed wells will be closed using reinforced cement concrete (RCC) slabs. Design of RCC slab will consider both superimposed loads (human and equipment loads) and severe corrosion risk from sewer gas from within wells; and
- RCC Slab will be designed and fixed in a modular manner such that access to pumps and appurtenances, and other equipment can be provided for maintenance, replacement and renewal purposes.

6.4.4 Climate Change

The urban sewer systems transport a large amount of sewage every day. The sewage in sewers contains abundant contaminants, particularly organic matter. The energetic metabolism of the microbial communities in biofilms attached to pipes and the anaerobic environment in sewer sediments provide suitable conditions for the transformation of contaminants. Due to these diverse bioreactions, especially fermentation, significant amounts of greenhouse gases such as methane (CH_4) and carbon dioxide (CO_2) can be generated in sewers. Thus, the excessive emission of greenhouse gases can induce climate change.

During the field survey, greenhouse gases emissions from existing sewerage system, open drains and nullahs were evident, due to timeworn sewage pipes, absence of sewerage system in proposed areas of the project, dumping of solid and liquid waste directly into storm water drains and nullahs. In addition to this, vehicular movement (fuel sweltering in vehicles releases carbon dioxide, NOx, SOx and particulate matter) and construction activities of development projects (releases CH_4, CO, CO_2, N_2O, H_2S, particulate matter) are also contributing to greenhouse emissions and smog in and around the project area. This impact is negative in nature and long term.

Mitigation Measures

- Sewerage pipes will be designed in such a way that they minimize leakages and withstand existing sewerage flows.
- Proper monitoring of sewerage pipes during operational phase to check leakages will be ensured; and
- Proper training for LWASA Staff will be conducted for operation and maintenance of sewer system, and Awareness among local population regarding impacts of Climate Change.

6.4.5 Seismic Hazard

The project area is in Seismic Zone 2A, where 2A (lower limit of moderate damage) represents peak horizontal ground acceleration from 0.08 to 0.16 gram. In this Zone, designing various types of structures will be done on the basis of Peak Ground Acceleration (PGA). A low to moderate intensity earthquake impacting the project site can adversely impact the development. This factor requires special consideration of the designers, keeping in view the recent earthquake of October 08, 2005, and September 25, 2013 and recent tremors within past few months.

Mitigation Measures

- The structures of the proposed project will be designed and constructed to withstand low to moderate earthquakes. For seismic hazard analysis, updated structural and seismic evaluations will be consulted; and
- To mitigate the seismic hazard, Seismic Building Code of Pakistan 2007 (SBC-07) will be adopted. This code specifies minimum requirements for seismic safety of buildings and structures and must be applied and used by design engineers in conjunction with the necessary understanding of the concepts of structural geotechnical and earthquake engineering.

6.4.6 Pollutant Load on Receiving Body

The main surface water bodies identified in the project area are River Ravi and Lahore Branch Canal. The quantity of water in River Ravi near Lahore has been greatly reduced in the past few years. The discharge of untreated wastewater from the city and industries from different sources especially Cantonment Drain, Allama Iqbal Town Drain, and Hudiara Drain (a natural drain which carries pollution loads from both Pakistan and India) alsoends up in Ravi, thus,

deteriorate quality of River Ravi water. Since the wastewater of the city is already ending up in River Ravi, the impact of sewage discharge owing to the proposed project (if discharged without treatment) remains similar to existing situation.

The wastewater quality was measured at three (03) different locations i.e. Sabzazar, Saggian Bypass and Niazi Chowk on October 21, 2021. The water samples were analyzed for the parameters specified in PEQS, 2016. The detailed wastewater results are given in **Table 6-5:**

Table 6-5: Wastewater Analysis of the Project Area

Sr. No.	Parameters	Unit	PEQS	IFC Effluent Guidelines	Sampling Locations		
					WW 1: Sabzazar	WW 2: Saggian Bypass	WW 3: Cantt Drain
1.	Temperature @ lab	°C	-		26	26	26
2.	pH Value @ 25 °C	pH Unit	6-9	6-9	8.12	7.69	7.98
3.	Total Dissolved Solids (TDS)	mg/L	3500		584	657	807
4.	Sulphate	mg/L	600		86	92	98
5.	Fluoride	mg/L	10		ND	ND	ND
6.	Total Chlorine	mg/L	1.0		ND	ND	ND
7.	Cyanide	mg/L	1.0		ND	ND	ND
8.	Chloride	mg/L	1000		55	85	135
9.	Sulfide	mg/L	1.0		0.056	0.064	0.082
10.	Oil & Grease	mg/L	10	10	ND	ND	ND
11.	Chemical Oxygen Demand (COD)	mg/L	150	125	179	250	165
12.	Biochemical Oxygen Demand (BOD5)	mg/L	80	30	91	118	86
13.	Ammonia (NH3)	mg/L	40		ND	ND	ND
14.	Phenolic Compounds	mg/L	0.1		ND	ND	ND
15.	Total suspended Solids (TSS)	mg/L	200	50	150	186	325

Sr. No.	Parameters	Unit	PEQS	IFC Effluent Guidelines	Sampling Locations		
					WW 1: Sabzazar	WW 2: Saggian Bypass	WW 3: Cantt Drain
16.	Arsenic (As)	mg/L	1.0		0.011	0.01	0.012
17	Barium (Ba)	mg/L	1.5		ND	ND	ND
18	Boron (B)	mg/L	6.0		ND	ND	ND
19	Cadmium (Cd)	mg/L	0.1		0.013	0.009	0.011
20	Chromium (Cr)	mg/L	1.0		ND	0.027	0.019
21	Copper (Cu)	mg/L	8.0		0.58	0.55	0.59
22	Iron (Fe)	mg/L	0.5		0.19	0.45	0.52
23	Lead (Pb)	mg/L	1.5		ND	ND	N.D
24	Manganese (Mn)	mg/L	0.01		0.13	0.11	0.2
25	Mercury (Hg)	mg/L	1.0		ND	ND	ND
26	Nickel (Ni)	mg/L	1.0		ND	ND	ND

Source: *EIA Report for Construction of Wastewater Treatment Plant at Babu Sabu, April 2024*

All samples had high organic contamination with chemical oxygen demand and biological Oxygen demand values higher than PEQS and IFC standards in all three samples. TSS value was higher at all the locations as compared to IFC standards. However as compared to PEQS, it was higher at one point i.e. Cant. Drain. This may be due to addition of sewage waste, industrial wastewater as well as other multiple sources of toxic water pollutants being dumped into water canals which end up in River Ravi.

The surface water tests were also conducted for River Ravi. The results are tabulated below in **Table 6-6**.

Table 6-6: Surface water Quality Test Results

Sr. No.	Parameters	Unit	PEQS 2016	WHO Class V	Monitoring Location	
					SW 1	SW 2
1	pH	-	6-9	<5.3	7.4	7.62
2	Total Dissolved Solids (TDS)	Mg/L	3500	-	208	212
3	Chloride	Mg/L	1000	-	30	07
4	Cyanide	Mg/L	1.0	-	0.059	ND

Sr. No.	Parameters	Unit	PEQS 2016	WHO Class V	Monitoring Location	
					SW 1	SW 2
5	Fluoride	Mg/L	10	-	0.2	0.26
6	Pesticides	Mg/L	0.15	-	ND	ND
7	Cadmium	Mg/L	0.1	>0.0039	BDL	ND
8	Chromium	Mg/L	1	>0.016	0.0005	ND
9	Copper	Mg/L	1	>0.018	0.143	0.5
10	Lead	Mg/L	0.5	>0.082	0.0002	ND
11	Mercury	Mg/L	0.01	>0.0024	BDL	ND
12	Selenium	Mg/L	0.5	-	BDL	ND
13	Nickel	Mg/L	1	>1.4	0.046	ND
14	Zinc	Mg/L	5	>0.12	0.184	0.56
15	Arsenic	Mg/L	1	>0.36	BDL	ND
16	Barium	Mg/L	1.5	-	0.335	ND
17	Manganese	Mg/L	1.5	-	0.158	0.14
18	Boron	Mg/L	6	-	0.050	ND
19	Color	NGVS	-	-	7 TCU	<5
20	Total Coliform Bacteria	NGVS	-	-	Positive	Positive
21	Fecal Coliform Bacteria	NGVS	-	-	Positive	Positive
22	Taste		Not Objectionable	-		Acceptable
23	Odor		Not Objectionable	-		Acceptable
24	Nitrite, NO_2	Mg/L	< 3	-		0.08
25	Nitrates, NO_3	Mg/L	< 50	-		0.50
26	Phenolic Compounds	Mg/L	N.S	-		ND
27	Total Hardness (as $CaCO_3$	Mg/L	< 500	-		144

Sr. No.	Parameters	Unit	PEQS 2016	WHO Class V	Monitoring Location	
					SW 1	SW 2
28	Residual Chlorine	Mg/L	N.S	-		ND
29	Turbidity	NTU	< 5	-		<5
30	Aluminum (Al)	Mg/L	< 0.2	5.0		0.95
31	Antimony (Sb)	Mg/L	< 0.005		-	ND

Source: *EIA Report for Construction of Wastewater Treatment Plant at Babu Sabu, April 2024*

NA= Not Applicable

BDL= Below Detection Limits

ND= Not Detected

PEQS= Punjab Environmental Quality Standards

NGVS= No Guideline Value Set

The test results have been compared with the stringent value from PEQS 2016 and WHO Class V. The results show that the value of pH is higher than the WHO class V. The results also show positive total Coliform, Fecal Coliform & E.Coli. The addition of chemicals and pollutants in river Ravi are responsible for high pH values and zinc. The positive bacterial values are due to discharge of wastewater effluents into River Ravi

6.4.7 Present Condition of Ravi River:

The flow in River Ravi varies from approximately 1,000 cusecs in November to 25,000 cusecs in August as per record of Punjab Irrigation Department measured through Gauge, located at Ravi Syphon. The River Ravi and its canal network is fed by link canals from River Chenab. One such canal known as Marala Link Canal seasonally transports water into River Ravi at Lahore Syphon. It is pertinent to mention that the minimum flow in River Ravi is only during the canal closure period in which the canal is closed for maintenance purposes.

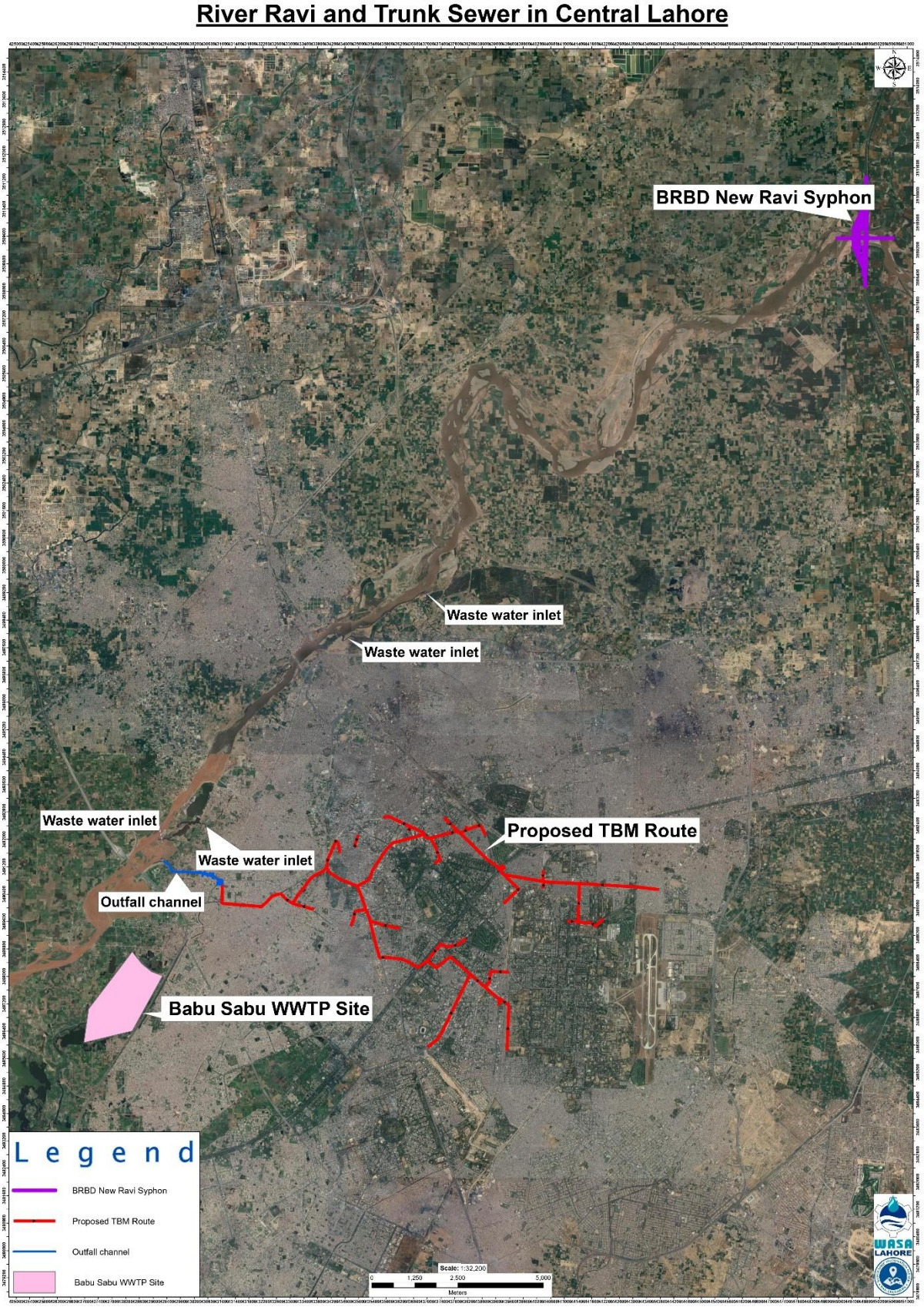


Figure 6-1: River Ravi and the Proposed Trunk Sewer in Central Lahore

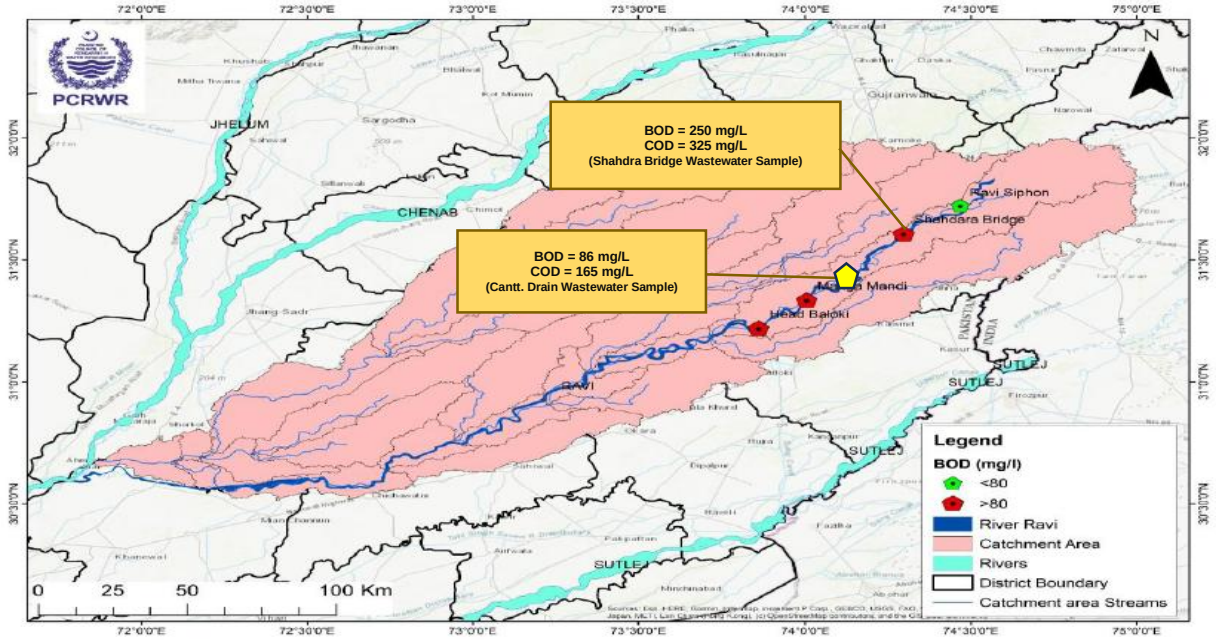


Figure 6-2: Pollution Load identification in River Ravi selected sites in term of COD – (PCRWR, June 2023)

Water samples collected from the Syphon site of the River Ravi were analyzed in accordance with the PEQS. The analysis indicated that the water quality parameters at this location were within permissible limits (BOD 80 mg/l & COD 150 mg/l). Specifically, the Dissolved Oxygen (DO) concentration was recorded at 5 mg/L, and the Chemical Oxygen Demand (COD) at 75 mg/L. These values suggest that the aquatic environment at the Syphon site is conducive to supporting aquatic life.

However, as the river progresses downstream toward Shahdara, it becomes increasingly contaminated due to the uncontrolled discharge of untreated industrial and domestic effluents entering into the river channel from multiple inlet points as shown in the Figure 6-1: River Ravi and the Proposed Trunk Sewer in Central Lahore **Figure 6-1**. At the confluence point where this wastewater merges with the river, the water quality deteriorates significantly. Measurements taken at this junction showed a Biochemical Oxygen Demand (BOD) of 250 mg/L and a COD of 325 mg/L, indicating a substantial organic and chemical pollution load that can severely impact aquatic ecosystems and render the water unfit for most uses without treatment.

The ultimate discharge point of the proposed project is located at approx. 27 km downstream of Syphon. The wastewater stream from Gulshan-e-Ravi disposal, prior to mixing with the already contaminated river water, exhibited comparatively lower pollutant concentrations, with BOD and COD values of 86 mg/L and 165 mg/L, respectively. This counterintuitive observation may be attributed to the relatively higher pollution already present in the river water at this point due to upstream discharges. Consequently, the introduction of wastewater with a slightly lower pollutant load exerts an overall diluting effect on the river's pollution profile. The measured flow at Syphon, excluding the seasonal inflow of Marala Link Canal is 49 Cumecs/day (1718 cusec/day). The perennial flow of 49 cumecs is available for dilution of wastewater. The wastewater flow in the River Ravi till the discharge point of the project will be approx. 2000 cusecs including 688 cusecs for the instant project.

Source:

1. Study Report Environmental Flow Assessment of Critical Sites of Ravi by PCRWR (Pakistan council of research on water resources, June 2023)
2. Environmental Impact Assessment of Babu Sabu Wastewater Treatment Plant

Mitigation Measures

- The wastewater streams incoming to the River Ravi from Shahdara and Mehmood Booti & Shadbagh will be treated by the proposed wastewater treatment plants by the Ravi Urban Development Authority (RUDA). Moreover, RUDA plans to build the waterfront city by regulating the river flow and advanced wastewater treatment.
- A wastewater treatment plant (WWTP) at Babu Sabu is planned by LWASA with the financial assistance of AFD, the PC-I of which is in appraisal phase at P&D Board. In Phase I, the proposed wastewater treatment plant (WWTP) at Babu Sabu will have a capacity of 164 cusecs (400,000 m³/day) to treat 150 cusecs (367,000 m³/day) of dry weather flow from the Larech Project up to 2035. The expected dry weather flow from this project is 200 cusecs (489,000 m³/day) up to 2050. The additional 50 cusecs (122,000 m³/day) from the Larech Project will be addressed in Phase II of the WWTP project, for which the Babu Sabu WWTP capacity will be increased to 408 cusecs (1,000,000 m³/day). Through both these phases, 100 percent of dry weather flow from Gulshan-e-Ravi will be treated.
- The current design of the proposed project will be reviewed by the EPC contractor and will incorporate the design change (if any) based on the site conditions.

6.4.8 Ground Water Pollution

The ground water in the project area is encountered at a depth of around 20 meters. The ground water contamination may occur during construction by the improper handling of construction material (fuel, lubricant, bitumen and asphalt) and sanitary water from construction camps and domestic sewage. During operation, probability of seepage through the sewers due to corrosion and leakage may also contaminate groundwater. This impact is permanent and moderately negative in nature.

Mitigation Measures

- Selection of standard materials during the planning stage will be considered for efficient seepage control; and
- Alternate arrangements will be suggested in design to cater the sewage flow during construction and operational phase.

6.4.9 Flooding Patterns

Since the site for the final disposal of the wastewater is in the flood plain of River Ravi downstream of the existing flood protection bund. Therefore, it is essential to provide flood protection bunds to protect the nearby community and disposal stations. However, any obstruction in the floodplain increases the potential for flooding of adjacent and downstream areas and interferes with natural hydrological processes. The construction in the flood plain may alter the volume of water it may hold, thus altering the extent of the area under flood. In this project, a very light construction activity is planned in the outfall drain. The drain is planned to be lined up and at some spots it might need some widening, nevertheless, there is no structure planned that could abstract the flow of water. This will have a minor negative impact.

Mitigation Measures

- Consideration of flood patterns and average rainfall of the area.
- Leave allowance for the rainwater to flow throw the channel.

6.4.10 Soil

Bore holes will be dug to carry out geotechnical investigation, due to this soil will be disturbed. A proper transportation system will be implemented for excavated materials movement via machinery.

Mitigation Measures

- Backfill the holes and restore the area to its original condition.

6.4.11 Traffic Congestion

The alignments proposed for trunk sewer are on the busy roads i.e. Garhi Shahu, Durand Road, Shimla Hill, Cooper Road, Queens Road, Bahawalpur Road, Chauburji, Infantry Road, Zafar Ali Road, Gurumangat, Shadman, Shama and Rasool Park. The roads are busy due to the presence of educational institutions, health care facilities, historical sites and government and private offices. During the construction phase, there is a high chance of traffic jams and congestion due to narrow roads and movement of heavy and light vehicles for access to above mentioned niceties. Hence, this impact is temporary and moderate in nature.

Mitigation Measures

- A traffic study has been carried out during the design phase, to determine the existing traffic load and the possible traffic congestion during the construction phase and evaluate the possible solutions to overcome these future traffic problems.
- The departments of Traffic Police and Safe City are in contact with the PMU and tentative traffic plans **(Annexure-VI)** has been shared with them.

6.4.12 Resource Conservation

Resources involved in the construction of the proposed project would include construction materials, water and fuel. Construction material to be used for construction activities includes coarse aggregates, fine aggregates, asphalt, Cementous materials, reinforced and structural steel. Almost all the materials to be used in the construction of the proposed project are non-renewable and therefore their sustainable use is necessary for the future use.

Excessive water consumption for drinking and washing purposes by the construction staff may pressurize water resources in the project area.

Fuel (diesel and petrol) will be used to operate construction machinery and generators. Sustainable use of energy resources is very important not only to continue future use but also to reduce air emissions. The overall impact is local, high, long term and definite.

Mitigation Measures

- Reduction of wastage of water through training of workers involved in water use will be planned.
- Careful selection of water sources to minimize disturbances to existing community water supplies.
- Plan for the reuse of construction waste materials will be formulated.
- Plan for use of solar panels at operation phase will be considered; and
- A good camp design and an efficient worksite management plan will be prepared that will help the contractor to reduce the water demand, and wastewater and solid waste volumes to the lowest levels.

6.5 IMPACTS ON BIOLOGICAL PARAMETERS

Trees of varying species and sizes, and vegetation exist in the project area. The project does not involve extensive tree cutting however, some plants will be affected especially near the launching and receptor station and disposal station. The impact is permanent and minor negative in nature.

Mitigation Measures

- Incorporate technical design measures to minimize removal of these trees, as far as possible.
- A plan for transplantation of trees, especially fruit trees, will be devised.
- Compensatory planting of ten trees against each fallen tree of similar floral function will be planned; and
- Plantation plan will prefer the prevalent indigenous species of plants.

6.6 IMPACTS ON SOCIOECONOMIC PARAMETERS

6.6.1 Physical and Cultural Resources

Physical and cultural resources identified in the project area include Chauburji, Miani saab graveyard, Tomb of Ghazi Alam Din Shaheed, Allama Iqbal Residence, Mian Mir Tomb and several mosques. People visit the mosques five times a day. Shrines and graveyards are visited occasionally by the surrounding community and devotees. These will not be directly affected but the people may face problems in access to visiting these facilities during the construction phase. This impact is temporary, localized and minor negative in nature. According to the Antiquities Act 1975, construction will be avoided within 200 feet of any heritage sites, and it must not disturb the access pathways. Therefore, LWASA must ensure that both the design consultant and contractor must abide by the law.

6.6.2 Public Utilities

Due to the proposed project, public utilities may be affected and create disruption to public services and economics. This impact is, however, temporary and moderately negative in nature. Mitigation measures will involve careful selection of the design by the design consultant to minimize disturbance to public utilities. Relocation of the public utilities will be planned and approved before project commencement if any, to avoid inconvenience to the public.

6.6.3 Land Acquisition and Resettlement

Most of the proposed alignment of trunk sewer is along the main roads which is the property of government. The land for disposal station is owned by LDA and is in the possession of LWASA. Additionally, the drainage channels are in the right way of LWASA. Hence no land acquisition is involved in the construction of trunk sewer, disposal station and drainage channels. However, there will be involuntary resettlement impacts on disposal stations and livelihood impacts on trunk sewer lines and drainage channels. In order to mitigate impacts on the livelihoods of business holders on trunk sewer line and drainage channels due to temporary disruption of businesses because of construction activities, a detailed Livelihood Restoration Plan (LRP) has been prepared.

The temporary land acquisition may be required from private property by the Contractor for:

- The development of facilities i.e. storage of material, workshops, machinery and equipment parking, and washing areas; and
- Access roads and tracks for haulage and transportation.

- Land utilization for construction activities may also induce temporary changes in the existing land use. This impact can be categorized as negative, local, low, short-term and probable.

Mitigation Measures

- Due consideration will be given to minimizing or no land acquisition in design phase.
- Land will be acquired according to the Land Acquisition Act (LAA), 1894; (if required)
- Compensation will be evaluated based on market rates.
- Compensation will be made before the construction starts; and
- To curb problems arising from loss of employment and livelihood, a detailed Livelihood Restoration Plan (LRP) has been prepared.

6.6.4 Project Resettlement Impacts

The areas of the proposed trunk and lateral sewers were visited physically with the help of GPS and sites of potential impacts were identified for the impact assessment. Based on the assessment of proposed project components and intervention, the laying of underground trunk sewers does not involve any land acquisition as all the jacking and recipient stations are located on the roads owned by Government. Similarly, no structures will be demolished, and no physical displacement will be involved. The anticipated impacts are temporary in terms of temporary loss of livelihood only. As per the findings of Impact Assessment Survey (IAS), the livelihood of different families is associated with the commercial activities which are under the impact of the project. With the project interventions in impact areas, 17 different types of business operators/shopkeepers and 30 workers will face a temporary impact on their commercial activities.

However, there are still resettlement impacts at the disposal station. The identified resettlement impacts include the physical displacement and relocation of government institutions and places, including the Metropolitan Corporation Lahore field office and Union Council No 77, as well as Patwar Circles namely Nonarian, Sanda Khurd, Babu Sabu, and Saggiyan Kalanwar. 93 fruit and non-fruit-bearing trees, public utilities, such as an electricity pole and transmission lines, will also be relocated. Currently, these departments are housed in different small buildings which would be replaced by a multi-story building, and all will be shifted to the new building. LWASA should build this building before the commencement of new disposal station.

Table 6-7 summarizes the resettlement impacts.

Table 6-7: Resettlement Impacts

Affected entity	No. of Affected Entities	Land Ownership	No. of Officials/ Affected Persons	Resettlement Impact
Government Offices				
Metropolitan corporation Lahore field office Union Council No 77	2	LWASA	3	Physical displacement requiring relocation
Kot Kamboh Patwar Circle	1	LWASA	2	Physical displacement requiring relocation
Nonarian - Sanda Khurd Patwar Circle	1	LWASA		Physical displacement requiring relocation

Affected entity	No. of Affected Entities	Land Ownership	No. of Officials/ Affected Persons	Resettlement Impact
Babu Sabu Patwar Circle	1	LWASA	2	Physical displacement requiring relocation
Saggiyan Kalanwar Patwar Circle	1	LWASA		Physical displacement requiring relocation
Generator room of existing disposal station	1	LWASA	1	Physical displacement requiring relocation
Store Room	1	LWASA		Physical displacement requiring relocation
Abandoned Tennis court	1	LWASA	-	Physical displacement requiring relocation
Fruit-bearing and non-fruit bearing trees				
Government Trees	93	LWASA		Removal but some govt. trees can be saved
Utilities				
Electricity pole	1	LWASA	-	Relocation but can be saved.

A Separate LRP has been prepared that comprehensively narrates the socio-economic impacts of the project.

6.7 ANTICIPATED IMPACTS DURING THE CONSTRUCTION PHASE

The following are the impacts envisaged during the construction phase resulting directly and indirectly from construction activities.

6.8 PENALTY CLAUSE FOR NON-COMPLIANCE OF ESHS

As per Tender document, the contractor may be panelized as follows in case of non-compliance of ESHS:

(i) Interim Payment Certificate Withheld claimed by the contractor

(ii) Performance security of the contractor will be deducted up to 1%.

6.9 IMPACTS ON PHYSICAL PARAMETERS

6.9.1 Visual Intrusion

There are 82 Jacking and 83 Recipient pits. The working area comprises pit and construction machinery and equipment including survey and alignment equipment, space for sewer pipes, control cabin, generator, slurry separation unit, water bowser and dump truck. The visual intrusion from large piles of excavation, and construction material for construction of launching and recipient stations is one of the possible adverse impacts during the construction phase of the project. The impact is considered to be negative, local, short-term and definite.

Table 6-8: Sizes of Pits

		Jacking Shaft	Working Area

Sr. No.	Trunk Sewer Dia (mm)	Width (m)	Length (m)	Width (m)	Length (m)
1	1050	4.5	5	6	45
2	1500	6.5	6	8	50
3	2400	8	8	8	50
4	3500	8.5	8	12	60
		Recipient Shaft			
1	1050	2.5	3.5	5	7
2	1500	5	4	6	7
3	2400	6.5	5	5	8.5
4	3500	6.5	5	5	8.5

Mitigation Measures

- Material stockpiles will be removed as soon as work is completed, and the area is re-landscaped.

6.9.2 Soil

The soil would be exposed to erosion due to removal of vegetation, excavations for launching and receptor stations, construction camps and workshops. The erosion of soil will be greatly reduced by using TBM technology. Erosion may increase during intense rainfall events. Contamination of soil may also be caused by oil and chemical spills or uncontrolled runoff from equipment washing yards. This impact is low and negative in nature.

Table 6-9: Excavation Quantity at Each Station

Route of Sewer	Diameter		Radius		Length	Volume
	Mm	m	Mm	m	m	m^3
Line A						
Karachi Phatak to Infantry / Allama Iqbal Road crossing	2400	2.4	1200	1.2	1195	5404
Mian Mir DS to Infantry Road	1050	1.05	525	0.525	595	515
Infantry Road DS to Infantry / Allama Iqbal Road crossing	1500	1.5	750	0.75	592	1046
Infantry / Allama Iqbal Rd crossing to Bird Market D/S	2400	2.4	1200	1.2	610	2758
Bird Market D/S to Allama Iqbal Road	1050	1.05	525	0.525	16	13
Bird Market D/S to Mughalpura / Allama Iqbal Road crossing	2400	2.4	1200	1.2	1429	646
Larech Colony to Garhi Shahu Bazar	600	0.6	300	0.3	787	222

Route of Sewer	Diameter		Radius		Length	Volume
	Mm	m	Mm	m	m	m^3
Ghazi Mohallah DS to Garhi Shahu Bazar	600	0.6	300	0.3	122	34
Garhi shahu Bazar to Mughalpura / Allama Iqbal Road crossing	600	0.6	300	0.3	197	55
Mughalpura / Allama Iqbal Road crossing to Durand Road Crossing	2400	2.4	1200	1.2	97	438
Muhammad Nagar to Durand Road Crossing	600	0.6	300	0.3	410	115
Durand Road / Allama Iqbal Road crossing to Davis / Durand Road crossing	2400	2.4	1200	1.2	823	3722
Governor House to Davis / Durand Road crossing	1050	1.05	525	0.525	848	734
Davis / Durand Road crossing To Edgerton Road Shimla Hill	2400	2.4	1200	1.2	250	1131
Lakshami Chowk DS to Abbott Road	1500	1.5	750	0.75	889	1571
Janki Devi DS to Abbott Road	600	0.6	300	0.3	94	26
Abbott Road to Egerton Road / Shimla Hill	1500	1.5	750	0.75	471	832
Edgerton Road /Shimla Hill to Ganga Ram Hospital Emergency Chowk	2400	2.4	1200	1.2	1641	7420
Mozang Adda to Ganga Ram Hospital Emergency Chowk	600	0.6	300	0.3	861	243
Ganga Ram Hospital Emergency Chowk to Qartaba Chowk	2400	2.4	1200	1.2	977	4420
TOTAL LENGTH & VOLUME FOR LINE A					**12,911**	**37,175**
Line B						
Gurumangat Rd DS to College Road / Q Block link Rd Crossing	1500	1.5	750	0.75	735	5,193
Before Q Block DS	1500	1.5	750	0.75	810	5,722
AT Q BLOCK DS	1500	1.5	750	0.75	810	5,722
Q Block Gulberg DS to College Road / Q Block link Rd Crossing	1050	1.05	525	0.525	495	1,715
College Road / Q Block link Rd Crossing to Gulberg Main Boulevard	1500	1.5	750	0.75	576	4,069
Central Point DS to Gulberg Drain along main boulevard	1050	1.05	525	0.525	2502	8,662
Gulberg Main Boulevard Crossing to G Block Gulberg DS	1500	1.5	750	0.75	775	5,481
G Block Gulberg DS	1050	1.05	525	0.525	30	103
G Block Gulberg DS to Canal Crossing	2400	2.4	1200	1.2	856	15,497
Zafar Ali Road DS to Shareef Colony	600	0.6	300	0.3	730	825

Route of Sewer	Diameter		Radius		Length	Volume
	Mm	m	Mm	m	m	m^3
AT Shareef Colony DS	600	0.6	300	0.3	44	50
Shareef Colony to Canal Crossing	600	0.6	300	0.3	700	791
Canal Crossing to Ichra/Ferozepur Road Crossing	2400	2.4	1200	1.2	1770	32,014
Ichra DS to Shama/Ferozpur Road intersection	1050	1.05	525	0.525	64	223
Ichra DS to Shama/Ferozpur Road intersection	2400	2.4	1200	1.2	815	14,742
Shadman DS to Shama DS	1050	1.05	525	0.525	872	3,021
AT Shama DS	1050	1.05	525	0.525	40	138
Shama DS To Shama/Ferozepur Road intersection	1050	1.05	525	0.525	45	156
Shama/Ferozpur Road intersection to Link Ferozepur Road Intersection	2400	2.4	1200	1.2	382	6,924
Rasool Park DS to Link Ferozepur Road Intersection	1500	1.5	750	0.75	763	5,396
Link Ferozepur Road intersection to Qartaba Chowk	2400	2.4	1200	1.2	705	12,764
TOTAL LENGTH & VOLUME FOR LINE B					**14,527**	**129,218**
Line C						
Qartaba Chowk to Chauburji Chowk	3500	3.5	1750	1.75	1063	40,922
Lytton Road DS to Chauburji Chowk	1050	1.05	525	0.525	686	2,376
PIA Planetarium to Chauburji chowk	1050	1.05	525	0.525	155.	538
	1050	1.05	525	0.525	136	472
Chauburji Chowk	1050	1.05	525	0.525	106	368
Chauburji chowk/Multan Road to Samanabd Morr	3500	3.5	1750	1.75	1558	59,948
Poonch Road DS to Samanabad Morr	1500	1.5	750	0.75	623	4403
Samnabad Morr to Gulshan-e-Ravi DS	3500	3.5	1750	1.75	2830	108,891
TOTAL LENGTH & VOLUME FOR LINE C					**7161**	**217,922**
TOTAL VOLUME OF EXCAVATED SOIL					**384,316**	

Mitigation Measures

- Stored excavated material will be covered and preferably reused.
- Prepare a plan for use and movement of construction vehicles within the area based on the nature of soil.
- Vehicles and equipment movement will be confined to dry areas with hardened soil; no vehicle and equipment will enter the damp areas, water areas, vegetative areas and areas with soft soil.

- Sprinkling water will help in reducing the erosion of soil;
- Non-bituminous waste from construction activities will be dumped in approved sites, in line with the guidelines for dump sites, and must be covered;
- Controlling runoff volumes and intercept runoff before it leaves the site;
- Excess spoil will be reused where possible and residual spoil can be disposed of at designated site to prevent erosion;
- Confining excavations to the specified spots as per the approved engineering drawings and unnecessary excavations will be avoided; and
- Re-vegetation of exposed areas around the site (if any) will be carried out rapidly, in order to mitigate against erosion of soil through surface water runoff and wind erosion.

6.9.3 Water Quality

The potential sources of water pollution associated with the construction of the proposed project have been identified and include:

Construction Site Runoff

Runoff from the construction works area may contain increased loads of sediments, suspended solids and other contaminants. Potential sources of pollution from the site include:

- Runoff and erosion from exposed soil surfaces, earth work areas and stockpiles e.g. grouting and cement material with the rain;
- Wash water from dust suppression sprays;
- Fuel and lubricants from maintenance of construction vehicles and mechanical equipment;
- Spillage of liquids stored on-site such as oil, diesel, and solvents etc. are likely to result in water pollution; and
- Uncontrolled discharge of debris and rubbish such as packaging, construction material and refuse.

Wastewater produced by On-Site Work Force

Wastewater would be generated from the workforce during the construction phase. However, wastewater can be adequately treated by interim sewage facilities, such as portable toilets, which can be installed within the construction site.

Construction waste, if left unattended will result in forming leachate that will percolate through the soil strata and will reach underground water table and hence, will end up contaminating groundwater. There is a probability that various materials like fuel, lubricant oil and other oily products, which are used during the construction phase may contaminate groundwater and channels carrying water.

Mitigation Measures

- Protection of groundwater reserves from any source of contamination such as the construction and oily waste that will degrade its potable quality;
- Water required for construction will be obtained in a sustainable way that the water availability and supply to nearby communities remain unaffected;
- Stockpiles of cement and other construction materials will be kept covered when not being used;
- Avoid stockpiling of earth fill especially during the intense rainfall events unless covered by tarpaulins or plastic sheets;

- Avoid fuel and other chemicals being stored at numerous locations around the site;
- Maintenance of vehicles and plant will be carried out only on impermeable areas where any oil spillages can be contained;
- Oils, fuel and chemicals must be stored at bunded fuel stores and mobile bunded stores;
- Careful planning of the works to avoid soil excavation during intense rainfall events;
- All kinds of waste will be stored in covered containers and disposed of safely as soon as possible; and
- Temporary sanitary facilities, such as portable chemical toilets, will be employed on-site. A licensed contractor will be responsible for appropriate disposal and maintenance of these facilities.

6.9.4 Ground Water

At line C the water table is at 18 m. The groundwater may get affected due to construction and the construction will also be affected due to interference of water.

6.9.5 Air Quality

Air quality will be affected by various construction activities. Emissions may be carried over longer distances depending upon the wind speed, direction, temperature of surrounding air and atmospheric stability. In certain climatic conditions such as hot summer in the city of Lahore, airborne dust can become a major nuisance if control techniques are not properly employed.

The critical sources of air pollution during the construction phase will be:

- Transportation of materials and other construction activities that create dust emissions;
- Vehicular exhaust emissions;
- Excavation operations;
- Construction equipment's; and
- Burning of fuel for cooking by workers.

The air emissions may cause health impacts such as dryness and roughness of the throat, eyes and nose, to the workers and staff of the contractor. These emissions may also affect the biophysical environment. Major air sensitive receivers identified in the project area are: Ganga Ram Hospital, Suraya Azeem Hospital, Queen Merry School and Queen Merry College, Home Economics College, NUML University, Aiwan-e-Iqbal, Government Post Graduate Islamia College, Fatima Jinnah Medical College, Punjab Assembly, Press Club, Faletti's Hotel, Hospitality Inn and Surgi-med Hospital, Punjab Institute of Mental Health, Lahore Gymkhana and Punjab Institute of Cardiology. In addition to these, high density settlements, numerous schools and clinics were also identified around the project area. The impact is temporary and moderately negative in nature.

Mitigation Measures

- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working condition, properly tuned and maintained in order to minimize the exhaust emissions;
- Open burning of solid waste from the contractor's camps will be strictly banned;
- Use of fuel with substantially lower Sulphur content;
- Proper maintenance and repair of power generators and construction machinery is needed

to minimize the hazardous emissions;

- Personal Protective Equipment (PPEs) like masks, safety goggles, safety shoes, safety belts and safety gloves will be provided to workers;
- PEQS, 2016 applicable to gaseous emissions generated by construction vehicles, equipment and machinery will be enforced during construction works;
- Regular water sprinkling on the site and access roads will be carried out to suppress excessive dust emission(s);
- Storage pile activity (i.e. loading and unloading) will be confined to the downwind side of the storage pile. This practice applies to areas around the storage pile as well as the pile itself. Storage piles will also be located away from downwind site boundaries;
- For the concrete mixing stations, the dumping of stone, sand, gravel and containers will be carried out in daytime; and the loading and unloading works for trucks, mortar mixing and pumping work may be carried out in daytime, or far from populated areas;
- Preventive measures against dust will be adopted for on-site mixing and unloading operations;
- The vehicles carrying construction materials and the construction material storage areas will be covered with tarpaulin;
- Vehicle speed in the project area will be prescribed not more than 20 kilometer per hour and controlled accordingly;
- Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested, and it will also provide a smooth riding surface for the traffic until the road is properly restored; and
- Air emission monitoring program for NO_2, SO_2, CO and PM_{10} will be undertaken by the EPC contractor, according to the program specified in the Environmental and Social Management and Mitigation Plan (ESMMP).

6.9.6 Noise and Vibration

The noise may be produced due to the operation of construction machinery i.e. Tunnel Boring Machine (TBM) and other equipment. Health risks associated with exposure to continuous noise levels include increase in blood pressure, hypertension, and temporary threshold shift.

Major noise sensitive receivers identified in the project area are Ganga Ram Hospital, Suraya Azeem Hospital, Bibi Pak Daman, Queen Merry School and Queen Merry College, Home Economics College, NUML University, Aiwan-e-Iqbal, Government Post Graduate Islamia College, Fatima Jinnah Medical College, Punjab Assembly, Press club, Faletti's Hotel, Hospitality Inn and Surgi-med Hospital, Punjab Institute of Mental Health, Lahore Gymkhana and Punjab Institute of Cardiology. In addition to these, high density settlements, numerous schools and clinics were identified around the project area. The impacts of noise would be temporary and adverse in nature.

Vibrations will be caused due to tunnel boring operations. The vibrations may affect the foundations of buildings specially the older ones. The Tomb of Ghazi Ilm Din Shaheed, Chauburji monument, Shimla Hill and Government Islamia College are some of the structures which are sensitive to the vibrations, resulting from tunnel boring machines. The impact of vibration will be reduced due to underground operations.

Any building that is within the influence zone and depending on age of the building may experience "no" or "low" impact. There will be no "high" impact, because the depth of tunnel is determined to have low or no impact on the structures above ground. In case contractor

determines any building exposed to "high" impact, then necessary mitigation measures needs will be taken by the Contrator. The contractor will design a tunnel system to keep existing conditions intact. Given below is **Table 6-10** specifying the depth and the distances of TBM from sensitive receptors.

Table 6-10: Depths and distances of MTBM from sensitive receptors

Place	Ground level (m)	Pipe Invert Level (m)	Depth upto Invert (m)	Inner Dia (mm)	Pipe thickness (mm)	Depth upto Crown (m)	Horizontal distance from center of tunnel to building line (m)
Shimla Hill	213.62	200.82	12.8	2400	225	10.175	30.5
Punjab Assembly	213.48	199.76	13.72	2400	225	11.095	33.5
Chuburji	209.37	192.98	16.39	3500	300	12.59	53
Nonarian Road	208.74	191.28	17.46	3500	300	13.66	6.7

Overall, the impacts of noise and vibration are temporary and minor negative in nature.

6.9.6.1 AREA OF INFLUENCE (AOI)

The AoI of the impact assessment study is 150 m on both sides of the alignment route. The major direct impacts due to project's construction activities include visual intrusion, noise and vibration, access/mobility problems, traffic congestion and dust emission.

6.9.6.2 IMPACT ON GROUND SETTLEMENT DUE TO MICRO TUNNELING

The ground surface settlement due to Micro tunneling was estimated using Attewell (1982). The ground surface settlement usually produces a trough (perpendicular to the tunnel alignment) with the maximum settlement along the centerline. The overall estimated ground settlement due to tunneling is less than 12mm (0.5 in.). The ground surface settlement was estimated based on the ground conditions described in, an assumed ground "volume loss" of 1% (typical for the ground conditions identified and with the use of MTBM with pressurized face). The zone of influence (ZOI) is expected to extend approximately 8.4 m (27.6 ft.) from the tunnel centerline, where settlement is estimated to be less than 1mm and 10 m from the tunnel centerline, where settlement is estimated to be 0 mm. **See Figure 6-3.**

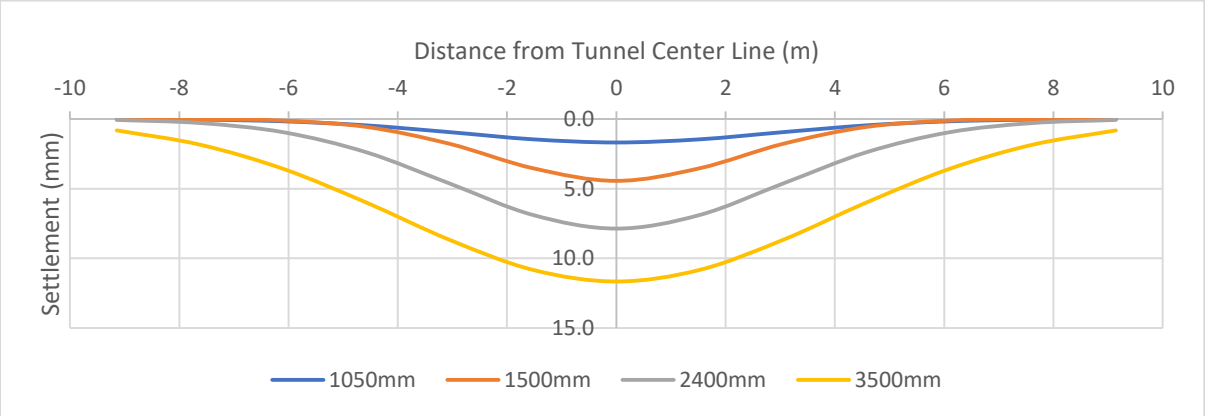


Figure 6-3: Distance from Tunnel Center Line (m)

6.9.6.3 IMPACT OF VIBRATION AND NOISE CONTROL

The tunnel cover varies from 8.51 m (27.9 ft.) to 19.37 m (63.5 ft.) along the alignment. Based on the vibration historical data and the tunnel depth, the anticipated peak particle velocity (PPV) is expected to be less than 1 mm/sec (less than 0.04 in./sec), in accordance with similar soft ground case histories documented in the Transport Research Laboratory (TRL) Report 429. This value is estimated at the ground surface directly above the tunnel. The vibration is significantly reduced with increased distance from the source.

A typical value of 13 mm/sec is the threshold for building, where there is a potential for damage. As indicated above, a list of critical structures/infrastructures will need to be identified and evaluated for potential damage due to vibration. Mitigation measures to protect these structures should be implemented. Buffer Zone of all tunnel sizes are given in the **Table 6-11**.

Table 6-11: Zone of Influence from Center Line of Tunnel

Inner Dia. of tunnel (mm)	Outer Dia. of tunnel (mm)	Standard Shaft width (m)	Center line of tunnel Distance from footpath (m)	Zone of Influence from center line of tunnel on both sides (m)
1050	1350	4.5	2.25	8.4
1500	1840	5	2.5	8.4
2400	2850	6	3	8.4
3500	4100	7	3.5	8.4

Mitigation Measures

- Contractors must do a pre-construction survey and make sure the buildings remain safe and occupiable during the tunneling and safe after construction when post-construction survey is compared to pre-construction survey. Contractors will have to pay for any damage done to any building in the corridor.
- Deployment of quieter Equipment.
- A cost-effective way to reduce noise at a construction worksite is to buy quiet equipment. In addition, the equipment in use will be the most suitable for the job. The contractor will avoid using equipment that is over-powered and conversely avoid using under-powered equipment. Wherever possible, the quietest equipment alternative will be used, which is mostly electronic powered equipment that is quieter than diesel powered equipment and also hydraulically powered equipment that is quieter than pneumatic power.

Modifying Existing Old Equipment

- The most common way to reduce the noise levels of common construction equipment is through worksite modifications. The contractor will make some worksite modifications by retrofitting existing equipment with damping materials and mufflers.

Barrier Protection

- An effective way of reducing noise is to locate noisy equipment behind purpose-built barriers. The barriers can be constructed on the work site from common construction material (plywood, block, stacks and spoils) or the barriers can be constructed from commercial panels which are lined with sound absorbing material to achieve the maximum

shielding effect possible. For effectiveness, the length of the barrier will be greater than its height. The noise sourcE4e will not be visible, and barrier will be located as close as possible either to the noise source or the receiver. The contractor may adopt these measures at the shaft construction sites.

- The TBM vibrations have a vertical impact up to 6m high. The tunnel construction starts from a depth of 8m and following a small gradient reaches about 20m near the termination point staying below the threshold levels.

Work Activity Schedule

- Work activity scheduling is administrative means to control noise exposure. Planning how noise sources are sited and organized on a work site will reduce noise hazards.
- The contractor will ensure that the jobs of the skilled and unskilled workers would be rotated, so that exposure time is limited. Transferring workers from a high exposure task to a lower exposure task will make the employee's daily noise exposure acceptable. Administrative controls include activity planning, for example: scheduling pavement breaking operations, to reduce the number of work site workers exposed. In addition, noisy equipment will not be run for periods longer than necessary, and will be switched off when not in use;
- The contractor will pay amplified attention to the maintenance of tools and equipment, as it will reduce worksite noise levels. Maintaining plant and equipment in good order not only increases its life but makes it safer to use and quieter. Loose and worn parts will be fixed as soon as possible. Ideally, the worksite will have a system in place for checking and servicing the various machines and power tools.

Noise Perimeter Zones

- Noise perimeter zones (NPZ) are another administrative control to limit exposure to noisy processes or equipment to as few workers as possible. NPZ are areas where noise levels of 80 dB;
- NPZ can be set up using a sound level meter to find the safe distance from the source (80 dB (A)) and the NPZ can be set up at that distance. Noise does not radiate from the source at the same level in all directions. Noise from machinery can be higher in one direction than another because the noise can also be either absorbed or reflected from surfaces it contacts, such as the ground or a wall. Therefore, measurements will be taken at several points in an area where people might be working. Once noise levels that are 80 dB (A) or more are determined, rope off this area as the Noise Perimeter Zone. Exclude all workers who do not need to be in that zone. All workers who need to work within the zone must wear hearing protection.
- Residents in and around the area of influence of the proposed project site will be notified earlier, before commencement of excavation operations;
- Horns will not be used unless it is necessary to warn other road users or animals of the vehicle's approach;
- Earth retaining walls will be constructed to contain the vibrations;
- Contractors will comply with submitted work schedule, keeping noisy operations away from sensitive points; implement regular maintenance and repairs; and employ strict implementation of operation procedures;
- Locating the concrete mixing and materials shipment yards at least two kilometers away from residential areas, schools, and hospitals, will also help reduce local noise levels;
- The plants and equipment used for construction will strictly conform to noise standards specified in the PEQS, 2016;

- Planting of buffer trees and shrubs in the proposed project site, if possible;
- Excavation near old and historical buildings will be avoided. As per Antiquities Act 1975, all the construction activities will be done 200 feet away from archaeological sites; If needed, No Objection Certificate (NOC) will be obtained from archeology departments and other concerned departments; and
- During construction work, vibration will be continuously monitored.

6.9.7 Solid Waste (Construction, Municipal, solar photovoltaic (PV) waste and Hazardous Waste)

Due to construction activities, municipal, construction and hazardous waste will be generated from construction activities and contractors' camps (27kg/capita/day). Insecure and unhygienic disposal of municipal solid waste particularly garbage and trash may cause degradation of soil and land. Insecurely disposed of heaps of waste containing kitchen garbage and food waste from construction camps can serve as breeding grounds for the disease spreading vectors and rodents. Throwing away solid waste into water channels and the wastewater network along the project route can result into choking of the latter. Empty containers containing the toxic, flammable and corrosive materials may pose hazard to the workers. This may result in health risks to work force and public, if disposal site is improperly selected.

Construction waste includes insulation, nails, electrical wiring, wood, plaster, scrap metal, paper bags, cement, and bricks. Improper dumping of waste may generate odor, soil and water pollution, and disease vectors.

This impact is temporary and minor negative in nature.

Mitigation Measures

- The waste generated from the camp site will be disposed of at LWMC approved sites;
- Contractor will be in close coordination with LWMC throughout this project;
- Burning of waste will be prohibited;
- Proper labeling of waste containers, including the identification and quantity of the contents, hazard contact information will be carried out;
- Training of employees involved in the transportation of hazardous material regarding emergency procedures will be ensured;
- Waste pile will be controlled so that it does not spread and start to impede other activities and stays at a height that it does not become a safety hazard. Barricades will also be placed around the pile to delineate the safe distance for other workers;
- Residual and hazardous wastes such as oils, fuels, and lubricants will be disposed-off via licensed third parties;
- Liquid waste, such as grey water, sewage, slurry and other wastewater will be collected from source by a designated tanker, and taken off-site for disposal at safe disposal facility;
- If the waste pile contains plastic, paper and other light-weight material it will be covered with a net, and tarpaulin or similar to stop waste from blowing around;
- Construction workers and supervisory staff will be encouraged and educated to practice waste minimization, reuse and recycling to reduce quantity of the waste;
- Waste disposal plan will be reviewed during the entire construction phase in the light of changing weather conditions;
- Construction waste such as waste wood will be recovered and recycled into wood for new

building projects, and cement, bricks, and plaster can be crushed and reused in other construction and building projects; and

- The contractor will ensure implementation of waste management plan.

6.9.8 Disposal of Slurry

A slurry type remote controlled Micro-tunnel Boring Machine (TBM) is selected for the implementation of the proposed project, as slurry (mixture of bentonite and other lubrication fluids) prevents the trench from collapsing by providing outward pressure, which balances the inward hydraulic forces and also retards water flow into the trench and allows the excavation machinery and excavation spoil to be moved without hindrance. The amount of Bentonite per shaft diameter is given in **Table 6-12.**

Table 6-12: Amount of Bentonite

Sr. No.	Size	Bentonite Quantity
1	1050mm	14Kg/m
2	1500mm	20Kg/m
3	2400mm	31Kg/m
4	3500mm	42.5Kg/m

However, inevitable earthwork operations during construction will open up scars on the land around the project area and there will be huge heaps of slurry containing bentonite near the jacking and launching stations of TBM which will require transportation and treatment, as liquid concrete being denser displaces the less-dense bentonite slurry and causes the latter to overflow from the trench.

The impacts of bentonite slurry are as follows:

- Bentonite slurry emits greenhouse gases in the environment, if disposed of improperly;
- It affects the health of workers working directly with this kind of clay by causing respiratory issues, skin allergies and gastrointestinal problems;
- The waste generated by bentonite slurry makes the clog drain and can also cause the perishing of local fauna and flora species; and
- The soil coming from the excavation using bentonite slurry retains a high level of moisture and is contaminated. This physical state makes it very difficult to move, transport, and dispose of the material and impacts negatively on other construction activities performed at the site. This impact is temporary and highly negative in nature.

Bentonite when gets wet it swells and gels, sticking together and forming clumps which can clog drains. It is important that it is disposed of properly and if left lying on the roadside it may clog the passages of rainwater seepage and cause flooding.

Mitigation Measures

- A Slurry management plan will be devised by contractor in coordination with LWASA and LWMC to treat slurry containing bentonite as required and disposed of designated sites (provided by LWASA near Babu Sabu Lahore wastewater treatment plant site) such that it causes minimum environmental damage.
- Slurry will be kept away from the residential areas along the proposed project route.
- Bentonite slurry will be kept away from drainage and sewer systems, where it can enter

into circulation with other water.

- Exhumed bentonite slurry will be recycled or re- used for other construction activities by its regular monitoring and testing; and
- The excavated materials that are unsuitable for use will be stored, transported and disposed of appropriately at designated sites (provided by LWASA).

6.9.9 Construction Camps Sites

There will be two camp sites located at (a) disposal station and (b) pipe manufacturing site. The construction camps may lead to environmental and social impacts in the project area especially arising from camp sites. However, these impacts will be temporary and minor negative in nature. **Table 6-13** summarizes potential impacts and proposed avoidance and mitigation measures associated with construction camps. Bentonite is a type of montmorillonite clay with a very high liquid limit. This means that even if a lot of water is added to it, the mixture does not lose its stability or consistency. A sanitation plan **(Annexure V)** will be adopted during construction phase to avoid sanitation related issues at construction sites.

Table 6-13: **Summary of Worker Camp Impacts & Mitigation Measures of Potential Impacts**

Potential Impact	Proposed Avoidance and Mitigation Measures
• Temporary visual intrusion • Noise emissions at a single location • Waste generation • Discharge of sanitary effluents and rainwater run-off.	• Restore the areas containing any temporary facilities to pre-existing conditions. • Implement landscaping plan for all facilities in areas where high landscape value and visual vulnerability to the proposed activities warrants site-specific landscape restoration measures. • Operate equipment in a manner sympathetic to the ambient noise environment. • Provide adequate warnings of impeding works to all potential receptors within a one-kilometer corridor surrounding the right-of-way via public notices and local news. • Avoid tree cutting for setting up camp facilities. • Provide proper fencing and compound wall for camp sites. • The camp site will be adequately drained to avoid the accumulation of stagnant water. • Camp site will not be located near (100 meter) water bodies, and any socially and archeologically sensitive areas.

	• Separate the workers' living areas and material storage areas clearly with a fencing and separate entry and exit; • Train employees in the storage and handling of materials which can potentially cause soil contamination. • Wastewater from the camps will be disposed of properly either into sewer system; if sewer system is not available, provide on-site sanitation with septic tank and soak pit arrangements (100 meters away from surface water body or groundwater well).
Social • Worker camp site • Employment contracts • Compliances of minimum wage rates • Work ethics • Awareness for Labor rights • Harassment awareness • Hygienic facilities at camp • Mess facility • Child Labar • GBV and Sexual abuse	**Social** Employment policies which aim to maximize job opportunities for local people will help to minimize tensions caused by different socio-cultural values. Training will be provided to all staff on camp management rules and overall discipline and cultural awareness. This will include, in appropriate languages: • A briefing on camp rules • A community relations orientation to increase awareness about the local area, cultural sensitivities and the project Code of Conduct. • Awareness-raising on health considerations, including STDs. The EPC contractor is required to develop a Construction Camp Management Plan to address: • Discipline. • Community liaison. • Ethnic tensions; and • Communicable diseases. • Mess facility at subsidized rates A Code of Conduct and Camp Rules will be required within the Construction Camp Management Plan, which provides policies and a disciplinary framework with respect to worker behavior. LWASA will ensure the compliances of HR and minimum wage rates by the contractor/s There will be zero tolerance policy towards GBV, sexual Abuse and child labor.

Mitigation Measures

- Reinstate any temporary facilities to pre-existing conditions in ecologically sensitive areas;
- Implement landscaping plan for all facilities in areas where high landscape value and

visual vulnerability to the proposed activities warrants site-specific landscape restoration measures;

- Operate equipment in a manner sympathetic to the ambient noise environment. Do not leave equipment idling unnecessary;
- Provide adequate warnings of impeding works to all potential receptors within a one-kilometer corridor surrounding the right-of-way via public notices and local news;
- Contractor will provide septic tank for the toilets to treat the sanitary wastewater before its discharge;
- Avoid tree cutting for setting up camp facilities;
- Provide labor with LPG for cooking as to avoid wood burning;
- Provide a proper fencing and compound wall for camp sites;
- The camp sites will be adequately drained to avoid the accumulation of stagnant water;
- Camp sites will not be located near (100 meter) water bodies, and any ecologically, socially, and archeologically sensitive areas;
- Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit;
- Train employees in the storage and handling of materials which can potentially cause soil contamination;
- Employment policies which aim to maximize job opportunities for local people will help to minimize tensions caused by different socio- cultural values;
- Training will be provided to all staff on camp sites management rules and overall discipline and cultural awareness. This will include, in appropriate languages;
- A briefing on camp rules; A community relations orientation to increase awareness about the local area, cultural sensitivities and the project Code of Conduct; and
- Awareness-raising on health considerations, including Sexually Transmitted Diseases (STDs).
- The EPC contractor is required to develop a Construction Camp Management Plan to address:
    - Discipline;
    - Community liaison;
    - Ethnic tensions;
    - Communicable diseases; and
    - A Code of Conduct and Camp Rules will be required within the Construction Camp Management Plan, which provides policies and a disciplinary framework with respect to worker behavior.

6.9.10 Traffic Disruption

Traffic load on Canal Road, Main Boulevard Gulberg, Gurumangat Road, Allama Iqbal Road, Egerton Road, Infantry road, Zafar Ali road, McLeod Road, Gulshan-e-Ravi Road (Chauburji area) and connecting access roads would be increased due to the project activities, and movement of heavy machinery especially during construction phase, but this will not be a significant concern as the construction will be carried in different packages and traffic can be diverted easily using proper traffic management plan. Thus, the impact is temporary and moderately negative in nature. The traffic load on the proposed project area is shown in **Figure**

6-4. The mitigation will include devising a traffic management plan (TMP) in coordination with Lahore Traffic Police Department. The TMP will be devised to provide safe passage for pedestrians, cyclists and vehicular traffic, around the construction sites with as little inconvenience and delay as possible. Nonarian road would need a specific traffic plan as it is only 25 feet wide and the corridor of impact is 20 feet, also a nullah runs along the road. It is planned to build 2 temporary bridges to augment traffic flow and bring in the materials and equipment to the construction site.

Mitigation Measures

- It is strongly recommended that the contractor be responsible for the submission of a final Traffic Management Plan (TMP), liaise with Traffic Police Department. Keeping in view the Micro Tunnel Boring Machine (MTBM) process. It is recommended that the TMP must comprise the following:
- Define scope of area that will be affected by construction activities.
- Provide sequence of construction operations;
- Describe when each phase will commence and finish;
- Provide duration of work;
- Note proposed hours of work activity on the site;
- Prior to creating diversions and detours the citizens will be consulted well in advance through electronic and print media;
- The narrow roads like Babu Sabu Nonarian Road and Garhi Shahu Bazar will require special attention due to local conditions; temporary bridges may be provided for access purposes;
- The traffic control plans will contain details of temporary diversions, details of arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, safety measures for transport of hazardous material and arrangement of flagmen;
- Special consideration will be given to the preparation of the traffic control plan for safety of pedestrians and workers at night;
- Schedule hauling of construction materials during off-peak hours;
- Establish speed limits especially in proximity to sensitive receptors and sensitize the truck drivers on speed limit;
- Vehicular access to and from hospitals and fire stations will be maintained through the use of steel road plates over open trenches;
- The Contractor will ensure that the diversion and detour is always maintained in running condition, particularly during the intense rainfall events to avoid disruption to traffic flow;
- All the construction activities including material, and waste and surplus soil stocking will be confined to the road carriageway by the Contractor, to the minimum possible extent. In addition to that proper barricading will be provided;
- Contractor will adopt best construction practices i.e. vertical cutting approach with proper shoring and bracing, to limit the width of trench excavation;
- The temporary traffic detours will be kept free of dust by frequent application of water;
- Traffic controls and diversions marked with signs, lights and other measures (flags) will be provided;
- At work site, public information, safety and caution boards will be provided including

contact information for public complaints; and

- A flag is raised through this ESMP that special attention will be given to traffic plans of Nunarian Rd.

Figure 6-4: A view of Traffic Load on the Proposed Project Area

6.9.11 Interference with Other Utilities

The proposed sewer and drains may interfere with the existing utilities and may cause temporary disruption to these facilities in the project area. The existing utilities that may interfere with proposed project activities are shown in **Figure 6-5.**

Figure 6-5: **Existing Utilities in the Proposed Project Area**

The affected poles include, electric, streetlight, PTCL, signal and safe city poles. The number of poles that may get affected by the project are mentioned in **Table 6-14.**

Table 6-14: Affected Number of Poles (surveyed on Aug 24)

Sr. No.	Alignments	Number of Poles
1.	Alignment A	41
2.	Alignment B	18
3.	Alignment C	15

Mitigation Measures

- Contractor in liaison with Client and Supervision Consultant will consult with all concerned departments Pakistan Telecommunication Company Limited (PTCL), Sui Northern Gas Pipelines Limited (SNGPL), and Lahore Electric Supply Company, to delineate their network locations and alignments;
- A taskforce comprising one member of each relevant government departments will be formed to promptly resolve any issue;
- Proper compensation will be given to the departments concerned, in case of utility disturbance or if need relocation;
- Inform residents in advance about complete project program, and disruption to utility services, while their work;
- Notices will be served to the affected people prior to the disruption in their utility services;
- Layout plans of the existing underground alignment will be shared with the site workers, so that they may avoid any damage to the existing structures and installation; and
- Concerned departments will be informed on an immediate basis, in case of any damage

to utility services to the sub surface infrastructure has occurred.

6.9.12 Greenhouse Gases and Climate Change

Greenhouse gases (GHG) may generate at site due to anthropogenic activities that will be carried out at the construction site.

The concentration of GHG in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. The main source of greenhouse gases will be:

- Direct emissions mainly from construction site equipment and site vehicles; and
- Indirect emissions from purchased electricity from external providers

This impact will be negative and permanent in nature.

Mitigation Measures

- Use construction machinery designed with suitable pollution abatement technology such as scrubbers;
- In order to control NO_2 emission at site, diesel engine equipment and machinery will be installed with catalytic converter, as it allows diesel engine to take advantage of the trade-off between NO_2, PM_{10} and fuel consumption, and calibrate the engine in a lower area of fuel consumption;
- Used and old electrical equipment will be banned that can also help to reduce urban emissions;
- Environmentally friendly fuel such as Liquefied Petroleum Gas (LPG) may be used instead of diesel;
- Burning of waste will be strictly prohibited at site;
- Awareness programs of causes and effects of climate change will be conducted for mitigating GHG emissions; and
- Use of solar panels at construction camp sites instead of diesel generators.

6.9.13 Resource Conservation

The materials used in construction of the proposed project would include coarse aggregates (crush), fine aggregates (sand), steel, water, asphalt, reinforcement and cement. Almost all the materials to be used in the construction of the proposed project are non-renewable and therefore their sustainable use is necessary for the future use.

Fuel will be used to operate construction machinery and asphalt and batching plants. Sustainable use of energy resources is very important not only to continue future use but also to help to reduce air emissions. For conservation of energy, efficiency of the engines and burning processes is very important. The impact is minor negative but is important as these fuels are non-renewable resources of energy.

Mitigation Measures

- Diesel and fuels with low Sulphur content will be used to operate construction machinery and equipment;
- The efficient and well-maintained equipment and machinery will be used;
- The equipment and machinery will be turned off when not in use;
- Regular maintenance of machinery to avoid fuel leakages;

- Reduction of wastage of water through training of workers involved in water use will be planned;
- Plan for reuse of construction waste materials may be formulated;
- A good camp design and an efficient worksite management plan will be prepared that may help the contractor to reduce the water demand, and wastewater and solid waste volumes to the lowest levels; and
- Use of solar panels at camp sites to conserve energy.

6.9.14 Impacts on Sensitive Receptors

The trunk sewer will pass through the center of the city encountering many sensitive receptors. List of line wise sensitive receptors are attached.

Table 6-15: List of Sensitive Receptors

Line A	Line B	Line C
20 (Total Sensitive Receptors at Line A)	**8 (Total Sensitive Receptors at Line B)**	**11 (Total Sensitive Receptors at Line C)**
Steps Prep evening coaching, Kangroo kids' school	Pioneer Public School	Graveyard with boundary wall. No impact
Study Cell Academy near the point, yet no impact	Orphanage (Mother Terresa Charity), PAC College, of PAC college.	Graveyard with boundary wall. No impact
Astana Aliya, Civil Defense Organization near the point, yet no impact	Family INN Hotel yet not be impacted. Access can be ensured	Shafi Mehshar Mosque, Suraiya Azeem Hospital on the right side of the road. No Impact
Siddique Science Academy, Amina medical and gynae center, Tanveer academy of commerce, yet no impact	JS Bank, yet not to be impacted.	Orange line station, Poonch House Staff Colony
Fida Dental Clinic	Coca Cola (CCI) Office, Les Anges Montessori Academy	Directorate general of Mines and Minerals
Garhi Shao Police station near the point, yet no impact	Iran Consulate	Pakistan Post Model Girls High School
Sir Ganga Ram hospital Fatima Jinnah College	American Lyceum School	Graveyard and Jamia Mosque Aqsa. Masjid Madina
Govt. Abu Alkhiar Girls middle school near the point, yet no impact		
Graveyard near the point, yet no impact		

Queen Marry Girls School. Access has to be provided		
Faletti's hotel. Access has to be provided		
Punjab Assembly Hall		
Cathedral school system, near the point, yet no impact		
Govt. Jinnah Degree College for women near the point, yet no impact		

6.10 IMPACTS ON ECOLOGICAL PARAMETERS

6.10.1 Flora

The project does not involve extensive tree cutting however, some plants will be affected especially near the launching and receptor station, and construction camps. The proposed project will not cause significant damage to the available trees and flora but approximately 194 trees may be cut down. The number of trees provided in the report is tentative and approximate, which will be finalized after final design. Impact on grasses, herbs, shrubs and other green cover is unable to assess at the current stage of the project, as consulted with the stakeholder department PHA.

The following impacts are also expected on the floral species in the surroundings of the project area:

During the construction dust laden polluted air will form a dust film on leaves thus blocking sunshine and stomata consequently hindering photosynthesis processes causing detrimental effect on the plant health;

- Exhaust of noxious gases from the movement of heavy machinery will further pollute air, which will adversely affect health and vigor of plants;
- Establishment of contractor's camps and warehouses for storage of equipment and material will involve clearing of vegetation from the area, causing a negative impact; and
- During construction activities the contractor's workers may damage the ornamental plants and trees, for use as fire-wood to fulfill the camps requirements.
- To minimize the impacts on flora, following mitigation measures will be adopted during construction stages:
- Compensatory planting of ten trees against each fallen tree of similar floral function will be planned which is 1940 (as per one ratio ten).
- The tree plantation program will be implemented in the project area and may prefer the prevalent indigenous species of plants (Attached as **Annexure VIII**);
- Efforts will be made to avoid cutting of trees for the project site and construction camps as far as practically possible.
- To minimize the dust emissions, regular water sprinkling will be strictly followed.
- The construction camps and workshop facilities will be established on barren land. However, if such type of land is not available, it will be ensured that minimum clearing of the vegetation occur.

- The Contractor's staff and labor will be strictly directed not to damage any nearby vegetation such as trees or bushes. They may use the paths and tracks for movement, but not allowed to trespass through green area.
- Construction vehicles, machinery and equipment will remain confined within their designated areas of movement; and
- Contractor will provide gas cylinders at the camp sites for cooking purposes and cutting of trees and bushes for fuel will not be allowed.

The number of trees that may get affected by the project are mentioned in **Table 6-16**.

Table 6-16: Affected number of trees

Sr. No.	ROW/DS	Number of Trees
1.	ROW	101
2.	Disposal Station	93
	Total	**194**

Mitigation Measures

- Compensatory planting of ten trees against each fallen tree of similar floral function will be planned which is 1940 (as per one ratio ten);
- The tree plantation plan will be implemented in the project area and may prefer the prevalent indigenous species of plants;
- Efforts will be made to avoid cutting of trees for the project site and construction camps as far as practically possible;
- To minimize the dust emissions, regular water sprinkling will be strictly followed;
- The Contractor staff and labor will be strictly directed not to damage any nearby vegetation such as trees or bushes. They may use the paths and tracks for movement, but not allowed to trespass through green area;
- Construction vehicles, machinery and equipment will remain confined within their designated areas of movement; and
- Contractor will provide gas cylinders at the Camp sites for cooking purposes and cutting of trees and bushes for fuel will not be allowed.

6.10.2 Fauna

The implementation of proposed project will have no major impacts on regional ecology. Impacts on fauna are expected low or negligible considering the urban environment and no suitable habitat for faunal species. The activities that may affect the local fauna are discussed below:

- Cutting of trees will adversely affect fauna as trees provide nesting and resting sites to the birds; and
- Refuse of the contractor's camps may attract birds and roadside mammals that might be hunted by the workers.

Mitigation Measures

- Hunting, poaching and harassing of wild animals will be strictly prohibited; and
- The camps will be properly fenced and gated, to check the entry of birds and mammals

in search of eatable goods.

6.11 IMPACTS ON SOCIOECONOMIC PARAMETERS

6.11.1 Discovery of Heritage Sites and Structures during Excavation

During excavation, there is a chance of finding artifacts. In case of finding any artifact, the contractor will immediately report through Supervision Consultant to Directorate General (DG) of Archeological Department, Government of Pakistan to take further suitable action to preserve those antiques or sensitive remains. Chance finds procedure **(attached as Annexure-IX)** will be adopted in case of any accidental discovery of cultural heritage.

6.11.2 Impacts on Historical, Cultural and Archaeological Sites

According to the field survey, Miani Sahib Graveyard, Shrine of Madho Lal Hussain, Shah Jamal Shrine, Shah Anayat Qadri Shrine, Mian Mir Shrine and Monument of Chauburji, are coming under the area of influence. However, as per Antiquity Act, 1975, the execution of the developmental projects along Monuments can be done if it is 60.96m (200 ft.) away from the excavation site. Thus, execution of the proposed project along Chauburji Monument is conventional.

Construction activities such as excavation and earthworks at these sites can cause traffic congestion and problems to tourists and visitors coming to and from these areas. Construction activities will also generate dust emissions which can deteriorate the existing condition of the buildings. The impact can be anticipated as negative and moderate in nature.

The project deploys MTBM technology which runs 8 meters underground at the starting point of the tunnel and has a downward gradient till it reaches the end where it is about 20 meters. According to MTBM experts buildings that fall 6-7 meters above the shaft are safe from all kinds of vibration impacts, hence by using this technology the project does not have any impact on the buildings on ground.

Mitigation Measures

- LWASA or the contractor will acquire approval from the concerned department prior to construction.
- Contractor will strictly follow the submitted work plan in order to avoid traffic problems.
- As per Antiquities Act 1975, all the construction activities will be done 200 feet away from archaeological sites.

Section 22 of Antiquity Act Punjab

"Execution of development schemes and new constructions in proximity to immovable antiquity. – Notwithstanding anything contained in any other law for the time being in force, no development plan or scheme or new construction on, or within a distance of two hundred feet of, a protected immovable antiquity shall be undertaken or executed except with the approval of the Director General."

- Construction Machinery that produces less noise and vibration will be used along these sites;
- Ensure regular sprinkling of water in all active construction areas near cultural and heritage sites;
- Follow steps mentioned in a chance find procedure in the event, if any unknown cultural heritage is found during any excavation activity; and
- Project Director will ensure that the chance find procedure is communicated to EPC contractor prior to start of project.

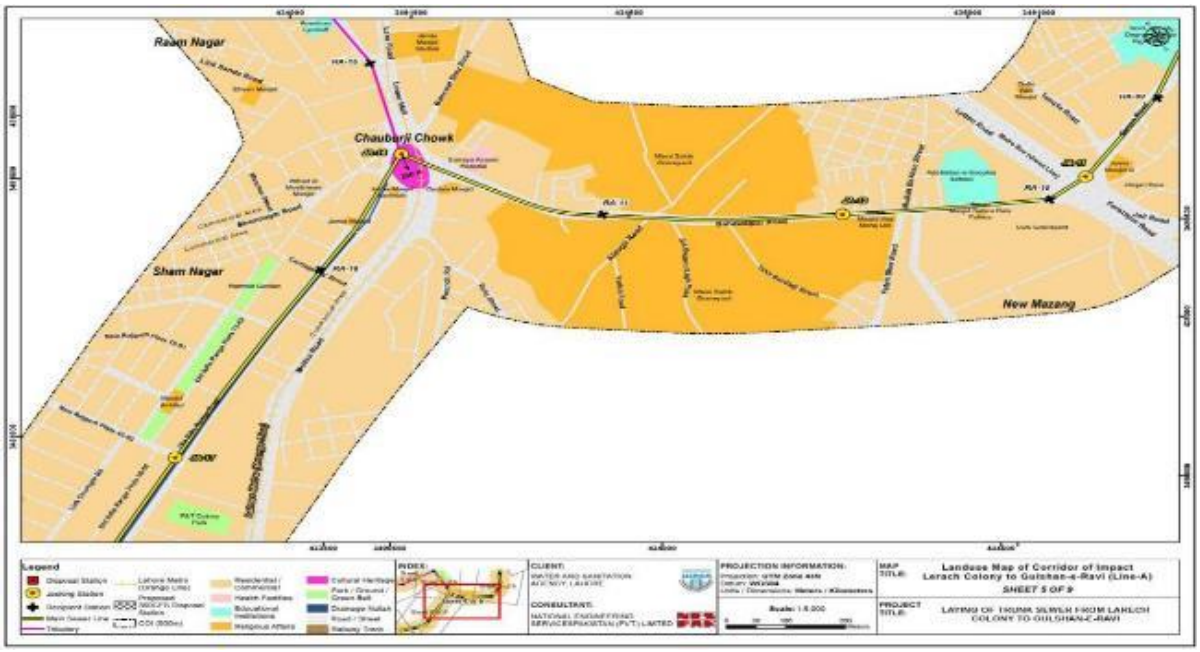


Figure 6-6: Distance of Chauburji Monument from Excavation Site

6.11.3 Health and Safety

a) Occupational Health and Safety

Workers may be exposed to an unsafe and unfavorable working environment due to improper storage, handling and transport of hazardous construction material. The health and safety issues are also associated with the malfunctioning in the operation of construction machinery and equipment which may cause minor to severe injuries to workers. Construction Health and Safety Checklist is attached as **Annexure-X**.

Mitigation Measures

- The EPC contractor must depute a safety officer with specified responsibilities to supervise all the construction activities at the proposed project site;
- Providing basic medical training to specified work staff, and basic medical service and supplies to workers;
- Obligatory insurance against accidents for laborers and employees;
- Layout plan for camp site, indicating safety measures taken by the contractor, e.g. firefighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents;
- Work safety measures and good workmanship practices will be followed by the contractor to ensure no health risks for laborers;
- Protection devices (ear muffs) will be provided to the workers, doing job in the vicinity of high noise generating machines;
- Disallow worker exposure to noise level greater than 85 dBA for duration of more than eight hours per day without hearing protection. The use of hearing protection will be enforced actively;
- Provision of protective clothing for laborers handling hazardous materials, e.g. helmet, adequate footwear for bituminous pavement works, protective goggles and gloves;
- Ensure strict use of wearing these protective clothing during work activities;

- Elaboration of a contingency planning in case of major accidents;
- All trenches deeper than two meters will be protected with wooden bracing to avoid safety risks to workers, public and nearby buildings and structures;
- Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas;
- Ensure moving equipment will be outfitted with audible back-up alarms;
- Ensuring the availability of a mobile dispensary at the active construction site throughout the construction period to provide emergency treatment; and
- Ensure that the site will be restricted for the entry of irrelevant people particularly children, disabled and elderly peoples;

Solar PV System Installation

Workers involved in the supply chain and installation of the Solar PV system may be exposed to various occupational health and safety risks, including injuries from working at heights & deep pits, exposure to electrical hazards, use of power tools, and prolonged outdoor work under varying weather conditions.

Mitiagation Measures

- Use suction lifters or panel grips to safely handle glass panels and avoid breakage or injury.
- Store panels in upright, secure positions to prevent tipping.
- Allow only trained electricians to perform DC and AC wiring, inverter installation, and system energization.
- Provide anti-reflective or UV-protective eyewear to workers installing panels under direct sunlight.
- Use anchorage points, full-body harnesses, and fall arrest systems when working on rooftops or elevated structures;
- Ensure ladders and scaffolding are stable and compliant with safety standards;
- Install batteries in ventilated, fire-rated enclosures away from direct sunlight and flammable materials;
- Train workers on battery chemical hazards (especially lithium-ion) and spill response;

Night Time Construction Activities

- The construction site will be appropriately illuminated, and lights will turn on 30 minutes prior to the sunset;
- No female worker shall be allowed to work at night shift;
- Site will be cordoned off and proper visible signage, flashing lights and flags will be installed at suitable points.
- The excavated areas will be barricaded.
- There will be minimum material and vehicular movement during the night;
- Quieter and environmental friendly equipment may be installed.
- Proper lighting, signage and information dissemination is required for the night.

- The nearby community will be informed prior to the nighttime activity; and
- In order to avoid accidents, Special Standard Operating Procedures for nighttime working and material handling will be developed by the contractor and relevant training will be given to the workforce.

Table 6-17: Construction Activities and Their OHS Risk

Activity	Risk	Mitigation Measure
Excavation Works	Exposure to airborne contaminants	Contractor will instill measures to control exposure to these contaminants, such as ventilation, respiratory protection, and work practices, as well as train employees on how to recognize and avoid hazards.
	Exposure to noise	Contractor will implement noise control measures, including engineering controls, administrative controls, and personal protective equipment, and train workers on how to recognize and avoid noise hazards.
	Structure collapse	Contractor will install fall protection equipment such as guardrails, safety nets, personal fall arrest systems, and train workers on how to use them to manage this risk.
	Slips, trips and falls	Contractor will install fall protection equipment such as guardrails, safety nets, personal fall arrest systems, and train workers on how to use them to manage this risk.
Electric Works	Electrocutions, Sparks, Electric Socks, etc.	Contractor will imply electrical safety procedures such as hazard assessments, the use of personal protective equipment, and training workers on how to identify and avoid electrical hazards.
Material Handling	Getting struck by object	Contractor will implement measures to prevent or control the movement of equipment and materials, such as barricades, warning signs, and personal protective equipment, to minimize this danger, and workers must be trained on how to recognize and avoid hazards.
	Musculoskeletal injuries due	Contractor will implement

Activity	Risk	Mitigation Measure
	to incorrect lifting, carrying, etc.	musculoskeletal injury prevention measures such as ergonomic work practices, lifting aids, and training workers on how to properly lift and carry materials to manage this risk.
Equipment Handling	Exposure to heat	Contractor will introduce heat-related illness prevention measures such as providing cool rest areas, hydration, and training workers on how to recognize and respond to heat-related illness symptoms.
	Getting caught-in or caught-between equipment or objects.	Contractor will implement measures to prevent workers from becoming entangled in or between equipment and objects, such as proper guarding, lockout/tag out procedures, and training workers on how to recognize and avoid hazards, to address this danger.
	Equipment failure and malfunction	Contractor will organize training sessions for workers about equipment usage, functioning, risks and its complexities in order to prepare them to safely handle the malfunctioning.
	Hand Arm Vibration Syndrome (HAVS)	Contractor will ensure that construction works are correctly planned to minimize exposure to vibration during work and workers are monitored and given appropriate protection when using vibrating tools and equipment.

b) Community Health and Safety

The construction activities and vehicular movement at construction sites, and access service roads may also result in roadside accidents particularly inflicting local communities, who are not familiar with presence of heavy equipment and machinery. Improper slurry management and transportation to its disposal can result in fugitive dust and visual degradation. The impact is temporary and negative in nature.

The last stretch of the tunnel, Line C, passes through Babu Sabu Nonarian Road which is narrow and a nullah runs by it, hence it is more prone to accidents. The site has challenges for the nearby community as well for the workers. Emittance of H_2S, a foul-smelling poisonous gas which might be harmful for the sewer-men and could be fatal sometimes, is one of them. The contractor will be instructed by PMU to device a site-specific safety plan and get it approved by PMC for this segment.

Quality of ground water and surface water resources available in the nearby local communities may get contaminated due to the construction activities, oil spillage and leakage and roadside

accidents. The laborers work with different transmittable diseases may cause spread out of those diseases in the residents.

Mitigation Measures

- Babu Sabu Nonarian Road and Garhi Shahu Road are narrow roads, and the resident and shops can face access issues besides other physical impacts. The contractor will prepare the site-specific workers and community safety and traffic management plans;
- There will be proper control on construction activities and oil spillage of vehicles;
- The labor with different transmittable diseases will be restricted within the construction site;
- Efforts will be made to create awareness about road safety among the drivers operating construction vehicles;
- Provide wooden bracing for all deep excavations that may require especially for sewer lines (less than two meters); identify buildings at risk prior to start of excavation work and take necessary precautions for safe conduct of work;
- Confine work areas: prevent public access to all areas where construction works are on-going through the use of barricading and security personnel;
- Minimize the duration of time when the sewer trench/shaft is (are) left open through careful planning; plan the work properly from excavation to refilling and road relaying;
- Enforce strict speed limit (20 kilometer per hour) for plying on unpaved roads, construction tracks;
- Regular water sprinkling will be done on all construction active areas present close to sensitive receptors in order to reduce dust exposure;
- Ramps will be placed in front of schools and houses gates so that accidents due to slips may be avoided;
- Timely public notification on planned construction works;
- Close consultation with local communities (residential areas along the project alignment) to identify optimal solutions for diversions to maintain community integrity and social links;
- Provision of proper safety signage, particularly at sensitive and accident-prone spots;
- If identified, consider guard rails at accident-prone stretches and sensitive locations;
- Reducing the impacts of vector borne diseases on long-term health effect of workers will be accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease, which includes prevention of larval and adult propagation of vectors through sanitary improvements and elimination of breeding habitat close to human settlements and by eliminating any unusable impounding of water;
- During construction work, pedestrian and vehicular passages will be provided for crossing near settlement; and
- Use of water will not disturb public water availability, and source of water will be selected carefully.

c) Accidental Risks

The project involves excavation operations and working at significant depths below surface. This increases probability of accidental injuries to workers and general public.

Following mitigation measures are suggested:

- Contractor will designate one of the staff members to act as lead person for emergency response and safety issues;

- Contractor will be responsible to provide first aid facilities at construction site as well as camp;
- Contractor will provide safety equipment's such as helmets, goggles, ear plugs, gloves, safety harnesses and safety shoes etc. to the workers;
- Safety signage will be erected at potentially dangerous working areas;
- Proper lighting arrangements will be ensured for night shift working;
- Contractor will be responsible to provide insurance against accidental death and injuries to workers and public; and
- Public and animal access to construction site will be restricted by providing fences.

d) Natural and Man-Made Disasters

Natural disasters (earthquakes) and accidents such as fire, falls, slips and trips may result in injuries, financial losses and may even lead to deaths. The workers will be trained and facilitated to cope with such disasters.

Mitigation measures include the following:

- An Emergency Response Plan for earthquakes and manmade disasters will be developed by contractor in coordination with LWASA and will be implemented in close consultation with the RESCUE 1122 Services and other concerned departments;
- Training of the LWASA staff and employees regarding the emergency procedures and plans will be regularly conducted;
- Emergency numbers will be clearly posted at all disposal stations; and
- Minor incidents and near misses will be reported, and preventive measures will be formulated accordingly by the LWASA Management.
- The Emergency Response Plan is attached as **Annexure XI**.

6.11.4 Disturbance to the Residents

The construction activities and vehicular movement may cause public inconvenience and disturbance to the residents during the execution of the proposed project in performing their routine activities. The general mobility of the locals in and around the project area will be affected especially near the project active sites.

The Babu Sabu Nonarian Road is a small road which is only 7.5 m broad with having a nullah run by it. A minimum working area of 6m is required, leaving a very small passage for the residents to pass by. The design team has suggested to build a removable bridge to provide alternate access and also to move machinery. Also, the equipment does not have to be parked in one line; it can be moved around as generators and slurry machine can be placed across the nullah to provide more space for the residents.

During the construction phase of the project, social and cultural conflicts may arise between labor force and local community. Use of local resources and products by the construction workers can generate stress on the local resources. Furthermore, difference in cultural values may also cause discomfort to residents. This impact is negative, local, low, short-term and probable.

Mitigation Measures

- During the construction phase, mobility of workers in the nearby areas will be strictly restricted by the contractor to avoid any inconvenience to the local communities especially

women;

- The contractor will select specific timings for construction work to cause least disturbance to the local population considering their peak movement hours;
- Contractor will take care of the concerns of the local community;
- The contractor and traffic police will implement the approved traffic management plan;
- The provision of a vehicle cleaning and washing facility will be provided at the exit of the construction site to mitigate dust issues. This will include the use of a high-pressure water hose to wash and clean the vehicles from mud;
- Local labor especially from nearby communities will be given preference for the construction works;
- Public notification through print or electronic media during the entire construction phase to avoid any inconvenience in accessibility to the locals; and
- Adequate training of especially for the transitive workforce of the station (involved both in the construction process and in the commissioning) to regard the customs of the area so that the locals do not feel insecure.

6.11.5 Employment

Due to the construction of the proposed project, economic and commercial activities will be generated in the study area, as the laborers and semi-skilled staff from nearby communities will have an opportunity to work for the construction of the proposed project. Similarly, the restaurants, hotels, and tea stalls present in and around the proposed project area will also benefit in income generation, as workers will visit them for food and nourishment. The impact is temporary and positive in nature. The installation of the Solar PV system will also generate a few temporary opportunities of employment.

6.11.6 Impacts on Livelihood

The construction activity may disturb the business and livelihoods of the shopkeepers and workers doing their business along the trunk sewer route. In the congested roads the existing shopkeepers will be affected by the excavation activities at the shaft locations. In this respect, the most critical areas include Larech Colony Road connecting with Allama Iqbal Road, Chauburji Park Road and Mushtaq Ahmed Gurmani Road. The main commercial activities in these areas include vegetables shops, meat shops, grocery stores, hair salons, furniture shops, beauty parlors, roadside eateries, workshops and electronic shops. At this stage the assessment of livelihood impacts has been carried out on the basis of the approximate location of the shafts. During the construction phase, these locations will be finalized and on that basis the livelihood impacts will be determined more accurately.

Mitigation Measures

- Standalone LRP is prepared, and it will be implemented before the start of the construction;
- Proper compensation will be provided to all the affectees losing their livelihoods in the project area;
- Relevant stakeholders will be engaged to design livelihood restoration measures including affectees of the proposed project area;
- Livelihood restoration committee will be formed by LWASA, to ensure monitoring of the compensation to be provided to the affectees;
- Initial assessment of compensation will be carried out for the income loss of the affectees

based upon the current approximation of the shaft locations. This assessment will be reviewed and revised on the basis of final shaft locations determined during the construction phase;

- Project Construction will be completed on time;
- Proper awareness and training will be conducted among the affectees regarding project benefits, reasons for acquiring lands and compensations to be provided.

6.11.7 Health Impacts (Diseases)

The health impacts that are envisaged to take place among employees, workers and local population of the proposed project are discussed below:

Communicable Diseases

For the implementation of project activities, skilled and unskilled labor is required by the contractor. Mostly, skilled and unskilled workers have been hired by the contractor on permanent and contract basis, belonging to different cultural backgrounds, which they utilize for different developmental projects. In this case, occurrence of communicable diseases like HIV/AIDs, respiratory diseases, and skin and eye infections are communal to take place during the execution of the proposed project. The project is of laying an underground sewer which for at many points runs along the existing nullahs. There are poisonous gases emitting from the nullahs that could make the workers sick. This impact is negative and moderate in nature.

6.11.8 Influx of Labor

For the implementation of project activities, skilled and unskilled labor is required by the contractor. Mostly, skilled and unskilled workers have been associated with the contractor since long which they utilize, where they are required for the projects, and while other workers are hired from the different areas that belong to different cultural backgrounds. Social problems and conflicts that are associated with Labor Influx are as follows:

- Risk of social conflict: Conflicts may arise between the local community and the construction workers, which may be related to religious, cultural or ethnic differences, or based on competition for local resources. Ethnic and regional conflicts may be aggravated if workers from one group are moving into the territory of the other;
- Increased risk of illegitimate behavior and crime: The influx of workers and service providers into communities may increase the rate of crimes and a perception of insecurity by the local community. Such illegitimate behavior and crimes can include theft, physical assaults, substance abuse, sexual assault and human trafficking;
- Impacts on community dynamics: Depending on the number of incoming workers and their engagement with the host community, the composition of the local community, and with it the community dynamics, may change significantly. Pre-existing social conflict may intensify as a result of such changes;
- Increased burden on and competition for public service provision: The presence of construction workers and service providers (and in some cases family members of either or both) can generate additional demand for the provision of public services, such as water, electricity, medical services, transport, education and social services. This is particularly the case when the influx of workers is not accommodated by additional and separate supply systems;
- Increased risk of communicable diseases and burden on local health services: The influx of people may bring communicable diseases to the project area, including sexually transmitted diseases (STDs), or the incoming workers may be exposed to diseases to which they have low resistance. Workers with health concerns relating to substance

abuse, mental issues or STDs may not wish to visit the project's medical facility and instead go anonymously to local medical providers, this can result in an additional burden on local health resources;

- Local inflation of prices, accommodations and rents: A significant increase in demand for goods and services due to labor influx may lead to local price hikes and crowding out of community consumers. Depending on project worker income and form of accommodation provided, there may be increased demand for accommodations, which again may lead to price hikes and crowding out of local residents.
- Increase in traffic and related accidents: Delivery of supplies for construction workers and the transportation of workers can lead to an increase in traffic, rise in accidents, as well as additional burden on the transportation infrastructure.
- Potential risks in solar installation include pressure on local resources and labor rights violations through subcontractors. To address this, the project will promote local hiring, enforce a worker code of conduct, and monitor supply chain practices to prevent child labor, forced labor, gender- based violence, sexual abuse, exploitation and harassment. Lack of written contracts for workers, their labor rights, violations including poor working conditions and poor terms of agreement for female employees, overtime work without pay etc, risks associated with the use of migrant labor and ethnic minorities and risks to freedom of movement e.g. being able to leave worker accommodation; and
- This impact is negative and temporary in nature.

Mitigation Measures

- Make arrangements to treat the affected workers on time to control the movement of vectors disease;
- Sensitize workers and surrounding communities on awareness and prevention of HIV/AIDS through training, awareness campaigns and workshops during community meetings;
- Provide proper and free HIV/AIDS health screening and counseling for site workers and community members;
- Develop and enforce a strict code of conduct for workers to regulate behavior in the local communities;
- Taking all sensible precautions to avert illicit, vicious conduct by or amongst the Contractor's personnel, and to preserve unity and harmony, and protection of people and property on and near the sites;
- Prohibiting drugs, alcohol, weapons, and ammunition on the worksite among personnel;
- Site security preparations must be contained within the Bills of Quantities (BoQs) to avoid any delays which might be caused due to insecurity;
- Appropriate fencing, security check points, gates and security guards will be provided at the construction sites to ensure the security of all plant, equipment, machinery and materials, as well as to secure the safety of site staff; and
- The Contractor must guarantee that good relations are maintained with local communities and their leaders to help reduce the risk of vandalism and theft.
- To mitigate labor risks during solar PV installation, the project will ensure all workers have written contracts, fair working conditions, and access to grievance mechanisms. Contractors will be screened for compliance with labor laws, and a code of conduct will prevent child labor, forced labor, and gender-based violence. Local hiring will be prioritized, and worker accommodation (if provided) will respect dignity and freedom of movement. Additionally, due diligence will be applied to the solar supply chain to identify

and avoid labor exploitation in the sourcing of panels, inverters, and batteries.

6.11.9 Gender Aspects

Gender Mainstreaming Category of the Development Project

Gender mainstreaming involves integrating gender perspective and analysis into all stages of designing, implementing and evaluating projects, policies and programs. Gender mainstreaming is known as a concept of ensuring that policy and decision-making takes account of cultural barriers, challenges and men's and women's different interests and needs. Recent studies and reports have clearly made a point that gender equality and mainstreaming are highly encouraged and recommended to reduce poverty and meet the United Nations Millennium Development Goals (MDGs). Present research and experiences have shown that development

Projects consider the economic, social, cultural, civil, and political rights, access and opportunities of women and men will inhabit the ability of people to secure better lives for themselves, their families and their communities.

Pakistani women face many gender inequalities and some advantages in the social context, which often determine their access to water and their participation in water related debates, policy, programs and community-based initiatives. As per Human Development Report 2018 Pakistan ranks 150/189 on the Gender Development Index have value 0.750 and Gender Inequality Index is also 150/189 have value 0.541. Whereas, as per the Global Gender Gap Report 2018, Pakistan ranks 148 having a score of 0.550. In Pakistan, large gap continues to exist between men and women in health, education, politics, and economic participation. Gender inequalities are deeply rooted in the country's social and cultural norms and practices, resulting in discrimination of women and girls, which adversely affect their quality of their life. The status of women in Pakistan is one of systemic gender subordination even though it varies considerably across classes, regions, and the rural-urban divide due to uneven socio-economic development and the impact of tribal, feudal, and capitalist social formations on women's lives. The Pakistani women of today do, however, enjoy a better status than in the past. Some of the discrimination against women in law has been repealed. However, there is still a long way to go. Among other issues, enrolment of girls in primary and secondary school is low and child marriages continue to be a problem. There is still much to be done in Pakistan for gender equality.

Punjab Women Development Policy-2018 has been developed for addressing the whole range of women Development concerns and challenges in line with the spirit of the Constitution, Pakistan's international commitments and priorities of the provincial government to pursue the goal of gender mainstreaming and women empowerment in Punjab. will simultaneously further the cause of national level commitments on gender mainstreaming besides deepening and strengthening Pakistan's commitment towards the whole body of international treaties on protecting and safeguarding women rights.

The Asian Infrastructure Investment Bank (AIIB) recognizes the importance of gender equality of successful and sustainable economic development and the need for inclusiveness and gender responsiveness in the Projects. The Bank demands to identify potential gender-specific opportunities as well as gender-specific adverse risks and impacts under the Projects and to develop mitigation measures to avoid or reduce such impacts and risks.

As per Asian Infrastructure Development Bank policy regarding gender mainstream categories of AIIB projects, an assessment has been conducted by using both secondary and primary data field survey was conducted and main findings are presented in the ESIA report to address issues related to the women specific to the project. Socio-economic survey

consultations held with women along the routes of Trunks Sewer to discuss their concerns and suggestion to mitigate the adverse impacts anticipated at different project levels.

The social assessment and public consultations have confirmed that there is extensive support for the project among the target beneficiary population, and provincial and district departments while the affected persons raised concerns related to disturbance of their business during project implementation.

The gender assessment was carried out by including gender specific questions in the social impact assessment surveys and studies of affected persons specifically related to resettlement impacts and risks. The poverty, social and gender assessment of targeted beneficiary population was conducted through a socio-economic questionnaire and qualitative participatory assessment tools. The studies also collected disaggregated production and income stream data by gender in order to differentiate the roles that men and women play in maintaining a household's livelihood, which was used to design a livelihood restoration and improvement plan.

The gender gap analysis of women's participation in the construction industry shows that women are not involved in formal construction industry, though they are involved in periodic maintenance activities of housing structures. Involvement of women in factory labor is low Women's omen ownership of formal businesses is also very low but, it is encouraging that women are getting jobs in government as well as private sector. Women in the Project area, participate in social and cultural activities they are also involved in the decision making. The assessment reveals the women participating in the daily life; however, their participation level is varied in various activities such as child caring is comparatively high, eventually the child care is perceived more women related job and they can care the children in a better way. Similarly, the women participation is in the household activities; it is a trend that women are usually responsible for the household activities. Women participation in the local representation is low, although 2001 Local Government Ordinance (2001) enhances the women representative in the political system, eventually a cultural barrier in women development.

6.11.10 Gender Based Violence (GBV), Harassment and Wage Discrimination

In the society, female plays important role in managing household as well as in income earning activities, but they face various challenges to get access to educational institutions and employment opportunities due to cultural bindings, economic vulnerability and lack of facilities.

According to Pakistan Demographic and Health Survey (PDHS), 2017-18, 28 percent of women of Pakistan age 15 to 49 have experienced physical violence, six percent have experienced sexual violence, and seven percent experienced violence during pregnancy. Three in ten women who have ever experienced physical or sexual violence sought help to stop the violence, yet 56 percent never sought help nor told anyone.

According to the population census of the Lahore 2023, the sex ratio of females is 47.6 percent. In order to combat gender issues, Government of Punjab introduced and implemented Punjab Protection of Women against Violence Act, 2016 to counter gender-based discrimination, violence against women, and economic and social empowerment of women. Positive steps have also been taken to encourage and promote women's participation in the political process and the workforce.

During survey, consultations with females were conducted at individual and at group levels to get their apprehension regarding the project activities and suggestions to mitigate the relevant impacts. It was observed that except in a few cases (restriction on movements), there was no gender-based violence prevailed among the consulted women. However, during construction phase gender-based violence might arise due to discrimination made against women by unequal work distribution and unequal pay structure among others. Sexual harassment against women might occur because of mixing of men and women at the

construction site, and moving on the roads, bus stops and markets. Educational institutions near the project alignment are also sensitive regarding gender issues. This impact is negative in nature during construction stage.

Mitigation Measures

- Awareness will be created among the females at individual and community levels about the construction sites;
- During the time of educational institutions workers will not be allowed to crowd in the surroundings;
- Alternative routes for pedestrian will be provided to avoid mixing of women with workers;
- Gender protection acts will strictly be enforced during the construction activities in the project area, and monitor the implementation through field staff and district level structure;
- Raise awareness among the communities of the potential risks of GBV, and establish response services in the communities that can respond to instances of GBV (particularly those related to issues of labor influx);
- The Contractor will make sure that no discrimination is made on the basis of gender while hiring of workers.
- Provisions of gender segregated bathing, changing, and sanitation facilities; and
- Contractor will take proper measures to address and resolve issues relating to harassment, intimidation, and exploitation, especially in relation to women.

6.11.11 Child Labor

Inhabitants of the project area have mix economic background and different sources of income. Children of low-income groups are mostly involved in different earning activities, as their parents prefer to get their children hired in small shops as helpers, and waiters in hotels for earning money, and supporting household livelihoods. However, the Punjab Restrictions on Employment of Children Act, 2016 prohibits the employment of children and restricts the employment of adolescents in certain occupations and processes such as construction industry, and whoever employs or permits a child (person under the age of 15 years) to work in an establishment will be liable to punishment with imprisonment.

The child labor impact might arise during the construction stage, as large number of skilled and unskilled labor will be required by the contractor for the construction activities of the proposed project. Child labor is also not allowed in the supply chain and installation of Solar PV system.

Mitigation Measures

- Awareness will be created among the local communities about the adverse impacts of child labor. For public awareness, meetings will be held in the project area, and announcements will be made using the available local platforms with the involvement of all sectors of the society;
- Contractors through contractual agreement will be bound to follow the labor standards, rules and regulations during hiring the labor force and all activities will be monitored by the social and environmental staff of the implementing agency;
- Client and Supervision consultant will ensure that contractor will have its employment policy in accordance with relevant act and labor policies in Pakistan, and the Contractor will ensure that its Human Resources Department follows the Recruitment Plan and related procedures for the employment of project workers on fair, voluntary and mutually agreed employment terms.

- Contractor will ensure the presence of all people at site are adults and have their proper identity cards with them.
- The client and the Contractor will implement a zero-tolerance policy for child labour/forced labour
- The Contractor will devise a management procedure to ensure that all workers are above the minimum legal age of employment at the time of hiring. This will include the verification of official personal registration documents i.e., national ID, passport etc.
-

6.12 ANTICIPATED IMPACTS AND MITIGATION MEASURES DURING OPERATION PHASE

The anticipated potential environmental and social impacts related to the proposed project have been studied for the operational stage and are discussed below.

6.13 IMPACTS ON PHYSICAL PARAMETERS

6.13.1 Change in Land Use

After the completion of the proposed trunk, the overall environmental conditions of the town will greatly improve due to elimination of stagnant wastewater, overflowing conditions in the streets, plantation of trees along proposed trunk sewer route, and exclusion of construction camps. This will have a major positive impact of the proposed project.

6.13.2 Repair and maintenance activities

The proposed project will include replacement of existing sewerage lines and elimination of disposal stations and lift stations, which will have a beneficial impact on the proposed project area. However, there are certain environmental risks from the operation of the sewer system, most notably from leaking sewer pipes, as untreated fecal material can damage human health and contaminate both soil and groundwater, temporary flooding of adjacent areas due to accidental leakages, bursts and blockages of lines and impairment of receiving water quality in surface and sub-surface source, due to inadequate and unavailability of sewage treatment process.

The tunnel maintenance will be more difficult and accident prone as compared to the present setup. The PMU or the operations management will have to develop specific SOPs for sending the men into the tunnel for repairs or cleanup.

Poor maintenance of a solar PV system can lead to reduced energy generation, increased system faults, and safety risks such as electrical fires or battery hazards. Over time, neglected components may degrade, causing costly repairs, shortened system life, and loss of environmental and economic benefits.

Mitigation Measures

- Establish a regular maintenance program including regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups;
- The retention times will be kept to their lowest possible, so that there is no stagnation of sewage for long time which could create anaerobic conditions;
- Provision of passive gas ventilation arrangement by providing a take-off vent from top of well by positioning vent in such a way that cover slab fitment, movement and drawl, if required for maintenance purposes is not compromised;

- Submersible sewage pumps of suitable rating, minimum submergence requirements, open impeller with cutting-tearing arrangement and high strength corrosion resistant heavy-duty construction will be proposed.
- Cleaning will be conducted more frequently for open channels and other storm drain facilities (using sandbags and inflatable dams).
- Develop an Emergency Response System for the sewerage system leaks, burst and overflows.
- Provide necessary health and safety training to the staff in sewer cleaning and maintenance.
- Rotation of sewer cleaning men after 20 minutes or for the least feasible time is to be adopted;
- The sewer men will be provided with adequate gear and masks for entering into the tunnel;
- Provision of sewer cleaning equipment for cleaning the sewers will be included in the project cost; and
- Development of a system to register public complaints and urgent clearance of blockages in the system.
- Maintenance of the 450 kW Solar PV system will include regular cleaning of panels, inspection of wiring and mounting structures, and performance monitoring through SCADA. Inverters and batteries (if applicable) will be checked periodically for faults or degradation. Corrective actions may involve replacing damaged panels, repairing faulty cables, or addressing electrical issues. Safety checks such as grounding tests and thermal scans will help prevent fire or performance risks.

6.13.3 Odor from Disposal Station

The operation of disposal station at Gulshan-e-Ravi might results in generation of odor during any malfunction which can cause nuisance to the residential community in the surroundings of the disposal station and the people passing by this area for schools, mosque and shops. The magnitude of this impact will be temporary and moderate adverse.

Mitigation Measures

- Strictly follow standard operating procedures and operational manual for operation and maintenance of lifting and pump stations;
- Ensure that operating staff is properly trained, and have clear understanding of odor issues related with operational practices;
- Ensure that pumping cycles are properly followed;
- Conduct H_2S monitoring, periodically at pumping stations and lifting stations;
- Screening of wastewater will be regularly done and screening waste will be disposed-off safely; and
- A landscape will be properly designed with provision of new trees and ornamental plants around

6.13.4 Water Quality

The disposal of untreated wastewater through Gulshan-e-Ravi disposal station will disturb the water quality of River Ravi resulting in reducing its assimilative capacity and limiting its intended use. Sludge from the disposal station if not managed properly will also have a negative impact on the surface water quality.

Mitigation Measures

- A treatment plant will be constructed for treatment of wastewater before its final disposal into the river Ravi; (another LWASA project - AFD funded);
- Proper sludge management plan will be devised;
- Pre-treatment of sludge will be done, as it can reduce its associated environmental impacts;
- Leakage and corrosiveness of sewer pipes and pumps will be regularly checked and monitored by trained LWASA staff members;
- Water quality monitoring will be conducted on quarterly basis and the quality will be maintained according to PEQS, 2016 for Surface and Ground Water; and
- Strictly follow standard operating procedures and operational manual for operation and maintenance of trunk sewer, to avoid abating the quality of surface and ground water.

6.13.5 Air Quality and Climate Change Aspects

Climate change is one of the main challenges to urban wastewater systems. The operation of sewerage scheme and disposal station will result in generation of gases including H_2S and CH_4 (due to anaerobic conditions). H_2S is a foul-smelling poisonous gas which might be harmful for the sewer-men and could be fatal sometimes. CH_4 is natural gas also referred to as a greenhouse gas is one of the main greenhouse gas contributors to global warming with a lifespan of about 12 years and a global warming potential of roughly 21– 23 times higher than carbon dioxide. Pakistan is signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and adopted Kyoto protocol in 1997. Under the Kyoto Protocol, Pakistan is committed to reduce GHG emissions into the environment to prevent interference with climate change. The GHG emissions for the proposed project are a concern due to the anaerobic conditions in the sewer lines and wet wells of the disposal station; whereas, the gas emissions during the conveyance of wastewater will be eliminated by the trench sewer. There is always a probability of malfunctioning of the system and uncontrolled leakage of these gases.

The existing sewerage system is old and outdated. It will be replaced with underground wastewater conveyance system through MTBM. This would impede the nuisance of environmental problems associated with open drains as well as the new system will consume 23% less electricity. The electric load of all the proposed "eliminated intermediate" pumping stations was taken and compared with the total electricity consumption of the proposed solution. A summarized analysis between 2025 to 2050 has been provided in Table 6-18 which states a net reduction of 77,269.707 Tons CO_2 eq in GWP was observed, yielding carbon credits of 127,612 unit.

Table 6-18: Comparison of Power Consumption & CO_2 Emissions b/w Existing and Proposed Sewerage System

Comparison of Power Consumption & CO2 Emissions b/w Existing and Proposed Sewerage System FOR 25 YEARS (2025-2050)					
Descriptions	**Unit**	**Existing System**	**Proposed System**	**Reduction**	**%age Reduction**
Power Consumption	KWh	426,762,243	329,468,783	97,293,460	23%

Fuel Consumption From Gensets	Gal	3,116,094	0	3,116,094	100%
CO2 Emissions Total	Kg	196,452,067	127,174,950	69,277,117	35%
Power Production	KWh	0	15,519,592	15,519,592	100%
CO2 Saving	Kg	0	7,992,590	7,992,590	100%
***Tons of CO2/ Carbon Credit**	Tons/Credits	196,452.07	119,182.36	**77,269.707**	**39%**

*1 Ton of CO2 = 1 Carbon Credit

During operation phase, operation of stand-by generator and un-necessary idling of diesel run will also result in the emission of pollutants (CO, Smoke, NO_2, SO_2 CO_2 and PM_{10}) into the air, thus deteriorating air quality. These emissions may adversely affect the health of the nearby residents and working staff.

This impact can be categorized as negative, local, medium, long-term and definite.

Mitigation Measures

- To mitigate the pollutants emissions use of low sulfur fuel will be ensured;
- Strict prohibition on re-used fuel;
- Location of generators will be carefully selected;
- Plantation of trees along the disposal and pumping stations to create a buffer zone that will help in absorbing the emissions;
- Use of gas generators (if possible) will be preferred for low emissions;
- Use of solar panels (renewable energy source) for running new installed pumps and generators, as it will save the energy;
- The height of the generator stacks will be high enough to disperse the emissions in the air;
- Provision of budget for regular monitoring of ambient air quality in accordance with PEQS, 2016;
- Improved monitoring, planning, and maintenance of the sewerage system by LWASA;
- Sewer-men will cover their faces with mask while entering the sewer for cleaning or maintenance purposes;
- Use gas detector before inspection;

- If possible, use different mechanisms to capture CH_4 and H_2S that can be used commercially; and
- Plan and execute appropriate tree plantation along the disposal station.

6.13.6 Noise

Due to the operation of proposed disposal station, noise may be produced due to the running of pumping machinery and standby generators which will be a constant source of nuisance to the local population and workers along with traffic jam on the busy roads of the proposed project such as Chauburji Road, Gurumangat Road, Bahawalpur Road, Infantry Road, Gari Shahu and Main Gulberg Road. Therefore, the magnitude of this impact is considered to be moderate adverse.

Mitigation Measures

- Regular maintenance of vibrating parts through a well-coordinated operation and maintenance procedure which consists of checking periodically all parts of the pumping machinery, its oiling to remove friction, replacement in case of malfunctioning and periodic noting of noise levels;
- All noisy equipment and machinery such as generators and blowers will be housed in closed rooms or buildings; and
- Provision of budget for regular monitoring of noise in accordance with PEQS, 2016.

6.13.7 Solid Waste (Construction, Municipal, Solar Photovoltaic (PV) waste and Hazardous Waste)

Domestic and hazardous wastes would generate during cleaning and maintenance facilities. The solid waste during operational phase will consist of plastics, metal and organic wastes present in sewer lines. Hazardous waste will be present in form of sludge. Such wastes can cause blockage to drainage systems. Some of these waste materials especially plastics and polythene which are not biodegradable may cause long term injurious effects on the environment. This will be a temporary and minor negative impact.

Improper disposal of solar system components—such as panels, batteries, and inverters—can lead to environmental pollution, including chemical leaks, soil and water contamination, and fire hazards. These parts may contain hazardous materials and contribute to electronic waste if not properly recycled or managed.

Mitigation Measures

- Proper disposal of sludge to the designated solid waste dumping site;
- Implementation of sludge handling and storage procedures will be ensured;
- Provide adequate ventilation where volatile wastes are stored;
- Waste minimization will be encouraged, and regular training will be provided to LWASA staff in correct identification and disposal of waste;
- Storage areas will be cleaned regularly to minimize odor, pests and nuisances and preserve visual amenity.
- All empty containers not suitable for reuse will be rinsed and punctured prior to disposal; and
- Schedule inspection of the sewer lines to keep it clean, and to identify any hazardous material.
- End-of-life solar components will be collected and disposed of through licensed recyclers or manufacturer take-back programs will also be considered if feasible. Hazardous

materials, especially from batteries, will be handled as per national regulations. Staff will be trained on safe disposal practices, and records will be maintained to ensure compliance.

6.13.8 Fire and Explosions Hazard

Improper handling and storage of chemicals and constructed electric installations (e.g; Solar PV system) can lead to fire and explosion that may in turn cause injury and possible death of a worker. Welding or cutting torch on or near drum (even empty) will never be used because products (even just residue) can ignite explosively. Fuel or oil spills around the generator and the presence of combustible materials may pose a risk of a fire explosion.

Mitigation Measures

- The whole area and storage tanks will be designed and constructed according to National Fire Protection Association (NFPA) standards for the prevention and control of fire and explosion hazards;
- Routine inspection will be carried out to check that the area around the generator is free of clutter and no flammable material is present;
- Workers will be trained on handling and controlling accidental spillage of flammable substances that may trigger fires;
- Appropriate fire safety equipment will be installed at convenient locations within the disposal and pumping stations;
- Equipment will be regularly examined and maintained by a reputable fire safety and security company;
- Fire drills will be conducted at least biannually to ensure that workers are familiar with the action to take in the event of fire or explosions;
- Fire awareness materials will be placed in strategic locations within the plant to educate the staff and visitors on what to do in the event of fire; and
- “No smoking signs and policy” will be displayed, as appropriate and actions to be taken against those not adhering to this order.

6.14 IMPACTS ON BIOLOGICAL PARAMETERS

No adverse impacts are envisaged on ecology of the study area during the operation phase. Flora comprising trees and ornamental plants will be planted in and around the project area during the construction phase with the compensated ratio of 1:10 to enhance the aesthetics value, and to control noise and air pollution. It will provide the following benefits:

- Creates a visual barrier and enhances the appearance of the disposal station;
- Captures and reduces odor concentrations by absorbing gases;
- Dilution and dispersion of the odor concentrations by the mixing, and redirection effects of the wind breaks, and directing odors up into the lower atmosphere; and
- Reduction in wind speeds which means fewer odorous gases and particles will by picked up, and conveyed by the wind.

However, mismanagement of green areas may result in clogging of drains, nuisance due to stagnant water and chemical pollution. This impact can be categorized as negative, local, low, short term and probable.

Mitigation Measures

- Maintenance of the green areas and the protection of saplings to ensure better

environmental conditions;

- Any tree that poses a concern to public safety will be immediately barricaded and evaluated by PHA. Issues of immediate concern would be trees or branches that are leaning or broken that may fall onto an area of pedestrian or vehicular activity; and
- Use of fertilizers will be strictly monitored in order to avoid any incident. Natural nutrients may be preferred.

6.15 IMPACTS ON SOCIOECONOMIC PARAMETERS

6.15.1 Change in Aesthetic Value

Construction of the proposed trunk sewer and drainage system, and elimination of disposal stations and lift stations will change the aesthetic value of the area. Proper landscaping and plantation of grasses and ornamental plants will increase the aesthetic value and will have a positive impact. The intermediate pumping stations will be rehabilitated, increasing its aesthetics. The design for the installation of Solar PV system should also be monitored minutely aesthetically.

6.15.2 Employment

During the operation phase of the proposed project, economic activity will be generated in the project area as the semi-skilled and technical staff will have an opportunity to work for the operation and maintenance of the proposed project. This is a permanent and moderate beneficial impact. The installation of Solar PV System will also generate some temporary opportunities of employment for the local skilled and un-skilled labor.

6.15.3 Abolition of Breeding Ground for Disease Vector

During intense rainfall events in the proposed project area especially in Gulshan-e-Ravi, Larech Colony, Gari Shahu and some other areas of Lahore, the wastewater becomes stagnant which acts as breeding grounds for disease vectors. After the completion of the proposed project, the sewerage water will be collected in wet wells and disposed of into the collection chamber through force main ultimately eliminating the breeding grounds. This aspect is highly beneficial for the reduction in health impacts of communities.

6.15.4 Emergency Preparedness and Response

The operation of the disposal station, on-grid and solar system may encounter emergencies like operation failure. In addition, disasters such as earthquakes and fires may occur. This impact is negative, temporary and moderate in nature.

Mitigation Measures

- An Emergency Response Plan for floods, earthquakes, and manmade disasters must be developed by LWASA, in close consultation with Fire Fighting Department (FFD) and National Disaster and Management Authority (NDMA);
- Training of staff and employees regarding the emergency procedures and plans will be regularly conducted;
- Responsible person to implement the Emergency Response Plan will be clearly designated;
- Emergency numbers will be clearly posted, so that a quick action is taken when an emergency arises;
- Firefighting systems will be calibrated and maintained regularly; and

- Regular drills for fire emergencies will be carried out.

6.15.5 Health Risks associated with Burst Sewers

Improper maintenance of trunk sewer can lead to dispersal of raw sewage particularly at manholes and burst areas into the environment. These can cause outbreaks of water borne related diseases like dengue, malaria, cholera and typhoid from contamination of water sources by raw sewage.

Mitigation Measures

- Ensure proper and periodic maintenance of sewer lines and disposal stations;
- Regular check, repair and maintenance of the sewer lines;
- Awareness rising among community members not to dump solids in manholes;
- Development of an inventory of system components, with information including age, construction materials, and drainage areas served elevations;
- Design manhole covers to withstand anticipated loads, and ensure that the covers can be readily replaced if broken, to minimize entry of garbage and silt into the system; and
- Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent build-up of solids and hydrogen sulphide generation.

6.15.6 Occupational Health and Safety (OHS) Considerations

During the operation phase, health and safety issues may arise. Operation and maintenance of the disposal station, sewerage and drainage may cause safety risks to staff (electrical and mechanical staff, solid waste management staff and maintenance staff), that may include injuries due to electric shocks, arc flash and arc blast, slipping and falling into deep manholes, poor handling and storage of hazardous substances such as alum and chlorine, and during handling of the solid waste. The impact will be considered moderate and negative in nature.

Mitigation measures

- An OHS Management Plan will be prepared and implemented for the O&M phase
- Operation and maintenance of machinery and equipment will be controlled and handled by efficient management, staff training, and other preventive measures;
- Proper storage and handling of fuel;
- Emergency Response Plan will be implemented;
- Emergency numbers will be clearly posted and communicated to the staff;
- Fire extinguishing equipment will be installed at the disposal stations;
- First Aid Kits will be provided at disposal stations;
- Provision of PPEs to the employees including masks, gloves, safety jackets and ear muffs;
- Necessary health and safety rules will be enforced by the LWASA for site management;
- Proper training will be given to site workers on health and safety measures;
- Cleaning and removal of stagnant water from site will be done on daily basis;
- Introduce aquarium fish such as Guppy fish into all stagnant water bodies; as it will eats the dengue larva and reduce its effecting areas;
- Fumigation will be done on site periodically;

- All hazardous substances such as bagged material and drum will be stored on pallets, and where possible under the cover of secondary containment;
- Hazardous materials will be well labelled and stored in their original containers;
- Material safety data sheets (MSDS) will be available and readily accessible to site workers;
- Clear signage will be posted alerting of possible danger at locations where dangerous and hazardous materials are present;
- Ventilation of sewers and manholes will be done before entry to avoid accumulation of noxious gases;
- Workers will also be inoculated against infectious diseases and kept under regular medical checkup;
- During maintenance of power supply, ensure that the live wire work is conducted by trained workers with strict adherence to specific safety and insulation standards (Pakistan Electric and telecommunication Safety Code-PETSAC-2014).
- If accident occurs, inform the relevant government departments like the RESCUE 1122 Services Department at once for rescue. Only site personnel who have been trained will use appropriate rescue equipment provided, to conduct the rescue operation according to the emergency rescue procedure, if possible. Moreover, at any time, especially when an accident has occurred, workers will not enter a manhole without any rescue equipment and support;
- The authorized person must implement all the safety measures recommended by the competent person of LWASA before issuing a work certificate to enter a manhole;
- Before any person enters a manhole, there will be a sufficient number of persons on standby outside, including those who are appointed to carry out a rescue operation inside the manhole, and those responsible for support services outside when such an operation is necessary; and
- While working in a manhole, if there are signs indicating that the safety of the workers is under threat, for example, the equipment that continuously monitors the quality of the air gives warning alarms, then evacuation of the workers from the dangerous environment will be made according to the emergency procedure, and the competent person of LWASA will reassess the environmental conditions afterwards.

6.15.7 Operational Sustainability

The most pressing need is the sustainability of wastewater collection system and disposal station, and it can be assessed on many factors including capacity issues of government departments dealing with municipal services, efficiency of the system and its performance, life cycle analysis (aging and deterioration), natural hazards (earthquakes, floods and fire outbreaks), escalation in population growth and energy requirements.

The three major drivers considered worldwide for ensuring sustainability are: (i) economic considerations, (ii) social considerations and (iii) environmental protection. Therefore, the municipal services provider i.e. LWASA, must consider these aspects in achieving appropriate and optimize use of sewer and drainage system.

6.15.8 Decommissioning Phase Impacts

The project can be decommissioned when its life and design period ends. Other reason of decommissioning can be considered if sewer network becomes ineffective, due to natural hazards, and unexpected changes in climate due to global warming. The proposed project

has been designed for an operational period of 25 years. Decommissioning of the project involves improvement, replacement and rehabilitation of sewer pipes and pumps, disposal stations, plant structure and allied utilities. The perceived impacts associated with decommissioning activities may be:

- Land use change;
- Dust emissions;
- Generation of solid and liquid waste;
- Noise and vibration issues;
- Disturbance to ecological resources;
- Occupational health and safety risks to LWASA staff and workers;
- Sanitation and drainage issues for local population due to timeworn sewer system; and
- Outbreak of waterborne diseases in the proposed area due to dilapidated wastewater collection system.

6.15.9 Cumulative Impacts

Cumulative impacts are the environmental and social impacts that result from the incremental impacts of one action and activity when added to past, present, and reasonably foreseeable future actions and activities.

The main cumulative impacts of the two components can be:

- Dust pollution due to excavation activities;
- Air pollution due to vehicular emissions in case of traffic jams during the construction phase;
- Increase in noise pollution due to construction activities and traffic jams;
- Traffic jams leading to time delays for daily commuters;
- Health issues to nearby local population and workers in the form of respiratory problems, cough, influenza, skin and eye allergies, due to dust emissions and smog;
- Conflict between skilled and unskilled workers of both projects due to construction activities;
- Hindrance in the implementation of the proposed project activities due to ongoing construction work; and

These impacts are temporary and minor to moderate in nature if managed properly.

6.15.10 Induced Impacts

The proposed project will have certain induced impacts on natural resources as well, and other aspects associated with the environment. In case of the proposed project, the induced impact will be on River Ravi whose quality will be declined due to untreated sewage. The water from River Ravi is used for agricultural purposes and green area by some local inhabitants; hence the pollutants from River Ravi are taken up by the crops and become part of food chain which can ultimately harm the human health (both short-term and long-term health impacts). Moreover, it can also harm the river ecology.

7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 GENERAL

Primary and secondary data pertaining to the project was collected and analyzed. Several site visits, surveys and consultations were made, and the route of the alignment and design were consulted. After which this ESMP was formulated as a standalone document which will become guidelines for the contractor to follow during the construction.

The ESMP provides brief description of environmental & social issues, mitigation measures to eliminate or reduce environmental and social impacts to an acceptable level, institutional framework for the implementation of the mitigation measures and environmental monitoring plan of air quality, water quality, and noise pollution parameters and social during construction and operational phase. A budgetary plan is also developed, indicating estimated costs to be incurred to mitigate potential adverse impacts of the proposed Project.

7.2 PROPOSED PROJECT DESCRIPTION

The proposed project aims to improve the wastewater management system in Lahore, which currently relies on open drains meant for rainwater to transport bulk wastewater, polluting the nearby River Ravi. The project will assist LWASA in constructing a modern conveyance system by constructing trunk sewers through underground tunneling and the construction of an ultimate pumping and disposal station at Gulshan-e-Ravi in the vicinity of the existing disposal station, which will safely transport domestic sewage, serving a population of 2.35 million over an area of about 15,658.2 acres in central Lahore. The construction of a gravity-based transport of wastewater infrastructure will also eliminate the need for intermediate pumping of wastewater at 22 different locations, resulting in cost savings for LWASA in payment of electricity charges. The total length of the sewer to be constructed is about 32.37 kilometers, which is divided into three construction legs.

The project comprises two components, including the laying of sewer lines and the construction of a pumping and disposal station at Gulshan Ravi along with restoration of existing outfall drains. Component-I involves.

i. Line A. laying of sewer 12.30 kilometers (including 159m open cut) from Karachi Phattak to Qartaba Chowk using micro-tunneling and pipe jacking technology, with launching and exit stations for the pipe jacking machine.
ii. Line B. laying of sewer 12.82 kilometers from Guru Mangant Road to Qartaba Chowk using similar technology.
iii. Line C. laying of sewer 7.25 kilometers from Qartaba Chowk to Gulshan-e-Ravi using similar technology.

Component II involves construction of an ultimate pumping and disposal station with a capacity of 688 Cusecs at Gulshan-e-Ravi, along with allied works, such as the installation of a SCADA system for gas concentration monitoring in trunk sewers, electromagnetic/ ultrasonic flow rate monitoring system, construction of an outfall channel, restoration and brick-lining of Cantonment Drain and Gulberg Drain, and installation of rider sewers along Cantonment Drain. An ultimate pumping and disposal station having a capacity of 688 cusecs with 16 pumps at Gulshan-e-Ravi in the vicinity of the existing disposal station will be constructed for the ultimate disposal of sewage to River Ravi. The wastewater will flow out from the disposal station through i) an existing drainage channel of 1.5 km long falling into the main drain and ii) a second drainage channel falling into other open drains. The first drainage channel required rehabilitation within the channel, while the second drainage channel will be constructed to increase the capacity of flow. The second open drain will also be rehabilitated till the final fall into River Ravi.

7.3 OBJECTIVES OF ESMP

The main objectives of the ESMP are to:

- Provide the details of the project impacts along with the proposed mitigation measures and the corresponding implementation activities
- Define the role and responsibilities of the Project Proponent (LWASA), Contractor, Supervisory Consultants and other key players and effectively communicate environmental issues among them
- Define a monitoring mechanism, reporting frequency and identify monitoring parameters to ensure that all the mitigation measures are completely and effectively implemented.
- Design the training and capacity building plan for enhancing the capacities of the key stakeholders on environmental and social management; and
- Identify the resources required to implement the ESMP and outline the corresponding financing arrangements.

7.4 INSTITUTIONAL SETUP FOR IMPLEMENTATION AND MANAGEMENT OF ESMP

7.4.1 Project Management Unit (PMU) Lahore Water and Sanitation Agency (LWASA)

The executing agency (EA) responsible for the Project is LWASA, which operates under LDA and is part of the Government of Punjab. LWASA, established under Section 10 (2) of the LDA Act-1975, is entrusted with the functions and authorities related to water supply, sewerage, and drainage, including the collection of fees and user charges from users for services rendered. As the EA for the project, LWASA will be responsible for the management and supervision of the project, ensuring its smooth implementation. LWASA will also play a crucial role in coordinating with other relevant agencies for the successful execution of the Project, as part of its mandate for interagency coordination.

As the EA of the Project, the LWASA has established robust systems for procurement, project management, and internal control for consultants, contractors, operators, and other relevant parties. Additionally, LWASA, sanctioned by the Government of Punjab, is responsible for taking appropriate measures for detailed engineering designing and implementation, operation, and maintenance of the project, as well as environmental and social safeguards compliance. For dispensation of these functions, LWASA requires dedicated support.

7.4.2 Project Management Unit

LWASA has established a PMU for the project headed by a Project Director (PD) and consisted of professional staff supported by a team of consultants known as Project Management Consultants (PMC) to assist LWASA in the implementation of the Project, as well as in supervision and monitoring, including environment and social safeguards management.

PMU will incorporate environmental and social safeguards management requirements into the Contracts of PMC and EPC/DBL (Engineering, Procurement, and Construction/Design-Build) Contractors at the appropriate stages of the Project implementation process. This will ensure that the Project is executed in compliance with the relevant environmental and social safeguards, in line with the Project's goals and objectives. PMU will ensure the implementation of ESIA, LRP, GAP, and SEP. PMU will be responsible for carrying out the following tasks.

i. The Overall responsibility for implementation of the Project lies with PMU

ii. Oversee and supervise the environmental and social management of the project

iii. Ensure that compensation is paid to APs against the displacement and livelihood losses

iv. Ensure that PMC deploys environmental and social staff for the implementation of ESIA, LRP, GAP, and SEP.

v. Ensure that PMC monitors the implementation of ESIA, LRP, GAP, and SEP in true letter and spirits

vi. Ensure through PMC that contractors prepare site-specific environmental and social management plans and implement them in true letter and spirit.

vii. Ensure through PMC that all HSE and CHS measures outlined in the safeguard documents are implemented.

viii. Review and finalize periodical environmental and social safeguards monitoring reports received from PMC & Contractor and submit them to AIIB.

ix. PMU will coordinate, update and seek necessary approvals regarding all necessary E&S activities from the Bank (AIIB) and local approving forums.

x. Ensure that the contractor updates all environmental and social safeguards documents as per the detailed engineering design.

xi. PMU will also redress all the reported grievances through the proposed GRM Mechanism

xii. PMU to ensure that PMC and EPC Contractor will perform their assigned roles and responsibilities as specified in their respective sections

7.4.3 Project Management Consultant

As the PMC, the consultancy firm will be responsible for managing the entire process of procurement of the EPC/DB contractor for LWASA (EA/Client/Employer). PMC will also be responsible for the effective supervision and assistance to PMU for project implementation, detail designing by EPC contractor, constructional works, environmental and social safeguards management. PMC will perform the following roles and responsibilities related to social and environmental management:

i. Environment and Social Safeguard Requirements: The PMC will ensure that environmental and social safeguard requirements are included in the design and bidding documents and contracts of the EPC/DB contractor, sub-contractors, and service providers. This will be done through the development of Terms of Reference (TORs) / Employers Requirement for environment and social management before the bidding stage.

ii. Assistance to PMU: The PMC will assist LWASA's PMU in overall project management and implementation, including the implementation of ESMP, LRP, GAP, and SEP. This will include reviewing and finalizing all environmental and social safeguard documents.

iii. Supervision and Monitoring: The PMC will supervise and monitor all project activities, including the implementation of social and environmental safeguard documents, by assuming the role of "LWASA representative". This will involve ensuring that the contractor and other parties are fully coordinating with LWASA, AIIB, and other stakeholders for the implementation of these documents.

iv. Capacity Building: The PMC will carry out capacity building of LWASA, PMU, and other relevant agencies in environment and social management. This will involve providing training and support to build the capacity of LWASA, and staff of other relevant departments as necessary.

v. Grievance Redress Mechanism (GRM): The PMC will conduct an independent investigation of grievances and prepare factual documentation describing the circumstances of the grievances with necessary documentation, records, and photographs. This may result in resolution or arbitration between the APs and LWASA and/or EPC/DB contractors, sub-contractors, or service providers. The PMC will also attend hearings and provide all legal and other support to LWASA.

vi. Health and Safety: The PMC will ensure that proper health and safety measures are put in place as per AIIB's policy and standards. This will involve overseeing the implementation by the contractor of the required environmental and social mitigation measures as per the ESIA reports, and GAP (Gender Action Plan).

vii. Progress Meetings: The PMC will organize monthly progress review meetings involving all stakeholders, including the consultant, contractor, client, line departments, and others as required. The PMC will also maintain records of meetings and follow up on agreed actions.

viii. Record Keeping: The PMC will maintain records, files, and reports of ESIA, LRP, GAP and SEP implementation, including necessary documentation, records, and photographs, in a manner suitable to meet GoPb, AIIB, and legal standards.

ix. Reporting: The PMC will prepare and issue all necessary reports on the implementation of ESMP, LRP, GAP and SEP, and the overall environment and social management, as required by LWASA and AIIB. The format and contents of the reports will be agreed upon with LWASA and AIIB and will include monthly progress reports submitted not later than the 7th day after the end of the month, detailed quarterly reports, and a detailed completion report of LRP, ESMP, GAP and SEP implementation. The reports shall include monthly photographs 4(referenced and dated) comprising an overview and focal photograph of all key issues, as well as records of supervision and monitoring of ESMP, LRP GAP and SEP implementation and other aspects of the environment.

x. PMC environment and social safeguards staff will conduct capacity-building activities for LWASA, LDA, and other relevant departments. The staff will also supervise the work of the contractors in the field to ensure compliance with the safeguard measures outlined in safeguards documents.

xi. The environment and social staff of PMC will review, validate, and ensure the quality of the monthly progress reports prepared by the contractors, and compile them into quarterly progress reports to be submitted to LWASA and AIIB for review and clearance. The staff will also provide support to LWASA in the preparation of a compensation and resettlement assistance completion report(s) prior to the award of the civil works contract, indicating the clearance of those sections where civil works could not commence until full payment of compensation and resettlement assistance to APs has been made.

7.4.4 Engineering Procurement and Construction/Design Build Operate Contractor

The EPC/DB Contractor will be responsible for carrying out the detailed engineering design of the project under the leadership of a full-time Team Leader/Resident Engineer. The Contractor will hire and engage social, gender, and environmental staff along with necessary support staff. The key tasks of the EPC/DB contractors will include:

i. Review the existing ESIA, LRP, GAP and SEP reports prepared during the preliminary design stage and update them based on changes made in the detailed engineering design and site-specific requirement.

ii. Hire and deploy Environment and Social Expert, HSE Expert and Resettlement and Gender Expert. These experts will be responsible to implement all the actions proposed in environmental and social safeguard documents including ESMP, LRP, GAP, and SEP, as well as the GRM by all parties involved in the project after seeking due approvals from

the PMU. They will conduct internal supervision and monitoring of these instruments throughout the project operations to ensure compliance and quality of services provided by the contractor. These specialists will prepare monthly and quarterly progress reports on the environment and safeguards, which will be submitted to the PMC for review and validation.

iii. The Environment and Social Experts of the contractor work in collaboration with the Environment and Social Specialists of the PMC throughout the project implementation in environmental and social safeguards compliance. They will ensure that the contractor's activities are in line with the agreed-upon environmental and social management measures and that any grievances raised by aggrieved persons are addressed through the GRM in a timely and satisfactory manner.

iv. Develop site-specific Environment and Social Management and Monitoring Plans (ESMMP).

v. Disseminate Information (through Brochures or any other media/form) to APs and other stakeholders and implementing all these safeguards documents as disclosed by PMU/ AIIB.

vi. Prepare and implement addendums to the ESIA, LRP, GAP and SEP, to mitigate unforeseen impacts, when required, based on changes in the project design during the execution stage.

vii. Prepare all requisite reports on environmental and social safeguards implementation and submit them to PMC.

viii. EPC will also address the comments received from PMU/AIIB on E&S Documents

7.4.5 Asian Infrastructure Investment Bank (AIIB)

AIIB provides technical guidance to PMU/LWASA and the consultants; supervises the preparation, updating, and implementation of LRP; reviews and approval of LRP, internal and external monitoring reports, and corrective action plan if needed for any identified gaps and provides guidance and required remedial/corrective actions targeting full compliance of the project with safeguard requirements as per ESF.

7.5 EXTERNAL MONITORING AGENCY (EMA)

PMU will hire individual experts or a consultancy firm to conduct external monitoring and evaluation of the ESIA / ESMP, LRP, GAP and SEP during implementation of the project, in order to ensure transparency, accountability, and effective implementation of environmental and social safeguards. The EMA will be responsible for conducting third-party monitoring and evaluation of the implementation of the Environmental and Social Impact Assessment (ESIA), Livelihood Restoration Plan (LRP), Gender Action Plan (GAP), and Stakeholder Engagement Plan (SEP).

The scope of work for the EMA will include, but not be limited to, the following:

- Review and assess the implementation progress of environmental and social safeguard instruments, as reported in the Internal Monitoring Reports (IMRs) prepared by the Executing Agency (EA).
- Verify on-ground implementation of all mitigation and management measures prior to and during the commencement of civil works.
- Evaluate the level of compliance with the approved safeguard documents and determine whether the intended objectives of these plans are being met.
- Identify any gaps or non-compliance issues and recommend corrective and time-

bound remedial actions for effective safeguard implementation.

- Engage with affected stakeholders where needed to validate the findings and ensure their concerns are being addressed.
- Prepare and submit periodic External Monitoring Reports (EMRs) to the PMU, EA, and funding agencies, highlighting key observations, good practices, gaps, and recommendations.
- External monitoring consultant will also issue a corrective action plan for gaps identified during their monitoring which will be implemented by LWASA.
- The reporting requirement of EMA will be on semi-annual basis.

7.6 DEPLOYMENT OF STAFF

For effective dispensation of environmental and social safeguards tasks, environment experts, resettlement experts, gender experts, and HSE experts are required to be deployed by PMU, PMC, and the contractor. This staff will be responsible for carrying out tasks for the implementation of environmental and social safeguards. The details of staff along with costs is given in **Table 7-1** below:

Table 7-1: Detail of Environment and Social Staff

Sr. No.	Position	No.	Scheduling (months)	Unit Cost (PKR.)			Cost estimates (PKR.)	Remarks
				Year 1	Year 2	Year 3		
	Construction Phase							
A1	**PMU Safeguards Unit**							
1	Manager Environmental & Social	1	30	-			-	Position approved by PDWP and provision already taken in PC-I. Further, as per the decision of P&D Board Punjab the same PMU Larechs will look forward to both Phases of LWWMP (Larechs and SWTP), accordingly 2 new positions of Deputy Manager (Environment) PPS-9 and Deputy Manager (Social) PPS-9 have been taken in the SWTP PC-I to strengthen the PMU staff which will be hired after SWTP PC-I approval from ECNEC. The in-house Staff from WASA is already looking forward to the project and will keep looking after the E&S components if required by the Bank.

Sr. No.	Position	No.	Scheduling (months)	Unit Cost (PKR.)			Cost estimates (PKR.)	Remarks
				Year 1	Year 2	Year 3		
A2	**Supervision Consultant**							
1	HSE Compliance Officer	2	30	-			-	Already taken in PMC Contract
2	Environment Expert	1	30	328,363	361,199	397,319	10,658,663	This provision is already made part of the PC-I Larechs and will be utilized during execution of the project (as and when needed).
3	Resettlement Expert	1	30	328,363	361,199	397,319	10,658,663	
4	Gender Expert	1	30	328,363	361,199	397,319	10,658,663	
5	Support Staff	4	30	160,000	176,000	193,600	20,774,400	
	Total						52,750,389	
	Indirect Cost (Communication Cost, administrative cost, Logistics support, Printing of Reports) - 10% Approx.						5,275,050	
	Variation / Contingency						2,529,581	
A3	**EPC Contractor**							
1	Environment & Social Expert	1	30	-	-	-	-	These experts' positions will be a part of the Employer's Requirement to be hired by EPC Contractor.
2	HSE Expert	2	30	-	-	-	-	
3	Resettlement & Gender Expert	1	30	-	-	-	-	
4	Support Staff			-	-	-	-	
	Indirect Cost (Communication Cost, Administrative cost, Logistics support, Printing of Reports)			-	-	-	-	
	Grand Total						**60,555,020**	

7.7 CAPACITY BUILDING AND TRAINING

To improve their capabilities in implementing ESIA to increase awareness and sensitivity towards social and environmental and social aspects of the project, it is crucial to provide training to all relevant staff of PMU, PMC technical staff, EPC/DB contractor, sub-contractors, service providers, and staff from other concerned departments. Environmental and Social Safeguards staff of PMC will provide awareness training and capacity support as needed to ensure the effective implementation of safeguard documents and for learning and development.

The main objective of the training program is to enable effective environmental and social management of the project in compliance with country/provincial laws and regulations, as well as AIIB (Asian Infrastructure Investment Bank) ES Policy, framework, and applicable standards. The training will focus on ensuring that the requirements of LRP and GAP are clearly understood and followed throughout the project implementation process. Project works will commence after approval of the Project by the BOD (Board of Directors) of AIIB, and engagement of PMC and EPC/DB Contractor. The PMU Environment and Social staff will be engaged to handle social, environment, and livelihood compensation issues, and the training program will provide them with the necessary knowledge and skills to effectively deal with these issues. The training/capacity building program will be expanded as per the requirements of the project functionaries.

The training program will include formal training workshops and on-the-job training. All the training will be systematically organized as per the prioritized needs of the staff. The detail of the training is summarized in **Table 7-2.**

Table 7-2: Training Program for Capacity Building

Sr. No.	Participants	Resource person/s	Topics	No. of session & Duration
1.	PMU technical staff, E&S staff EPC/DBO Contractor, sub-contractors and service providers	Resettlement Specialist and Gender Specialist and	● Introduction to AIIB ES Policy, framework and standards ● Brief on LAA and AIIB Policy, Gaps and Measures to Bridge the Gaps ● Brief on the process of recovery possession of encroached land and Resettlement Planning ● Process for identification of impacts and mitigation measures, ESIA/RP/LRP/GAP/SEP preparation, implementation, and monitoring requirements. ● Incorporation of ES safeguards and gender into project design and civil works contracts	Two courses, each of 2 days in duration, (one before the start of the Project and the other just before the start of civil works)

Sr. No.	Participants	Resource person/s	Topics	No. of session & Duration
			● Social sensitivities, human and gender aspects of the project ● Introduction to the ESMP, RP, LRP, GAP and SEP, their importance, and step-by-step implementation ● Consultation, participation, and disclosure ● Entitlements and compensation/resettlement and rehabilitation assistance ● Institutional arrangements ● GRM importance and processes ● Monitoring and evaluation of ESMP, RP, LRP, GAP and SEP ● Budget and Financing for ESMP, RP, LRP, GAP and SEP implementation	
2.	Selected site personnel including project, contractor's and service providers staff	Social and Gender Specialist and Resettlement Specialist	● Introduction to AIIB ES Policy, framework and standards ● Introduction to the ESMP, RP, LRP, GAP and SEP, its importance, and step-by-step implementation ● Social and gender sensitivities of the project ● Consultation, participation and information dissemination ● GRM importance and processes ● Dealing with APs and communities and the public regarding social, gender, and resettlement issues ● Awareness of Occupational, Health & Safety ● Labor management procedures	Prior to start of construction 2 days

Sr. No.	Participants	Resource person/s	Topics	No. of session & Duration
			● Importance, requirements and techniques of Social Monitoring and Reporting	One day
			● Awareness of transmissible diseases ● Social and cultural values (including gender issues)	One day
3.	Relevant staff of LWASA, PMU, contractors Survey and other technical Staff	Social and Gender Specialist and Resettlement Specialist	● Explanation of social parameters to be considered while carrying out surveys for the project.	One 2-day duration course at the start of field activity and 2 courses of half-day duration to be repeated when required
4.	Drivers,	Traffic Police (To be hired) relevant staff of contractors, sub-contractors and service providers	● Road Safety, Defensive Driving, Waste Disposal, Cultural Values and Social Sensitivity.	One day (2 hours session to be held after every 4 to 6 months)
5.	PMU staff, PMC, Contractors' staff		● Issues and Challenges in LRP and GAP implementation ● Review and Revision of Corrective Action Plans	1 day every month throughout the project cycle

7.8 BIDDING AND CONTRACT DOCUMENTS

ESMP is to be included in the bidding and contract documents and verified by the LWASA-Environmental & Social Committee. The LWASA-Environmental & Social Committee will ensure that bidding and contract documents include specific provisions requiring contractors to submit a site-specific environmental and social management plan (SSESMP) prior to start work. The selected contractor will be audited and monitored in the clauses mentioned in the ESMP. No work can be started prior to the approval of ESMP from LWASA Environmental Committee and AIIB. A copy of the approved SSESMP will be kept all the time on site during the construction period of the project. Non-compliance with, or any deviation from, the conditions set out in the SSESMP may lead to failure in compliance and will require corrective actions.

7.9 MONITORING AND EVALUATION

The Monitoring and Evaluation (M&E) process serves to regularly check, assess, and evaluate the status of project activities. It plays a critical role in identifying and resolving bottlenecks at various stages of project implementation and expediting necessary actions. In the context of LRP implementation, M&E serves the interests of project planners, executors, and financiers, who all share a common concern for timely corrective measures. The specific objectives of monitoring and evaluation of LRP implementation are as follows:

i. Administrative monitoring to ensure that LRP implementation timelines are being met.
ii. Assessment of the implementation and sufficiency of compensation and rehabilitation assistance measures.
iii. Identification and timely resolution of problems or potential issues in accordance with the process defined in the LRP.
iv. Identification of immediate methods for responding and mitigating hardships/issues.
v. Monitoring and evaluation (M&E) of LRP implementation will be taken up at all stages of the project. The M&E activities to ensure the effective implementation of LRP are as follows:

7.9.1 Internal Monitoring

One of the main roles of PMU will be to see the proper and timely implementation of all activities of LRP. This will be a continuous activity overseen by the Environment and Social Staff and Project Director of PMU. The Social Safeguard Staff under EPC/DBO Contractor will also assist by sharing information and granting access to relevant records.

The staff of PMC will develop a progress and performance monitoring system to collect and organize monitoring outputs regularly. An information system will be established and periodically updated to contain the database on livelihood compensation planning and implementation, monitored by the Safeguard experts of PMU with the assistance of the social safeguard specialist of PMC. The LRP database, generated through census, socioeconomic survey, recovery possession of encroached government land, resettlement and rehabilitation payments, and consultations/stakeholder engagement, will serve as baseline and essential inputs for the management information system (MIS) for monitoring. Progress monitoring and evaluation of intended outcomes of LRP implementation will be carried out to ensure effective implementation.

7.9.2 Internal Monitoring Role and Responsibilities

The Social Safeguard specialist under PMC will develop a set of gender-disaggregated monitoring indicators and monitoring formats for internal monitoring of LRP. The roles and responsibilities under the monitoring and evaluation plan are outlined as follows:

i. The Project Director of PMU will be responsible for monitoring the progress of the implementation of the resettlement plan, with support from ES teams of PMU and PMC.

ii. LWASA management and PMU will review the effectiveness of the monitoring arrangements related to environmental and social issues every three months and make necessary refinements. PMU will also take into consideration the findings and suggestions made by the third-party/individual consultant engaged in external monitoring of E&S implementation.

7.9.3 Internal Monitoring Arrangements

The monitoring of LRP implementation will primarily be the responsibility of WASA with the support of SS of PMU. The SS will review the status of LRP implementation based on various key indicators at different stages of the resettlement process, including:

i. Reviewing the effectiveness of the recovery possession of encroached land and resettlement planning process, including the adequacy of enumeration of project resettlement impacts, timeframe, budgetary provisions, institutional arrangements, GRM (Grievance Redress Mechanism), and mitigation of unforeseen resettlement impacts.

ii. Verifying if consultations and dissemination campaigns have been organized and carried out effectively to ensure APs are aware of their entitlement packages, payment procedures, grievance redress mechanisms, etc.

iii. Verifying if land and assets situated on the land have been recorded and payments for compensation, resettlement and rehabilitation assistance have been made only to entitled APs recorded before the cut-off date.

iv. Verifying if a grievance redress committee has been established during the stage of detailed engineering design to ensure fairness and transparency during the LRP implementation process.

v. Verifying if the provision of finances for compensation, resettlement, and rehabilitation assistance has been provided on time.

vi. Verifying if three-month advance notices have been given to residents of houses for relocation before demolition of the houses.

vii. Monitoring timely disbursement of compensation, resettlement, and rehabilitation assistance amounts to APs as per the schedule in an efficient and transparent manner, and in conformity with the provisions in the Entitlement Matrix.

viii. Verifying provision of skilled, semi-skilled, and unskilled labor opportunities and employment to affected households (AHs), including the number of persons whose skills are upgraded.

ix. Recording and addressing concerns/grievances of APs on a timely basis during and after the land acquisition and resettlement process, consistent with the LRP.

x. Addressing efficiently any major issues of conflict between APs and contractors during the implementation of resettlement activities.

xi. Monitoring impacts on livelihoods and providing progress and lessons learned to the Project Director for immediate actions and provision of additional funds to cover additional mitigation activities.

xii. Monitoring the effective implementation of the Gender Action Plan, collection of gender-disaggregated data, and gender-specific consultations with women.

xiii. Assessing the degree of satisfaction of APs and AHs who received support for the restoration of their income and livelihood.

xiv. Monitoring changes in social and economic parameters related to the living standards of AHs.

xv. Monitoring the efficient restoration of public utilities and/or other affected services/infrastructure.

The internal monitoring will be carried out on the following key indicators:

- Awareness raising/information disclosure for APs and other stakeholders
- Compensation paid to APs
- Compensation paid to government departments
- Process of compensation payment
- Satisfaction level of APs on compensation payment
- Satisfaction certification of government departments over compensation payment
- Duration of compensation payment
- Grievances on their redressal of compensation payment.

These indicators will be used to assess the progress and performance of LRP implementation, and the findings will inform the necessary actions to ensure that the resettlement activities are

carried out efficiently, transparently, and in compliance with the policy, principles, targets, budget, and duration as laid down in the updated LRP.

Reporting Requirements and Disclosure

The PMU, with the support of PMC, will prepare internal monitoring reports and submit them to AIIB on a quarterly basis during the project implementation period (Table). These reports will cover the status of ESIA, LRP, GAP and SEP implementation, including mitigation measures and remedial actions taken to address adverse environment, land acquisition, resettlement and livelihood impacts, the status of GRM implementation, as well as documentation of complaints and grievances received, and corresponding actions taken for resolution and status of capacity building activities. The Social safeguard staff will maintain up-to-date records of ESIA, LRP, GAP and SEP implementation. Findings of monitoring activities will be included in Monthly Progress Reports regularly and compiled in six-monthly monitoring reports. Similarly, the 3rd party monitoring report/external monitoring report will also be prepared on a quarterly basis to validate the internal monitoring report. The reports will identify the gaps and appropriate recommendations for compliance purposes. The monitoring reports shall reflect the progress in compensation payments and implementation of the LRP, as well as any problems encountered and suggestions for corrective actions. AIIB will review the monitoring reports and, when approved, will issue a notice to proceed with the construction work. All environmental and social safeguards reports and documents shall be disclosed on the websites of AIIB in English and of PMU in the local language.

Table 7-3: Reporting Mechanism for Reporting

Type of Report	Reporting Period	Submitted By	Approval by
Internal Monitoring Report	Quarterly basis	PMU/LWASA	AIIB
EMR	Semi-Annual basis	EMA/PMU/LWASA	AIIB
Final Evaluation Report	On completion of the project	PMU/LWASA	AIIB

7.10 ENVIRONMENTAL AND SOCIAL MONITORING

The Environmental and Social Management Plan (ESMP) covers Monitoring Plan which is also associated with the mitigation plan during the different stages of the project. It ensures that mitigation measures are being effectively implemented. The monitoring of the project is imperative for implementing ESMP. The PMC, through the Environmental Specialist and Resettlement Specialist, will carry out the monitoring at the field level on a regular basis. The PMU environmental and social staff will also carry out periodic monitoring during their site visits. Environmental and Social Safeguard implementation monitoring is an essential tool for testing whether the adopted environmental and social management measures are meeting their stated objectives. Complementary methodology approaches will be applied to monitor the proposed actions under the ESMP:

***Compliance Monitoring*;** which checks whether the actions proposed under the ESMP have been carried out by visual observation, photographic documentation and the use of checklists prepared for the ESMP;

***Effects Monitoring*;** which records the consequences of projects activities on the biophysical and social environment; as applicable, these effects will be measured by applying selected indicators.

The plan also explains the monitoring mechanism and identifies a set of verifiable monitoring parameters to ensure that all proposed mitigation measures laid down in the ESMP are

completely and effectively implemented.

Table 7-4: Environmental and Social Management Plan during Design Phase

No.	Parameters	Target	Mitigation Measures	Responsibility	Compliance Monitoring Responsibility
A) Biophysical Environment					
1.	Odor from Pump Stations and Sewer Pipes	To eliminate the issue of odor during operation phase	▪ Internal surfaces of pipes will be designed in such a way that it provides protection against Hydrogen Sulfide (H_2S) reactions. ▪ Proposed wells will be closed using reinforced cement concrete (RCC) slabs. Design of RCC slab will consider both superimposed loads (human and equipment loads) and severe corrosion risk from sewer gas from within wells; and ▪ RCC Slab will be designed and fixed in a modular manner such that access to pumps and appurtenances, and other equipment can be provided for maintenance, replacement and renewal purposes.	PMC Lahore Water and Sanitation Agency (LWASA)	Proponent through Project Management Consultants (PMC)
2.	Climate Change	To combat issues of greenhouse emissions from leakages of pipes	▪ Sewerage pipes will be designed in such a way that it minimizes leakages and withstand existing sewerage flows; ▪ Proper monitoring of sewerage pipes during operational phase to check leakages will be ensured; and ▪ Proper training for LWASA Staff will be conducted for operation and maintenance of sewer system, and Awareness among local population regarding impacts of Climate Change.	DC and LWASA	Proponent through PMC
3.	Seismic Hazard	To keep the structures safe and	▪ The structures of the proposed project will be	PMC and	Proponent

No.	Parameters	Target	Mitigation Measures	Responsibility	Compliance Monitoring Responsibility
		intact in case of earthquake	designed and constructed to withstand low to moderate earthquakes. For seismic hazard analysis, updated structural and seismic evaluations will be consulted; and ▪ To mitigate the seismic hazard, Seismic Building Code of Pakistan 2007 (SBC-07) will be adopted. This code specifies minimum requirements for seismic safety of buildings and structures and has to be applied and used by design engineers in conjunction with the necessary understanding of the concepts of structural geotechnical and earthquake engineering.	LWASA	through PMC
4.	Pollutant Load on Receiving Body	Increase in collection efficiency of wastewater of lower pollutant load	▪ The wastewater streams incoming to the River Ravi from Shahdara and Mehmood Booti & Shadbagh will be treated by the proposed wastewater treatment plants by the Ravi Urban Development Authority (RUDA). ▪ A wastewater treatment plant (WWTP) is planned by LWASA as a separate project that has been designed and shall be constructed with financial assistance of Agence Francaise de Development (AFD) at Babu Sabu.	PMU Babu Sabu, RUDA and LWASA	Proponent through PMUs
5.	Groundwater	Elimination of seepage through the sewers due to corrosion and leakage	▪ Selection of standard materials during the planning stage will be considered for efficient seepage control; and ▪ Alternate arrangements will be suggested in design to cater the sewage flow during construction and operational phase.	PMC and LWASA	Proponent through PMC

No.	Parameters	Target	Mitigation Measures	Responsibility	Compliance Monitoring Responsibility
6.	Flooding Patterns	Provision of rainwater drainage during intense rainfall events	▪ Consideration of flood pattern and average rainfall of the area in design.	PMC and LWASA	Proponent through PMC
7.	Topography	To avoid adverse permanent changes in the topography of the proposed project site	▪ Due consideration will be given to aesthetic improvement during the design phase by avoiding excessive excavation and removal of vegetation.	PMC and LWASA	Proponent through PMC
8.	Traffic Congestion	To reduce the congestion of traffic	▪ A traffic study will be carried out during the design phase, to determine the existing traffic load and the possible traffic congestion during the construction phase and evaluate the possible solutions to overcome these future traffic problems.	PMC and LWASA	Proponent through PMC
9.	Resource Conservation	To minimize unnecessary and excessive use of resources	▪ Reduction of wastage of water through training of workers involved in water use will be planned. ▪ Careful selection of water source to minimize disturbances to existing community water supplies. ▪ Plans for reuse of construction waste materials will be formulated. ▪ Plan for use of solar panels at operation phase will be considered; and ▪ A good camp design and an efficient worksite management plan will be prepared that will help the contractor to reduce the water demand, and wastewater and solid waste volumes to the lowest levels.	PMC and LWASA	Proponent through PMC
10.	Flora	Evade tree cutting as much as possible	▪ Incorporate technical design measures to minimize removal of these trees, as far as possible;	PMC and LWASA	Proponent through PMC

No.	Parameters	Target	Mitigation Measures	Responsibility	Compliance Monitoring Responsibility
			▪ A plan for the transplantation of trees especially fruit trees, will be devised; ▪ Compensatory planting of ten trees against each fallen tree of similar floral function will be planned; and ▪ Plantation plan will prefer the prevalent indigenous species of plants.		
B) Socioeconomic Environment					
11.	Livelihood Impact	Prevaricate livelihood issues	▪ Due consideration will be given to minimizing or no land acquisition in design phase; ▪ Land will be acquired according to the Land Acquisition Act (LAA), 1894; (if required) ▪ Compensation will be evaluated based on market rates; ▪ Compensation will be made before the construction starts; and ▪ In order to curb problems arising from loss of employment and livelihood, a detailed Livelihood Restoration Plan (LRP) has been prepared.	PMC and LWASA	Proponent through PMC

KEY DC Design Consultant LWASA Lahore Water and Sanitation Agency

Table 7-5: Environmental and Social Management Plan during Construction and Operational Phase

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
A) Construction Phase						
i) Biophysical Environment						
1.	Visual Intrusion	To remove excavation and construction material from the site after completion of construction activity	▪ Material stockpiles will be removed as soon as work is completed and the area is re-landscaped.	Soil erosion and dust pollution	Visual Inspection Daily	CC, SC and LWASA
2.	Soil	To minimize soil erosion and seepage runoff	▪ Stored excavated material will be covered and preferably reused; ▪ Prepare a plan for use and movement of construction vehicles within the area based on the nature of soil; ▪ Vehicles and equipment movement will be confined to dry areas with hardened soil; no vehicle and equipment will enter the damp areas, water areas, vegetative areas and areas with soft soil; ▪ Sprinkling of water will help in reducing the erosion of soil; ▪ Non-bituminous wastes from construction activities will be dumped in approved sites, in line with the guidelines for dump sites, and must be covered; ▪ Controlling runoff volumes and intercept	Soil erosion and contamination and dust pollution	Visual Inspection Daily	CC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			runoff before it leaves the site; ▪ Excess spoil will be reused where possible and residual spoil can be disposed of at designated site to prevent erosion; ▪ Confining excavations to the specified spots as per the approved engineering drawings and unnecessary excavations will be avoided; and ▪ Re-vegetation of exposed areas around the site (if any) will be carried out rapidly, in order to mitigate against erosion of soil through surface water runoff and wind erosion.			
3.	Water Quality	To avoid or minimize deteriorating the quality of water	▪ Protection of groundwater reserves from any source of contamination such as the construction and oily waste that will degrade its potable quality; ▪ Water required for construction will be obtained in a sustainable way that the water availability and supply to nearby communities remain unaffected; ▪ Stockpiles of cement and other construction materials will be kept covered when not being used; ▪ Avoid stockpiling of earth fill especially during the intense rainfall events unless covered by tarpaulins or plastic sheets; ▪ Avoid fuel and other chemicals being stored at numerous locations around the site;	Surface runoff and dumping of solid and liquid waste in water body	Visual Inspection Daily and Surface and Ground Water Monitoring quarterly during the whole construction period	EC, CC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			▪ Maintenance of vehicles and plant will be carried out only on impermeable areas where any oil spillages can be contained; ▪ Oils, fuel and chemicals must be stored at bunded fuel stores and mobile bunded stores; ▪ Careful planning of the works to avoid soil excavation works during intense rainfall events; ▪ All kinds of waste will be stored in covered containers and disposed of safely as soon as possible; and ▪ Temporary sanitary facilities, such as portable chemical toilets, will be employed on-site. A licensed contractor will be responsible for appropriate disposal and maintenance of these facilities.			
4.	Air Quality	To minimize air pollution and maintain the air quality	▪ All vehicles, machinery, equipment and generators used during construction activities will be kept in good working condition, properly tuned and maintained in order to minimize the exhaust emissions. ▪ Open burning of solid waste from the contractor's camps will be strictly banned. ▪ Use of fuel with substantially lower Sulphur content; ▪ Proper maintenance and repair of power generators and construction machinery is needed to minimize the hazardous	Emission of dust particles from construction machinery, equipment, soil erosion and exhaust gasses from generators and other earthmoving vehicles. Unusual	Visual Inspection Daily and Air Quality Monitoring quarterly during the whole construction period	EC, EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			emissions; ▪ Personal Protective Equipment (PPEs) like masks, safety goggles, safety shoes, safety belts and safety gloves will be provided to workers; ▪ PEQS, 2016 applicable to gaseous emissions generated by construction vehicles, equipment and machinery will be enforced during construction works; ▪ Regular water sprinkling on the site and access roads will be carried out to suppress excessive dust emission(s); ▪ Storage pile activity (i.e. loading and unloading) will be confined to the downwind side of the storage pile. This practice applies to areas around the s t o r a g e pile as well as the pile itself. Storage piles will also be located away from downwind site boundaries; ▪ For the concrete mixing stations, the dumping of stone, sand, gravel and containers will be carried out in daytime; and the loading and unloading works for trucks, mortar mixing and pumping work may be carried out in daytime, or far from populated areas; ▪ Preventive measures against dust will be adopted for on-site mixing and unloading operations; ▪ The vehicles carrying construction materials	noise/sounds and vibrations		

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			and the construction material storage areas will be covered with tarpaulin; ▪ Vehicle speed in the project area will be prescribed not more than 20 kilometer per hour and controlled accordingly; ▪ Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored; and ▪ Air emission monitoring program for NO_2, SO_2, CO and PM_{10} will be undertaken by the EPC contractor, according to the program specified in the Environmental and Social Management and Mitigation Plan (ESMMP).			
5.	Noise and Vibration	To minimize the impact of noise on workers and local community	▪ The vibrations produced during the excavation by the tunneling activities will be closely monitored; ▪ Deployment of quieter Equipment; ▪ A cost-effective way to reduce noise at a construction worksite is to buy quiet equipment. In addition, equipment in use will be the most suitable for the job. The contractor will avoid using equipment that is over-powered, and conversely avoid using under powered equipment. Wherever	Noise and vibration from construction machinery and equipment	Consistent Vibrations monitoring Visual Inspection Daily and Noise Quality Monitoring quarterly during the whole construction period	EC, EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			possible, the quietest equipment alternative will be used, which is mostly electronic powered equipment that is quieter than diesel powered equipment and also hydraulically powered equipment that is quieter than pneumatic power; ▪ Modifying Existing Old Equipment The most common way to reduce the noise levels of common construction equipment is through worksite modifications. The contractor will do some worksite modifications by retrofitting existing equipment with damping materials and mufflers; ▪ Barrier Protection An effective way of reducing noise is to locate noisy equipment behind purpose-built barriers. The barriers can be constructed on the work site from common construction building material (plywood, block, stacks and spoils) or the barriers can be constructed from commercial panels which are lined with sound absorbing material to achieve the maximum shielding effect possible. For the effectiveness, the length of the barrier will be greater than its height. The noise source will not be visible, and barrier will be located as close as possible either to the noise source or the receiver. The contractor may adopt these measures at the shaft construction sites;			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			▪ Work Activity Scheduling Work activity scheduling are administrative means to control noise exposure. Planning how noise sources are sited and organized on a work site will reduce noise hazards; ▪ The contractor will ensure that the jobs of the skilled and unskilled workers would be rotated, so that exposure time is limited. Transferring workers from a high exposure task to a lower exposure task will make the employee's daily noise exposure acceptable. Administrative controls include activity planning, for example: scheduling pavement breaking operations, to reduce the number of work site workers exposed. In addition, noisy equipment will not be run for periods longer than necessary, and will be switched off when not in use; ▪ The contractor will pay amplified attention to the maintenance of tools and equipment, as it will reduce worksite noise levels. Maintaining plant and equipment in good order not only increases its life, but makes it safer to use and quieter. Loose and worn parts will be fixed as soon as possible. Ideally, the worksite will have a system in place for checking, and servicing the various machines and power tools; ▪ Noise Perimeter Zones Noise perimeter zones (NPZ) are another administrative control to limit exposure to noisy			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			processes or equipment to as few workers as possible. NPZ are areas where noise levels of 80 dB; ▪ NPZ can be set up using a sound level meter to find the safe distance from the source (80 dB (A)) and the NPZ can be set up at that distance. Noise does not radiate from the source at the same level in all directions. Noise from machinery can be higher in one direction than another because the noise can also be either absorbed or reflected from surfaces it contacts, such as the ground or a wall. Therefore, measurements will be taken at several points in an area where people might be working. Once noise levels that are 80 dB (A) or more are determined, rope off this area as the Noise Perimeter Zone. Exclude all workers who do not need to be in that zone. All workers who need to work within the zone must wear hearing protection; ▪ Residents in and around the area of influence of the proposed project site will be notified earlier, before commencement of excavation operations; ▪ Horns will not be used unless it is necessary to warn other road users or animals of the vehicle's approach; ▪ Earth retaining walls will be constructed to contain the vibrations; ▪ Contractors will comply with submitted work schedule, keeping noisy operations away			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			from sensitive points; implement regular maintenance and repairs; and employ strict implementation of operation procedures; ▪ Sensitize truck drivers to avoid hooting, especially when passing through sensitive areas such as mosques, churches, residential areas educational institutions and hospitals; ▪ Locating the concrete mixing and materials shipment yards at least two kilometers away from residential areas, schools, and hospitals, will also help reduce local noise levels; ▪ The plants and equipment used for construction will strictly conform to noise standards specified in the PEQS, 2016; ▪ Planting of buffer trees and shrubs in the proposed project site, if possible; and ▪ Excavation near old and historical buildings will be avoided. As per Antiquities Act 1975, all the construction activities will be done 200 feet away from archaeological sites; If needed, No Objection Certificate (NOC) will be obtained from archeology departments and other concerned departments.			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
6.	Solid Waste (Construction, Municipal, solar photovoltaic (PV) waste and Hazardous Waste)	To avoid and minimize nuisance and environmental pollution in the project area due to solid waste.	▪ The waste generated from the camp site will be disposed of at LWMC approved sites; ▪ Contractor will be in close coordination with LWMC throughout this project; ▪ Burning waste will be prohibited; ▪ Proper labeling of waste containers, including the identification and quantity of the contents, hazard contact information will be carried out; ▪ Training of employees involved in the transportation of hazardous material regarding emergency procedures will be ensured; ▪ Waste pile will be controlled so that it does not spread and start to impede other activities, and stays at a height that it does not become a safety hazard. Barricades will also be placed around the pile to delineate the safe distance for other workers; ▪ Residual and hazardous wastes such as oils, fuels, and lubricants will be disposed-off via licensed third parties; ▪ Liquid waste, such as grey water, sewage, slurry and other wastewater will be collected from source by a designated tanker, and taken off-site for disposal at safe disposal facility; ▪ If the waste pile contains plastic, paper and other light-weight material it will be covered	Burning of waste at camp site, and open dumping of waste into water bodies and nearby road sides	Visual Inspection Daily	EPCC, SC, LWMC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			with a net, and tarpaulin or similar to stop waste from blowing around; ▪ Construction workers and supervisory staff will be encouraged and educated to practice waste minimization, reuse and recycling to reduce quantity of the waste; ▪ Waste disposal plan will be reviewed during the entire construction phase in the light of changing weather conditions; ▪ Construction waste such as waste wood will be recovered and recycled into wood for new building projects, and cement, bricks, and plaster can be crushed and reused in other construction and building projects; and ▪ The contractor will ensure implementation of waste management plan.			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
7.	Disposal of Slurry	Proper disposal of slurry from the site	▪ A Slurry management plan will be devised by contractor in coordination with LWASA and LWMC to treat slurry containing bentonite as required and disposed of designated sites (provided by LWASA) such that it causes minimum environmental damage; ▪ Slurry will be kept away from the residential areas along the proposed project route; ▪ Bentonite slurry will be kept away from drainage and sewer systems, where it can enter into circulation with other water; ▪ Exhumed bentonite slurry will be recycled or re- used for other construction activities by its regular monitoring and testing; ▪ Proper landscaping, which will be given due consideration along with re-establishment of the local and indigenous vegetation; and ▪ The excavated materials that are unsuitable for use will be stored, transported and disposed of appropriately at designated sites (provided by LWASA).	Open dumping of slurry	Visual Inspection Weekly	EPCC, SC, LWMC and LWASA
8.	Construction Camps Sites	Minimize disturbance to local people and local ecology	▪ Reinstate any temporary facilities to pre-existing conditions in ecologically sensitive areas; ▪ Implement landscaping plan for all facilities in areas where high landscape value and visual vulnerability to the proposed activities	Surface and ground water pollution, damage to local flora and fauna, and conflicts with the local	Visual Inspection Start of the Project and twice a month	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			warrants site-specific landscape restoration measures; ▪ Operate equipment in a manner sympathetic to the ambient noise environment. Do not leave equipment idling unnecessary; ▪ Provide adequate warnings of impeding works to all potential receptors within a one-kilometer corridor surrounding the right-of-way via public notices and local news; ▪ Contractor will provide septic tank for the toilets to treat the sanitary wastewater before its discharge; ▪ Avoid tree cutting for setting up camp facilities; ▪ Provide labor with LPG for cooking as to avoid wood burning; ▪ Provide a proper fencing and compound wall for camp sites; ▪ The camp sites will be adequately drained to avoid the accumulation of stagnant water; ▪ Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit; ▪ Train employees in the storage and handling of materials which can potentially cause soil contamination; ▪ Employment policies which aim to maximize job opportunities for local people will help to	communities		

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			minimize tensions caused by different socio-cultural values; ▪ Training will be provided to all staff on camp sites management rules and overall discipline and cultural awareness. This will include, in appropriate languages; ▪ A briefing on camp rules; A community relations orientation to increase awareness about the local area, cultural sensitivities and the project Code of Conduct; and ▪ Awareness-raising on health considerations, including Sexually Transmitted Diseases (STDs). ▪ The EPC contractor is required to develop a Construction Camp Management Plan to address: o Discipline; o Community liaison; o Ethnic tensions; o Communicable diseases; and o A Code of Conduct and Camp Rules will be required within the Construction Camp Management Plan, which provides policies and a disciplinary framework with respect to worker behavior.			
9.	Traffic Disruption	To avoid traffic jams and congestions	▪ It is strongly recommended that the contractor will be responsible for the submission of a final Traffic Management	Traffic issues due to construction	Visual Inspection Daily	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			Plan (TMP), liaise with Traffic Police Department. Keeping in view the Micro Tunnel Boring Machine (MTBM) process. It is recommended that the TMP must comprise the following: ▪ Define scope of area that will be affected by construction activities; ▪ Provide sequence of construction operations; ▪ Describe when each phase will commence and finish; ▪ Provide duration of work; ▪ Note proposed hours of work activity on the site; ▪ Prior to creating diversions and detours the citizens will be consulted well in advance through electronic and print media; ▪ The narrow roads like Babu Sabu Nonarian Road and Garhi Shahu Bazar will require special attention due to local conditions; temporary bridges may be provided for access purposes; ▪ The traffic control plans will contain details of temporary diversions, details of arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, safety measures for transport of hazardous material and arrangement of flagmen; ▪ Special consideration will be given to the	activities		

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			preparation of the traffic control plan for safety of pedestrians and workers at night; ▪ Schedule hauling of construction materials during off-peak hours; ▪ Establish speed limits especially in proximity to sensitive receptors and sensitize the truck drivers on speed limit; ▪ Vehicular access to and from hospitals and fire stations will be maintained through the use of steel road plates over open trenches; ▪ The Contractor will ensure that the diversion and detour is always maintained in running condition, particularly during the intense rainfall events to avoid disruption to traffic flow; ▪ All the construction activities including material, and waste and surplus soil stocking will be confined to the road carriageway by the Contractor, to the minimum possible extent. In addition to that proper barricading will be provided; ▪ Contractor will adopt best construction practices i.e. vertical cutting approach with proper shoring and bracing, to limit the width of trench excavation; ▪ The temporary traffic detours will be kept free of dust by frequent application of water; ▪ Traffic controls and diversions marked with signs, lights and other measures (flags) will			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			be provided; ▪ At work site, public information, safety and caution boards will be provided including contact information for public complaints; and ▪ A flag is raised through this ESMP that a special attention will be given to traffic plans of Nunarian Rd.			
10.	Interference with other Utilities	Minimize disturbance to existing utilities	▪ Contractor in liaison with Client and Supervision Consultant will consult with all concerned departments Pakistan Telecommunication Company Limited (PTCL), Sui Northern Gas Pipelines Limited (SNGPL), and Lahore Electric Supply Company, to delineate their network locations and alignments; ▪ A taskforce comprising on one member of each relevant government departments will be formed to promptly resolve any issue; ▪ Proper compensation will be given to the concerned departments, in case of utility disturbed or if need relocation; ▪ Inform local residents via notices in advance about complete project program, and disruption to utility services, while their work. ▪ Layout plans of the existing underground alignment will be shared with the site workers, so that they may avoid any damage to the existing structures and installation; and ▪ Concerned departments will be informed on	Displacement of utilities for construction activities	Visual Inspection Start of the Project	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			immediate basis, in case of any damage to utility services to the sub surface infrastructure has occurred.			
11.	Greenhouse Gases and Climate Change	To avoid emissions of greenhouse gases	▪ Use construction machinery designed with suitable pollution abatement technology such as scrubbers; ▪ In order to control NO_2 emission at site, diesel engine equipment and machinery will be installed with catalytic converter, as it allows diesel engine to take advantage of the trade-off between NO_2, PM_{10} and fuel consumption, and calibrate the engine in a lower area of fuel consumption; ▪ Used and old electrical equipment will be banned that can also help to reduce urban emissions; ▪ Environmentally friendly fuel such as Liquefied Petroleum Gas (LPG) may be used instead of diesel; ▪ Burning of waste will be strictly prohibited at site; ▪ Awareness programs of causes and effects of climate change will be conducted for mitigating GHG emissions; and ▪ Use of solar panels at construction camp sites instead of diesel generators.	Emissions from construction machinery and equipment and improper dumping of solid and liquid waste	Visual Inspection Daily	EPCC, SC and LWASA
12.	Resource Conservation	Sustainable use of resources	▪ Diesel and fuels with low Sulphur content will be used to operate construction machinery	Operation of construction	Visual Inspection Daily	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			and equipment; ▪ The efficient and well-maintained equipment and machinery will be used; ▪ The equipment and machinery will be turned off when not in use; ▪ Regular maintenance of machinery to avoid fuel leakages; ▪ Reduction of wastage of water through training of workers involved in water use will be planned; ▪ Plan for reuse of construction waste materials may be formulated; ▪ A good camp design and an efficient worksite management plan will be prepared that may help the contractor to reduce the water demand, and wastewater and solid waste volumes to the lowest levels; and ▪ Use of solar panels at camp sites to conserve energy.	machinery		
13.	Flora	Avoid tree cutting and protection of floral species from disturbance and impairment	▪ Compensatory planting of ten trees against each fallen tree of similar floral function will be planned which is as per one ratio ten; ▪ The tree plantation plan will be implemented in the project area and may prefer the prevalent indigenous species of plants; ▪ Efforts will be made to avoid cutting of trees for the project site and construction camps as	Construction sites and camps in and around the green area	Visual Inspection Daily	EPCC, SC, PHA and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			far as practically possible; ▪ To minimize the dust emissions, regular water sprinkling will be strictly followed; ▪ The Contractor staff and labor will be strictly directed not to damage any nearby vegetation such as trees or bushes. They may use the paths and tracks for movement, but not allowed to trespass through green area; ▪ Construction vehicles, machinery and equipment will remain confined within their designated areas of movement; and ▪ Contractor will provide gas cylinders at the Camp sites for cooking purposes and cutting of trees and bushes for fuel will not be allowed.			
14.	Fauna	Protection of floral species from disturbance and hunting	▪ Hunting, poaching and harassing of wild animals will be strictly prohibited; ▪ The camps will be properly fenced and gated, to check the entry of birds and mammals in search of eatable goods.	Construction sites and camps	Visual Inspection Daily	EPCC, SC and LWASA
ii) Socioeconomic Environment						
15.	Historical, Cultural and Archaeological Sites	Avoid damage to historical site and monuments	▪ LWASA or the contractor will acquire an approval from the concerned department prior to construction; ▪ Contractor will strictly follow the submitted	Noise and vibration from excavation sites and traffic	Visual Inspection Daily	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			work plan in order to avoid traffic problems; ▪ Alternate route will be assigned for the people going towards these historical and cultural places during public holidays; ▪ As per Antiquities Act 1975, all the construction activities will be done 200 feet away from archaeological sites; **Section 22 of Antiquity Act Punjab** *"Execution of development schemes and new constructions in proximity to immovable antiquity. – Notwithstanding anything contained in any other law for the time being in force, no development plan or scheme or new construction on, or within a distance of two hundred feet of, a protected immovable antiquity shall be undertaken or executed except with the approval of the Director General"* ▪ Construction Machinery that produces less noise and vibration will be used along these sites; ▪ Ensure regular sprinkling of water in all active construction areas near cultural and heritage sites; ▪ Follow steps mentioned in a chance find procedure in the event, if any unknown cultural heritage is found during any excavation activity; and ▪ Project Director will ensure that the chance find procedure is communicated to EPC	disruption near historical sites and routes		

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			contractor prior to start of project.			
16.	Health and Safety	To avoid or minimize occupational (skilled & un-skilled workers, supply chain labor and workers) and health hazards, community hazards, accidental risks and man-made disasters	**Occupational Health and Safety:** ▪ The EPC contractor must depute a safety officer with specified responsibilities to supervise all the construction activities at the proposed project site; ▪ Providing basic medical training to specified work staff, and basic medical service and supplies to workers; ▪ Obligatory insurance against accidents for laborers and employees; ▪ Layout plan for camp site, indicating safety measures taken by the contractor, e.g. firefighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents; ▪ Work safety measures and good workmanship practices will be followed by the contractor to ensure no health risks for laborers; ▪ Protection devices (ear muffs) will be provided to the workers, doing job in the vicinity of high noise generating machines; ▪ Disallow worker exposure to noise level greater than 85 dBA for duration of more than eight hours per day without hearing	Construction activities	Visual Inspection Daily	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			protection. The use of hearing protection will be enforced actively; ▪ Provision of adequate sanitation, washing, cooking and dormitory facilities including light up to satisfaction; ▪ Provision of protective clothing for laborers handling hazardous materials, e.g. helmet, adequate footwear for bituminous pavement works, protective goggles and gloves; ▪ Ensure strict use of wearing these protective clothing during work activities; ▪ Elaboration of a contingency planning in case of major accidents; ▪ All trenches deeper than two meters will be protected with wooden bracing to avoid safety risks to workers, public and nearby buildings and structures; ▪ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; ▪ Ensure moving equipment will be outfitted with audible back-up alarms; ▪ Ensuring the availability of a mobile dispensary at the active construction site throughout the construction period to provide emergency treatment; ▪ Ensure that the site will be restricted for the entry of irrelevant people particularly			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			children, disabled and elderly peoples; ▪ Adequate lightning devices, barriers, yellow tape and safety signage will be posted; and ▪ Use of safety signs at the construction site. **Solar PV system installation** ▪ Use suction lifters or panel grips to safely handle glass panels and avoid breakage or injury. ▪ Store panels in upright, secure positions to prevent tipping. ▪ Allow only trained electricians to perform DC and AC wiring, inverter installation, and system energization. ▪ Provide anti-reflective or UV-protective eyewear to workers installing panels under direct sunlight. ▪ Use anchorage points, full-body harnesses, and fall arrest systems when working on rooftops or elevated structures; ▪ Ensure ladders and scaffolding are stable and compliant with safety standards; ▪ Install batteries in ventilated, fire-rated enclosures away from direct sunlight and flammable materials; ▪ Train workers on battery chemical hazards (especially lithium-ion) and spill response;			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			Community Health and Safety: ▪ Babu Sabu Nonarian Road and Garhi Shahu Road are narrow roads and the resident and shops can face access issues besides other physical impacts. The contractor will prepare the site-specific workers and community safety and traffic management plans; ▪ There will be proper control on construction activities and oil spillage of vehicles; ▪ The labor with different transmittable diseases will be restricted within the construction site; ▪ Efforts will be made to create awareness about road safety among the drivers operating construction vehicles; ▪ Provide wooden bracing for all deep excavations that may require especially for sewer lines (less than two meters); identify buildings at risk prior to start of excavation work and take necessary precautions for safe conduct of work; ▪ Confine work areas; prevent public access to all areas where construction works are on-going through the use of barricading and security personnel; ▪ Attach warning signs, blinkers to the barricading to caution the public about the hazards associated with the works, and presence of deep excavation;			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			▪ Minimize the duration of time when the sewer trench/shaft is (are) left open through careful planning; plan the work properly from excavation to refilling and road relaying; ▪ Enforce strict speed limit (20 kilometer per hour) for plying on unpaved roads, construction tracks; ▪ Regular water sprinkling will be done on all construction active areas present close to sensitive receptors in order to reduce dust exposure; ▪ Ramps will be placed in front of schools and houses gates so that accidents due to slips may be avoided; ▪ Timely public notification on planned construction works; ▪ Close consultation with local communities (residential areas along the project alignment) to identify optimal solutions for diversions to maintain community integrity and social links; ▪ Provision of proper safety signage, particularly at sensitive and accident-prone spots; ▪ If identified, consider guard rails at accident-prone stretches and sensitive locations; ▪ The communicable disease of most concern during construction phase, like sexually-transmitted disease (STDs) such as			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			HIV/AIDS, will be prevented by successful initiative typically involving health awareness; education initiatives; training heath workers in disease treatment; immunization program and providing health service; ▪ Reducing the impacts of vector borne diseases on long-term health effect of workers will be accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease, which includes: Prevention of larval and adult propagation of vectors through sanitary improvements and elimination of breeding habitat close to human settlements and by eliminating any unusable impounding of water; ▪ During construction work, pedestrian and vehicular passages will be provided for crossing near settlement; and ▪ Use of water will not disturb public water availability, and source of water will be selected carefully. **Accidental Risks:** ▪ Contractor will designate one of the staff members to act as lead person for emergency response and safety issues; ▪ Contractor will be responsible to provide first aid facilities at construction site as well as camp; ▪ Contractor will provide safety equipment			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			such as helmets, goggles, ear plugs, gloves, safety harnesses and safety shoes etc. to the workers; ▪ Safety signage will be erected at potentially dangerous working areas; ▪ Proper lighting arrangements will be ensured for night shift working; ▪ Contractor will be responsible to provide insurance against accidental death and injuries to workers and public; and ▪ Public and animal access to construction site will be restricted by providing fences. **Night time Construction Activities:** ▪ The construction site will be appropriately illuminated and lights will turn on 30 minutes prior to the sunset; ▪ Site will be cordoned off and proper visible signage, flashing lights and flags will be installed at suitable points; ▪ There will be minimum material and vehicular movement during the night; ▪ Female workers will not be allowed to work after sunset; ▪ The nearby community will be informed prior to the night time activity; and ▪ In order to avoid accidents Special Standard Operating Procedures for night time working and material handling will be developed by			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			the contractor and relevant training will be given to the workforce. **Natural and Man-Made Disasters:** ▪ An Emergency Response Plan for earthquakes and manmade disasters will be developed by contractor in coordination with LWASA and will be implemented in close consultation with the RESCUE 1122 Services and other concerned departments; ▪ Training of the LWASA staff and employees regarding the emergency procedures and plans will be regularly conducted; ▪ Emergency numbers will be clearly posted at all disposal stations; ▪ Minor incidents and near misses will be reported, and preventive measures will be formulated accordingly by the LWASA Management; and ▪ The Emergency Response Plan has been prepared and can be made available upon request.			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
17.	Disturbance to the Residents and Social and Cultural Conflicts	Avoid social and cultural conflicts with residents	▪ During the construction phase, mobility of workers in the nearby areas will be strictly restricted by the contractor to avoid any inconvenience to the local communities especially women; ▪ The contractor will select specific timings for construction work to cause least disturbance to the local population considering their peak movement hours; ▪ Contractor will take care of the concerns of the local community; ▪ The contractor and traffic police will implement the approved traffic management plan; ▪ Local labor especially from nearby communities will be given preference for the construction works; ▪ Public notification through print or electronic media during the entire construction phase to avoid any inconvenience in accessibility to the locals; and ▪ Adequate training of especially for the transitive workforce of the station (involved both in the construction process and in the commissioning) to regard the customs of the area so that the locals do not feel insecure.	Construction camps and sites	Visual Inspection Daily	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
18.	Impacts on Livelihood	Avoid temporary land acquisition and disturbance to local business holders	▪ Standalone LRP is prepared, and it will be implemented before the start of the construction; ▪ Proper compensation will be provided to all the affectees losing their livelihoods in the project area; ▪ Relevant stakeholders will be engaged to design livelihood restoration measures including affectees of the proposed project area; ▪ Livelihood restoration committee will be formed by LWASA, to ensure monitoring of the compensation to be provided to the affectees; ▪ Initial assessment of compensation will be carried out for the income loss of the affectees based upon the current approximation of the shaft locations. This assessment will be reviewed and revised on the basis of final shaft locations determined during the construction phase; ▪ Project Construction will be completed on time; ▪ Proper awareness and training will be conducted among the affectees regarding project benefits, reasons for acquiring lands and compensations to be provided.	Effects on livelihood due to construction activities	Visual Inspection Start of the Project	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
19.	Influx of Labor	To avoid conflicts related to labor influx	▪ Make arrangements to treat the affected workers on time to control the movement of vectors disease; ▪ Sensitize workers and surrounding communities on awareness and prevention of HIV/AIDS through training, awareness campaigns and workshops during community meetings; ▪ Provide proper and free HIV/AIDS health screening and counseling for site workers and community members; ▪ Develop and enforce a strict code of conduct for workers to regulate behavior in the local communities; ▪ Taking all sensible precautions to avert illicit, vicious conduct by or amongst the Contractor's personnel, and to preserve unity and harmony, and protection of people and property on and near the sites; ▪ Prohibiting drugs, alcohol, weapons, and ammunition on the worksite among personnel; ▪ Site security preparations must be contained within the Bills of Quantities (BoQs) to avoid any delays which might be caused due to insecurity; ▪ Appropriate fencing, security check points, gates and security guards will be provided at the construction sites to ensure the security	Hiring of workers during the construction supervision	Visual Inspection Start of the Project	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			of all plant, equipment, machinery and materials, as well as to secure the safety of site staff; and ▪ The Contractor must guarantee that good relations are maintained with local communities and their leaders to help reduce the risk of vandalism and theft. ▪ To mitigate labor risks during solar PV installation, the project will ensure all workers have written contracts, fair working conditions, and access to grievance mechanisms. Contractors will be screened for compliance with labor laws, and a code of conduct will prevent child labor, forced labor, and gender-based violence. Local hiring will be prioritized, and worker accommodation (if provided) will respect dignity and freedom of movement. Additionally, due diligence will be applied to the solar supply chain to identify and avoid labor exploitation in the sourcing of panels, inverters, and batteries.			
20.	Gender Based Violence Harassment and Wage Discrimination	Avoid gender discrimination and conflicts	▪ Awareness will be created among the females at individual and community levels about the construction sites; ▪ During the timing of educational institutions workers will not be allowed to crowd in the surroundings; ▪ Female workers will not be allowed to work in	Hiring of workers during the construction supervision, and during construction activities	Visual Inspection Start of the Project and Daily	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			the night shift; ▪ Gender protection act will strictly be enforced during the construction activities in the project area, and monitor the implementation through field staff and district level structure; ▪ Raise awareness among the communities of the potential risks of GBV, and establish response services in the communities that can respond to instances of GBV (particularly those related to issues of labor influx); ▪ The Contractor will make sure that no discrimination is made on the basis of gender while hiring of workers; ▪ Provisions of gender segregated bathing, changing, and sanitation facilities; and ▪ Contractor will take proper measures to address and resolve issues relating to harassment, intimidation, and exploitation, especially in relation to women.			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
21.	Child Labour	Prohibit hiring of child under age 18	▪ Awareness will be created among the local communities about the adverse impacts of child labor. For public awareness, meetings will be held in the project area, and announcements will be made using the available local platforms with the involvement of all sectors of the society; ▪ Contractor through contractual agreement will be bound to follow the labor standards, rules and regulations during hiring the labor force and all activities will be monitored by the social and environmental staff of the implementing agency; ▪ Client and Supervision consultant will ensure that contractor will have its employment policy in accordance with relevant act and labor policies in Pakistan, and the Contractor will ensure that its Human Resources Department follows the Recruitment Plan and related procedures for the employment of project workers on fair, voluntary and mutually agreed employment terms. ▪ ▪ Contractor will ensure the presence of all people at site are adults and have their proper identity cards with them. ▪ The client and the Contractor will implement a zero-tolerance policy for child labour/forced labour	Hiring of workers during the construction supervision	Visual Inspection Start of the Project	EPCC, SC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			▪ The Contractor will devise a management procedure to ensure that all workers are above the minimum legal age of employment at the time of hiring. This will include the verification of official personal registration documents i.e., national ID, passport etc.			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
B) Operation Phase						
i) Biophysical Environment						
1.	Repair and Maintenance Activities	Checking and leakage of sewer pipes	▪ Establish regular maintenance program including regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups; ▪ The retention times will be kept to its lowest possible, so that there is no stagnation of sewage for long time which could create anaerobic conditions. ▪ Provision of passive gas ventilation arrangement by providing a take-off vent from top of well by positioning vent in such a way that cover slab fitment, movement and drawl, if required for maintenance purposes is not compromised. ▪ Submersible sewage pumps of suitable rating, minimum submergence requirements, open impeller with cutting-tearing arrangement and high strength corrosion resistant heavy-duty construction will be proposed. ▪ Cleaning will be conducted more frequently for open channels and other storm drain facilities (using sandbags and inflatable dams); ▪ Develop an Emergency Response System for the sewerage system leaks, burst and	Sewer pipes	Visual Inspection Twice a month	EPCC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			overflows; ▪ Provide necessary health and safety training to the staff in sewer cleaning and maintenance; ▪ Develop standard operating procedures and operational manual for operation and maintenance of lifting and pump stations, and provision of sufficient O&M staff in annual budget; ▪ Provision of sewer cleaning equipment for cleaning the sewers will be included in the project cost; and ▪ Development of a system to register public complaints and urgent clearance of blockages in the system. ▪ Maintenance of the 450 kW Solar PV system will include regular cleaning of panels, inspection of wiring and mounting structures, and performance monitoring through SCADA. Inverters and batteries (if applicable) will be checked periodically for faults or degradation. Corrective actions may involve replacing damaged panels, repairing faulty cables, or addressing electrical issues. Safety checks such as grounding tests and thermal scans will help prevent fire or performance risks.			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
2.	Odor	Minimize emission of H_2S from disposal stations	▪ Strictly follow standard operating procedures and operational manual for operation and maintenance of lifting and pump stations; ▪ Ensure that the operating staff is properly trained, and have clear understanding of odor issues related with operational practices; ▪ Ensure that pumping cycles are properly followed; ▪ Conduct H_2S monitoring, periodically at pumping stations and lifting stations; ▪ Screening of wastewater will be regularly done, and screening waste will be disposed-off safely; and ▪ The landscape will be properly designed with provision of new trees and ornamental plants around the boundary, roadside and stretches of open land.	Sewer pipes, and disposal and pumping stations	Visual Inspection Twice a month	EPCC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
3.	Water Quality	To avoid contamination of surface and ground water quality	▪ A treatment plant will be constructed for the treatment of wastewater before its final disposal into the river Ravi; (another LWASA project - AFD funded); ▪ Proper sludge management plan will be devised. ▪ Pre-treatment of sludge will be done, as it can reduce its associated environmental impacts; ▪ Leakage and corrosiveness of sewer pipes and pumps will be regularly checked and monitored by trained LWASA staff members; ▪ Water quality monitoring will be conducted on quarterly basis and the quality will be maintained according to PEQS, 2016 for Surface and Ground Water; and ▪ Strictly follow standard operating procedures and operational manual for operation and maintenance of trunk sewer, to avoid abating the quality of surface and ground water.	Surface runoff and sewer pipes	Visual Inspection Twice a month, and surface and ground water monitoring biannually during operational phase	EPCC and LWASA
4.	Air Quality and Climate Change Aspects	To avoid air pollution and emission of greenhouse gases	▪ To mitigate the pollutants emissions use of low sulfur fuel will be ensured; ▪ Strict prohibition on re-used fuel; ▪ Location of generators will be carefully selected; ▪ Plantation of trees along the disposal and pumping stations to create a buffer zone that	Sewer pipes and disposal and pumping stations	Visual Inspection Twice a month, and air quality monitoring biannually during operational phase	EPCC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			will help in absorbing the emissions; ▪ Use of gas generators (if possible) will be preferred for low emissions; ▪ Use of solar panels (renewable energy source) for running new installed pumps and generators, as it will save the energy; ▪ The height of the generator stacks will be high enough to disperse the emissions in the air; ▪ Provision of budget for regular monitoring of ambient air quality in accordance with PEQS, 2016; ▪ Improved monitoring, planning, and maintenance of the sewerage system by LWASA; ▪ Sewer-men will cover their faces with mask while entering the sewer for cleaning or maintenance purposes; ▪ Use gas detector before inspection; ▪ If possible, use different mechanisms to capture CH_4 and H_2S that can be used commercially; and ▪ Plan and execute appropriate tree plantation along the disposal station.			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
5.	Noise	To avoid noise pollution	▪ Regular maintenance of vibrating parts through a well-coordinated operation and maintenance procedure which consists of checking periodically all parts of the pumping machinery, its oiling to remove friction, replacement in case of malfunctioning and periodic noting of noise levels; ▪ All noisy equipment and machinery such as generators and blowers will be housed in closed rooms or buildings; and ▪ Provision of budget for regular monitoring of noise in accordance with PEQS, 2016.	Pumping machinery and standby generators	Visual Inspection Daily and noise monitoring biannually during operational phase	EPCC and LWASA
6.	Solid Waste (Construction, Municipal, solar photovoltaic (PV) waste and Hazardous Waste)	To avoid and minimize nuisance and environmental pollution due to generation of solid waste and implementation of effective solid waste management system	▪ Proper disposal of sludge to the designated solid waste dumping site; ▪ Implementation of sludge handling and storage procedures will be ensured; ▪ Provide adequate ventilation where volatile wastes are stored; ▪ Waste minimization will be encouraged and regular training will be provided to LWASA staff in correct identification and disposal of waste; ▪ Storage areas will be cleaned regularly to minimize odor, pests and nuisances and preserve visual amenity; ▪ All empty containers not suitable for reuse will	Cleaning and maintenance facilities	Visual Inspection Daily	EPCC, WMC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			be rinsed and punctured prior to disposal; ▪ An organized collection system and its implementation through a licensed contractor; and ▪ Schedule inspection of the sewer lines to keep it clean, and to identify any hazardous material. ▪ End-of-life solar components will be collected and disposed of through licensed recyclers or manufacturer take-back programs will also be considered if feasible. Hazardous materials, especially from batteries, will be handled as per national regulations. Staff will be trained on safe disposal practices, and records will be maintained to ensure compliance.			
7.	Fire and Explosions Hazard	Avoid damage for improper handling and storage of chemicals, and constructed electric installations e.g: solar system	▪ The whole plant area and storage tanks will be designed and constructed according to National Fire Protection Association (NFPA) standards for the prevention and control of fire and explosion hazards; ▪ Routine inspection will be carried out to check that the area around the generator is free of clutter and no flammable material is present; ▪ Workers will be trained in handling and controlling accidental spillage of flammable substances that may trigger fires;	Chemicals containers and electric installations	Visual Inspection Daily	EPCC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			▪ Appropriate fire safety equipment will be installed at convenient locations within the disposal and pumping stations; ▪ Equipment will be regularly examined and maintained by a reputable fire safety and security company; ▪ Fire drills will be conducted at least biannually to ensure that workers are familiar with the action to take in the event of fire or explosions; ▪ Fire awareness materials will be placed in strategic locations within the plant to educate the staff and visitors on what to do in the event of fire; and ▪ "No smoking signs and policy" will be displayed, as appropriate and actions to be taken against those not adhering to this order.			
8.	Flora	Avoid damage and impairment to local flora	▪ Maintenance of the green areas and the protection of saplings to ensure better environmental conditions; ▪ Any tree that poses a concern to public safety will be immediately barricaded and evaluated by PHA. Issues of immediate concern would be trees or branches that are leaning or broken that may fall onto an area of pedestrian or vehicular activity; and ▪ Use of fertilizers will be strictly monitored in order to avoid any incident. Natural nutrients may be preferred.	Management of green areas	Visual Inspection Weekly	EPCC, PHA and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
ii) Socioeconomic Environment						
9.	Emergency Preparedness and Response	Avoid damage due to operation failure and fire explosion	▪ An Emergency Response Plans for floods, earthquakes, and manmade disasters must be developed by LWASA, in close consultation with Fire Fighting Department (FFD) and National Disaster and Management Authority (NDMA); ▪ Training of staff and employees regarding the emergency procedures and plans will be regularly conducted; ▪ Responsible person to implement the Emergency Response Plan will be clearly designated; ▪ Emergency numbers will be clearly posted, so that a quick action is taken when an emergency arises; ▪ Firefighting systems will be calibrated and maintained regularly; and ▪ Regular drills for fire emergencies will be carried out.	Disposal and pumping stations, and electric installations	Visual Inspection Weekly	EPCC and LWASA
10.	Health Risks associated with Burst Sewers	Proper maintenance of trunk sewer	▪ Ensure proper and periodic maintenance of sewer lines and disposal stations; ▪ Regular check, repair and maintenance of the sewer lines; ▪ Awareness rising among community members not to dump solids in manholes;	Sewer Pipes	Visual Inspection Monthly	EPCC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			▪ Development of an inventory of system components, with information including age, construction materials, and drainage areas served elevations; ▪ Design manhole covers to withstand anticipated loads, and ensure that the covers can be readily replaced if broken, to minimize entry of garbage and silt into the system; and ▪ Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent build-up of solids and hydrogen sulphide generation.			
11.	Occupational Health and Safety	Ensure healthy and safe working environment for workers	▪ All hazardous substances such as bagged material and drum will be stored on pallets, and where possible under the cover of secondary containment; ▪ Hazardous materials will be well labeled and stored in their original containers; ▪ Material safety data sheets (MSDS) will be available and readily accessible to site workers; ▪ Clear signage will be posted alerting of possible danger at locations where dangerous and hazardous materials are present; ▪ Ventilation of sewers and manholes will be done before entry to avoid accumulation of noxious gases; ▪ Workers will also be inoculated against	Sewer pipes, pumping and disposal stations, management of solid waste and manholes	Visual Inspection Weekly	EPCC and LWASA

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			infectious diseases and kept under regular medical checkup; ▪ During maintenance of power supply, ensure that the live wire work is conducted by trained workers with strict adherence to specific safety and insulation standards (Pakistan Electric and telecommunication Safety Code-PETSAC-2014); ▪ The disposal station will be monitored and maintained periodically; ▪ Blank off all pipelines connected to the manhole to prevent any dangerous gas or fume from entering the manhole; ▪ Remove any sewage or sludge in the manhole beforehand to prevent any toxic or noxious gases that may have accumulated in it from being released and endangering the workers in the manhole in the course of their work; ▪ Use a ventilating blower to supply fresh air into the manhole to ensure that the air inside is maintained, and safe for the workers. Ensure a sufficient supply of power outlets for the operation of the ventilation blower(s); ▪ The responsible person (LWASA Engineers and Inspectors) will take all the safety measures such as erecting fencing, posting of warning notices, implementing necessary personal protective equipment (PPEs), to ensure the safety of relevant personnel			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			working in the manhole; ▪ The authorized person must implement all the safety measures recommended by the competent person of LWASA before issuing a work certificate to enter a manhole; ▪ Before any person enters a manhole, there will be a sufficient number of persons on standby outside, including those who are appointed to carry out a rescue operation inside the manhole, and those responsible for support services outside when such an operation is necessary; ▪ While working in a manhole, if there are signs indicating that the safety of the workers is under threat, for example, the equipment that continuously monitors the quality of the air gives warning alarms, then evacuation of the workers from the dangerous environment will be made according to the emergency procedure, and the competent person of LWASA will reassess the environmental conditions afterwards; ▪ If accident occurs, inform the relevant government departments like the RESCUE 1122 Services Department at once for rescue. Only site personnel who have been trained will use appropriate rescue equipment provided, to conduct the rescue operation according to the emergency rescue procedure, if possible. Moreover, at any time, especially when an accident has occurred, workers will not enter a manhole without any			

No.	Parameter	Target	Mitigation Measures	Monitoring Indicators	Monitoring and Reporting Frequency	Responsibility
			rescue equipment and support; and ▪ The responsible person will provide and inspect all equipment (like resuscitators) and personal protective equipment (like approved breathing apparatus, safety helmets, protective clothing, safety harnesses and rescue ropes). LWASA will provide training to ensure that the workers understand clearly how such equipment and tools are to be used.			

KEY

EPCC	EPC Contractor	LWASA	Lahore Water and Sanitation Agency
SC	Supervision Consultant	PHA	Parks and Horticulture Authority
LWMC	Lahore Waste Management Company		

7.11 ENVIRONMENTAL MONITORING

Environmental Monitoring is undertaken during both the construction and operational phases, to ensure the effectiveness of the proposed mitigation measures against identified adverse environmental and social impacts in the ESIA report.

The main objectives of the construction phase monitoring plan will be to:

- Monitor the actual impact of the works on the project site physical, biological and socio-economic receptors.
- Recommend mitigation measures for any unexpected impact or where the impact level exceeds the anticipated impact.
- Ensure compliance with legal obligations including safety on construction site; and
- Monitor the rehabilitation of borrow areas and the restoration of construction campsites as described in the ESMP; and
- Ensure the safe disposal of excess construction materials.

The main objectives of monitoring during the operational phase will be to:

- Appraise the adequacy of the ESIA with respect to the project predicted long-term impacts of operation of the trunk sewer on physical, biological and socio-economic environment.
- Evaluate the effectiveness of the mitigation measures proposed in the ESMP and recommend improvements, if and when necessary; and
- Compile periodic Environmental Monitoring reports based on recommendations in ESMP.

7.11.1 Construction Phase Compliance Monitoring

Compliance monitoring, which checks whether the actions proposed under the ESMP have been carried out by visual observation, photographic documentation and the use of checklists prepared for the ESMP.

7.11.2 Construction Phase Effects Monitoring

Parameters to be analyzed during construction and operation of the project and responsibilities for monitoring and reporting have been tabulated under **Table 7-6.**

Table 7-6: Effects Monitoring Plan

Sr. No.	Parameter	Means of Monitoring	Location	Frequency	Responsible Agency	
					Implementation	Supervision
A	**Construction Phase**					
1	Drinking Water Quality	These parameters include: Groundwater quality monitoring will be done during the construction phase at the selected locations. The parameters mentioned in PEQS, 2016 (given in Section 2) will be monitored to assess groundwater quality.	Selected locations on Trunk Sewer Line Route, Disposal Station-Gulshan-e-Ravi and Outfall drain	Quarterly	EPC Contractor	PMC
2	Solar PV system	During the construction phase, monitoring will focus on health and safety compliance, dust and noise levels, waste management, and proper handling of solar equipment.	Selected locations on Disposal Station Gulshan-e-Ravi	At the time of Due Diligence	Contractor	PMU/PMC
3	Surface Water Quality	Surface water quality monitoring will be done during the construction phase at the selected locations. The parameters mentioned in PEQS, 2016 for disposal in inland waters (given in Section 2) will be monitored to assess surface water quality.	Selected locations on disposal Station-Gulshan-e-Ravi and Outfall drain	Quarterly	EPC Contractor	PMC
4	Ambient Air Quality	Ambient air quality monitoring will be carried out during the construction phase for the parameters CO, NO2, SO2, Lead, SPM and PM10 in accordance with PEQS, 2016 for ambient air.	At every 5 km along the Trunk Sewer Line Route, at Disposal Station-Gulshan-e-Ravi and at Outfall drain	Quarterly	EPC Contractor	PMC

Sr. No.	Parameter	Means of Monitoring	Location	Frequency	Responsible Agency	
					Implementation	Supervision
5	Noise Level	The noise level monitoring will be carried out during the whole construction period for the proposed Project in accordance with PEQS, 2016 for noise.	At every 5 km along the Trunk Sewer Line Route, at Disposal Station-Gulshan-e-Ravi and at Outfall drain.	Quarterly	EPC Contractor	PMC
B	**Operation Phase**					
1	Drinking Water Quality	Drinking water quality monitoring will be done during the operation phase in accordance with PEQS, 2016 for drinking water.	Selected locations on Trunk Sewer Line Route, Disposal Station-Gulshan-e-Ravi and Outfall drain	Biannually	LWASA	LWASA
2	Solar PV system	It will be monitored as per the national and international guidelines such as NEPRA, PEPA, ARE and IEC etc.	Selected locations on disposal Station-Gulshan-e-Ravi	Quarterly in internal monitoring reports	PMU/PMC/EPC	PMU
3	Surface Water Quality	Surface water quality monitoring will be done during the operation phase in accordance with PEQS, 2016 for disposal in inland waters.	Selected locations on disposal Station-Gulshan-e-Ravi and Outfall drain	Biannually	LWASA	LWASA
4	Ambient Air Quality	Air quality monitoring will be done during the operational phase of the proposed Project. The parameters will be monitored are CO, NO_2, SO_2, Lead, SPM, and PM_{10} in accordance with	At every 5 km along the Trunk Sewer Line Route, at Disposal Station-Gulshan-e-Ravi and at Outfall drain	Biannually	LWASA	LWASA

Sr. No.	Parameter	Means of Monitoring	Location	Frequency	Responsible Agency	
					Implementation	Supervision
		PEQS, 2016 for ambient air.				
5	Noise Level	The noise level monitoring will be carried out during the operational phase in accordance to PEQS, 2016 for noise.	At every 5 km along the Trunk Sewer Line Route, at Disposal Station-Gulshan-e-Ravi and at Outfall drain	Biannually	LWASA	LWASA

7.12 ENVIRONMENTAL AND SOCIAL MONITORING AND MITIGATION COST

For an effective implementation of environmental and social mitigation measures during construction and operational phase, it is very important to provide sufficient funds for the implementation of environmental and social mitigation measures, monitoring, and training. The estimated cost of environmental and social mitigation measures, monitoring and training is given in the **Table 7-7.**

Table 7-7: ESMP Implementation Cost

Sr. No.	Activity	Description	Cost (PKR)	Details
1	Medical screening for workers	PKR. 3,000 per person for 750 employees	2,250,000	Medical screening of the Workers before deployment on site.
2	Material Storage, handling, and use	Three Number of tarpaulins of Rs. 20,000 each	60,000	Three tarpaulins are proposed during the whole construction phase for the Protection of material and dust control.
3	Handling of solid waste (Construction, Municipal, Solar Photovoltaic (PV) waste and Hazardous Waste etc.)	Includes the cost of collection, transportation, and disposal to the designated site.	360,000	PKR. 10,000 per month for 36 months to collect construction waste from all the active sites on daily basis.
4	Health and Safety of Workers	For 750 employees for the provision of dust masks, safety shoes, gloves, first aid box, ear plugs, safety helmets and safety jackets	19,066,000	For detail, please refer to **Annexure–XII**.

Sr. No.	Activity	Description	Cost (PKR)	Details
		(Hi Vis) and provision of dust bins, warning tap, safety cones, safety sign boards and water sprinkling		
5	Environmental Testing Cost	Ambient air, drinking water, wastewater and noise	2,375, 000	Refer to **Table 1.3** for detailed schedule and cost of environmental testing During construction and operation phase.
6	Cost of environmental and social training	Short Seminars, Courses, Trainings and Lectures on Environment, Social, Gender specific and Occupational, Health and Safety constituents and components (Rs. 50,000/- per session twice a year during construction and operational phase).	350, 000	Refer to **detail of the training**
		Construction Phase:		
		5 x 50,000 = 250,000		
		Operational Phase:		
		2 x 50,000 = 100,000		
7	Tree Plantation	Approximately 101 number of different trees may be cut down along the ROW and 93 at the disposal station during construction phase. Therefore, Compensatory planting of ten trees against each fallen tree of similar floral function will be planned which is 1940.	1,120,000	
8	Medical and Health Insurance of workers for accidental coverage	Lump Sum	10,000,000	
Total ESMP Cost			**32,593,000**	
E&S Consultants (Phase – II)			**60,555,020**	
LRP Cost			**62,330,000**	
GAP Cost			**8,615,000**	
SEP Cost			**2,500,000**	
Grand Total Cost			**166,856,020**	

The grand total budget for Environmental and social management cost of the project will be

approximately **PKR 166,856,000/-** or **166.9 million**.

Table 7-8: Budget Estimate for Environmental Monitoring and Compliance during the Construction and Operation Phase

Components	Parameters	Quantity (No. of samples x No. of Locations x Frequency)	Frequency	Responsibility	Duration	Cost (PKR)
A) Construction Phase (30 Months)						
Ambient Air Quality	CO, NO_2, SO_2, Lead, SPM, $PM_{2.5}$ and PM_{10}	1x5x8= 40	Quarterly @ PKR. 20,000 per sample	EPCC and SC	24 hours	800,000
Noise Level	Day and night time levels on dB (A) Scale (min-max)	1x5x8= 40	Quarterly @ PKR 1,500 per point	EPCC and SC	24 hours	60,000
Drinking Water Quality	Physical Parameters: Color, pH, Taste, Odor, Turbidity, Total Hardness as Calcium Carbonate and Total Dissolved Solids Biological Parameters: E. Coliform, Fecal Coliform and Total Coliform **Chemical Parameters:** Aluminum, Antimony, Arsenic, Barium, Cadmium, Chloride, Chromium, Copper, Cyanide, Fluoride, Lead, Manganese, Mercury, Nickel, Nitrate, Nitrite, Selenium, Residual Chlorine, Zinc and Phenolic Compounds	1x5x8= 40	Quarterly @ PKR13,000 per sample	EPCC and SC	-	520,000
Wastewater Quality	Physical Parameters: Temperature, pH, Color, Total	1x5x8= 40	Quarterly @ PKR13,000 per sample	EPCC and SC	-	520,000

Components	Parameters	Quantity (No. of samples x No. of Locations x Frequency)	Frequency	Responsibility	Duration	Cost (PKR)
	Dissolved Solids, and Total Suspended Solids **Biological Parameters:** Biochemical Oxygen Demand, Chemical Oxygen Demand, and Fecal Coli **Chemical Parameters:** Grease and Oil, Lead, Phenolic compounds, Cyanide, Chloride, Fluoride, Anionic Detergents, Sulphate, Sulphide, Ammonia, Calcium, Cadmium, Chromium, Copper, Mercury, Selenium, Nickel, Silver, Zinc, Arsenic, Barium, Iron, Manganese, Boron and Total chloride					
TOTAL (A) =						**1,900,000**
B) Operation Phase (12 Months)						
Ambient Air Quality	CO, NO_2, SO_2, Lead, SPM, $PM_{2.5}$ and PM_{10}	1x5x2 = 10	Biannually @ PKR. 20,000 per sample	LWASA	24 hours	200,000
Noise Level	Day and nighttime levels on dB (A) Scale (min-max)	1x5x2 = 10	Biannually @ PKR. 1,500 per point	LWASA	24 hours	15,000
Drinking Water Quality	Physical Parameters: Color, pH, Taste, Odor, Turbidity, Total Hardness as Calcium Carbonate and Total Dissolved Solids Biological Parameters: E. Coliform, Fecal Coliform and Total Coliform Chemical Parameters: Aluminum, Antimony, Arsenic, Barium, Cadmium, Chloride, Chromium, Copper, Cyanide, Fluoride, Lead, Manganese, Mercury, Nickel, Nitrate, Nitrite, Selenium, Residual Chlorine, Zinc and Phenolic Compounds	1x5x2 = 10	Biannually @ PKR13,000 per point	LWASA	-	130,000
Wastewater Quality	**Physical Parameters:** Temperature, pH, Color, Total Dissolved Solids, and Total Suspended Solids **Biological Parameters:** Biochemical Oxygen Demand, Chemical Oxygen Demand, and Fecal Coli **Chemical Parameters:** Grease and Oil, Lead, Phenolic compounds, Cyanide, Chloride, Fluoride, Anionic Detergents, Sulphate, Sulphide, Ammonia, Calcium, Cadmium, Chromium, Copper, Mercury, Selenium, Nickel, Silver, Zinc, Arsenic, Barium, Iron, Manganese, Boron and Total chloride	1x5x2 = 10	Biannually @ PKR. 13,000 per point	LWASA	-	130,000
TOTAL (B) =						**475,000**
GRAND TOTAL (A+B) =						**2,375, 000**

KEY

EPCC EPC Contractor SC Supervision Consultant LWASA Lahore Water and Sanitation Agency

Notes:

- Provision must be given in annual budget of operation phase for environmental monitoring. For this, the cost of operation phase (i.e. PKR. 475,000) must be considered with an annual increment of 10%.
- All the environmental parameters will be analyzed as per Punjab Environmental Quality Standards (PEQS), 2016.

8 GRIEVANCE REDRESS MECHANISM

An integrated grievance redress mechanism (GRM) at the project level for environmental and social concerns is established to facilitate amicable and timely resolution of complaints and grievances of the AHs, including local communities regarding the social, environmental, and resettlement aspects of the project. The GRM is already in place for the preparatory phase of the project, it is a two-tiered structure. However, during the execution of the project the three-tier GRM will be notified at following levels:

i. Grievance Redress Committee at field/construction site (GR Cell),
ii. Grievance Redre5ss Committee at LWASA PMU
iii. Grievance Redress Committee at LWASA Management

The GRM shall be gender-responsive, culturally appropriate, and readily accessible to the stakeholders at no cost and without retribution. The stepwise process of the proposed GRM is summarized below.

8.1 REGULATORY FRAMEWORK FOR GRIEVANCE REDRESSAL MECHANISM

The Punjab Environment Protection Act of 1997 (Amended 2012) established the Environment Protection Agency (EPA) within the Environment Protection & Climate Change Department (EPCCD) in Punjab. The EPA's primary responsibility is to safeguard, conserve, rehabilitate, and enhance the environment while preventing and controlling pollution and promoting sustainable development in the province. It sets standards called Punjab Environmental Quality Standards (PEQS) to regulate the discharge of effluents, wastes, air emissions, and noise, both generally and for specific areas or sources, in accordance with relevant laws and regulations.

The Punjab Environment Protection Act specifically addresses grievance redressal mechanisms and aims to protect the environment while providing avenues for individuals and communities to address their concerns and seek remedies. The Act, as the name suggests, primarily focuses on the protection and conservation of the environment in the Punjab region of Pakistan. As LRP is as is part of ESIA, therefore this regulatory frame will be applicable. Some key provisions of the Punjab Environment Protection Act of 1997 (Amended 2012) related to grievance redressal mechanisms are as follows:

Section 14: Complaints and Redressal

- Allows individuals and organizations to file complaints with the Punjab EPA regarding environmental issues.
- Empower the Punjab EPA to investigate complaints and take appropriate actions for redressal.

Section 15: Powers of Punjab EPA

- Grants the Punjab EPA authority to issue directives for remedial measures.
- Enables the agency to order the closure or alteration of polluting industrial units.
- Provides the power to impose fines and penalties for environmental violations.

Section 16: Environmental Tribunals

- Establishes environmental tribunals to handle disputes and appeals related to environmental matters.
- Gives the tribunals the authority to adjudicate cases and provide remedies.

Section 22: Public Awareness and Participation

- Recognizes the importance of public awareness and involvement in environmental protection.
- Requires the Punjab EPA to promote awareness and facilitate public participation in environmental impact assessments and hearings.

Section 28: Protection of Whistleblowers

- Prohibits retaliation against individuals reporting environmental violations or participating in the grievance redressal process.
- Ensures confidentiality and protection for whistleblowers.

Section 33: Compliance Monitoring and Inspections

- Authorizes the Punjab EPA to conduct regular monitoring and inspections to ensure compliance with environmental standards.
- Establishes reporting procedures for violations and specifies penalties for non-compliance.

8.2 AIIB REQUIREMENTS

As per the requirements of the Asian Infrastructure Investment Bank (AIIB), a suitable project-level grievance redress mechanism must be established in accordance with AIIB's Environment and Social Policy, as well as applicable standards, to address concerns and grievances of project-affected persons and stakeholders. This mechanism will receive and facilitate resolution of concerns or grievances from individuals or groups who believe they have been adversely affected by the Project's environmental or social impacts, or those who feel that their interests are at risk due to the Project's construction and operations activities. The mechanism will also ensure protection of complainants from retaliation and respect their request for anonymity, if desired, while addressing concerns related to the project's social, resettlement, and environmental performance.

Although measures have been identified to mitigate the environmental, social, and resettlement impacts of the Project, it is acknowledged that despite best efforts, some individuals/households and stakeholders may still be dissatisfied with the measures adopted. To address such situations, an effective Grievance Redress Mechanism (GRM) has been established to ensure timely and successful implementation of the project. The GRM will provide a public forum for aggrieved parties to raise their concerns and seek adequate resolution. It will receive, evaluate, and facilitate the resolution of concerns, complaints, and grievances related to the environmental and social performance of the Project at the project level.

8.3 AIMS AND OBJECTIVES OF GRIEVANCE REDRESSAL MECHANISM

The primary objective of the Grievance Redress Mechanism (GRM) will be to investigate charges of irregularities and complaints and grievances received from affected persons (APs) and other stakeholders, and provide a time-bound, early, transparent, and fair resolution process to address and resolve environmental and social concerns and grievances linked to the project. The key objectives of the GRM are as follows:

i. Provide a clear process for APs and other stakeholders to provide comments and raise grievances, ensuring that their voices are heard and addressed in a systematic manner.
ii. Allow APs and other stakeholders to raise concerns, complaints, and grievances anonymously, using multiple intake locations and modes, to protect their identity and ensure confidentiality.

iii. Structure and manage the handling of concerns and grievances in an organized manner, while also monitoring the effectiveness of the mechanism to continuously improve its performance.
iv. Ensure that concerns and grievances are handled in a fair and transparent manner, in accordance with provincial laws and regulations, AIIB's environment and social policy framework and standards, and international best practices, to ensure a just resolution for all parties involved.

The GRM will be designed to uphold these objectives and provide a robust and responsive mechanism for addressing and resolving concerns and grievances related to the environmental and social impacts of the project.

8.4 NATURE OF COMPLAINTS TO BE REDRESSED

It is anticipated that during the implementation and operational phases of the project, grievances and complaints may arise from affected persons (APs) and other stakeholders related to various issues, including but not limited to:

i. Compensation and resettlement and rehabilitation assistance, such as the name of AP(s) missing from the eligible APs' list, incorrect identification of losses (such as damage to assets or loss of income) during the design stage, improper distribution of compensation and/or resettlement assistance, delays in the payment of compensation and resettlement assistance, etc.
ii. Disruptions caused by civil works contractors, such as disruptions to general public services/utilities during civil works, non-observance of project principles as laid down in the Resettlement Plan (RP) and environmental issues, etc.
iii. Any other issues arising during the project implementation that may affect APs and other stakeholders.

To ensure that APs and other stakeholders are aware of the Grievance Redress Mechanism (GRM), the Environmental and Social (ES) staff of the PMU, Project Management Consultant (PMC) and LWASA will conduct public awareness campaigns, disseminate information materials, and hold face-to-face meetings with both literate and illiterate APs. Information about the GRM will be posted on notice boards at site offices of contractors and sub-contractors, construction camps, and concerned Government Departments.

8.5 ESTABLISHED TWO TIER GRIEVANCE REDRESSAL MECHANISM (GRM) FOR PREPARATORY PHASE

The Grievance Redressal Mechanism of the project for the Preparatory Phase (before Execution) is already in place to resolve the concerns and grievances of the affected persons.

A first tier of the Grievance Redressal Committee (GRC) has been notified for the Project to resolve the concerns and grievances of Affected Persons with the approval of the Managing Director, LWASA vide office order no. PD/LWWMP/WASA/207-215 dated 13.4.2023. The committee is responsible for resolution of the complaints (received if any) within three (03) to seven (07) days. If necessary, this committee will consult with all relevant parties (e.g., Affected Persons, the public, women, and relevant government departments) to resolve the issues.

The designated 2nd tier Committee will resolve those complaints/ grievances that are not resolved directly by the first tier LWASA designated Committee. In such cases, the first tier

Committee will provide all the relevant data to the second tier Grievance Redressal Committee and GRC will suggest the corrective measures and assign clear responsibilities for implementing its decision within 10 working days, depending on the nature of the grievance.

8.6 PROPOSED THREE-TIER GRIEVANCE REDRESSAL MECHANISM (GRM)

The Three-Tier GRM (Grievance Redressal Mechanism) for the Project will be established in LWASA to provide a time-bound, early, transparent, and fair resolution for grievances. The Environment and Social (ES) staff of PMU will conduct public awareness campaigns on the GRM, with the support of ES staff of PMC (Project Management Consultant) and LWASA. All complaints received, whether verbal or in writing, will be properly documented and recorded in the Complaint Management Register(s). The focal point responsible for receiving grievances will be Project Director, Project Management Unit, Lahore Wastewater Project, LWASA, contact number, +92-333-3330287, +92-42-9926843, Email Address: ProjectDirector.LWWMP@gmail.com. This will enhance the overall communication between the Project affected persons and the Project Management Unit.

PMU will install a complaint box in the office and the Contractor will install a box in the field office, and PMU assign a dedicated telephone number for the registration of complaints. PMU will also designate a staff that will be the focal point to record the complaints and report to PMU and concerned offices. At the construction site, a Grievance Redress (GR) Cell will be established to address the grievance at the site. The grievance resolution flow mechanism is given in **Figure 8-1.**

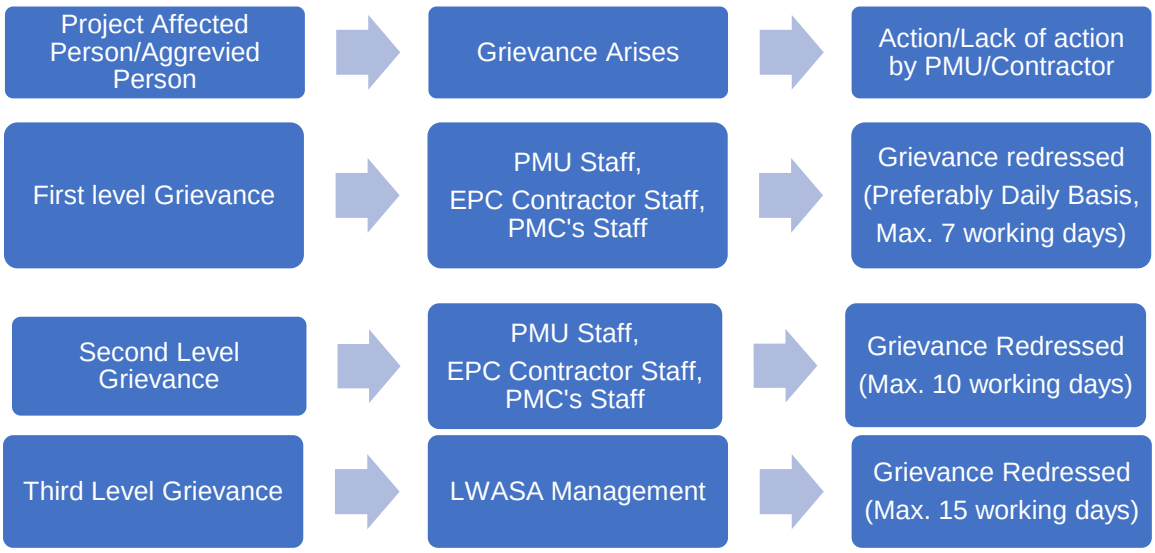


Figure 8-1: Grievance Redress Mechanism during Execution Phase of the Project

8.6.1 First Tier of GRM

A Grievance Redress (GR) Cell will be established at the construction site to address the grievances at the site prior to execution phase of the project this will serve the purpose of first tier GRM. The GR Cell will be comprised of the Manager E&S PMU, environment manager, and social manager of the EPC contractor and resident engineer, and HSE officer of PMC and one community representative. This cell will be the fastest and most accessible grievance redress forum for redressing the complaints on-site. Complaints will be resolved within seven (7) working days, depending on the nature of the grievance, however, most of the complaints will be addressed promptly at the site preferably on daily basis. In case the complaints are not resolved by GR Cell, complaints will be forwarded to the second-tier Grievance Redress Committee (GRC). The composition of the GR Cell is given in **Table 8-1** and will be notified

prior to execution phase of the project.

Table 8-1: Composition of Grievance Redress Cell (First-Tier)

S. No.	Designation/Department	Office
1	Manager E&S, PMU Larechs	Chair of the Committee
2	Resident Engineer, Project Management Consultant (PMC)-L	Member (Secretary)
3	Health Environment Safety (HSE) officer of PMC	Member
4	Environment Manager EPC Contractor	Member
5	Social Manager EPC Contractor	Member
6	Two Community Representative (one Male and One Female)	Member

Efforts will be made to address concerns and grievances at the local level by the ES staff of PMU, PMC (Project Management Consultant), or through the involvement of representatives of the APs Committee and informal mediators. The ES staff of PMU and PMC may seek additional support and guidance from LWASA (Water and Sanitation Agency Lahore) in grievance redressal matters. Investigation of grievances will involve site visits and consultations with relevant parties to identify and reach on a realistic picture of the grievances.

The functions of the GRC include resolving problems, recommending possible solutions and providing support to affected persons arising from various social, resettlement, and environmental issues such as land acquisition (temporary or permanent) if any, asset acquisition, eligibility for entitlements, compensation, damages, resettlement assistance, as well as environment-related issues such as dust, noise, utilities (electric power, gas, telephone optical fiber, water supply), waste disposal, traffic interference, access, and public safety. The GRC will reconfirm grievances of APs, categorize, and prioritize them, and aim to provide solutions within 7 working days. The ES staff of PMU will be responsible for processing and presenting all relevant documents, field inquiries, and evidence/proofs to the GRC, maintaining a database of complaints, recording decisions, issuing minutes of meetings, and monitoring to ensure that formal orders are issued and required actions against decisions are being carried out. The PMC and EPC Contractor ES staff will assist PMU in these tasks as and when required.

Grievances will be documented, and personal details of the complainant (such as name, address, date of complaint, nature of complaint, etc.) will be included unless anonymity is requested. A tracking number will be assigned for each grievance, and it will include the following elements:

i. Initial grievance sheet: This will include a description of the grievance, and an acknowledgement of receipt will be handed back to the complainant when the complaint is registered, either verbally or in writing.
ii. Grievance monitoring sheet: This will mention the actions taken, such as investigation and corrective measures.

iii. Closure sheet: One copy of this sheet will be handed over to the complainant after they agree to the resolution and sign-off on it

8.6.2 Second Tier of GRM

The PMU will serve as the second tier of the GRM (Grievance Redressal Mechanism) and will provide the fastest and most accessible mechanism for resolving grievances. The Committee will comprise of the PD, ES staff of PMU, PMC & EPC Contractor. Complaints will be resolved within three (3) to seven (7) working days, depending on the nature of the grievance. A second tier of the Grievance Redressal Committee (GRC) will be notified during execution phase for the Project to resolve the concerns and grievances of Affected Persons. If necessary, this committee will consult with all relevant parties (e.g., Affected Persons, the public, women, and relevant government departments) to resolve the issues. The composition of the second-tier Committee is given in **Table 8-2.**

Table 8-2: Composition-PMU Level GRC (Second tier of GRM)

S. No.	Designation/Department	Office
1	Project Director, PMU Larechs	Chair of the Committee
2	Manager E&S, PMU Larechs	Member (Secretary)
3	Representative of E&S staff of PMC	Member
4	Representative of E&S staff of EPC Contractor	Member
5	Community Representative	Member

The ES staff of PMU will organize training on GRM and grievance registration and handling procedures, in coordination with the ES staff of PMC, for LWASA to familiarize them with the process. The contractor will develop a code of conduct for GBV, SEA and will be bound to implement it in letter and spirits. The second tier GRC will meet as necessary when there are grievances to be addressed and will aim to resolve problems and provide support to affected persons within 10 working days, depending on the nature of the grievance.

8.6.3 Third Tier of GRM

The third tier of the Grievance Redress Mechanism (GRM) is the Grievance Redress Committee (GRC), will be established by LWASA (Water and Sanitation Agency) prior to the execution phase of the Project to resolve the concerns and grievances of affected persons. The GRC will be chaired by the Managing Director, LWASA. The GRC consists of the Managing Director (MD), LWASA Deputy Managing Director (Engg), LWASA, Project Director, Project Management Unit (PMU), LWWMP, and any other co-opted member. The Committee will resolve those complaints/ grievances that are not resolved directly by the second – tier designated Committee at PMU Level. In such cases, the second tier Committee will provide all the relevant data to the third tier Grievance Redressal Committee and GRC will suggest the corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 working days, depending on the nature of the grievance (in case the solution is possible within the prescribed time). An office order for the constitution of the third tier

Committee will be issued prior to the execution phase with the approval of the Managing Director, LWASA. The proposed structure of the third tier Grievance Redressal committee is provided in **Table 8-3.**

Table 8-3: Structure-Grievance Redressal Committee (Third tier GRC)

S. No.	Designation/Department	Office
1	Managing Director LWASA, Lahore	Chair of the Committee
2	DMD Engineering, LWASA, Lahore	Deputy Chair
3	Project Director (LWWMP)	Member
4	Manager E&S PMU	Member (Secretary)
5	Any other co-opted member	Member

If the complainants are dissatisfied with the decision of the GRC, they still have access to approach the Government's Administrative or Court of Law for judicial remedies. GRC-PMU will maintain a database of complaints and their resolution status at each level and report grievance resolution status updates, GRM-related data in semi-annual safeguard monitoring reports, and monthly monitoring reports to AIIB.

8.7 FUNCTIONS OF GRC

Following are the functions of GRC:

- The first tier GR cell will provide and maintain record of all grievances received at tier-one level (site).
- Tier one GRC will promptly register any received complaint and will be responsible to redress the issue within 7 working days of receipt of complaint.
- In case the complaints are not resolved by GR Cell, complaints will be forwarded to the second-tier Grievance Redress Committee (GRC).
- Second Tier GRC will review the complaint and will be responsible to redress the issue within 10 working days of receipt of complaint.
- In case the complaints are not resolved by Second-Tier GRC, complaints will be forwarded to the third-tier Grievance Redress Committee (GRC).
- The third tier Committee will resolve or communicate its decision within 15 working days for the complaints/ grievances which are not resolved directly by first and second tiers.

The aim of the Grievance Redressal Committee (GRC) will be as follows:

i. Ensure effective implementation of the Grievance Redressal Mechanism for concerns and issues falling under their jurisdiction.

ii. Provide easy access to the Grievance Redressal Mechanism, allowing grievances to be filed verbally, by phone, in writing, or via web-based provisions, including the option to submit grievances anonymously.
iii. Address and resolve all referred grievances in a timely and impartial manner within 10 working days of receipt.
iv. Deal promptly with issues related to:
    a. Resolving day to day site issues related to E&S aspects,
    b. recommending possible solutions,
    c. providing support to affected persons arising from various social, resettlement, and environmental issues such as land acquisition (temporary or permanent) if any,
    d. asset acquisition,
    e. eligibility for entitlements,
    f. compensation,
    g. damages (if any),
    h. resettlement assistance, as well as environment-related issues such as dust, noise, utilities (electric power, gas, telephone optical fiber, water supply),
    i. waste disposal,
    j. traffic interference,
    k. access, and public safety
    l. any other related matter
v. Seek assistance from other persons or institutions when needed.
vi. Inform about GRC and AIIB accountability mechanisms to APs.
vii. Record and reply to aggrieved parties/persons with speaking orders/minutes of meetings/decisions of the committee, keeping a copy as a record.
viii. The decision/judgment made by GRC will be communicated to Aggrieved Persons and E&S team of Bank in monitoring reports.
ix. Provide the option to the aggrieved parties to file an appeal for review of the decision / Judgment of the GRC within 10 working days of receiving the review matter, and the GRC may reconsider the matter/ case or refer the case to the appropriate forum after examining the appeal.
x. In such cases where grievances cannot be resolved by the GRC, the affected person can seek alternative redressal and approach higher Administrative Authorities or the court of law, as appropriate.

Court: If the project-level GRM will not be able to resolve the grievance or the complaining party is not satisfied with the decision, it shall be resolved as per law and court order of Pakistan which will be outside of the project GRM scope. The GRC cannot impede an AP's access to the legal system, according to ESF. Thus, an AP can approach the courts at any time in accordance with the applicable legal provisions as per Section 18 of the Land Acquisition Act 1894. Implementing the GRC's decision will be contractually binding on the contractor. Also, if not satisfied with the resolution of the issue by project-level GRM, the complaining party can send the complaint to AIIB's Accountability Mechanism discussed below, after making good faith efforts to resolve the grievance with AIIB's operation department.

8.8 AIIB'S ACCOUNTABILITY MECHANISM/ PROJECT-AFFECTED PEOPLE'S MECHANISM (PPM)

Affected persons and people in the project areas shall also be informed about the AIIB's Accountability Mechanism, and that they should at first put good faith efforts for resolving the complaints on the project level-GRM and the project implementing agencies in the country. Two or more APs (can be from the same family) can submit their complaint to the AIIB's Accountability Mechanism (AM). The AM is a last resort mechanism. The project-affected persons shall first address the issue with the project-level GRM, and then they shall make good faith efforts to address the issue with the relevant AIIB operations department. Complaints will not be eligible in certain cases such as:

- About actions not related to something AIIB did or did not do in formulating, processing, or implementing an AIIB-assisted project;
- About an AIIB-assisted project for which 2 or more years have passed since the loan or grant closing date;
- About matters those complainants have not made good faith efforts to address with the operations department concerned;
- About decisions made by AIIB, the borrower or executing agency, or the private sector client on the procurement of goods and services, including consulting services; and allegations of fraud or corruption in AIIB-assisted projects (these will be managed by other facilities).

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