

EIA REPORT



PUNJAB AAB-E-PAK AUTHORITY

**SUBMISSION OF:
ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT OF PROVISION
OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY
(PHASE-I) CENTRAL ZONE**

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LIST OF ABBREVIATION

Ac	Activated Carbon
BOQ	Bill of Quantities
ECSP	Engineering Consultancy Services Punjab
EIA	Environmental Impact Assessment
EMC	Environmental Management Committee
EMM	Environmental Mitigation Matrix
EMMP	Environmental Monitoring and Mitigation Plan
GEC	Green Engineering Consultant
GIS	Geographic Information System
HUD/PHED	Housing Urban Development & Public Health Engineering Department
m ³ /h	Cubic meter per hour
mg/l	Milligram per liter
PCRWR	Pakistan Council of Research in Water Resources
PEC	Pakistan Engineering Council
PHIMC	Punjab Health Initiative Management Company
PMU	Project Management Unit
RO	Reverse Osmosis
RSF	Rapid Sand Filter
SDG	Sustainable Development Goals
SES	Sustainable Environmental Solutions
sq.km	Square kilometer
SWTP	Surface Water Treatment Plant
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UF / PF	Ultra-Filtration / Pre-Filtration
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

1) Introduction

Safe and clean water is important for public health, whether it is used for drinking, domestic use, food production or recreational purposes. Improved water supply and sanitation, and better management of water resources, can boost countries' economic growth and can contribute greatly to poverty reduction. The State of Pakistan is in charge of providing clean water for drinking. Safe drinking water for everyone is a goal of Pakistan's National Water Policy. Also, it is the sixth goal of the **Sustainable Development Goals (SDGs)**, which calls for integrated water resource management, efficient water use, and the provision of water and sanitation for everyone.

In Punjab 69.62 million population lives in rural areas out of which only 14.98 million is served with clean drinking water. Rest 54.64 million is un-served population. So only 21.51% population living in rural areas have access to safe drinking water. 88% of samples collected from the rural areas of the Punjab Province were found to be unsafe for drinking. A sufficient quantity of clean drinking water is one of the most important requirements for a healthy life, but in many areas of Punjab and throughout Pakistan, waterborne infections may be a major cause of death. It also plays a significant role in ensuring economic viability, as water-borne diseases cost Pakistan's economy \$1.3 billion annually. According to estimates, water borne illnesses claim the lives of 250,000 children in Pakistan under the age of five every year.

In order to address this situation, the Government of Punjab has endeavored to develop a program to improve water supply in terms of, both, access and quality of drinking water, especially in rural areas of the Punjab Province. The project aims on targeting areas in Punjab that have excessively brackish (natural) groundwater making it unacceptable for drinking purposes. For this purpose, the Government of Punjab initiated the **Punjab Aab-e-Pak Project** under which a **Punjab Aab-e-Pak Authority** has been established as a Special Purpose Vehicle (SPV) to conceive, plan, design, execute and manage projects for provision of safe drinking water to the communities in rural and Peri-urban areas of Punjab. As a newly established organization, "**Sustainable Environmental Solutions (SES)**" with assistance from WaterAid, Pakistan, prepared a feasibility study for providing safe and clean drinking water to the people of Punjab. This project will provide & improve the water supply (safe and clean drinking water) in rural and peri-urban areas of the province of Punjab as per World Health Organization's (WHO) Guidelines for Drinking water Quality. The Punjab Aab-e-Pak Project is a mega program which will cover Divisions of **Faisalabad, Lahore & Sahiwal** with their respective Districts in the province of Punjab This area is also called the **Central Zone of Punjab**. This landmark Program will provide safe drinking water in a comprehensive, integrated and sustainable manner in collaboration with the relevant stakeholders through effective water delivery networks.

The design life of this project is 20 years and Successful implementation of this project will result in provision of contamination free potable water to the underserved areas in Punjab and consequently, eliminate water-borne diseases to improve public health. When completed, the project aims to advance the development of a significantly healthier, more active, and forward-thinking workforce while also helping to increase the nation's GDP.

2) Environmental Legislative Requirements

The National Conservative Strategy (NCS) is the principle document which addresses the environmental issues of the country. The Pakistan Environmental Protection Act (PEPA), 1997 is the key regulation authorizing the government to frame regulations for the protection and safeguard of the environment. This Environmental Impact Assessment (EIA) Study has been conducted for the project of “Provision of Clean Drinking Water by Punjab Aab-e-Pak Authority”, as a mandatory requirement of Punjab Environmental Protection Act (PEPA), 2012 as an amendment of Pakistan Environmental Protection Act, 1997. Section 12 (1) of this Act states that:

“No proponent of a Project shall commence construction or operation unless he has filed with the Provincial Agency an initial environmental examination or, where the Project is likely to cause an adverse environmental effect, an environmental impact assessment, and has obtained from the Provincial Agency approval in respect thereof.”

Engineering Consultancy Services Punjab, (Pvt.) Ltd (ECSP) has been engaged to carry out the Environmental Impact Assessment (EIA) process of the proposed project.

3) Project Description

The Punjab Aab e Pak Authority (PAPA) is the Proponent of this Project. The PAPA, a company in the Public sector of the Government of Punjab intends to construct **Water Supply Project** for drinking water only. This project will cover the Divisions of **Faisalabad, Lahore and Sahiwal** with their respective Districts to construct the drinking water supply facility which shall include the development of source of water, treatment unit and Markaz e Aabs to distribute the treated water to villages. This project also includes the sub-project of a Surface Water Treatment Plant of **10m³/hr.** capacity at **Okara, Renala Khurd Tehsil** and a Conventional Water Treatment Plant of **35m³/hr.** capacity at **Chak Jhumra, Faisalabad**.

The primary objective of this project is to improve the health of the people of rural Punjab through provision of safe drinking water which shall lead to reduction/elimination of water borne diseases and eventually boost the economy of the area. The government of Punjab intends to develop projects of safe drinking water supply to the deserved i.e. rural and Peri-urban population, using localized and customized solutions, with regard to sources and supply options and sustainable O&M models with community engagement and participation. The areas which are worst affected in terms of contamination level and non- availability of water supply system will be taken up for interventions at the earlier stages of the project.

Contract of Engineering Consultancy Services for Detailed Design and Resident Supervision for Provision of Clean Drinking Water (Phase-I) - **Central Zone** for the Punjab Aab-e-Pak Project of Punjab, Pakistan has been signed between **Punjab Aab-E-Pak Authority, Government of the Punjab** and **Engineering Consultancy Services Punjab (Pvt.) Ltd.** (ECSP) on **October 15th, 2020**. The services will cover the Central Zone Division of Faisalabad, Sahiwal, and Lahore and other sub-projects in the subdivisions of Faisalabad and Sahiwal.

The overall scope of the instant consultancy services is to carry out (a) Detailed Engineering Design and (b) Resident Construction Supervision for components of the Project to be carried out in Central Zone which comprises of:

- i. 197 water filtration plants (RO and UF Plants),
- ii. 200 Direct Supply Schemes (after Pre-Treatment through Packaged Plants),
- iii. 01 Surface Water Treatment Plant of **10m³/hr.** capacity at **Okara, Renala Khurd Tehsil**,
- iv. 01 Conventional Treatment Plant of **35m³/hr.** capacity at **Chak Jhumra, Faisalabad** the source of water for which is from the existing System of shallow tube-wells, only.

In General, a total of 399 number of Treatment plants will be installed by the Punjab Aab-e-Pak Authority in Central Zone of Punjab.

In order to achieve the timeline for installation of treatment plants, the project is expected to be divided into multiple contracts which shall be shared with the consultant after finalization. The Consultant shall be required to provide services in conformity to those packaged contracts. The consultant shall check the feasibility and suitability of the proposed treatment plants, direct supply treatment plants, Surface water treatment Plants and Conventional Treatment Plants and recommend/ validate the most favorable solution and prepare designs and conduct resident supervision accordingly.

The criteria for site selection will be based on the following:

- a) Those sites will be selected only where PHED's Functional Rural Water Schemes exist.
- b) Schemes would be chosen for treatment as per water quality results by PCRWR.
- c) If PCRWR results for water quality are not available then the results of PHED will be used.
- d) Population would be projected up to the planning horizon for 2040.

Project is divided in different contracts keeping in view the geographical spread of the area.

Multiple treatment solutions as per local situation are proposed depending upon the source and quality of water, area and urgency for providing potable water, difficulty faced by the residents to fetch clean drinking water. Following multiple solutions are proposed:

- i. Direct supply through pipelines or installation of taps for a community at sweet water sources with no pollution
- ii. RO plant as standalone solution or Surface water treatment plant with pipeline network to Markaz-e-Aab if TDS in groundwater are more than 1000 mg/l
- iii. Ultra-filtration plants if TDS in groundwater are less than 1000 mg/L and water contaminated with microbes and other organics.
- iv. UF plant with additional filter according to other contaminants or Surface water treatment plant with pipeline network to Markaz-e-Aab or Shallow depth tube wells at canals with conventional treatment and pipeline network to Markaz-e-Aab for high TDS groundwater with other contaminants like, Arsenic, Iron, Fluoride or Nitrate
- v. Hand operated UF plants recommended for small communities (population size ≤ 800)
- vi. Completely prefabricated, site mounted, assembled and commissioned compact Rapid Sand Filtration treatment plants. Such plants will be used for medium population range (from 8000 to 50,000).
- vii. Hand carry water bottles of 12/19 liters capacity will be provided to the consumers to carry drinking water from plants to their houses.
- viii. Water quality testing on regular basis will be arranged.

Construction contracts will be made at Division/Zone level according to quantum of work.

Water quality of ground water will be analyzed by taking water samples from each site. TDS and other contaminants like Arsenic, Fluoride, Nitrates, bacterial etc. of each sample will be checked by the consultant and based on measured data along with the population statistics; the plant with appropriate treatment technology will be selected and installed at the identified villages.

Type of Plant	Criteria
RO Plant	• Groundwater TDS>1000 mg/l • Groundwater TDS>1000 mg/l with other contaminants like Arsenic, Iron, Fluoride or Nitrate. • Significant Population
UF / PF Plant	• TDS < 1000 ppm • Other contaminants like colloids, bacteria, viruses etc. • Significant Population
UF / PF with Additional Filters	• TDS < 1000 ppm • Other contaminants like colloids, bacteria, viruses etc. • Other contaminants like Arsenic, Iron, Fluoride or Nitrate. • Significant Population
Conventional	• Groundwater TDS>>1000 mg/l with other contaminants like Arsenic, Iron, Fluoride or Nitrate. • Existing Bores along canals • Significant Population
SWTP	• Groundwater TDS>>1000 mg/l with other contaminants like Arsenic, Iron, Fluoride or Nitrate • Medium population range (from 4000 to 200,000)
Hand pump	• Water with organic contamination in Tribal/Remote/Scattered settlements • (population size≤ 800)

Direct Supply to Markaz-e-Aab	• Sweet water zone • Existing water supply Schemes with possible contamination
--------------------------------------	---

The most suitable options are provided as a list along with the locations of treatment plants in the project description of each division where treatment plants are being installed. The options selected are most suitable, environmentally sound and economically viable.

The salient features of the project are given below:

Sr. No.	Salient Features	
1	Project Title	Provision of Clean Drinking Water by Punjab Aab-e-Pak Authority (Phase-I)
2	Project Location	Central Zone of Punjab Province in the Divisions of Faisalabad, Lahore and Sahiwal with their respective Districts
3	Proponent	Punjab Aab-e-Pak Authority (PAPA)
4	Consultants	Engineering Consultancy Services Punjab Pvt. Ltd. (ECSP)
5	Cost of the Project	Rs.1272.225 Million
6	Status of the Project	Construction Phase

4) Socio-Environmental Baseline Conditions

The baseline conditions were studied with respect to physical, biological and socioeconomic environment. The physical environment includes topography, geology and soils, climate, hydrology and drainage, land use, surface water quality, ground water quality, ambient air quality, noise levels, and seismicity.

The climate of the project area is hot in summer and moderate in winter. The coldest month is December and the hottest is June. According to the Seismic Zoning Map (prepared by Pakistan Meteorological Department), the proposed Project area falls in Zone-2.

Green Engineering Consultant has been engaged to carry out for the water quality analysis of the project area in the Central Zone of Punjab with the divisions of Faisalabad, Lahore and Sahiwal. Lab test for water quality check for Renala Khurd and Chak Jhumra were performed by the same consultant.

The biological environment of the Project Area includes flora and fauna. The floral species found in the Project Area include some trees, bushes and shrubs. Some of the project area is surrounded by the agricultural land as well. The faunal species noticed/reported in the Project Area include mammals (dogs, cats etc.), mongoose, squirrel, amphibians (frog, toad, turtle etc.), reptiles (small and medium sized lizards, snakes etc.), house sparrows, house crow, etc. However, no endangered species are found in the Project Area. The aspects covered under

socio-economic environment of the Project Area include population and communities, mother tongue, occupation, health care facilities, educational facilities, physical and cultural heritage (shrine, mosque, graveyard), respondent's age group, marital status, willingness to pay for improved Drinking Water Facility Services, common diseases found in the area etc. Overall, the public generally supports the project and visualize it as a good project.

5) Impact Assessment and Mitigation Measures

The proposed project will have both positive and negative impacts during the construction and operational phases, for which proper mitigation measures are necessary.

Sr.No	Parameters		Pre-Construction Phase	Construction Phase	Post-Construction/ Execution Phase
1	<i>Ecological Environment</i>				
1.1	Avifauna (Birds)		N/A	0T	N/A
1.2	Trees		N/A	-1P	+1P
1.3	Endangered Species		N/A	N/A	N/A
1.4	Fauna		N/A	N/A	N/A
1.5	Aquatic life		N/A	N/A	N/A
1.6	Crop Cutting		N/A	N/A	N/A
2	<i>Physical Environment</i>				
2.1	Land Use		N/A	-1T	N/A
2.2	Climate Change		N/A	0T	0P
2.3	Ground depletion	Water	N/A	0T	+1P
2.4	Ground Quality	Water	N/A	0T	0P
2.5	Surface Quality	Water	N/A	0T	N/A
2.6	Air Quality		0T	-1T	0P
2.7	Noise		0T	-1T	0P
2.8	Solid Waste Management		0T	-1T	N/A
3	<i>Socio-Economic Environment</i>				
3.1	Loss of Electricity/Sui-gas Transmission lines		N/A	N/A	N/A
3.2	Loss of water and sewerage distribution pipelines		N/A	-1T	+1P
3.3	Loss of telephone lines		N/A	N/A	N/A
3.4	Accessibility infrastructure Roads/Railways		N/A	-1T	N/A
3.5	Loss of Assets		N/A	N/A	N/A
3.6	Aesthetic		0T	-1T	+1P
3.7	Quality of Life		N/A	-1T	+2P
3.8	Mosques		N/A	N/A	N/A
3.9	Monuments		N/A	N/A	N/A
3.10	Employment Opportunities		0T	+1T	N/A
3.11	Public Health		N/A	-1T	+1P

Key:

- +** = Positive
- = Negative
- 3** = High
- 2** = Medium
- 1** = Low
- 0** = Negligible

P = Permanent T = Temporary
--

During the field survey, significant efforts were made to identify the main social, cultural and environmental issues related to the project. Various government departments and agencies were also contacted for obtaining salient information along with area resident/ stakeholders. Most of the perceived impacts are during construction phase. Following is the list of main concerns identified in the study:

- Disturbance to the public movement during construction;
- Excavation and Vibrations due to construction machinery may affect the nearby structures during construction.
- Air and noise pollution due to the operating of construction machinery during construction phase of the project;
- Solid waste generation during construction and operational phase;
- Accidental leaks/spills of hazardous chemicals from construction activities and machinery;
- Health and safety issues of the workers.

6) Environmental Monitoring & Management Plan (EMMP)

EMMP is a sort of the master plan which supervises all stages of the Project to safeguard the environmental aspects of the project during pre-construction, construction and operational phase of the proposed project. It addresses the main components like environmental mitigation and monitoring programs, institutional arrangements and budgeting. Management plans including air, dust, wastewater generated noise quality, health and safety, capacity building, site management, emergency management are recommended in this report.

A total of **Rs. 87.02 Million** EMMP budget is calculated, which has covered direct cost of environmental operations like monitoring of air, water, noise, site rehabilitation of the construction areas of treatment plants and Markaz-e-Aabs, internal audit, tree plantation cost etc.

7) Stakeholders Consultation

An important aspect of the Environmental Impact Assessment (EIA) process is the early participation of the public. The broad objective of project people consultations and participation is to take the project area people in confidence about the impacts of the project, addressing their concerns, if any, about the project during different stages and activities of the project.

The project stakeholders are the project affected/project area people, who reside or own businesses or land subject to expropriation due to project activities. The other important stakeholders identified include the local Government representatives and Government officials of the relevant departments like the Environmental Protection Department (EPD), Water and Sanitation Agency (WASA), Development Authorities of the Divisions, Public Health Engineering Department, Municipal Corporation, Irrigation Department, WAPDA, interested NGO/ CBO and general people. During the process of consultation, the important points explained and discussed with the participants were as under: -

- Objectives of the project.

- Existing water quality of the area.
- Plan of the Punjab Aab-e-Pak Authority for the Provision of Clean Drinking Water for the people of Central Zone of Punjab.
- Possible / expected impacts of the projection area.
- Suggestions for improvement in the project.

During this process, the objectives and scope of the work, expected benefits of the adverse impacts, if any, were clearly explained.

8) Conclusion and Recommendations

The installation of Clean Drinking Water Supply Facilities by Punjab Aab-e-Pak Authority in the Central Zone of Punjab will bring about some significant positive Impacts while moderate to minor adverse impacts on the physical, ecological, and socio-economic environment of the project area. These Impacts have been identified and possible mitigation measures for the adverse impacts have been provided. The execution of the project will surely reduce the outbreak of waterborne diseases and consequently will improve the health and living condition of the people of the project area i.e. Faisalabad, Lahore and Sahiwal.

- Environmentally sustainable engineering practices should be followed to control soil erosion, solid waste management, water contamination, air pollution, noise levels, etc.
- If any tree is uprooted, the contractor should plant at least five folds of tree lost.
- Minimum nuisance to the local community should be ensured.
- The proponent must apply for Environmental Approval (NOC) to Punjab-EPD before proceeding further into project implementation

CHAPTER 1 INTRODUCTION

Punjab is the most populous province of Pakistan with approximately 110 million population as per Population Census 2017. Located in central-eastern region of the country, Punjab is the second-largest province of Pakistan by land area and the largest province by population. This population's access to piped drinking water is less than 50%. Even less than 30% of people living in rural areas have access to clean drinking water.

In order to address this situation, the Government of Punjab has endeavored to develop a program to improve water supply in terms of, both, access and quality of drinking water, especially in rural and peri-urban areas of the province. The project aims on targeting areas in Punjab that have excessively brackish (natural) groundwater making it unacceptable for drinking purposes. The Government of Punjab has established **Punjab Aab-e-Pak Authority (PAPA)** to conceive, plan, design, execute and manage projects to provide sustainable supply of clean drinking water to each individual of about 70 million populations living in rural areas in 137 tehsils of Punjab province. Successful implementation of Aab-e-Pak project will result in to eliminate water- borne diseases, and will provide continuous, safe, acceptable, physically accessible, and affordable water for drinking purpose.

The Punjab Aab-e-Pak Authority has split Punjab Province into three zones, namely the **North Zone, Central Zone, and South Zone**, with further divisions of administrative divisions in order to better administer the provision of clean and safe water to the people of rural Punjab as follows:

North Zone: Gujranwala, Sargodha and Rawalpindi Division

Central Zone: Lahore Division, Sahiwal Division & Faisalabad Division

South Zone: Multan, Bahawalpur, DG Khan Divisions & Tribal Areas of DG Khan

The main focus of this report is the provision of safe & clean drinking water supply to the rural and peri-urban areas of **Central Zone of Punjab**. Three Divisions comes under the **Central Zone** of Punjab i.e. **Faisalabad, Lahore and Sahiwal Divisions**.

Each zone has been further divided into "**Priority Zones**" and the "**Remaining Areas**" of Divisions of each Zone" as a result of the previous feasibility assessment conducted by the Punjab Aab-e-Pak Authority. For instance, the Central Zone of Punjab has been classified into the following priority zones:

- **Priority Zones of Central Punjab:** Lahore and Faisalabad Division
- **Remaining Areas of Central Punjab:** Sahiwal Division

The Villages, where water treatment plants are to be installed, have already been identified by the Punjab Aab-e-Pak Authority which would be provided to the selected consultant for further study and implementation of the project. Furthermore, the details of the location and type of those treatment plants are discussed in the **Chapter # 3** of this report.

1.1 BACKGROUND

Water is a vital resource, and everyone has the right to access to inexpensive and safe drinking water. The State of Pakistan is in charge of providing clean water for drinking. Safe

drinking water for everyone is a goal of Pakistan's National Water Policy. Also, it is the sixth goal of the **Sustainable Development Goals (SDGs)**, which calls for integrated water resource management, efficient water use, and the provision of water and sanitation for everyone. According to the SDGs, Pakistan's vision 2025 addresses the issue of water security and aspires to increase water storage capacity, increase agricultural productivity by 20%, and guarantee that all Pakistani's have access to clean drinking water.

Water for drinking purposes mainly comes out from the surface and underground aquifers near the rivers or canals. Due to the addition and seepage of untreated urban, industrial, and agricultural effluents into water sources, and infiltration from sewers, the quality of surface and ground water is quickly declining by the day. Additionally, it may expose people to chemical, biological, and physical pollutants. The main focus of this report is the provision of safe & clean drinking water supply to the rural areas of **Central Zone of Punjab**. Three Divisions comes under the **Central Zone** of Punjab i.e. **Faisalabad, Lahore and Sahiwal**.

There are very limited water supply facilities available in Rural Areas of Punjab. Pakistan Living Standards Measurement Survey (PLSM) 2018-19 depicts that:

- Overall, 18% of households use tap water as main drinking water source.
- In Punjab only 12 % of the households use tap water as main drinking water source, which is the lowest among all provinces.

In Punjab 69.62 million population lives in rural areas out of which only 14.98 million is served with clean drinking water. Rest 54.64 million is un-served population. So only 21.51% population living in rural areas have access to safe drinking water.

A sufficient quantity of clean drinking water is one of the most important requirements for a healthy life, but in many areas of Punjab and throughout Pakistan, waterborne infections may be a major cause of death. It also plays a significant role in ensuring economic viability, as water-borne diseases cost Pakistan's economy \$1.3 billion annually. According to estimates, water borne illnesses claim the lives of 250,000 children in Pakistan under the age of five every year.

The Government of Punjab has created the **Punjab Aab-e-Pak Authority (PAPA)** in August 2019. The primary goal of this authority's existence is to supply 36 districts of Punjab Province with safe and clean drinking water to rural, semi urban, and peri-urban areas. As a newly established organization, "**Sustainable Environmental Solutions (SES)**" with assistance from WaterAid, Pakistan, prepared a feasibility study for providing safe and clean drinking water to the people of Punjab. This study was approved by the governing body at its 7th Meeting held on February 11th, 2020.

The design life of this project is 20 years and Successful implementation of this project will result in provision of contamination free potable water to the underserved areas in Punjab and consequently, eliminate water-borne diseases to improve public health. When completed, the project aims to advance the development of a significantly healthier, more active, and forward-thinking workforce while also helping to increase the nation's GDP.

1.2 NAME OF THE PROJECT

Provision of Clean Drinking Water by Punjab Aab-e-Pak Authority (Phase-I) Central Zone

1.3 SCREENING OF THE PROJECT

This project includes provision of source and supply of drinking water through Markaz-e-Aabs and establishment of treatment plant facilities in the rural areas of **Faisalabad Division, Lahore Division and Sahiwal Division** and the sub-project of a Surface Water Treatment Plant at **Renala Khurd**, District Okara, Sahiwal Division and a Conventional Treatment Plant at Faisalabad Subdivision **Chak Jhumra**. According to **Schedule II of IEE/ EIA regulations 2022**, states that Water supply schemes and treatment plants with a higher cost of Rs.50 million and above, will require an EIA. Therefore, this project falls in schedule II, Category "F" and thus an EIA is triggered on this Project. The Provincial Laws of Punjab require EIA of projects proposed for its effective implementation to help and ensure that they are environmentally sound and sustainable.

Punjab Aab-e-Pak Authority (PAPA) complies with PEPA, 1997 and Punjab Environmental Protection (Amendment) Act, 2012. Also, as per policy of PAPA, it seeks to promote environmentally sound, socially acceptable and commercially viable Safe Drinking Water Supply Projects.

1.4 PROJECT PROPONENT

The Government of Punjab (GOP) has established an organization called as, the **Punjab Aab-e-Pak Authority (PAPA)**. PAPA, the client plans to design, execute and manage projects for safe drinking water supply in the rural areas having sweet water sources as well as saline and contaminated water sources in the selected districts of Punjab Province. Using localized and customized solutions, with regard to sources and supply options, sustainable O&M models, and community engagement and participation, the Employer intends to develop safe drinking water supply schemes for the underserved, i.e. rural, and peri-urban population, under the Aab e Pak Project. The water supply or the treatment option would be based on the standard of the current water sources, the accessibility of the infrastructure, population density, and the level of community involvement. Under this project, those areas will be served on the priority bases which are severely affected in terms of contamination level.

1.5 PROJECT CONSULTANT

Punjab Aab-e-Pak Authority (PAPA) has engaged with **Engineering Consultancy Services Punjab (ECSP)** for the preparation of the Environmental Impact Assessment (EIA) report for this project.

The primary contact of the focal person from ECSP is:

Amjad Ghafoor

Chief Engineer (Environment and Social Division),
Engineering Consultancy Services Punjab (Pvt.) Limited
83-A, E/1, Main Boulevard, Gulberg III, Lahore
Phone: +92-42-35717681-84
Email: amjad.ghafoor@ecsp.com.pk

1.6 PREVIOUS STUDIES

The PAPA has conducted earlier research on water supply. According to the findings of these feasibility studies, some regions have brackish groundwater while others have sweet underground water that is tapped for drinking and other domestic needs. The main topics of the earlier feasibility studies were the treatment options for surface and groundwater resources. The earlier results from these investigations revealed that the samples of groundwater sources tests had revealed contamination of several substances, such as TDS, Arsenic, Fluorides, and Nitrates, which exceeded their acceptable limits of associated national and international regulations.

The **Figure 1-1** given below shows the map of Punjab districts with brackish water resource.

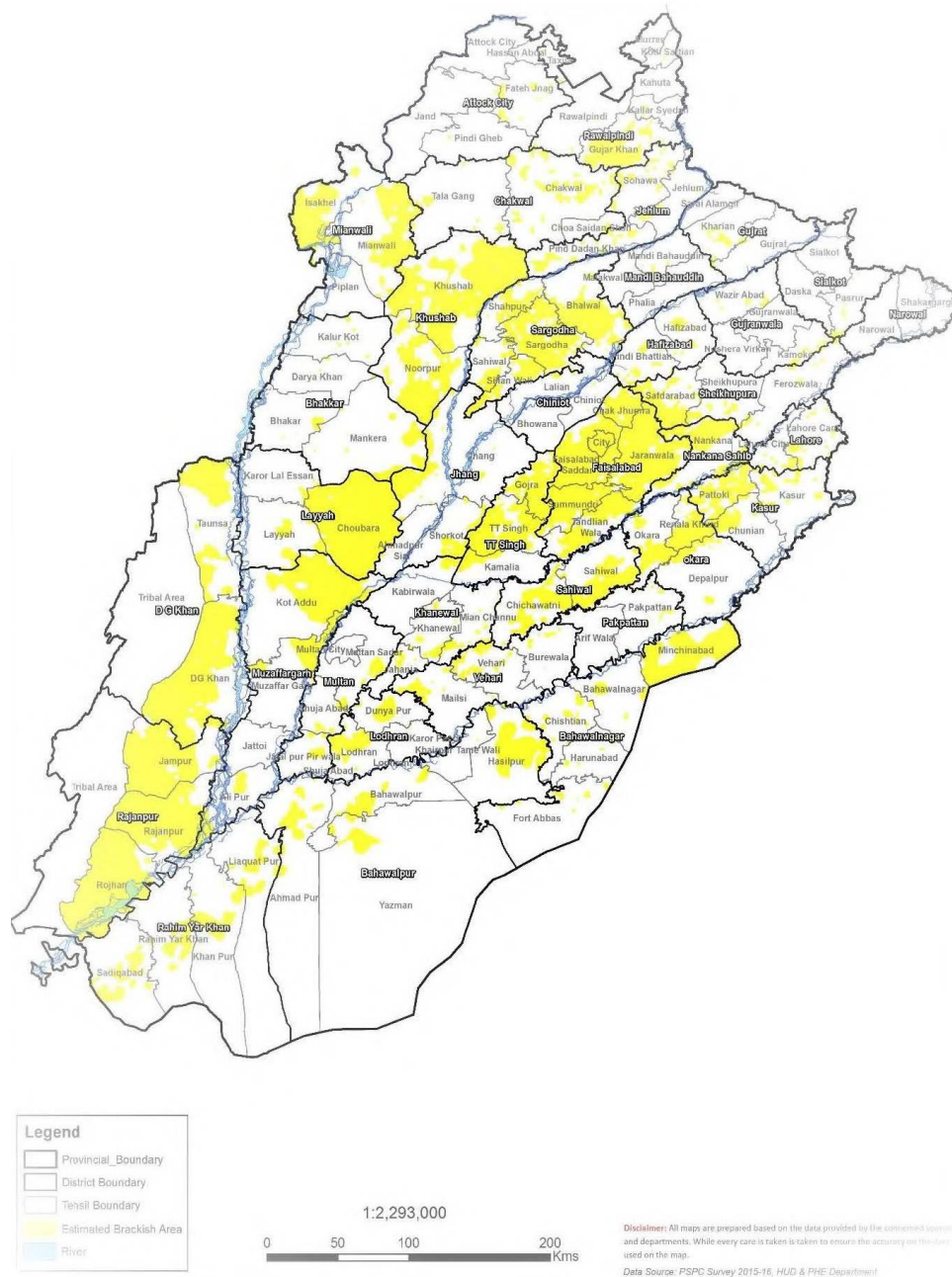


Figure 1-1: Map of Punjab Showing Brackish Areas

1.7 RECOMMENDED SOLUTIONS

Different treatment options are suggested depending on the source and quality of the water, the location and need for potable water, and the difficulty locals have accessing clean drinking water. The proposed solutions are:

- i. Direct supply through pipelines or installation of taps for a community at sweet water sources with no pollution.
- ii. RO plant as standalone solution or Surface water treatment plant with pipeline network to Markaz-e-Aab if TDS in groundwater are more than 1000 mg/l.
- iii. Ultra-filtration plants if TDS in groundwater are less than 1000 mg/L and water contaminated with microbes and other organics.
- iv. UF plant with additional filter according to other contaminants or Surface water treatment plant with pipeline network to Markaz-e-Aab or Shallow depth tube wells at canals with conventional treatment and pipeline network to Markaz-e-Aab for high TDS groundwater with other contaminants like, Arsenic, Iron, Fluoride or Nitrate
- v. Hand operated UF plants recommended for small communities (population size ≤ 800)/
- vi. Completely prefabricated, site mounted, assembled and commissioned compact Rapid Sand Filtration (RSF) treatment plants. Such plants will be used for medium population range (from 8000 to 50,000).
- vii. Hand carry water bottles of 12/19 liters capacity will be provided to the consumers to carry drinking water from plants to their houses.
- viii. Water quality testing on regular basis will be arranged.
- ix. Construction contracts will be made at Division/Zone level according to quantum of work.

The Punjab Aab e Pak Authority has appointed a team of consultants made up of national experts to complete the project. On the sites/areas chosen for the implementation of suggested water supply schemes with adequate solutions, the consultants would carry out water quality tests and a fundamental socioeconomic assessment. In order to offer safe drinking water through Markaz-e-Aabs, the consultants would recommend the installation of site-specific as well as cluster-based schemes by taking into account various workable water treatment options. These water treatment options will be examined from the perspectives of cost, quality, viability, and adoption. The best solution will be chosen based on all of these factors.

1.8 PURPOSE & SCOPE OF WORK FOR THE EIA REPORT

The purpose and scope of this EIA report is to identify and assess the environmental impacts and propose mitigation measures for the significant adverse impacts that are likely to occur due to the implementation of this project. This project includes the construction and operation of Markaz-e-Aabs, and associated structures with the running of Treatment Plants. Another key feature of the EIA process is to work closely with the relevant stakeholders to ensure that the project design reflects environmental sensitivities and meets the social needs of the beneficiaries and the people living in the surroundings.

The scope of EIA work under the consultancy assignment covers the **Central Zone of Punjab** having Divisions of **Faisalabad, Lahore and Sahiwal** with their respective districts. The various Districts of Division Faisalabad, Lahore and Sahiwal are provided in the **Table 1-1** below.

Table 1-1: Divisions of Central Punjab with their Districts

Sr. No.	Name of Division	Name of Districts
1	Faisalabad	District Faisalabad
		District Jhang
		District Toba Tek Singh
		District Chiniot
2	Lahore	District Lahore
		District Kasur
		District Nankana Sahib
		District Sheikhupura
3	Sahiwal	District Sahiwal
		District Okara
		District Pakpattan

1.9 OBJECTIVES OF THE EIA STUDY

The primary goal of the EIA study is to evaluate the environmental effects that are likely to result from the construction and operation of the Project i.e. **Provision of Clean Drinking Water by Punjab Aab-e-Pak Authority (Phase-I) Central Zone** and to recommend mitigation strategies to lessen the likely adverse effects.

For achieving the above objectives, the study was mainly divided into following sections:

- Identification of all requirements as set forth by Pakistan Environmental Protection Act. 1997 and the Guidelines for preparation of EIA reports, etc.
- Study of existing regulatory framework in Pakistan with reference to the developmental projects;
- Study of Guidelines for the preparation of EIA reports;
- Collection and scrutinizing data related to physical, ecological and socio economic, and physical resources of the project area;
- Evaluation of data and identification of significant environmental impacts;
- Plan Identification of necessary mitigation measures to minimize the negative impacts; and preparation of an Environmental Management.

1.10 LIMITATIONS OF THE EIA STUDY

As the detailed design was emergent, the proponent actually requested an EIA analysis after starting the detailed design. **Engineering Consultancy Services Punjab (ECSP)** is responsible for carrying out this study because it is required by Punjab-EPA regulations.

1.11 APPROACH & METHODOLOGY

Overall baseline conditions such as topography, climate, ground water, rainfall, water quality, temperature, geology, seismology, and other physical environmental factors are studied in order to prepare the EIA Report, while the biological environment, such as the fauna and flora of the project area, is also taken into consideration. In addition to the baseline conditions, detailed discussions of the alternatives, an environmental impact description and mitigation plan, and an overall environment management plan outlining the steps taken to reduce the project's significant negative impacts as well as those of the associated construction activities are all sought. In order to obtain reliable information on the environmental circumstances and the needs of the socio-economic surveys, a number of surveys pertaining to data collecting were conducted during the study.

The Government of the Punjab is compelled by law to do this Environmental Impact Assessment (EIA), which was previously required by the Government of Pakistan's Environment Protection Act of 1997 but is now treated as a provincial matter following the constitution's 18th amendment. Stakeholder consultations are a part of the evaluation process both during and after the report is finished and made publicly available.

1.12 NATURE, SIZE & LOCATION OF THE PROJECT

The Program will cover **03 Central Divisions of Punjab** i.e. **Faisalabad, Lahore and Sahiwal** in the province of Punjab. This landmark Program will provide safe drinking water in a comprehensive, integrated and sustainable manner in collaboration with the relevant stakeholders through effective water delivery networks. The proposed Project will ensure carpet coverage of safe and clean drinking water supply to every household in rural Punjab. The project is aimed to provide clean and safe drinking water facilities to the rural population of the Punjab province.

Map of the Divisions / Project Area is shown below as figure. **Figure 1-2.**

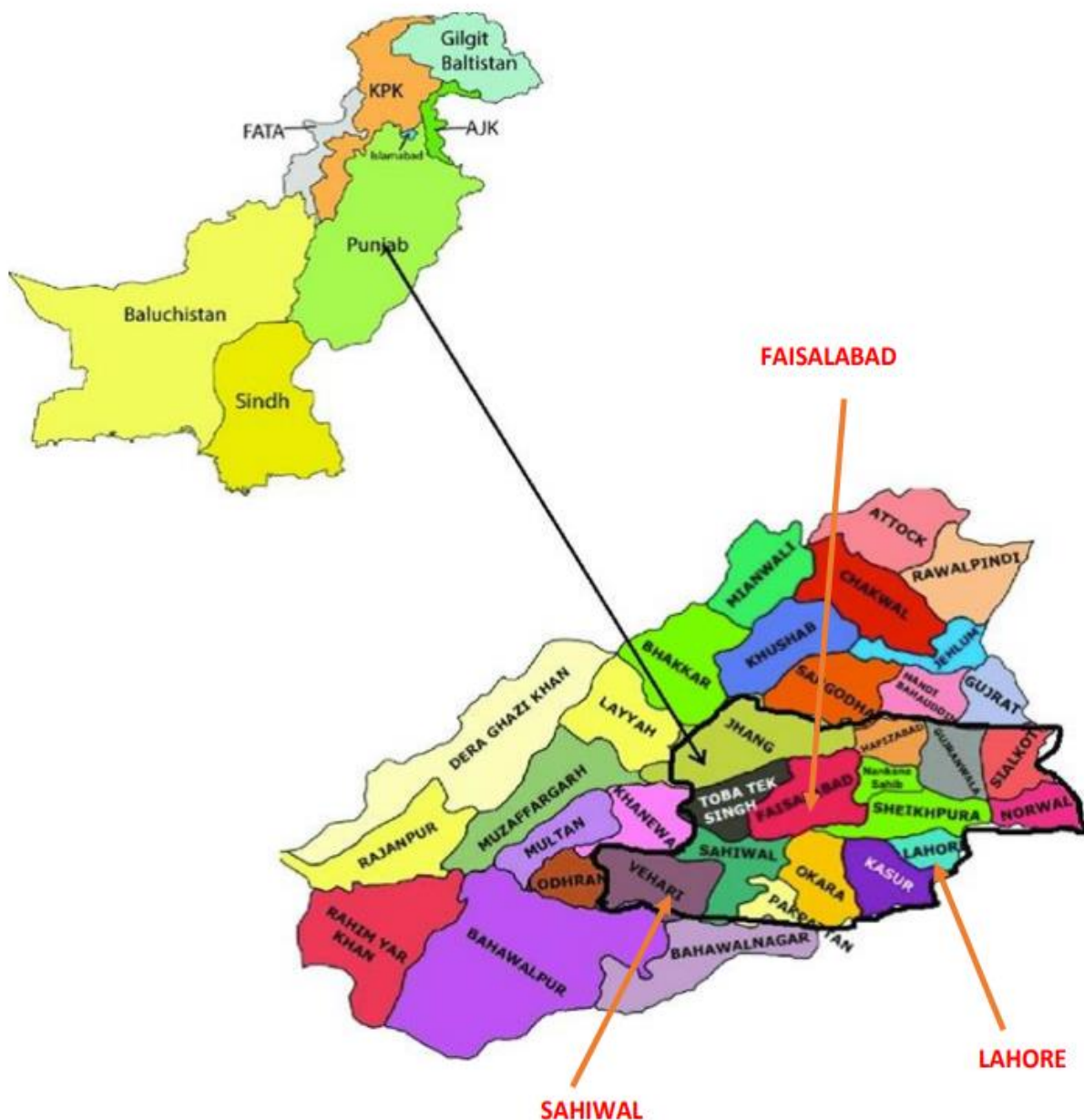


Figure 1-2: Area for Aab e Pak Project (Central Zone)

Project is divided in different contracts keeping in view the geographical spread of the area.

The chosen option will be based on the quality of the current water sources, the availability of infrastructure, the project's cost, the population densities, and a sustainable strategy for producing potable drinking water.

1.13 CRITERIA FOR SITE SELECTION FOR THE INSTALLATION OF TREATMENT PLANTS

The criteria for site selection will be based on the following:

- a. Those sites will be selected only where PHED's Functional Rural Water Schemes exist.

- b. Schemes would be chosen for treatment as per water quality results by PCRWR.
- c. If PCRWR results for water quality are not available then the results of PHED will be used.
- d. Population would be projected up to the planning horizon for 2040.

1.14 STRUCTURE OF THE REPORT

The draft EIA report is divided into eight chapters.

Chapter-1 covers an introduction to the proposed Project.

Chapter-2 provides the country's environmental legislative requirements and framework applicable to the proposed Project together with the guidelines.

Chapter-3 presents the description of the Project including project components and activities, design parameters, detail of infrastructure facilities, alternatives, etc.

Chapter-4 describes in detail the existing environmental baseline conditions of the Study Area related to the physical, ecological and social domains of environment.

Chapter-5 exhibits the assessment of the impact at construction and operational phases of the proposed project along with their mitigation measures.

Chapter-6 outlines EMMP along with proposed institutional framework required for effective implementation and monitoring.

Chapter-7 explains the public/stakeholder consultation mechanism and findings.

Chapter-8 gives the conclusions and recommendations.

1.15 ENVIRONMENTAL IMPACT ASSESSMENT TEAM

Table 1-2: Environmental Impact Assessment Team

Sr. No.	Name	Position
1	Sheikh Amjad Ghafoor	Chief Engineer, Environment
2	Muhammad Abdullah	Engineer (Environment)
3	Asad Naveed	Junior Environmentalist
4	Hamza Shahid	Junior Water Treatment Engineer
5	Jawad Mubeen	Site/Survey Environmental Inspector

CHAPTER 2 LEGISLATIVE AND REGULATORY OVERVIEW

2.1 GENERAL

This section provides an overview of the policy, legal, and administrative framework that apply to the proposed Project for Provision of Clean Drinking Water to the residents of Punjab Province (Central Zone) i.e. Division Faisalabad, Division Lahore and Division Sahiwal by Punjab Aab-e-Pak Authority (PAPA). The proposed project is anticipated to comply with policy framework of Environmental Laws of Environmental Protection Agency (EPA) and all relevant international, national, and provincial legislations relating to environmental and social fortification of the proposed project.

2.2 INTRODUCTION

A number of environmental laws exist in Pakistan, containing number of clauses concerning protection of the environment however its history began over three decades ago. The Pakistan Environmental Protection Ordinance (PEPO) 1983 was the first legislation promulgated for the protection of environment. Pakistan Environment Protection Agency (Pak-EPA), however, was established in 1984. No significant environmental policy, guidelines and regulations were enacted until early 1990's. The National Conservation Strategy (NCS) was developed and approved by the federal cabinet in 1992. Provincial Environmental Protection Agencies were also established in 1992-1993 including Punjab-EPA. National Environmental Quality Standards (NEQs) were established in 1993. Detailed environmental guidelines started in 1996. The National Assembly and the Senate conferred Pakistan Environmental Protection Act (PEPA) in 1997. National Environment Policy was passed by the parliament in 2005 which received World Bank approval in 2011. The Punjab Aab e Pak Project has been assessed in compliance of existing legal framework on the environment in Pakistan as described henceforth.

2.3 NATIONAL LAWS AND REGULATIONS

The enactment of the Pakistan Environmental Protection Act (PEPA) 1997 conferred broad-based enforcement powers to the environmental protection agencies. The publication of the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations (IEE-EIA Regulations), 2000 provided the necessary details on the preparation, submission and review of initial environmental examinations (IEE) and environmental impact assessments (EIA). In addition to the PEPA, 1997, Pakistan's statute books contain a number of other laws that have clauses concerning the regulation and protection of the environment. The Environmental Protection Agency (EPA), Punjab is a Regulatory body under provisions of the Punjab Environmental Protection Act, 1997 (Amendment 2012) in the Province of the Punjab.

Most of the existing laws on environmental and social issues have been enforced over an extended period of time, and are context-specific. The laws relevant to the developmental projects are briefly reviewed below:

2.4 NATIONAL WATER POLICY 2018

The objective of the National Water Policy is to take cognizance of the emerging water crisis and provide an overall policy framework and guidelines for a comprehensive plan of action. Pakistan has a federal system of government and the provinces enjoy a considerable degree of 2 autonomy under the 18th Amendment to the Constitution. Thus, this policy is a national framework within which the provinces can develop their master plans for sustainable development and management of water resources. The water resource is a national responsibility but irrigation and agriculture, as well as rural and urban water supply, environment, and other water-related sub-sectors, are provincial subjects.

2.5 PUNJAB WATER POLICY 2018

This Punjab Water Policy is a sectoral policy document at the provincial level. The overall objective of Punjab's Water Policy is to provide clear policy directions to the Government of Punjab on the sustainable management and development of water from all sources of water (surface water, groundwater, and rainwater), for all sub-sectors of water use (domestic, stock water, agriculture, industry, commercial and environment) and all regions (Indus basin canal commands and outside the canal commands) at the basin level through equitable water allocations, management, and development.

The Policy contributes to helping eliminate hunger, food insecurity, and malnutrition. The first 3 priorities for the consumptive and non-consumptive uses of water are set as:

- Drinking and Sanitation (WASH);
- Irrigation;
- Livestock, fisheries, and wildlife.

The specific objectives of the Policy include:

- Rigorously pursue Demand Management through water conservation, improving irrigation efficiency, increasing water productivity, adjusting cropping patterns, developing water-food-energy nexus and population control;
- Enforce Drinking Water and Sanitation Standards in urban and rural areas through the construction of water treatment plants, sewage disposal, solid waste management, proper landfills siting, and management;
- Increase Water Availability through advocacy of construction of large dams at the Federal level, construction of small and medium dams, beneficial use of floodwaters, reallocation between sectors, and recycling and reuse of wastewater.

2.6 PAKISTAN ENVIRONMENTAL PROTECTION ACT, 1997

The Act is applicable to a broad range of issues and extends to air, water, soil, marine and noise pollution, as well as the handling of hazardous waste. Some portions from the Act are reproduced below for reference purposes.

- **Section-11 (1) (Prohibition of Certain Discharges or Emissions):** "Subject to the provisions of this Act and the rules and regulations made there under no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollution or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards."

- **Section-12 (1) (IEE and EIA):** "No proponent of a project shall commence construction or operation unless he has filed with the Federal Agency an Initial Environmental Examination (IEE) or, where the project is likely to cause an adverse environmental effect, an Environmental Impact Assessment (EIA), and has obtained from the Federal/ Provincial Agency approval in respect thereof".
- **Section 12-2b (Review of IEE and EIA):** The Federal/ Provincial Agency shall review the EIA report and accord its approval subject to such conditions as it may deem fit to impose, or require that the EIA be re-submitted after such modifications as may be stipulated or rejected, the project as being contrary to environmental objectives.
- **Section-14 (Handling of Hazardous Substances):** "Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle or import any hazardous substance except (a) under a license issued by the Federal Agency and in such manner as may be prescribed; or (b) 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"
- **Section 15 (Regulation of Motor Vehicles):** Subject to provision of this clause of the Act and the rules and regulations made there under, no person shall operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the NEQS, or where the applicable standards established under clause (g) of subsection (1) of Section-6 of the Act.
- **Section 17 (Penalties):** Whoever contravenes or fails to comply with the provisions of section 11, 12, 13, or section 16 or any order issued there under shall be punishable with fine which may extend to one million rupees, and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues: Provided that if contravention of the provisions of section 11 also constitutes contravention of the provisions of section 15, such contravention shall be punishable under sub-section (2) only.

2.7 REVIEW OF IEE/ EIA REGULATIONS (2022)

The Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2022, prepared by the Pak-EPA under the powers conferred upon it by the PEPA, 1997 provide the necessary details on the preparation, submission, and review of the initial environmental examination (IEE) and the environmental impact assessment (EIA).

Categorization of projects for IEE and EIA is one of the main components of the IEE/EIA Regulations, 2022. Projects have been classified on the basis of expected degree of adverse environmental impact. Project types listed in Schedule II of the regulations are designated as potentially seriously damaging to the environment, and those listed in Schedule I as having potentially less adverse effects.

Schedule-I projects require an IEE to be conducted, rather than a full-fledged EIA, provided that the project is not located in an environmentally sensitive area. The projects listed in Schedule-II are generally major projects and have the potential to affect a large number of people in addition to significant adverse environmental impacts. For the Schedule II projects, conducting an EIA is necessary. According to Schedule-II; List of Projects requiring EIA of the IEE/ EIA regulations, 2022, the following is the exact version of the Clause F:

2.8 GUIDELINES FOR ENVIRONMENTAL ASSESSMENT, PAKISTAN EPA

The Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. The guidelines that are relevant to the proposed project are listed below:

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

2.9 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 in order to regulate environmental pollution.

2.10 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 in order 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 below.

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

Sr. No.	Pollutant	PEQS, 2016	
		Time-Weighted Average	Concentration standard
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
		(mg/l)	(mg/l)
A) CHEMICAL PARAMETERS			
1	Aluminum (Al)	≤ 0.2	0.2
2	Ammonium (NH3)	-	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

Sr. No.	Parameters	PEQS, 2016	WHO
		(mg/l)	(mg/l)
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
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	Odor	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	$\leq 30^{\circ}\text{C}$	$\leq 30^{\circ}\text{C}$
2	pH value (H ⁺)	6-9	6-9

Sr. No.	Parameters	Discharge into Inland Waters	Discharge into Sewage Treatment
		PEQS, 2016	PEQS, 2016
		(mg/l)	(mg/l)
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

2.11 SUPPLY AND TREATMENT

“Water supply schemes and treatment plants with total cost of Rs.50 million and above”
(Source: IEE/ EIA Regulations 2022)

2.12 PUNJAB ENVIRONMENTAL PROTECTION ACT 1997

After 18th Constitutional Amendment in the Constitution of Pakistan, the Federal Ministry of Environment has been dissolved and subject of environment has been handed over to provinces, thus Punjab-EPA has formulated its own act. The major content of the act is same as of PEPA, 1997 but minor amendments/ changes have been made viz.:

- The Name of Act has been changed into “Punjab Environmental Protection (Amendment) Act, 2012”.
- For the words “Federal Government”, wherever occur, the word “Government” Shall be substituted;
- For the words “Federal Agency”, wherever occur, the words “Provincial Agency” shall be substituted; and for the word “National”, wherever occurs, the word “Punjab” shall be substituted.

All the other clauses, sub-clauses, sections and sub-sections are almost same.

2.13 PUNJAB ENVIRONMENTAL PROTECTION ACT (AMENDED), 2012

The Punjab Protection Act, 2012 under Clause 12 entails the provision of filing an initial environmental examination or environmental impact assessment (where the project is likely to cause an adverse environmental effect) and obtaining environmental approval from the Agency, in respect thereof before the construction of the proposed project.

2.14 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, programs, 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 proposed project will abridge the emission of Hydrogen Sulphide and greenhouse gases from the open drains present in the proposed project area.

2.15 LAND ACQUISITION ACT, 1894

Land Acquisition Act 1894 provides the acquisition of private properties for public purposes including development projects in Pakistan. It comprises fifty-five sections dealing with area notifications, survey, acquisition, compensation, apportionment awards, disputes resolutions, penalties and exemptions. The latest revision/amendments including land acquisition rules 1983 and general regulation called standing order No. 28 shall be applicable.

2.16 CODE OF CRIMINAL PROCEDURE, 1898 (ACT V OF 1898)

This act provides details of the procedures to be adopted in handling legal cases. Various sections such as section 494 have been renumbered as sub-section (1) thereof and after sub-section (1) renumbered as aforesaid, the following sub-section (2) and (3) have been added.

2.17 FOREST ACT, 1927

Forest Act of 1927 establishes the right of the Government to designate areas for reserved forest, village forest and protected forest, and they may acquire such areas in order to prohibit or restrict the public use of such resources or other activities within them.

2.18 PUNJAB WILD LIFE PROTECTION ACT 1974

This act was enacted on 1st February 1974. The purpose of this act is to provide for the Protection, preservation, conservation and management of wildlife in the Province of the Punjab. The act may be called Punjab Wildlife Act 1974 and it extends to the whole province of Punjab. This legislation creates a wildlife department and provides the protection to the wildlife.

2.19 PUNJAB IRRIGATION AND DRAINAGE AUTHORITY ACT, 1997

This Act aims to implement the strategy of the Government of Punjab for streamlining the Irrigation and Drainage System; to replace the existing administrative setup and procedures with more responsive, efficient and transparent arrangements; to achieve Economical and effective operation and maintenance of the irrigation, drainage and flood control system in the Province; and to make the irrigation and drainage network sustainable on a long-term basis and introduce participation of beneficiaries in the operation and management.

2.20 PUNJAB LOCAL GOVERNMENT ACT 2013

It is expedient to establish an elected local government system to devolve political, administrative and financial responsibility and authority to the elected representatives of the local governments; to promote good governance, effective delivery of services and transparent decision making through institutionalized participation of the people at local level; and, to deal with ancillary matters; It is enacted as follow: This Act may be cited as the Punjab Local Government Act 2013.

- It extends to the whole of the Punjab except the Cantonment areas or any other area excluded by the Government by notification in the official Gazette.
- It shall come into force on such date as the Government may, by notification, appoint and Different dates may be appointed for coming into force of different provisions of this Act.

2.21 FACTORIES ACT, 1934 (AS AMENDED TO 1997)

The pertinent clauses of the Act are those that deal with health, safety and welfare of the workers, disposal of solid waste and effluent, and damage to private and public property. It also deals with the regulations for handling and disposing of toxic and hazardous materials. As the construction activity has also been classified as an 'industry', the regulations will be applicable to the Contractors.

2.22 PROTECTION OF TREES ACT, 1949

This Act prohibits cutting or lopping of trees along roads and canals planted by the Forest Department, without permission of the Forest Department. This Act prohibits cutting of trees in PAPA area.

2.23 MOTOR VEHICLE ORDINANCE, 1965 AND RULES, 1969

The Motor Vehicles Ordinance, 1965, has been extended with effect from March 05, 1978, to the whole of Pakistan. It deals with the licensing requirement for driving; powers of licensing authority, Regional Transport Authority and those of Court vis-à-vis disqualification for license and registration requirements to control road transport; compensations for the death of or injury to a passenger of public carrier; powers of Road Transport Corporation; traffic rules, power to limit speed, weight, use of vehicles; power to erect traffic signs; specific duties of drivers in case of accident and powers of police officers to check and penalize traffic offenders.

2.24 ANTIQUITY ACT, 1975

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The act is designed to protect antiquities from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the project proponents are obligated to: Ensure that no activity is undertaken in the proximity of a protected antiquity, and If during the course of the Project an archaeological discovery is made, it should be reported to the Department of Archaeology, Government of Pakistan.

2.25 LABOR LAWS

Labor laws in Pakistan are governed by several legislative tools. However, the principal labor rights are provided by the constitution of Pakistan. In addition to constitutional rights, Acts and Ordinances have been enforced for limiting working hours, minimum working age and conditions of employment. The laws will be applicable to the PAPA construction contractors.

2.26 EMPLOYMENT OF CHILD ACT, 1977

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows the child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth years of age. The ECA states that no child shall be employed or permitted to work in any of the occupation set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, beerri (kind of a cigarette) making, cement manufacturing, textile, construction and others). PAPA is a project which will go through construction and operation phase; hence employment of Child Act 1977 will be applicable to PAPA construction activities.

2.27 LOCAL GOVERNMENT ORDINANCE, 2001

This Act empowers the Government of Pakistan and provincial governments to enforce laws for land use; conservation of natural vegetation; air, water, and land pollution; disposal of solid waste and wastewater effluents; and public health and safety, including some provisions for environmental protection. Section 93 of this Ordinance pertains to environmental pollution,

under which the local councils are authorized to restrict causing pollution to air, water or land. PAPA will have to follow the Local Government Ordinance 2001 with regards to pollution of air, water and land.

2.28 EIGHTEENTH AMENDMENT TO CONSTITUTION OF PAKISTAN ACT 2010

The constitution of Pakistan has been amended by Eighteenth Amendment by Act 2010 by due process of Law on 19th April 2010. “Environmental pollution and ecology” used to be listed at number 24 of the Concurrent Legislative List of Schedule IV of the Constitution of Pakistan. Under the 18th amendment to constitution of Pakistan, the entire Concurrent List has been omitted.

The 18th amendment to Pakistan’s constitution does away with all the entries in the Concurrent List. Now, under the constitution, the parliament in Islamabad is competent to legislate only on matters in the Federal Concurrent List and the provinces have the power to legislate on anything that isn’t on the Federal Concurrent List. The regulatory arrangement sat at odds with the needs and demands of enforcement. First, not all of the federal EPA’s powers and functions were delegated to provincial Punjab-EPA.

2.29 THE 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. This act will also trigger as Shah Jahan Monument is present in the proposed project route.

2.30 THE PUNJAB POLYTHENE BAG RULES, 2004

This rule prohibits the manufacturing, sale, use and import of polythene bags that is below 15-micron thickness. This rule will elicit if polythene bags with more than 15-micron thickness used during construction activities.

2.31 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 emanates air pollutants above the permissible limit.

2.32 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) shall apply for engineering design of buildings, like structures and related components.

Construction of buildings in defilement of the Building Code shall 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.

2.33 THE 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.

2.34 HANDLING OF HAZARDOUS SUBSTANCES, PEPA, 2000

Subject to the provisions of this act, no person shall 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.

2.35 LABOR AND HEALTH AND SAFETY LEGISLATION

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

- Article 11 of the Constitution prohibits all forms of slavery, forced labor and child labor;
- Article 17 provides for a fundamental right to exercise the freedom of association and the right to form unions;
- Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone; and
- 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: 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.

2.36 ISO 18001 OCCUPATION HEALTH AND SAFETY ASSESSMENT SERIES (OHSAS)

OHSAS 18001 is an Occupation Health and Safety Assessment Series for health and safety management systems to help organizations to control occupational health and safety risks. The OHSAS specifications are applicable to any institute that desires to establish an OH&S management system to eradicate or reduce risk to employees and other interested parties who may be exposed to the risks allied with the project activities. The construction of the proposed project may involve various health and safety issues to construction labour; therefore, these ISO 18001 guidelines will be applicable and pertinent. This series will elicit during construction and operational phase to ensure health and safety of workers associated with the project activities.

2.37 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 if gender-based violence observed in the project area during construction phase.

2.38 DISASTER MANAGEMENT ACT, 2010

The act is administered by 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.

2.39 POLICY FRAMEWORK

2.39.1 National Conservation Strategy (NCS), 1992

The Pakistan National Conservation Strategy (NCS) is the principal policy document for environmental issues in the country and was developed and approved by the Government of Pakistan on March 1, 1992. The NCS works on a ten-year planning and implementation cycle. The NCS deals with 14 core areas which are;

- Maintaining soils in cropland; Increasing irrigation efficiency; Protecting watersheds; Supporting forestry and plantations;
- Restoring rangelands and improving livestock; Protecting water bodies and sustaining fisheries; Conserving biodiversity;
- Increasing energy efficiency;
- Developing and deploying material for renewable energy; Preventing/abating pollution;
- Managing urban wastes;
- Supporting institutions for common resources; Integrating population and environmental programs and preserving the cultural heritage.

2.39.2 National Environmental Policy

This policy was implemented in 2005 to provide an overarching framework for addressing the environmental issues facing Pakistan. It gives directions for addressing. Sectorial issues and provides means for promoting conservation and environmental protection in water, air and waste management, forestry, and transport. The policy aims to promote protection of the environment, the honoring of international obligations, sustainable management of resources and economic growth. PAPA will be required to promote, conserve and protect environment.

2.39.3 Guidelines for Preparation and Review of Environmental Reports

These guidelines on the preparation of environmental reports address project proponents, and specify the:

- Nature of the information to be included in environmental reports;
- Need to incorporate suitable mitigation measures into every stage of project implementation;

- Need to specify monitoring procedures; and the Terms of reference for the reports are to be prepared by the project proponents themselves.

2.39.4 Policy and Procedures for Filling, Review and Approval of Environmental Assessments 2022

These policies and procedures define the policy context and the administrative procedures that govern the environmental assessment process, from the project pre-feasibility stage to the approval of the environmental report.

2.39.5 Guidelines for Public Consultations, 1997

The guidelines deal with approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in impact assessment.

2.39.6 Guidelines for Sensitive and Critical Areas, 1997

The guidelines identify officially notified protected areas in Pakistan, including critical ecosystems, archaeological sites, etc., and present checklists for environmental assessment procedures to be carried out within or near to such sites. Environmentally sensitive areas include, among others, archaeological sites, biosphere reserves and natural parks, and wildlife sanctuaries and preserves, none of which are relevant to the Project area.

2.40 NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS 2000; AMENDED IN 2010)

NEQS were first promulgated in 1993 and were amended in 2000, 2009 and 2010. The NEQS 2000 includes Environmental Quality Standards for Municipal and Liquid Industrial Effluents (32 parameters) and Industrial Gaseous Emissions (18 parameters). NEQS 2009 provides standards for motor vehicle exhaust and noise (in used vehicles and new vehicles). NEQS 2010 provides the standards for ambient air quality (9 parameters), drinking water quality (32-parameters) and noise (four zones during day and night).

2.41 ENVIRONMENTAL REGULATORY AUTHORITIES

The development of statutory and other instruments for environmental protection has steadily gained priority in Pakistan since the late 1970's. The Pakistan Environmental Protection Ordinance (PEPO) 1983 was the first legislation in Pakistan designed specifically for the protection of the environment. The promulgation of this Ordinance was followed in 1984 by the creation of Pakistan Environmental Protection Council (PEPC).

2.42 PAKISTAN ENVIRONMENTAL PROTECTION COUNCIL

The PEPC is the highest inter-ministerial statutory body in the country headed by the Chief Executive and is responsible for:

- Formulating national environmental policy; Enforcing PEPA 1997;
- Approval of the NEQS;

- Provision of guidelines for the protection and conservation of biodiversity in general as well as conservation of renewable and non-renewable resources; and in the amendment of the PEPA 1997 for the word Pakistan is substituted by Punjab.

2.43 PAKISTAN ENVIRONMENT PROTECTION AGENCY (PAK-EPA)

The PAK-EPA is headed by a Director General and has wide ranging functions as set out in PEPA 1997. These include preparation and co-ordination of national environmental policy for approval by PEPC, administering and implementing PEPA 1997 and preparation, revision or establishment of NEQS. The PAK-EPA has issued regulations regarding the environmental assessment procedures known as Review of Initial Environmental Examination (IEE) and EIA Regulations, 2022; these provide a firm legal status to the IEEs and EIAs. The jurisdiction of the EPA is applicable to the following projects:

- On federal land; Military projects;
- Involving trans-country impacts; and Bearing trans-province impacts.

2.44 ENVIRONMENTAL PROTECTION DEPARTMENT (EPD), PUNJAB

Punjab, along with other provinces, has its own Environmental Protection Department (EPD) as a provincial level counterpart of the PAK-EPA. It is headed by a Director General who exercises powers delegated to him by the provincial government. The IEE and EIA reports pertaining to projects falling within Punjab are to be submitted to Punjab EPA for approval. Punjab Aab e Pak Company is responsible for providing the complete environmental documentation required by the Punjab-EPA and remain committed to the approved Project design. No deviation is permitted in design and scope of work during Project implementation without the prior and explicit permission of the Punjab-EPA.

CHAPTER 3 PROJECT DESCRIPTION

3.1 INTRODUCTION

Safe and clean water is important for public health, whether it is used for drinking, domestic use, food production or recreational purposes. Improved water supply and sanitation, and better management of water resources, can boost countries' economic growth and can contribute greatly to poverty reduction.

According to an official survey reports (Zahid, 2018)¹, 79% water samples collected from rural areas of 12 Districts in the province of Punjab were found to be unsafe for human consumption, while 88% water samples collected from rural areas of 21 Districts of the province were also found to be unsafe. Not surprisingly, the mortality due to water borne diseases is very high. Similarly, according to a study (Hagris et al., 2013), the maximum values of Na, Ca, Mg, Cl, HCO₃, SO₄, TDS and Conductivity are found in Faisalabad, Punjab. Overall, 23% of the rural population in Punjab lives in predominantly brackish water area. The range of high TDS goes up to 1000 mg/L. According to a **UNICEF** and **PCRWR** report (Aziz Ullah et al., 2011)², the Arsenic concentration above permissible level is found in various areas of Punjab and the maximum arsenic above 50 µg/L was found in the South Punjab. Data collected in rural Punjab suggests that Arsenic levels above WHO permissible limit of 0.01 mg/L is found in about 37 locations. A report presented on Water, Sanitation and Hygiene in Pakistan (Cooper, 2018)³, suggests that there are still a lot of unprotected wells, springs and other open water surfaces that are being used for to meet the everyday water demands in rural Punjab. The results are further corroborated by the Report of Consumer Rights Commission of Pakistan supported by the Japan Fund for Global Environment (JFGE) which states that every 5th Pakistani child under the age of five suffers from waterborne diseases and roughly 50% of mortality and 40% of hospital admissions are also caused by waterborne diseases.

In order to address this situation, the Government of Punjab has endeavored to develop a program to improve water supply in terms of, both, access and quality of drinking water, especially in rural areas of the province. The project aims on targeting areas in Punjab that have excessively brackish (natural) groundwater making it unacceptable for drinking purposes.

For this purpose, the Government of Punjab initiated the **Punjab Aab-e-Pak Project** under which a **Punjab Aab-e-Pak Authority (PAPA)** has been established as a Special Purpose Vehicle (SPV) to conceive, plan, design, execute and manage projects for provision of safe drinking water to the communities in rural and Peri-urban areas of Punjab. This project will provide & improve the water supply (safe and clean drinking water) in rural and peri-urban areas of the province of Punjab as per World Health Organization's (WHO) Guidelines for Drinking water Quality. The Punjab Aab E Pak Project is a mega program which will cover Divisions of **Faisalabad, Lahore & Sahiwal** with their respective Districts in the province of Punjab. This landmark Program will provide safe drinking water in a comprehensive,

¹ Zahid, J. (2018). Impact of clean drinking water and sanitation on water borne diseases in Pakistan.

² Azizullah, A., Khattak, M. N. K., Richter, P., & Häder, D. P. (2011). Water pollution in Pakistan and its impact on public health—a review. *Environment international*, 37(2), 479-497.

³ Cooper, R. (2018). Water, sanitation and hygiene services in Pakistan.

integrated and sustainable manner in collaboration with the relevant stakeholders through effective water delivery networks.

3.2 ABOUT PROPONENT

Punjab Aab-e-Pak Authority is constituted under the Punjab Aab-e-Pak Authority Act 2019 and is responsible for the provision of clean drinking water to the people of Punjab, in consultation with the relevant entities including the local governments. The Punjab Aab e Pak Authority (PAPA) is the Proponent of this Project. The PAPA, a company in the Public sector of the Government of Punjab intends to construct **Water Supply Project** for drinking water only.

This project will cover the Divisions of **Faisalabad, Lahore and Sahiwal** with their respective Districts/Tehsils to construct the drinking water supply facility which shall include the development of source of water, treatment unit and Markaz e Aabs to distribute the treated water to villages.

This project also includes the sub-projects of a Surface Water Treatment Plant at subdivision **Renala Khurd**, District Okara and a Conventional Treatment Plant at Faisalabad Subdivision **Chak Jhumra**.

3.3 TYPE AND CATEGORY OF THE PROJECT

According to the **PAK-EPA Regulations 2022** for Review of IEE and EIA, Punjab Aab e Pak Project falls under category '**F**' **Schedule II** (Water supply schemes and treatment plants with total cost of Rs.50 million and above) of Schedule-II Projects, which requires an EIA. The provisions of Section-12 of the EIA Act also apply on this project.

3.4 OBJECTIVES OF THE PROJECT

The primary objective of this project is to improve the health of the people of rural Punjab through provision of safe drinking water which shall lead to reduction/elimination of water borne diseases and eventually boost the economy of the area. The government of Punjab intends to develop projects of safe drinking water supply to the deserved i.e. rural and Peri-urban population, using localized and customized solutions, with regard to sources and supply options and sustainable O&M models with community engagement and participation. The option would be determined by the quality of existing water sources, availability of infrastructure, population density and level of community participation.

The areas which are worst affected in terms of contamination level and non- availability of water supply system will be taken up for interventions at the earlier stages of the project.

Safe drinking water is water with microbial, chemical and physical characteristics that meet WHO guidelines or national standards on drinking water quality;

Access to drinking water means that the source is less than 1 kilometer away from its place of use and that it is possible to reliably obtain at least 5 liters safe drinking water per member of a household per day.

3.5 SCOPE OF WORK

Contract of Engineering Consultancy Services for Detailed Design and Resident Supervision for Provision of Clean Drinking Water (Phase-I) - Central Zone for the Punjab Aab-e-Pak Project of Punjab, Pakistan has been signed between **Punjab Aab-E-Pak Authority, Government of the Punjab** and **Engineering Consultancy Services Punjab (Pvt.) Ltd. (ECSP)** on **October 15th, 2020**. The services will cover the Central Zone Division of Faisalabad, Sahiwal, and Lahore and other sub-projects in the subdivisions of Faisalabad and Sahiwal.

The overall scope of the instant consultancy services is to carry out (a) Detailed Engineering Design, Obtaining Environmental NOC from EPA, Punjab and (c) Resident Construction Supervision for components of the Project to be carried out in Central Zone which comprises of:

- i. 197 water filtration plants (RO and UF Plants),
- ii. 200 Direct Supply Schemes (after Pre-Treatment through Packaged Plants),
- iii. 01 Surface Water Treatment Plant of **10m³/hr.** capacity at **Okara** at **Renala Khurd Tehsil**
- iv. 01 Conventional Treatment Plant of **35m³/hr.** capacity at **Chak Jhumra, Faisalabad** the source of water for which is from the existing System of shallow tube-wells, only.

In General, a total of 399 number of Treatment plants will be installed by the Punjab Aab-e-Pak Authority in Central Zone of Punjab.

Types (i) and (ii) fall under the main projects of Divisions in which the Districts of the respective Divisions are considered, while types (iii) and (iv) fall under the sub-projects in which Sub-divisions of Tehsils are considered for the project.

In order to achieve the timeline for installation of treatment plants, the project is expected to be divided into multiple contracts which shall be shared with the consultant after finalization. The Consultant shall be required to provide services in conformity to those packaged contracts. The consultant shall check the feasibility and suitability of the proposed treatment plants, direct supply treatment plants, Surface water treatment Plants and Conventional Treatment Plants and recommend/ validate the most favorable solution and prepare designs and conduct resident supervision accordingly.

3.6 WORK PLAN

The Consultants have carefully drawn up a Work Plan that takes into consideration the nature and objectives of the Project. The Work Plan is based on the Consultant's understanding of the project from the TOR and the Consultants' vast experience in undertaking similar projects under similar conditions. The Work Plan is based on several significant points as follows:

A clear understanding of the TOR of the assignment and the objectives of the Project;

- A comprehensive response to the requirements of the Project;
- Simple, effective Work Plan and Methodology which can be readily understood to ensure that an integrated team approach from the various components and phases will achieve the objectives of the Project;

- An appropriate and efficient project organization with clear lines of communication and established protocols for liaison with all involved people i.e. organizations and strong project management.

3.7 CRITERIA FOR SITE SELECTION

The criteria for site selection will be based on the following:

- a) Those sites will be selected only where PHED's Functional Rural Water Schemes exist.
- b) Schemes would be chosen for treatment as per water quality results by PCRWR.
- c) If PCRWR results for water quality are not available then the results of PHED will be used.
- d) Population would be projected up to the planning horizon for 2040.

Project is divided in different contracts keeping in view the geographical spread of the area.

3.8 RECOMMENDED SOLUTIONS

The solution opted would be determined on the basis of quality of existing water sources, availability of infrastructure, cost of the project, population densities and sustainable solution for potable drinking water purposes.

Multiple treatment solutions as per local situation are proposed depending upon the source and quality of water, area and urgency for providing potable water, difficulty faced by the residents to fetch clean drinking water. Following multiple solutions are proposed:

- i. Direct supply through pipelines or installation of taps for a community at sweet water sources with no pollution
- ii. RO plant as standalone solution or Surface water treatment plant with pipeline network to Markaz-e-Aab if TDS in groundwater are more than 1000 mg/l
- iii. Ultra-filtration plants if TDS in groundwater are less than 1000 mg/L and water contaminated with microbes and other organics.
- iv. UF plant with additional filter according to other contaminants or Surface water treatment plant with pipeline network to Markaz-e-Aab or Shallow depth tube wells at canals with conventional treatment and pipeline network to Markaz-e-Aab for high TDS groundwater with other contaminants like, Arsenic, Iron, Fluoride or Nitrate
- v. Hand operated UF plants recommended for small communities (population size ≤ 800)
- vi. Completely prefabricated, site mounted, assembled and commissioned compact Rapid Sand Filtration treatment plants. Such plants will be used for medium population range (from 8000 to 50,000).
- vii. Hand carry water bottles of 12/19 liters capacity will be provided to the consumers to carry drinking water from plants to their houses.
- viii. Water quality testing on regular basis will be arranged.
- ix. Construction contracts will be made at Division/Zone level according to quantum of work.

3.9 DESIGN METHODOLOGY

Following treatment options are proposed for direct supply on basis of groundwater quality and functionality of the water supply schemes:

- i. **Sand /Activated Carbon Filter Plants**
- ii. **Reverse Osmosis Filter Plants**

3.10 SAND / ACTIVATED CARBON FILTER PLANTS

This includes both sand filtration (SF) and activated carbon units (AC) are designed in villages where water supply scheme has TDS value less than 1000 mg/l. If contaminants like arsenic, fluoride & nitrate exist in water source, additional removal units for these impurities are appended to Sand and Activated Carbon Filter Plants. The capacity of the plant will be of 2000 liter/hour. The water sources of the plants will be water supply scheme already working in the village. In the village where water supply schemes are non-functional, the source of the filtration plant will be ground water. These Sand/Activated Carbon Filters are applied after the pre-filtration / ultra-filtration process depending upon the need to achieve desired level of purification.

3.11 REVERSE OSMOSIS (RO) PLANTS

In areas where water supply is non-functional and TDS values of ground water of the area is more than 1000 mg/l, RO plants are designed. If contaminants like arsenic, fluoride & nitrate exist in the groundwater, RO plants can also remove all these impurities.

3.12 WATER DEMAND

The determination of water demand depends upon the estimation of the future population at selected design period. PAPA approved 3 liters/ca/d drinking water for the village population while 2 liters/ca/d is reserved for public usage, i.e. school, mosques, hospitals and unforeseen conditions. Therefore, a total of **5 liters/ca/d** will be supplied in the village, and designs will be tailored accordingly.

Water demand of **5 liters per capita per day (5 lpcd)** is used for the calculation of water demand for the year 2020 & 2041.

3.13 POPULATION PROJECTION

A fundamental pre-requisite to begin the design of water supply facilities is a determination of the design capacity. It is difficult to estimate the population growth due to economic and social factors involved. As the design horizon of the drinking water facilities is for the next 20 years so population is projected for the year 2041 of the respective Divisions of Central Zone of Punjab. Forecasting of population accomplished with different mathematical methods by using present and past population records that obtained from local census office. Population projection is prepared on the basis of census report 2017.

Approved Population Projection Method

Selection of any method depends on the relevant data availability and the projection period (short term or long term). Because of unavailability of latest census data 2020 on Tehsil wise, Punjab Aab-e-Pak Authority has approved Geometric Method for the population projection using 2017 census data. This approved formula for population projection is used overall in the Central Zone of Punjab for each of the contract.

Geometric Growth Method

This method assumes that a population will change by the same percentage rate over a given increment of time in the future as during the base period. The average geometric rate of population change during the base period can be computed as:

$$P_t = (P_l) [(1 + r)^z]$$

Where;

P_t, is the population in the target year,

P_l, is the population in the launch year,

r, is the average geometric rate of change, and

z, is the number of years in the projection horizon

3.14 TUBE WELL AND PUMP

Submersible pumps are provided by keeping in view their less maintenance frequency. In RO Plants, pumping machinery for tube wells is designed on 100% extra flow, as the recovery from RO Plants are normally 50%. For Sand and Activated Carbon Filter Plants where water supply schemes are non-functional, pumping machinery are designed with 10% safety margin in required flow.

3.15 TRANSMISSION SYSTEM (PIPE LINES)

Pipeline is designed with required to convey water from rising main of water supply scheme to Markaz-e -Aab.

3.16 DISPOSAL OF REJECTED WATER

- **In-case of UF/PF and Direct Water Supply Plants**

Sewer discharge is a low-cost solution and PEQs allows the effluent having TDS less than 3500 PPM to drain the sewers. So, the rejected water will be discharge in to sewerage / open drain system of villages. While the maximum value of TDS recorded during the sampling was 1750 PPM; Hence, the rejected water can be safely disposed into the sewerage/open drain system of the villages. This methodology is applied in all the three divisions of Central Zone of Punjab with the Project area of Lahore Division, Faisalabad Division and Sahiwal Division.

- **In-case of Reverse Osmosis (RO) Plants**

The brine produced in the case of the RO system varies from 30% to 40% (meaning that 30% to 40% of the feed water will be brine) of the feedwater. This brine from RO plants will be injected back into the earth through the injection well. Below image will explain the methodology of using injection well in the process:

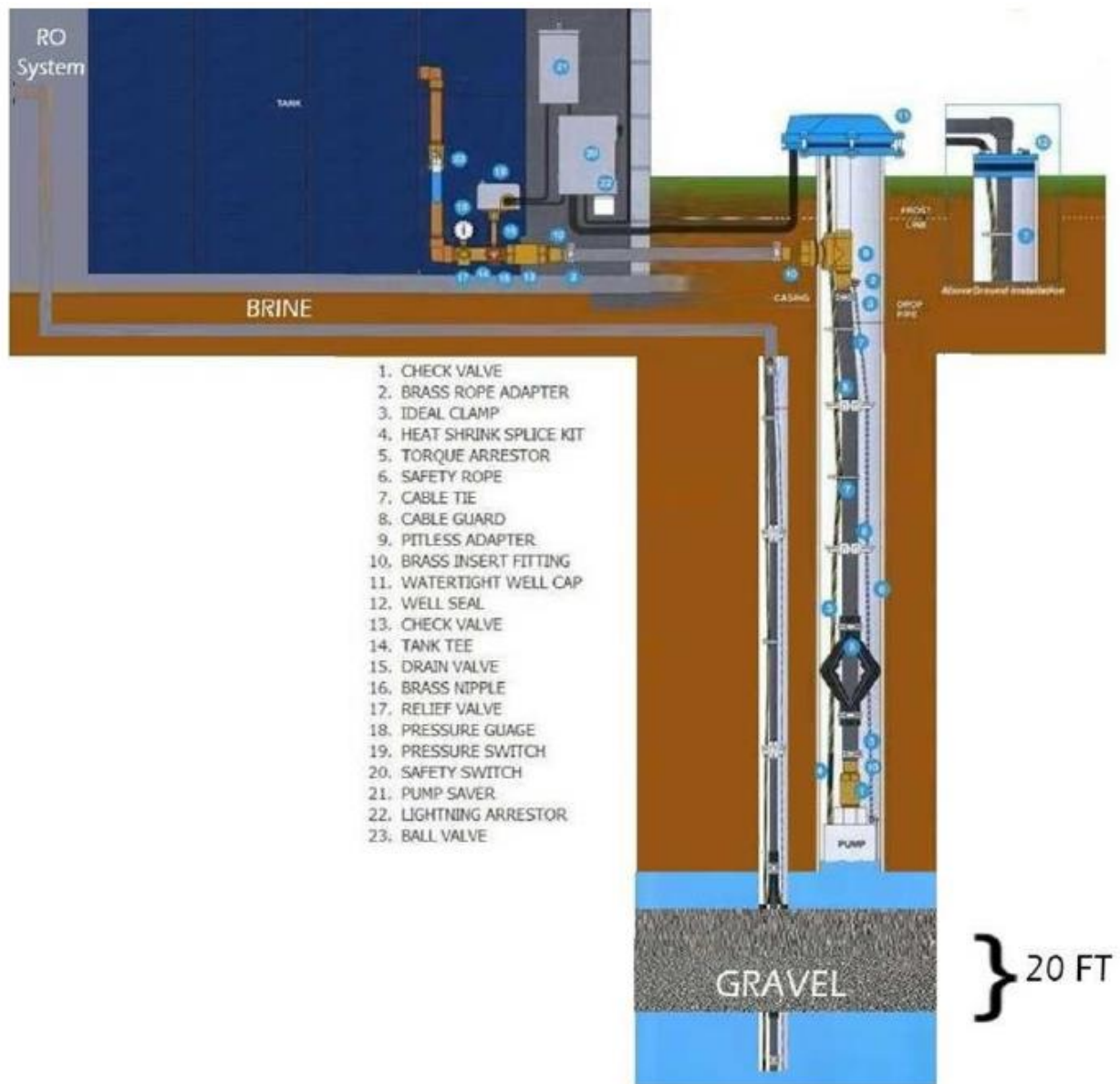


Figure 3-1: Methodology for Disposal of Brine

3.17 DESIGN HORIZON

Design Horizon of all the drinking water facilities will be for the next 20 years i.e. for the year 2041.

3.18 PROVISION OF LAND FOR THE INSTALLATION AND CONSTRUCTION OF CLEAN DRINKING WATER FACILITIES

The Land for the installation and construction of treatment plants and Markaz-e-Aabs at the identified locations of Faisalabad, Lahore and Sahiwal Division have been provided to the contractor by the local community at free of cost. Some of the land is also state owned. However, it was considered to select only those lands for the construction of treatment plants and Markaz-e-Aabs which are barren so that there would be no cutting of trees to install and construct the project.

While in Renala Khurd, Okara where a Surface Water Treatment Plant of 10m³/hr. has to be installed and in Chak Jhumra, Faisalabad where a Conventional Water Treatment Plant of 35m³/hr. has to be installed; in both areas, the identified land is owned by the Government/State. Hence, there will be no disputes regarding land acquisition and resettlement. Marking of land during the field visits is given below in the **Figure 3-2**:



Figure 3-2: Site Assessment of Land for Construction of Project

3.19 LOCATION OF THE PROJECT

This project covers a large area of Central Punjab with divisions of **Faisalabad, Lahore and Sahiwal** with their districts where quality of drinking water is quite low. Furthermore, the project has sub-contract area of subdivision of Faisalabad, **Tehsil Chak Jhumra** for the construction of a Conventional Treatment Plant. This project also includes the Construction of a Surface Water Treatment Plant at **Renala Khurd Tehsil** in the Okara District of Sahiwal Division.

The Domestic & Commercial consumers may be charged after 01 years for water fetching in order to meet the annual O & M expenses. For revenue collection an agency or community organization may be established.

3.20 PROJECT DETAILS FOR INSTALLATION AND CONSTRUCTION OF TREATMENT PLANTS AND DIRECT SUPPLY IN FAISALABAD DIVISION

3.20.1 Project Location for Faisalabad Division

Faisalabad Division is an administrative division of Punjab, Pakistan. The reforms of 2000 abolished the third tier of government but was restored again in 2008.

The Project covers the 04 Districts of the Faisalabad Division which are mentioned below:

Districts	Area (km ²)	Population (2017)
Faisalabad	5856	7,873,910
Jhang	6166	2,743,416
Toba Tek Singh	4364	2,190,015
Chiniot	2643	1,369,740

Each District has the population living in both urban and rural areas. The scope of the project is to provide clean & pure drinking water to the residents of the project area. Blown-up map of the Faisalabad Division is shown in **Figure 3-3** and is also attached as **Annexure III-A**.

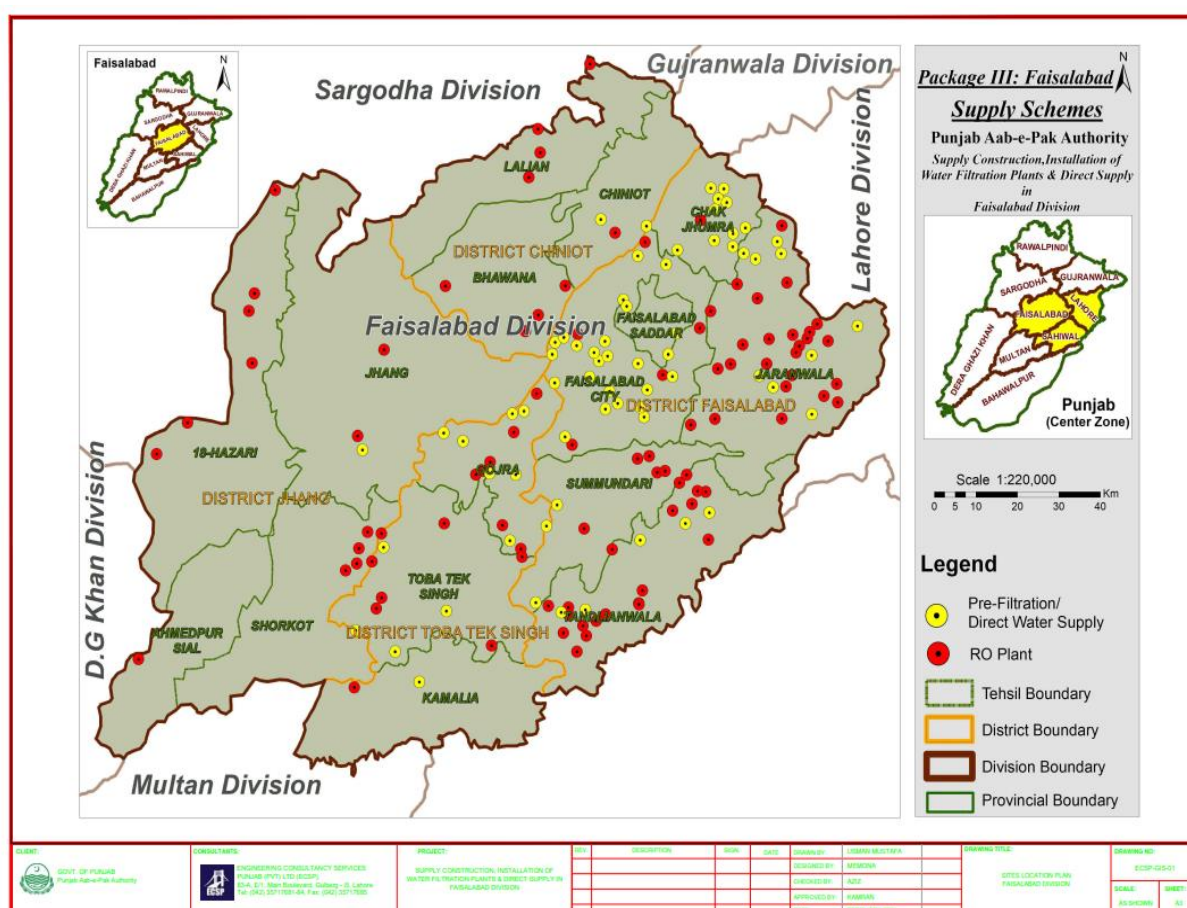


Figure 3-3: Map Showing Faisalabad Division

3.21 DISTRICT WISE MAPS OF FAISALABAD DIVISION FOR INSTALLATION OF TREATMENT PLANTS

3.21.1 District Faisalabad

Faisalabad District is one of the districts of Punjab province, Pakistan. According to the 2017 census of Pakistan it had a population of 7,873,910 of which almost 42% were in Faisalabad City. It is the third largest city of Pakistan after Karachi and Lahore.

Map of District Faisalabad is shown below in the **Figure 3-4**.

The red points indicate the location of RO plants and yellow points in the map indicates the locations of Pre-Filtration/Direct Supply plants in the respective areas.

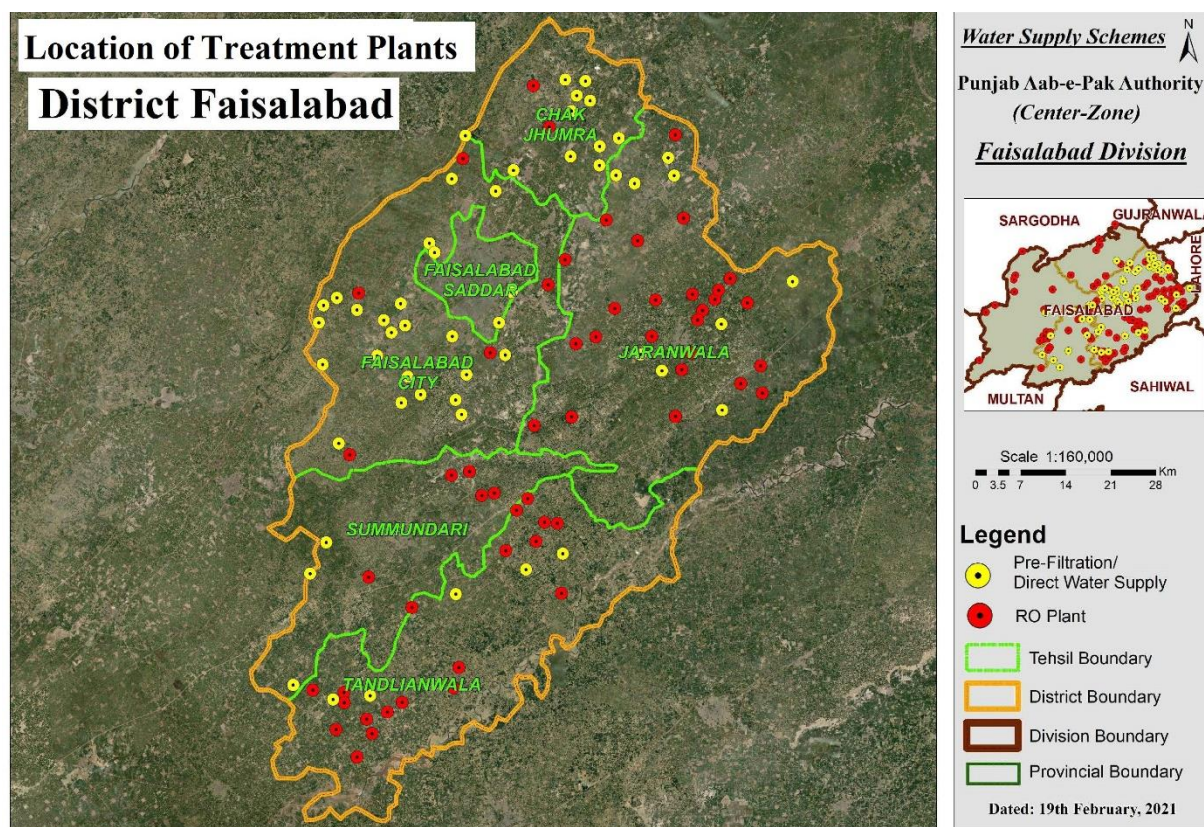


Figure 3-4: Map Showing District Faisalabad

3.21.2 District Jhang

Jhang District is a district of Faisalabad division in the Punjab province, Pakistan. The city of Jhang is the district's capital. According to the 2017 census of Pakistan it had a population of 2,743,416 of which 95% of the population in the Jhang and Shorkot Tehsil identified their first language as Punjabi, and 3.8% as Urdu. The local dialect, Jhangi, is intermediate between Standard Punjabi and Saraiki.

Map of District Jhang is given below in the **Figure 3-5**.

The red point indicates the location of RO plants and yellow points in the map indicates the locations of Pre-Filtration/Direct Supply plants in the respective areas of the district.

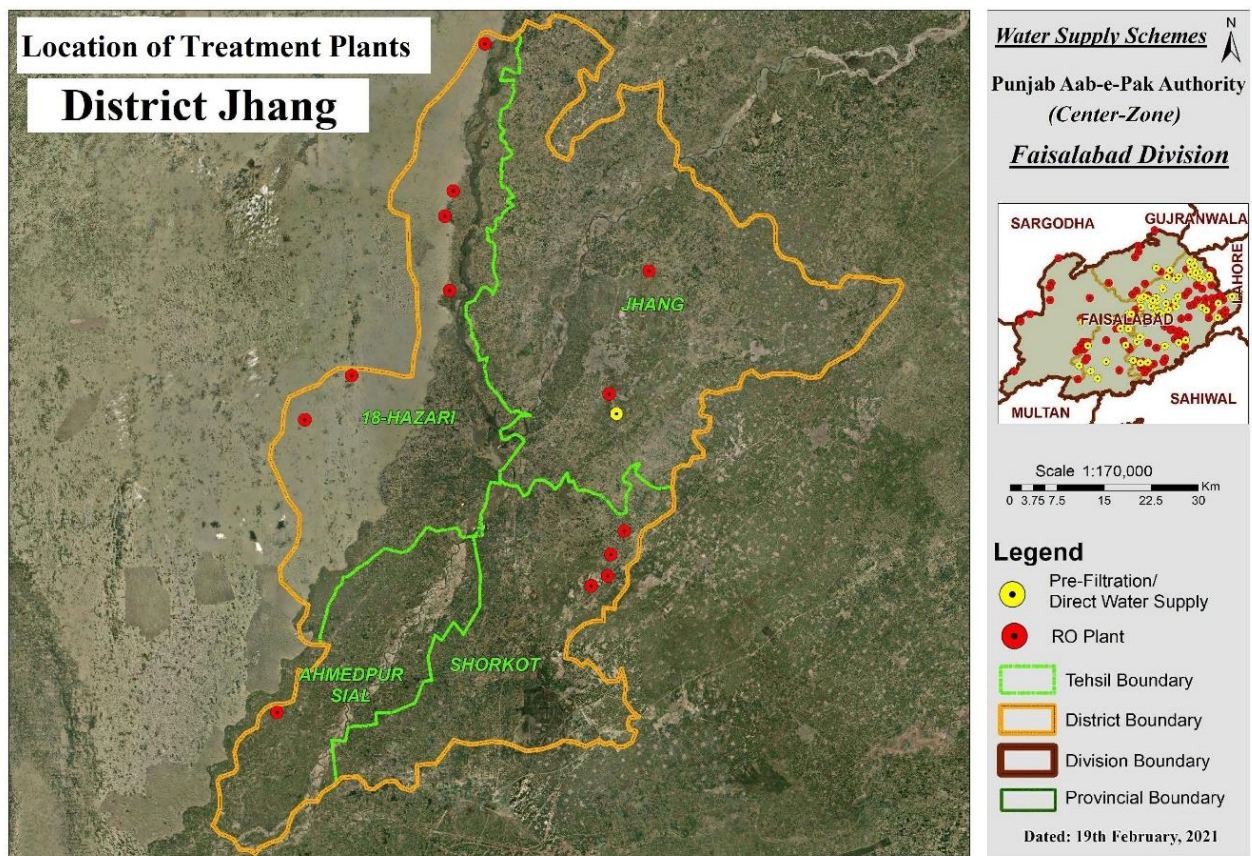


Figure 3-5: Map Showing District Jhang

3.21.3 District Toba Tek Singh

Toba Tek Singh District is a district of Faisalabad Division in the Punjab province of Pakistan. It is located between 30°33' to 31°2' Degree north latitudes and 72°08' to 72°48' Degree longitudes. It became a separate district in 1982. According to the 2017 census of Pakistan, the population was 2,190,015. According to the census, Punjabi was the predominant first language, accounting for 98.9% of the district's population.

Map of District Toba Tek Singh is given below in the **Figure 3-6**.

The red points indicate the locations of RO plants and yellow points in the map indicates the locations of Pre-Filtration/Direct Water Supply plants in the respective areas of the district.

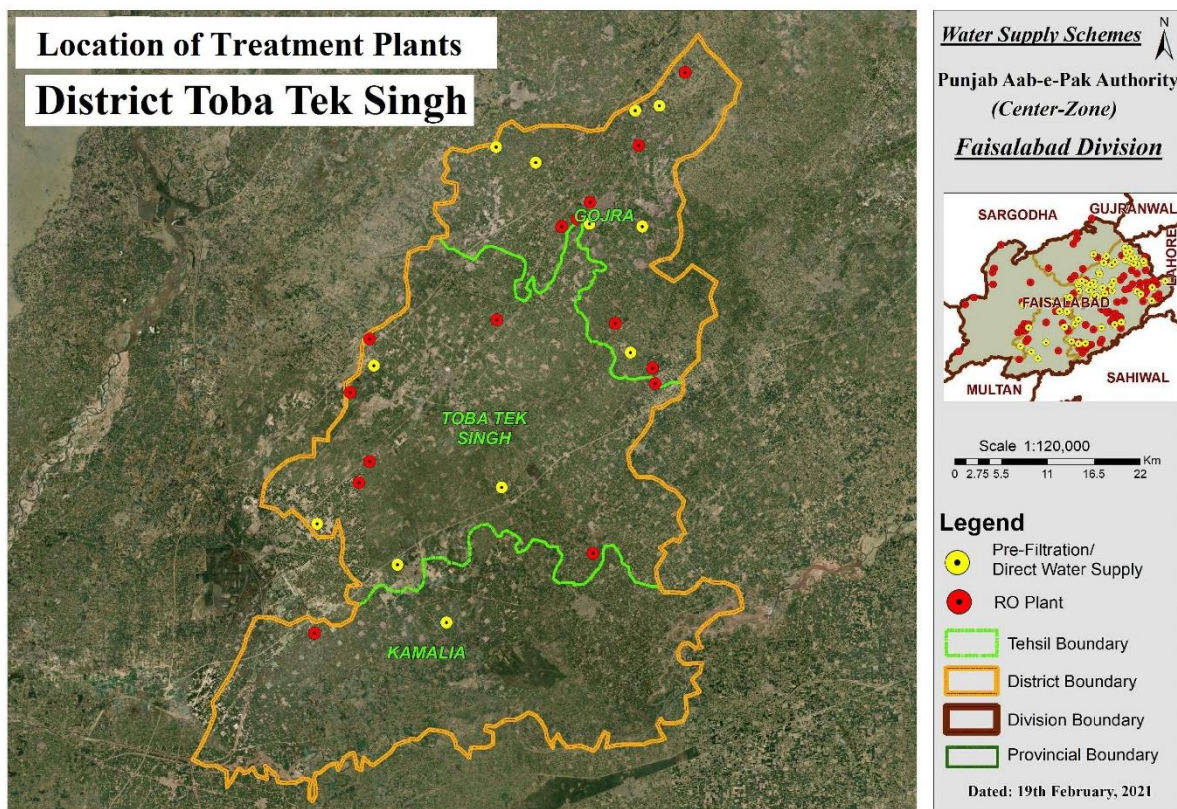


Figure 3-6: Map Showing District Toba Tek Singh

3.21.4 District Chiniot

Chiniot District became the 36th district of the Punjab province of Pakistan in February 2009. According to the 2017 census of Pakistan, it had a population of 1,369,740. At an earlier time, it was a Tehsil of Jhang District. It also has a River Passing by names the River Chenab it has a Bridge. It has a monument in the name of Brave Soldiers who defended the Nation by Defending the Bridge of Chenab River Chiniot.

Map of District Chiniot is given below in the **Figure 3-7**.

The red points indicate the locations of RO Plants and yellow points in the map indicates the locations of Pre-Filtration/Direct Water Supply plants in the respective areas of the district.

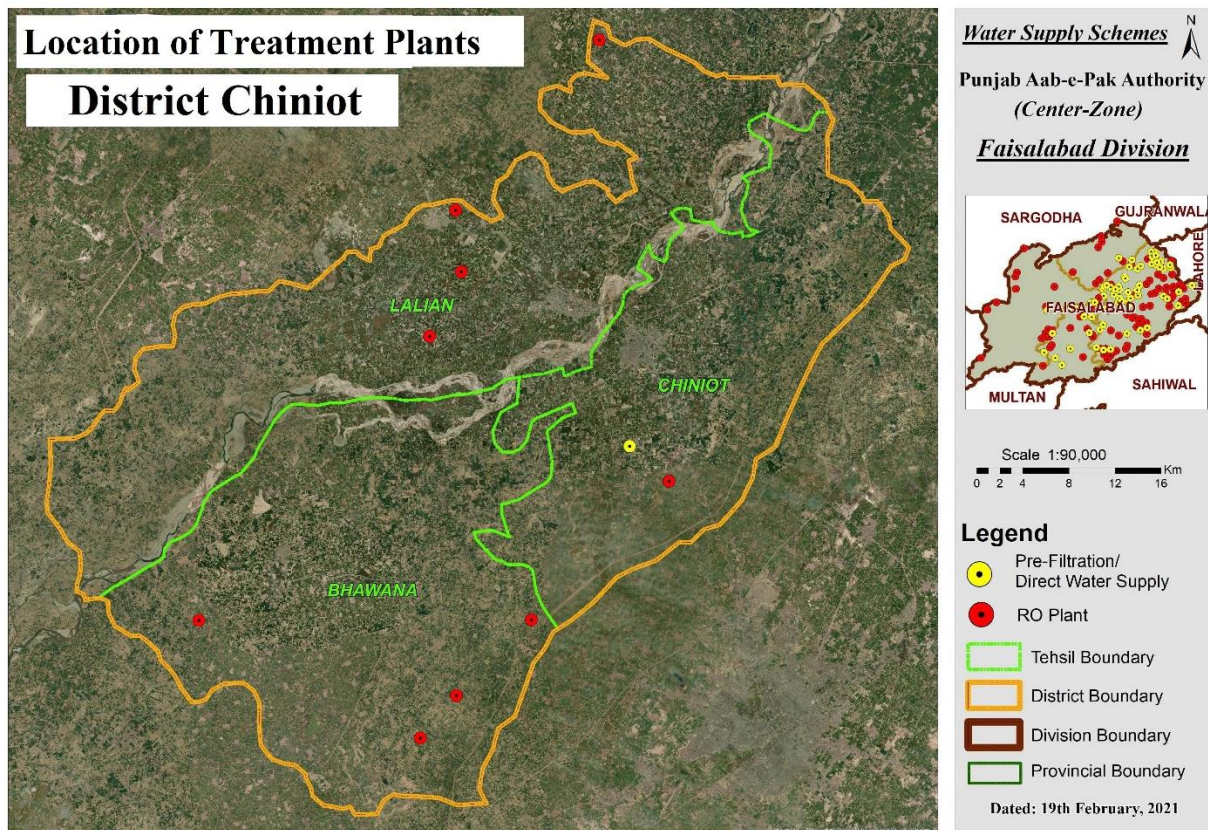


Figure 3-7: Map Showing District Chiniot

3.22 PROJECT SITE FEATURES (FAISALABAD): LAND USE, ROAD ACCESS, AND VEGETATION

Faisalabad Division is an administrative division of the Punjab province, Pakistan. Faisalabad Division has 4 Districts and 17 Tehsils. Faisalabad District is Industrial Zone and 3rd largest City of Pakistan. In District Faisalabad, mixed land use pattern is observed in all four districts which is agricultural, residential, commercial, as well as recreational places. But the area falling under the jurisdiction of this project in all four districts is agricultural mainly having settlements in the form of villages. **Figure 3-8.**

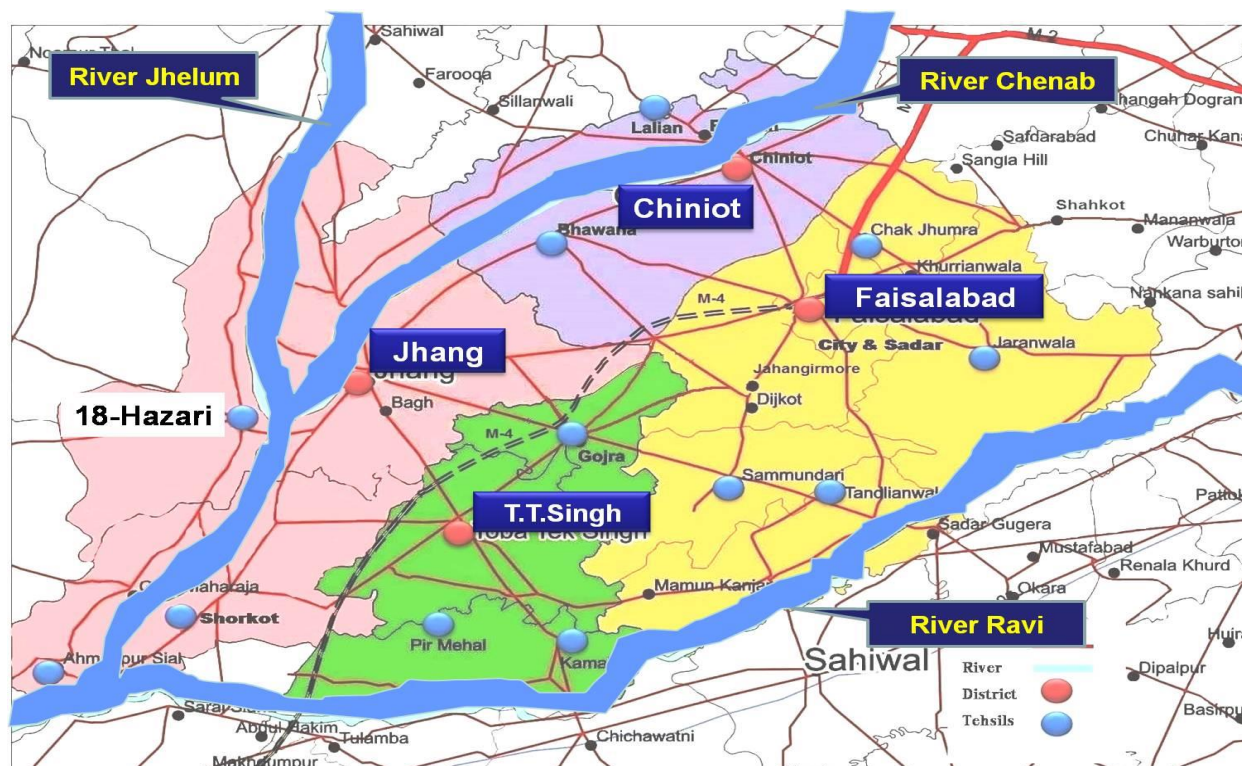


Figure 3-8: Map Showing Faisalabad Division with its Districts

Faisalabad has grown to become a major industrial and distribution center because of its central location in the region and connecting roads, rails, and air transportation. It has been referred to as the Manchester of Pakistan. Generally, metaled road network is found in city area of all four districts of Faisalabad as well as most of the district headquarters and major towns are linked through it.

Faisalabad has a semi-arid climate, with summers that last from mid-April through late-October and are quite hot and humid. The hottest months are May and June, while July, August, and the first half of September, with the exception of days when it rains, can be oppressively humid. Due to the large number of dry and dusty storms that occur in June, it is by far the hottest month of the year. The average annual rainfall is about 375 millimeters (14.8 in), half of the yearly rainfall takes place in July and August during the monsoon season.

The soil consists of young stratified silt loam or very fine sandy loam which makes the subsoil weak in structure with common kankers at only five feet. The course of the rivers within Faisalabad are winding and often subject to frequent alternations. In the rainy season, the currents are very strong. This leads to high floods in certain areas which do last for a number

of days. The Major crops of Faisalabad are Wheat, Corn, Rice, Sugar Cane, Sun Flower and Oil seeds. The major fruits of the Faisalabad are Guavas, Mangoes, Citrus, Jaman, Banana and Lychee. While major vegetables are potatoes, Carrot, Turnip, Onion, Peas, Tomatoes and Chilies.

3.23 SAFE DRINKING WATER SUPPLY STATUS IN FAISALABAD DIVISION

Between 1998 and 2017, Faisalabad's population expanded from 2.0 million to 3.2 million. By 2030, it is predicted to double. Future use of water and sanitary infrastructure will be under a great deal of stress because of this. Additionally, over pumping of the groundwater poses a threat to its sustainability, and cross-contamination from sewage pipelines is to blame for the decline in the quality of the domestic water supply. In 2015, water supply provided was about 501,000 m³/day (110 MGD) to the city which only fulfilled 77 per cent of the total water demand of 650,000 m³/day (142 MGD), causing a shortfall of 149,000 m³/day (32 MGD). Most of the population meets its water demands by extracting groundwater through private wells on their premises in addition to limited supply of municipal tap water. Only 60 per cent of households in the city have access to municipal water supply. There are total 162 water supply schemes in Faisalabad. 104 schemes (64%) are functional which are serving 5.9% of the population. 58 schemes (36%) are non-functional. Out of non- functional water supply schemes, 36 schemes (62%) are temporarily closed and 22 schemes (38%) are permanently closed. Because of temporarily closed water supply schemes, about 249,000 people are suffering. On observation, reason for temporarily closed schemes were found to be community dispute and collection of O&M funds and non-payment of electricity bill and breakage in transmission/distribution network (PCRWR, 2011).

There are 104 functional water supply schemes. 96 schemes (92%) of the functional schemes, have the groundwater sources while 8 schemes (8%) of the functional schemes obtain water from the surface water sources (PCRWR, 2011)⁴. Out of the 104-functional water supply scheme, there are no water treatment practices in 90 schemes (86%). However, on 14 schemes (14%), some sort of bleaching powder, potassium permanganate, etc. is being used for treatment purpose.

The situation of drinking water (groundwater) quality in Faisalabad city was found to be unsatisfactory on the basis of five years' water quality monitoring program conducted by Pakistan Council of Research in Water Resources (PCRWR). According to the Water Quality Report (2015-16)⁵, investigation revealed that 42 per cent of the samples were found polluted with E. coli and coliforms and same percentage of samples were identified with excessive concentrations of TDS and sulphates. Major portion of groundwater in Faisalabad city is of permanent hardness type. Key contaminants found in the groundwater of Faisalabad are hardness, fluoride, TDS and bacteria making it unfit for the drinking purpose. Housing Urban Development and Public Health Engineering Department (HUD and PHED) is the provincial administrative department of the government of Punjab which is responsible for the provision of drinking water to the communities in the rural and urban areas of the province. Therefore,

⁴ Kausar, S., Asghar, K., Anwar, S. M., Shaukat, F., & Kausar, R. (2011). Factors affecting drinking water quality and human health at household level in Punjab, Pakistan. *Statistics*, 100(100), 0.

⁵ Yamin, M., Nasir, A., Sultan, M., Ismail, W. I. W., Shamshiri, R., & Akbar, F. N. (2015). Impact of sewage and industrial effluents on water quality in Faisalabad, Pakistan. *Advances in Environmental Biology*, 9(18), 53-59.

now Government of the Punjab has endeavored to develop “The Punjab Aab e Pak Project” (the project) to improve water supply (safe and clean drinking water) in rural and peri-urban areas of the province of Punjab as per World Health Organization’s Guidelines for Drinking-water Quality.

3.24 CHARACTERISTICS OF SELECTED AREA (FAISALABAD DIVISION)

A study was conducted by the **Green Engineering Consultant (GEC)** to assess the Water quality of Faisalabad Division under Punjab Aab-e-Pak project. Water quality was monitored at one hundred and Sixty-Two (**162**) selected locations to conduct a comparison of pollutants/contamination level with respective standards. During the first stage of Field surveys, water samples were collected from existing PHED tube wells to evaluate the present drinking water quality status of existing water supply schemes in Faisalabad Division. For this purpose, list of existing operational schemes located within project area was collected from PHED. Consultant’s engineers visited all site together with Aab-e-Pak and PHED representative for sample collection and sending sealed samples to PSQCA lab in Lahore. These samples were transported on daily basis to the laboratory.

In order to check water quality of existing PHED borehole water in Faisalabad Division. Water Quality was evaluated on the basis of some principles like Color, Odor, Taste, EC, pH, Turbidity, Alkalinity, Calcium, Chloride, Total Hardness, Nitrate, Potassium, Sodium, TDS, Chromium, Fluoride, Iron, Manganese, Arsenic, E-coli, Total Coliforms and COD.

Results show that the levels of parameters (TDS, Fluoride, Turbidity, Hardness, Arsenic, Nitrate & Microbial parameters) were out of limits of their respective standard. TDS, fluorides and Arsenic level were found very high in the tested water samples of Faisalabad Division. Main reason for these higher values is that, these water sources are contaminated and having high quality of soluble salts. Water analysis results show that the hardness, nitrates and microbiological parameters at some locations are within the limit of PEQS/WHO standards.

Microbiological parameters testing results show that at some locations microbial contents are high because of sewerage contamination. Hence it was concluded from the analyzed results of collected water samples that this water is contaminated and not suitable for drinking use of public of Faisalabad Division. Installation and operation of water filtration plants is essential for provision of clean and healthy water for people of Faisalabad Division.

As per WHO drinking water guidelines, upper limit of TDS value is 1000 mg/l but for the design purpose a safe value of 800 mg/l is selected considering the 20 years design period of project. The quality of water (TDS value) is depend upon many factors and cannot be ensure a fixed value of TDS throughout the design period of tube well, so a safety margin is necessary to cater future variation in TDS level of raw water. This was presented by consultants to PAPA technical committee and approved by PAPA technical committee members.

Detailed Water Quality Analysis lab reports are attached as an **Annexure IV-A**.

3.25 DESIGN SUMMARY FOR FAISALABAD DIVISION

The project will provide potable water to the people living in Faisalabad Division. Markaz- e-Aab will be constructed in 138 villages from where people can fetch the water for drinking purposes. Water supply schemes/Villages in Faisalabad Division supplied with drinking water are summarized below:

Table 3-1: Design Summary of Treatment Plants for Faisalabad Division

Sr. No.	Type of Plant	No. of Plants
1	Direct Supply / Pre-filtration Plant (Chlorination, Sand & Activated Carbon Filter)	09
2	Pre-filtration Plant (Chlorination, Sand & Activated Carbon Filter) with Source development	13
3	Pre-filtration Plant with Sand, Activated Carbon & Arsenic removal Filter with Source development	22
4	Reverse Osmosis with Source development	94
	Total	138

3.26 DETAILS OF PLANT LOCATIONS AT FAISALABAD DIVISION

Details of locations of treatment plants in the specified villages is attached as table given below:

Table 3-2: Details of Plants Location at Faisalabad Division

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION						
SUMMARY OF PLANTS						
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS	
					Type of Plant	Capacity (m3/hr.)
RO & UF PLANTS CHINIOT DISTRICT						
1	Faisalabad	Chiniot	Bhowana	199 JB Ramoana	SandFilter, Activated Carbon Filter along with Chlorination	2
2				205 JB Goltrainwali	RO Plant	2
3				Najma Abad Nalka Stop	RO Plant	2
4			Chiniot	150	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
5				130 Jhok Chogata	RO Plant	2
6			Lalian	Jalley Wala	RO Plant	2
7				Moza Bhabhrana	SandFilter, Activated Carbon Filter along with Chlorination	2

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION						
SUMMARY OF PLANTS						
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS	
					Type of Plant	Capacity (m3/hr.)
8				Sangra Sadaat	SandFilter, Activated Carbon Filter along with Chlorination	2
9				Jabana	RO Plant	2
RO PLANTS FAISALABAD DISTRICT						
10			Chak Jhumra	158 RB Burewala	RO Plant	2
11				273 RB Sadiqabad	RO Plant	2
12				631 GB	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
13				237 GB	RO Plant	2
14				236 GB	RO Plant	2
15				110 GB	RO Plant	2
16				238 GB	RO Plant	2
17				210 RB	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
18	Faisalabad	Faisalabad	Jaranwala	62 GB East	RO Plant	2
19				121 GB	RO Plant	2
20				111 GB	RO Plant	2
21				625 GB	RO Plant	2
22				234 GB	RO Plant	2
23				240 GB	RO Plant	2
24				235 GB	RO Plant	2
25				630 GB (Reru)	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
26				629 GB Baghidai	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
27				125 GB	SandFilter, Activated Carbon Filter, Arsenic	2

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION						
SUMMARY OF PLANTS						
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS	
					Type of Plant	Capacity (m3/hr.)
					Filter along with Chlorination	
28				353 GB	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
29				206 RB Sadonana	SandFilter, Activated Carbon Filter along with Chlorination	2
30				89 GB	RO Plant	2
31				106 GB	RO Plant	2
32				381 GB Shamali	RO Plant	2
33				95 RB Dosanj	RO Plant	2
34				52 RB Bawa Chak-Kartarpur	RO Plant	2
35				34 GB	RO Plant	2
36			Summundri	168 GB Saraj	RO Plant	2
37				175 GB Mengra	RO Plant	2
38				474 GB Patiala	RO Plant	2
39				174 GB Shimali (Sukrangian)	RO Plant	2
40				169 GB Thikrian	RO Plant	2
41				448 GB Lisharan	RO Plant	2
42			Tandlian wala	548 GB	RO Plant	2
43				551 GB	RO Plant	2
44				422 GB Katuwala	RO Plant	2
45				430 GB (Devre)	RO Plant	2
46				Killianwala	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION						
SUMMARY OF PLANTS						
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS	
					Type of Plant	Capacity (m3/hr.)
47				425 GB	RO Plant	2
48				Chahthali Wala	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
49				619 GB Junian	RO Plant	2
50				593 GB	RO Plant	2
51				428 GB Lakarwala	RO Plant	2
52				556 GB	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
53				558 GB	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
54				553 GB	RO Plant	2
55				614 GB	RO Plant	2
56				Thatta Beg	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
57				494 GB Lal Tarana	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
UF PLANTS WITH FLOURIDE FAISALABAD DISTRICT						
58	Faisalabad	Faisalabad	Jaranwala	60 RB	RO Plant	2
59				59 RB	RO Plant	2
60				68 RB	RO Plant	2
61				151 RB	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
62				54 GB Dhaliwal	RO Plant	2

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION						
SUMMARY OF PLANTS						
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS	
					Type of Plant	Capacity (m3/hr.)
63				65 RB Ringal Ningal	SandFilter, Activated Carbon Filter along with Chlorination	2
64				21 GB	RO Plant	2
65				583 GB	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
66				150 RB Madoana	RO Plant	2
67				563 GB	RO Plant	2
68				245 RB Abadi Hussain Abad	RO Plant	2
69				72 JB Gulalipur	SandFilter, Activated Carbon Filter along with Chlorination	2
70				4 JB	RO Plant	2
71				237 RB Khudia Lakkan	RO Plant	2
72				Chak 37 (Gardana)	RO Plant	2
73				87 GB Baba de Beri	RO Plant	2
74				261 RB (Bhagwali)	RO Plant	2
75				255 RB	RO Plant	2
76				270 RB	RO Plant	2
77				69 (Chabba Ghirwali)	RO Plant	2
78				226 RB Chima	RO Plant	2
79				252 RB	RO Plant	2
80				249 RB Baluchanwala	SandFilter, Activated Carbon Filter along with Chlorination	2
81				82 JB Naurangabad	RO Plant	2
82			Summun dri	215 GB Daud Hamza	RO Plant	2

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION						
SUMMARY OF PLANTS						
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS	
					Type of Plant	Capacity (m3/hr.)
83				222 GB Kohala	RO Plant	2
84			Chak Jhumra	187 RB Balloana	RO Plant	2
85				155 Punnu	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
86				132 RB Sahowala	RO Plant	2
87				Tandlian wala	507 GB Ratangarh	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination
88			411 GB Majhiana		RO Plant	2
89			549 GB		RO Plant	2
90			395 GB Paliwala		RO Plant	2
91			600 GB Nara Khichian		SandFilter, Activated Carbon Filter along with Chlorination	2
UF PLANTS 2000 LPH						
92	Faisalabad	Faisalabad	Chak Jhumra	131 Bochuana	RO Plant	2
93				142 RB	RO Plant	2
94				133 Kamalpur	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
95				126 RB Paharang	RO Plant	2
96			Faisalaba d Sadar	241 RB	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
97				104 JB Harmoian	RO Plant	2
98				233 RB Hari singhwala	SandFilter, Activated Carbon Filter along with Chlorination	2

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION							
SUMMARY OF PLANTS							
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS		
					Type of Plant	Capacity (m3/hr.)	
99				9 JB Bolewala	RO Plant	2	
100				41 Satlana	SandFilter, Activated Carbon Filter along with Chlorination	2	
101				39 Dabbora	SandFilter, Activated Carbon Filter along with Chlorination	2	
102				Tandlian wala	552 GB	RO Plant	2
RO PLANTS JHANG DISTRICT							
103	Faisalabad	Jhang	18-Hazari	Miran Pakka	RO Plant	2	
104				Machiwal	RO Plant	2	
105				Chandana	RO Plant	2	
106				Bharrerri	SandFilter, Activated Carbon Filter along with Chlorination	2	
107				Bullo	SandFilter, Activated Carbon Filter along with Chlorination	2	
108				Kot Shakir	RO Plant	2	
109				Ahmedpur Sial	5/3-L	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
110				Jhang	Basti Islamabad	RO Plant	2
111					Shabirabad	RO Plant	2
112				Shorkot	487 JB (Hokran)	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
113					482 JB (Nawan Kot)	RO Plant	2
114					489 JB (Narhool)	RO Plant	2
RO PLANTS TOBA TEK SINGH							
115				300 JB	RO Plant	2	
116				297 JB	RO Plant	2	
117				97 JB	RO Plant	2	

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION						
SUMMARY OF PLANTS						
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS	
					Type of Plant	Capacity (m3/hr.)
118				246 GB Partabpur	RO Plant	2
119				278 JB	RO Plant	2
120				420 JB	RO Plant	2
121			Pir Mahal	689/ 31 GB	RO Plant	2
122			T.T Singh	345 GB	RO Plant	2
123				319 JB	RO Plant	2
124				397 JB	RO Plant	2
125				344 GB	RO Plant	2
126				401 JB Kuja	RO Plant	2
127				187 GB Ahniyanwala	SandFilter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2
UF PLANTS TOBA TEK SINGH District						
128			Gojra	356 JB	RO Plant	2
129				343 JB	RO Plant	2
FAISALABAD DISTRICT DIRECT SUPPLY						
130	Faisalabad	Faisalabad	Faisalabad Sadar	66 JB	SandFilter, Activated Carbon Filter along with Chlorination	2
131				215 RB	SandFilter, Activated Carbon Filter along with Chlorination	2
TOBA TEK SINGH DISTRICT DIRECT SUPPLY						
132				298/JB	SandFilter, Activated Carbon Filter along with Chlorination	2
133				281/ JB	SandFilter, Activated Carbon Filter along with Chlorination	2
134				367/ JB	SandFilter, Activated Carbon Filter along with Chlorination	2
135			Pir Mahal	Chak No. 320 GB	SandFilter, Activated Carbon Filter along with Chlorination	2

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION						
SUMMARY OF PLANTS						
Sr. No.	Division	District	Tehsil	Village (Corrected Name)	RECOMMENDATIONS	
					Type of Plant	Capacity (m ³ /hr.)
136				327 GB	SandFilter, Activated Carbon Filter along with Chlorination	2
137				680/ 21 GB	SandFilter, Activated Carbon Filter along with Chlorination	2
138			T.T Singh	Rajana Town	SandFilter, Activated Carbon Filter along with Chlorination	2

3.27 POPULATION PROJECTION AND WATER DEMAND FOR FAISALABAD DIVISION

As the design horizon of the drinking water facilities is for the next 20 years so population is projected for the year 2041 of the respective districts of Faisalabad Division.

Population Projection and Water Demand for Faisalabad Division in respective areas of treatment plants is given in the table below. **Table 3-3.**

Table 3-3: Detailed Population Projection and Water Demand for Faisalabad Division

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE-1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growt h Rate	Projected populatio n	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
Division Faisalabad							
Chiniot District RO							
RO & UF Plants							
1	Bhowana	C K 199 Jb Ramoana	9,992	1.86	14,714	73.57	9.20
2		Ck No 205 Jb Goltrainwali	2,664	1.86	3,924	19.62	2.45
3		Najma Abad Nalka Stop	9,992	1.86	14,714	73.57	9.20
4	Chiniot	Chak 150	2,664	1.86	3,924	19.62	2.45

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE-1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growt h Rate	Projected populatio n	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
5	Lalian	Chak No 130 Jhok Chogata	3,331	1.86	4,905	24.52	3.07
6		Jalley Wala	3,331	1.86	4,905	24.52	3.07
7		Moza Bhabhrana	16,653	1.86	24,523	122.61	15.33
8		Sangra Sadaat	9,992	1.86	14,714	73.57	9.20
9		Jabana	2,664	1.86	3,924	19.62	2.45
DISTRICT FAISALABAD RO							
10	Chak Jhumra	Chak 158 (Burewala)	2,371	1.97	3,572	17.86	2.23
11		Chak 273 Rb (Sadiqabad)	3,063	1.97	4,613	23.07	2.88
12	Jaranwala	Chak 631	2,823	1.97	4,253	21.26	2.66
13		Chak 237	4,471	1.97	6,735	33.68	4.21
14		Chak 236	6,068	1.97	9,141	45.71	5.71
15		Chak 110	3,272	1.97	4,928	24.64	3.08
16		Chak 238	4,394	1.97	6,619	33.09	4.14
17		Chak 210 Rb	6,225	1.97	9,377	46.88	5.86
18		Chak 62 Gb	2,759	1.97	4,155	20.78	2.60
19		Chak 121	5,225	1.97	7,871	39.35	4.92
20		Chak 111 Gb	2,655	1.97	3,999	19.99	2.50
21		Chak 625	3,415	1.97	5,144	25.72	3.21
22		Chak 234	4,626	1.97	6,968	34.84	4.35
23		Chak 240	21,640	1.97	32,597	162.98	20.37
24		Chak 235	5,127	1.97	7,722	38.61	4.83
25		Chak 630 (Reru)	2,188	1.97	3,295	16.48	2.06
26		Chak 629	4,569	1.97	6,882	34.41	4.30
27		Chak 125	3,216	1.97	4,844	24.22	3.03
28		Chak 353	8,721	1.97	13,137	65.68	8.21

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE-1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growt h Rate	Projected populatio n	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
					2,041	m ³ /D	m ³ /hr
			Nos.	(%)	Nos.	2041	2041
29		Chak 206 Rb	2,646	1.97	3,986	19.93	2.49
30		Chak 89 Gb	2,312	1.97	3,483	17.42	2.18
31		Chak 106 Gb	6,611	1.97	9,958	49.79	6.22
32		Chak 381 Gb Shamali	5,364	1.97	8,080	40.40	5.05
33		Chak 95 Rb Dosanj	3,033	1.97	4,569	22.84	2.86
34		Chak 52	2,841	1.97	4,279	21.39	2.67
35		Chak 34 Gb	4,702	1.97	7,083	35.42	4.43
36		Chak 168 Gb (Saraj)	2,674	1.97	4,028	20.14	2.52
37	Summundri	Chak 175 Gb (Mengra)	3,703	1.97	5,577	27.89	3.49
38		Chak 474 Gb (Patiala)	5,135	1.97	7,736	38.68	4.83
39		Chak 174 Gb Shimali (Sukrangian)	2,654	1.97	3,997	19.99	2.50
40		Chak 169 Gb (Thikrian)	2,414	1.97	3,636	18.18	2.27
41		Chak 548	6,605	1.97	9,949	49.75	6.22
42	Tandian Wala	Chak 551 Gb	3,949	1.97	5,948	29.74	3.72
43		Chak 422 Gb (Katuwala)	5,882	1.97	8,861	44.30	5.54
44		Thatta Lal Tarana	3,495	1.97	5,264	26.32	3.29
45		Chak 430 Gb (Devre)	3,673	1.97	5,533	27.66	3.46
46		Killianwala	4,398	1.97	6,625	33.13	4.14
47		Chak 425 Gb (Shara Da Khu)	5,384	1.97	8,110	40.55	5.07
48		Chahthali Wala	4,699	1.97	7,078	35.39	4.42
49		Chak 619 Gb Junian	3,365	1.97	5,068	25.34	3.17
50		Chak 593 Gb	2,878	1.97	4,335	21.67	2.71
51		Chak 428 Gb (Lakarwala)	3,876	1.97	5,839	29.20	3.65
52		Chak 556 Gb	4,879	1.97	7,350	36.75	4.59

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE-1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growt h Rate	Projected populatio n	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
53		Chak 558 Gb	3,313	1.97	4,991	24.95	3.12
54		Chak 553 Gb	2,441	1.97	3,678	18.39	2.30
55		Chak 614 Gb	3,602	1.97	5,426	27.13	3.39
56		Thatta Beg	2,001	1.97	3,014	15.07	1.88
UF PLANTS WITH FLOURIDE							
57		494 GB Lal Tarana	5,241	1.97	6527	26.5	3.23
58	Jaranwala	Chak 60 RB	6,938	1.97	10,451	52.25	6.53
59		Chak 59 RB	2,025	1.97	3,050	15.25	1.91
60		Chak 68 RB	6,885	1.97	10,372	51.86	6.48
61		Chak 151 RB	2,383	1.97	3,590	17.95	2.24
62		Chak 54 GB Dhaliwal	4,780	1.97	7,200	36.00	4.50
63		Chak 65 RB	4,626	1.97	6,968	34.84	4.35
64		Chak 21 RB	8,418	1.97	12,680	63.40	7.93
65		Chak 583 RB	3,727	1.97	5,613	28.07	3.51
66		Chak 150 RB	5,088	1.97	7,665	38.32	4.79
67		Chak 563 RB	3,146	1.97	4,739	23.69	2.96
68		Chak 245+250 RB	5,451	1.97	8,212	41.06	5.13
69		Chak 72 JB (Gulalipur)	3,732	1.97	5,622	28.11	3.51
70		Chak 4 JB	3,503	1.97	5,277	26.39	3.30
71		Chak 237 RB (Khudian Lakkan)	3,482	1.97	5,244	26.22	3.28
72		Chak 37 (Gardana)	3,053	1.97	4,599	22.99	2.87
73		Chak 87 Gb (Baba Di Beri)	2,460	1.97	3,706	18.53	2.32
74		Chak 261 (Bhagwali)	4,216	1.97	6,350	31.75	3.97
75		255 RB	3,171	1.97	4,776	23.88	2.99
76		270 RB	6,725	1.97	10,130	50.65	6.33
77		Chak 69(chabba Ghirwali)	3,473	1.97	5,231	26.16	3.27

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE-1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growt h Rate	Projected populatio n	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
78		Chak 226 RB (Chima)	8,805	1.97	13,263	66.32	8.29
79		Chak 252 RB	4,792	1.97	7,218	36.09	4.51
80		Chak 249 RB (Batuchanwala Janubi)	2,881	1.97	4,340	21.70	2.71
81		Chak 82 JB Naurang Abad	3,186	1.97	4,800	24.00	3.00
82		Summundri	chak 215 daud hamza	4,948	1.97	7,454	37.27
83	Chak 222 GB (Kohala)		5,923	1.97	8,922	44.61	5.58
84	Chak Jhumra	Chak 187 RB (Balloana)	7,954	1.97	11,982	59.91	7.49
85		Chak 155 (Punnu)	2,473	1.97	3,725	18.63	2.33
86		Chak 132 RB Sahowala	7,834	1.97	11,800	59.00	7.38
87	Tandian Wala	507 GB Ratangarh	3,748	1.97	5,646	28.23	3.53
88		Chak 411 GB Majhiana	4,383	1.97	6,602	33.01	4.13
89		Chak 549 GB	6,001	1.97	9,039	45.19	5.65
90		Chak 395 GB (Palliwalla)	2,866	1.97	4,317	21.58	2.70
91		Chak 600 GB (Nara Khichian)	4,225	1.97	6,365	31.82	3.98
UF PLANTS 2000 LPH							
92	Chak Jhumra	Chak 131 (Bochuana)	2,967	1.97	4,470	22.35	2.79
93		Chak 142 RB	6,137	1.97	9,245	46.22	5.78
94		Chak 133 (Kamalpur)	3,421	1.97	5,154	25.77	3.22
95		Chak 126 RB (Paharang)	8,146	1.97	12,270	61.35	7.67
96	Faisalabad	Chak 241 RB	6,041	1.97	9,100	45.50	5.69

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE-1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growt h Rate	Projected populatio n	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
97		Chak 104 JB Harmoian	2,294	1.97	3,455	17.28	2.16
98		Chak 233 RB (hari Singhwala)	3,007	1.97	4,529	22.65	2.83
99		Chak 9 JB (Bolewala)	4,827	1.97	7,271	36.35	4.54
100		Chak 41 (Satlana)	5,566	1.97	8,385	41.92	5.24
101		CHAK 39 Dabbora)	5,604	1.97	8,441	42.20	5.28
102	Ta ndi an Wa s	Chak 552 GB	3,659	1.97	5,511	27.56	3.44
DISTRICT JHANG							
103	18-Hazari	Miran Pakka	2,664	2.04	4,072	20.36	2.54
104		Machi Wall	3,331	2.04	5,090	25.45	3.18
105		Chandana	3,997	2.04	6,108	30.54	3.82
106		Bharrerri	5,329	2.04	8,144	40.72	5.09
107		Bullo	8,660	2.04	13,234	66.17	8.27
108		Kot Shakkir	16,653	2.04	25,449	127.25	15.91
109	Ahmed Pur Sial	Chack 5/3l	2,664	2.04	4,072	20.36	2.54
110	Jhang	Basti Islamabad	3,997	2.04	6,108	30.54	3.82
111		Shabbir Abad	6,661	2.04	10,180	50.90	6.36
112	Shorkot	Chack No 487	3,331	2.04	5,090	25.45	3.18
113		Chak 482 Jb (Nawan Kot)	3,864	2.04	5,904	29.52	3.69
114		Chack No 489	3,331	2.04	5,090	25.45	3.18
DISTRICT TOBA TEK SINGH RO							
115		Chak 300	3,442	1.59	4,794	23.97	3.00
116		Chak 297 Jb	2,970	1.59	4,136	20.68	2.58
117		Chak No 97 Jb	3,778	1.59	5,262	26.31	3.29
118		Chak 246	5,168	1.59	7,198	35.99	4.50
119		Chak 278 Jb	4,188	1.59	5,833	29.17	3.65

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE-1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN FAISALABAD DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growt h Rate	Projected populatio n	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
120	Pir Mahal	Chak 420 Jb	2,998	1.59	4,176	20.88	2.61
121		Chak No. 689/31 Gb	2,980	1.59	4,150	20.75	2.59
122	T.T.Singh	Chak No. 345 Gb	3,573	1.59	4,977	24.88	3.11
123		Chak No. 319 Jb	5,623	1.59	7,832	39.16	4.89
124		Chak No. 397 Jb	3,868	1.59	5,387	26.93	3.37
125		Chak No. 344 Gb	3,180	1.59	4,428	22.14	2.77
126		Chak No. 401 Jb (A)	2,722	1.59	3,792	18.96	2.37
127		Chak No. 187 Gb	3,332	1.59	4,640	23.20	2.90
UF PLANTS WITH FLOURIDE							
128	Gojra	Chak 356	2,440	1.59	3,399	16.99	2.12
129		Chak No 343/JB	2,207	1.59	3,074	15.37	1.92
DIRECT SUPPLY							
DISTRICT FAISALABAD							
130	Faisalabad Sadar	66/JB	24,130	1.97	36,348	181.74	22.72
131		215/RB	18,804	1.97	28,324	141.62	17.70
DISTRICT TOBA TEK SINGH							
132		298/JB	10,350	1.59	14,415	72.07	9.01
133		281/JB	7,600	1.59	10,585	52.92	6.62
134		367/JB	6,400	1.59	8,914	44.57	5.57
135	Pirmahal	320/GB	6,530	1.59	9,095	45.47	5.68
136		327/GB	8,250	1.59	11,490	57.45	7.18
137		680/21 GB	6,320	1.59	8,802	44.01	5.50
138	T.T.Singh	Rajana Town	6,300	1.59	8,774	43.87	5.48

3.28 PROJECT DETAILS OF SUPPLY, CONSTRUCTION & INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION

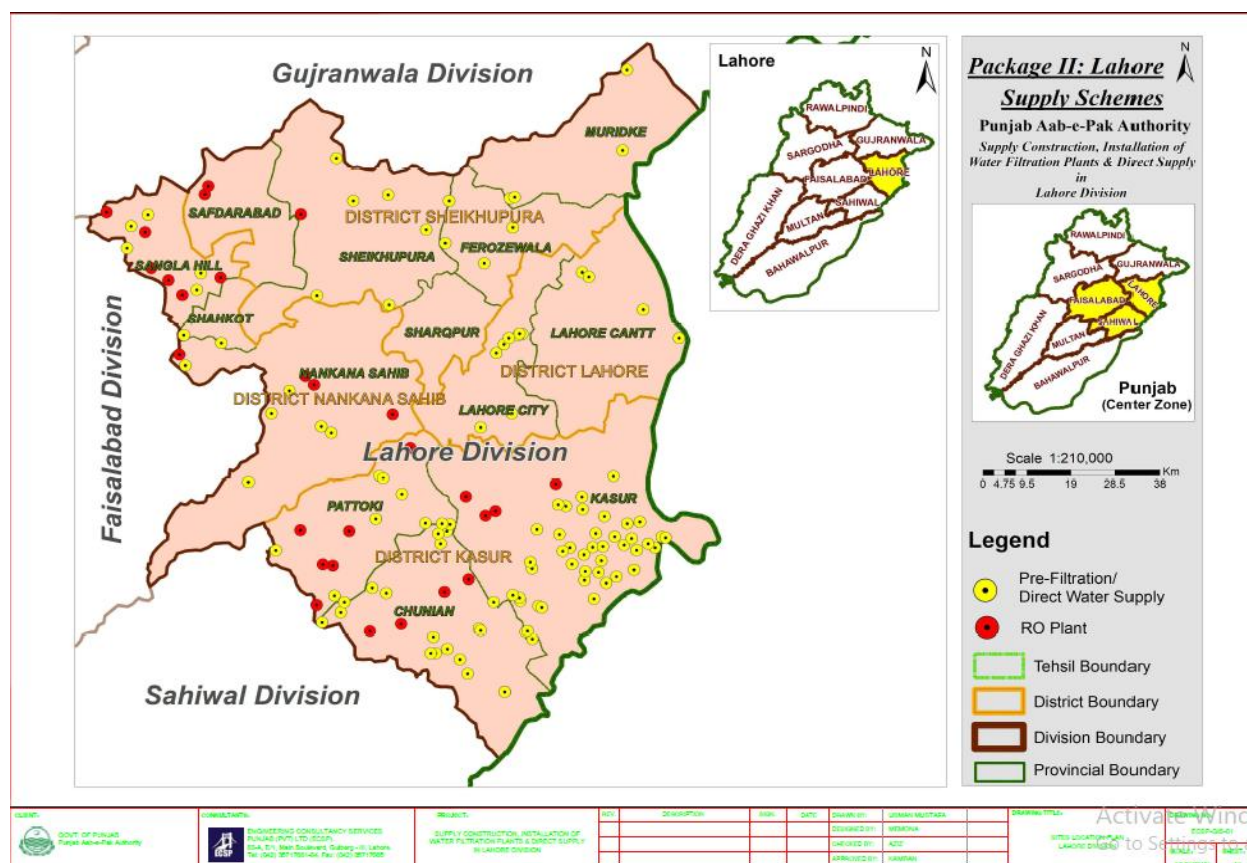
3.28.1 Project Location for Lahore Division

Lahore is the capital of Pakistan's Punjab province and the country's second largest city after Karachi, as well as the world's 26th largest city.

The Project covers the 04 Districts of the Division Lahore which are mentioned below:

Districts	Area (km ²)	Population (2017)
District Kasur	1772	3,454,996
District Lahore	3030	11,126,2853
District Nankana Sahib	3995	1,356,374
District Sheikhupura	2960	3,460,426

There are total 573 villages in Lahore Division. Each Tehsil has the population living in both urban and rural areas. The Project will cater to the rural areas under this project. Blown-up map of Lahore Division is shown below in the **Figure 3-9** and is also attached as **Annexure III-B**.



3.29 DISTRICT WISE MAPS OF LAHORE DIVISION FOR INSTALLATION OF TREATMENT PLANTS

3.29.1 District Kasur

Kasur District is a district in Punjab, Pakistan, located in the Lahore Division. Kasur is the district capital and the birthplace of the Sufi poet Bulleh Shah, who is well known in the region and throughout Pakistan. According to the 2017 census of Pakistan it had a population of 3,454,996. The district has a total area of 4,796 square kilometers. Kasur district is connected to Lahore from the east, Nankana Sahib from the north, Faisalabad from the west, and Okara and India from the south.

The figure below shows the map of district Kasur with yellow points indicating Pre-Filtration / Direct Supply and red points indicating the locations of RO plants at the identified locations of the district. **Figure 3-10.**

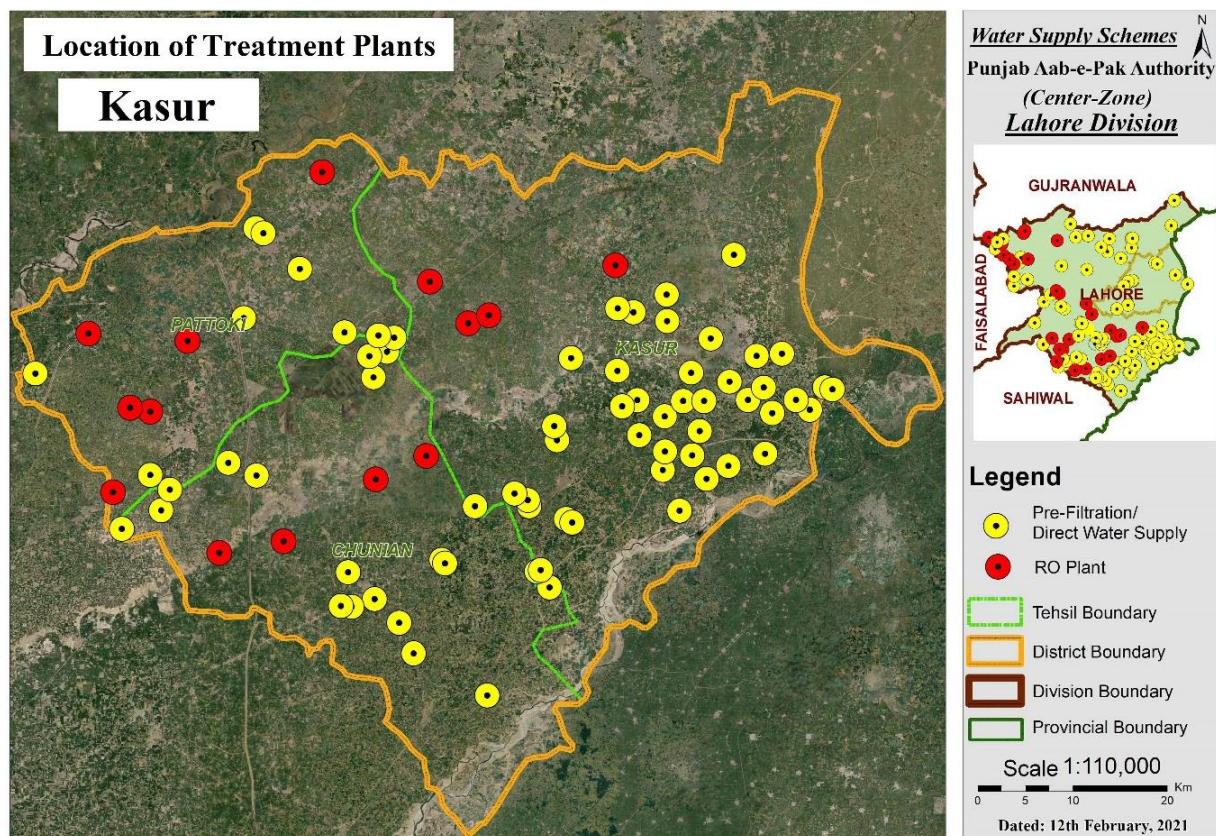


Figure 3-10: Map Showing District Kasur

3.29.2 District Lahore

Lahore is the second most populous city in Pakistan, after Karachi, and the world's 26th most populous city. It is the capital and largest city of the province of Punjab. According to the 2017 census of Pakistan it had a population of 11,126,285. Lahore is a major industrial and economic center in Pakistan. It is the largest city in Pakistan, as well as the historic capital and cultural center of the Punjab region, and it is one of the most socially liberal, progressive, and cosmopolitan cities in the country. It is located in the country's northeast, close to the international border with India.

The figure below shows the map of district Lahore with yellow points indicating the locations of Pre-Filtration treatment plant/Direct Water Supply facilities in the district. **Figure 3-11.**

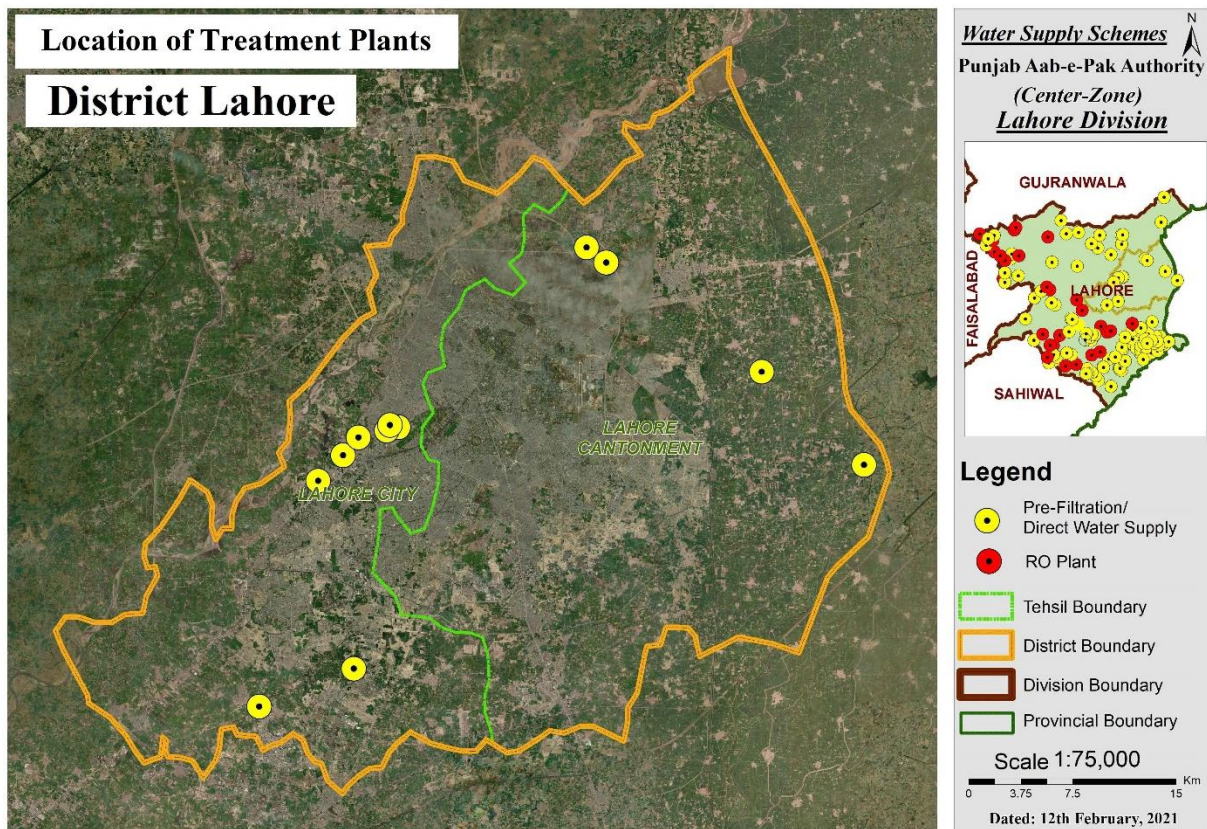


Figure 3-11: Map Showing District Lahore

3.29.3 District Nankana Sahb

Nankana Sahib District is a district in Pakistan's Punjab province. Shahkot is Nankana Sahib's largest urban center. According to the 2017 census of Pakistan it had a population of 1,356,374. Nankana Sahib is located approximately 75 kilometers (47 miles) west of Lahore and approximately 53 kilometers (33 miles) east of Faisalabad.

The figure below shows the map of district Nankana Sahib with yellow points indicating Pre-Filtration/Direct Supply and red points indicating the locations of RO treatment plant facilities in the district. **Figure 3-12.**

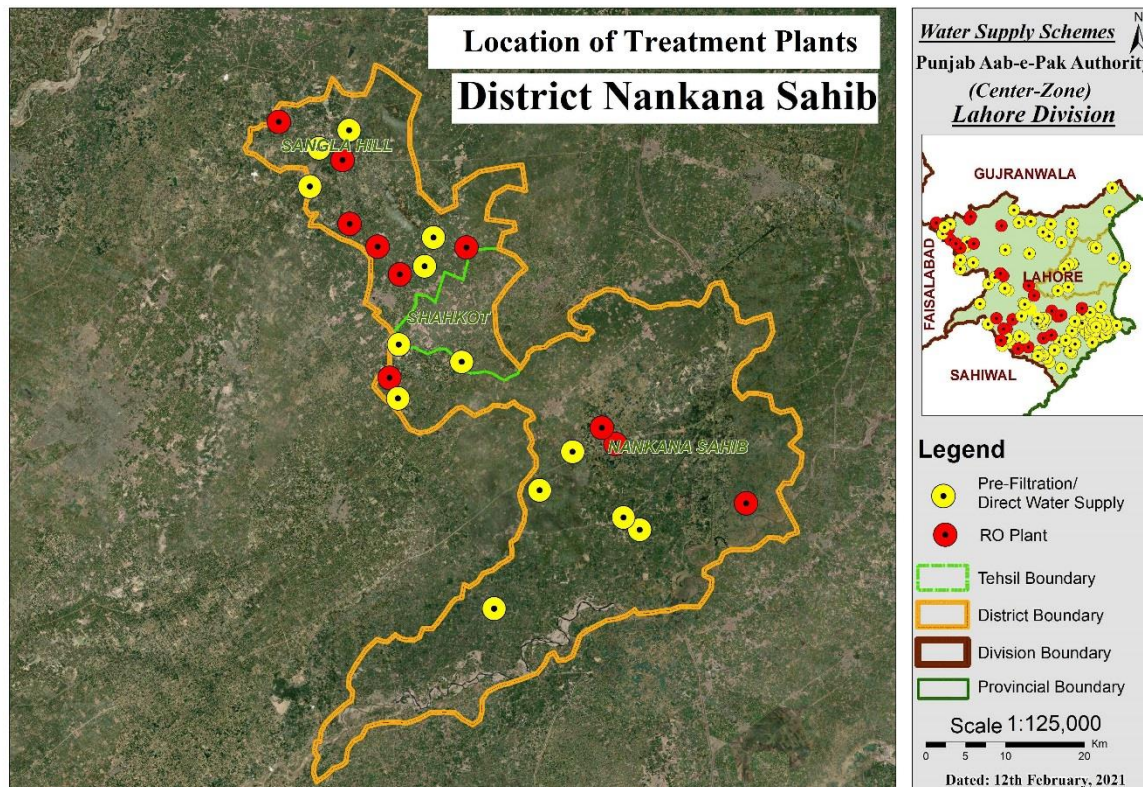


Figure 3-12: Map showing District Nankana Sahib

3.29.4 District Sheikhupura

Sheikhupura is a district in Pakistan's Punjab Province's Lahore Division. Sheikhupura is the district's administrative center. According to the 2017 census of Pakistan it had a population of 3,460,426 of which 25.45% of population were urban.

The figure below shows the map of district Sheikhupura with yellow points indicating Pre-Filtration/Direct Supply and red points indicating the locations of RO treatment plant facilities in the district. **Figure 3-13.**

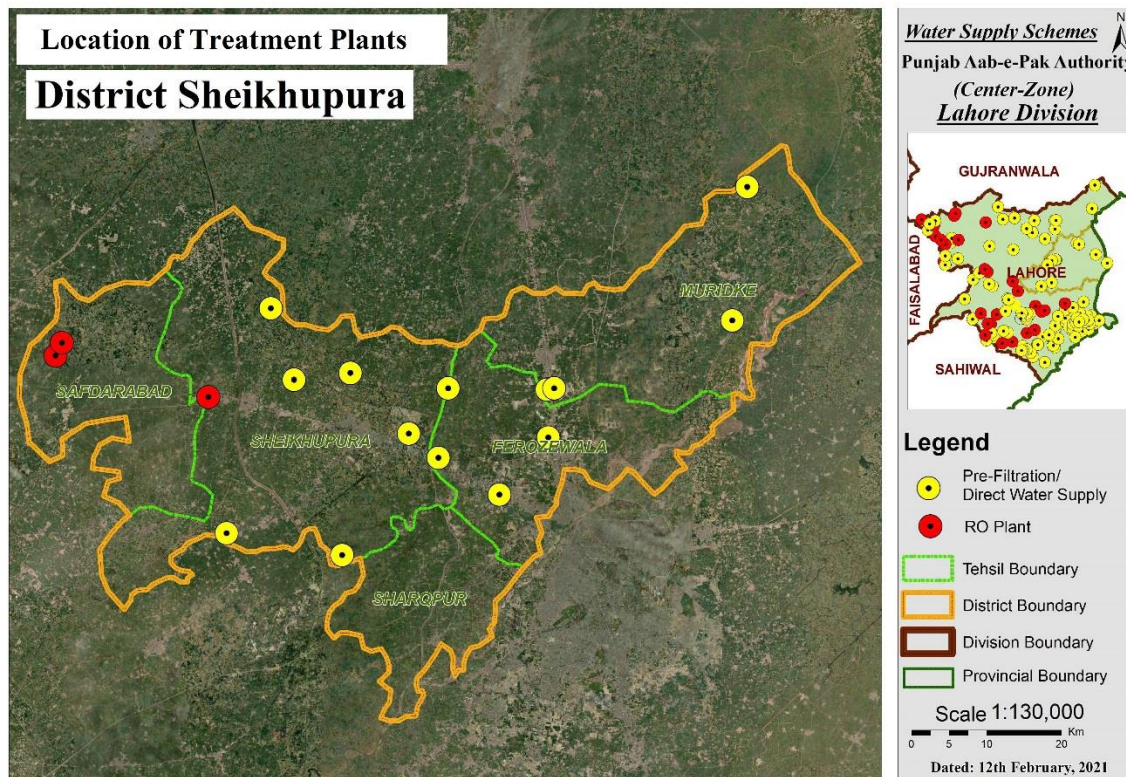


Figure 3-13: Map showing District Sheikhupura

3.30 PROJECT SITE FEATURES (LAHORE): LAND USE, ROAD ACCESS, AND VEGETATION

Lahore is the 2nd largest city of Pakistan. At earlier times, most of the land were used for agriculture purposes but due to rapid urbanization, the city has now become a financial hub for business activities.

It is the 2nd largest city of Pakistan after Karachi both in terms of population and urban hierarchy. The total area of Lahore is 11727 square km (1172700 hectares). This city's population in Pakistan is only exceeded by nearby city Karachi. The population density currently sits around 6,300 residents per square kilometer i.e. 16,000 individuals per square mile. (Riaz, 2014)⁶

⁶ Riaz, O., Ghaffar, A., & Butt, I. (2022). Modelling land use patterns of Lahore (Pakistan) using remote sensing and GIS. Global Journal of Science Frontier Research. Environment & Earth Science, 14(1), 24-30.

Physio graphically, the land of Lahore is made of alluvial soil deposited by Ravi through ages. Lahore is plain alluvial land with a gentle slope towards south east. Its height above sea level ranges from 700 feet in north east to 680 feet in south west with a slope gradient of 1 foot per 5-10 kilometers. The first underground water table is found at depth of 35 to 40 meters. But this water is not drinkable. Drinkable water is available at a depth of 125 to 150 meters.

Lahore city administration has given prime importance to public transport services in Lahore. But still desired level of convenience and efficiency has not been achieved because of the absence of any integrated public transport system. Metro bus, Speedo Buses, Orange Line, Local Vans and Qing qi Rickshaws are all operating through their independent schedules with least consideration to that of others. Travelers using more than one mode of transport for their complete trip do not find whole system well harmonized. There is a need to find whether integration of currently independently operating transport systems can bring any improvements in services.

Lahore is a part of Indo-Gangetic plain formed in front of the Himalayas (Bender & Raza, 1995). Lahore has fertile soil suitable for vegetation and plantation. Its soil and climatic conditions support all types of crops. Major crops of Lahore are wheat, rice, sugarcane, cotton, and vegetables. The cropping pattern of Lahore also shifted from cash crops to food grain crops and vegetables to fulfill the needs of the city. Now the major cash crops like cotton and sugarcane are not seen on the city profile. In 1998, the land area under wheat was 50,000 hectares; rice, 32,000 hectares; and vegetable, 6,317 hectares. The major vegetable was potatoes, which accounted for 70% of the area under vegetables. But now the agriculture area has been reduced significantly due to rapid urbanization and industrialization of the city.

3.31 SAFE DRINKING WATER SUPPLY STATUS IN LAHORE DIVISION

The mega city of Lahore with an area of 17,000 hectares is provincial capital of Punjab and the second largest city of Pakistan. The availability of sufficient and safe drinking water is a major difficulty in Pakistan's mega city Lahore, and it is anticipated that the situation may worsen over the next few years. The Water and Sanitation Agency (WASA), Lahore, is responsible for providing water supplies to the majority of the study area. WASA, Lahore, which regularly takes water samples from its installed tube wells in residential areas of Lahore, provided the water quality information for the year 2012. They analyzed collected water samples in their laboratory for 19 of the drinking water quality parameters. The analyses of the water samples conducted using standardized procedures for testing water (APHA-AWWA-WPCF) in accordance with WHO drinking water guidelines (WHO, 2011). Temperature, odor, color, taste, pH, turbidity, TDS, conductivity, total hardness, Calcium, Magnesium, alkalinity, Cl, NO₂, NO₃, CO₃, HCO₃, and E. coli are among the parameters that were analyzed.

This study concludes that groundwater quality parameters including pH, electric conductivity, Ca, Cl and TDS are well within the permissible limits defined by WHO for the drinking water. However, alkalinity, HCO₃ and Mg are crossing their respective safe limits in some parts of Lahore residence. Groundwater in subdivisions of Gulberg, Anarkali and Mozang, is found to be marginally fit for drinking purpose. So, these areas need special attention of authorities regarding provision of the safe drinking water to the community. Surrounding areas of the above-mentioned locations have also been spotted to be touching upper limits of the safety margins, so in near future these regions of groundwater may also become unsuitable for

human use.

A study was also carried out to find out the arsenic level in drinking water and different drinking water sources used by the female inhabitants of Sheikhpura district. Regarding the amount of arsenic in the drinking water, District Sheikhpura is extremely contaminated. The young female's primary source of intake is drinking water. As a result, taking preventative steps is necessary to lower the potential level of arsenic in drinking water.

3.32 CHARACTERISTICS OF SELECTED AREA (LAHORE DIVISION)

Green Engineering Consultant (GEC) performed "water analysis services for ECSP as per scope of work" under the Punjab Aab e Pak Project to ensure compliance with standards and regulations. The methodology included the following phases: sample collection and preservation, testing of water samples, preparation of monitoring and analysis reports, and submission of reports to ECSP. This study was conducted to assess the Water quality of Lahore Division under Punjab Aab e-Pak project. In the current study, water samples were collected from One hundred sixty-four (**164**) different locations in the Lahore Division. Water sampling was completed between the 11th of December and the 15th of January 2021. The observed results for water quality parameters are compared to the Punjab Environmental Quality Standards (PEQS) and the World Health Organization (WHO) standards. The results show that the parameters (TDS, Fluoride, Turbidity, Hardness, Arsenic, Nitrate, and Microbial parameters) were above their respective limits. TDS and fluoride levels were found to be extremely high in Lahore Division water samples tested. The main reason for these higher values is that these water sources are contaminated and have high soluble salt quality. Water analysis results show that hardness, nitrates, and microbiological parameters are all within PEQS/WHO limits in some locations. Microbiological parameter testing results show that microbial content is high in some locations due to sewerage contamination.

Considering the lab results, there is a need to provide proper water treatment facilities for the people of Lahore to achieve better living standards.

Detailed Water Quality Analysis lab reports are attached as an **Annexure IV-B**.

3.33 DESIGN SUMMARY FOR LAHORE DIVISION

The project will provide potable water to the people living in Lahore Division. Markaz- e-Aab will be constructed in 146 villages from where people can fetch the water for drinking purposes. Water supply schemes/Villages in Lahore Division supplied with drinking water are summarized below in **Table 3-4**:

Table 3-4: Design Summary of Treatment Plants for Lahore Division

Sr. No.	Type of Plant	No. of Plants
1	Direct Supply / Pre-filtration Plant (Chlorination, Sand & Activated Carbon Filter)	82
2	Direct Supply / Pre-filtration Plant with Sand, Activated Carbon & Arsenic removal Filter	03

Sr. No.	Type of Plant	No. of Plants
3	Direct Supply / Pre-filtration Plant with Sand, Activated Carbon & Fluoride removal Filter	01
4	(Dysfunctional Schemes) Direct Supply Plant with Source development (Chlorination, Sand & Activated Carbon Filter)	16
5	(Dysfunctional Schemes) Direct Supply / Pre-filtration Plant with Source development & Sand, Activated Carbon & Fluoride removal Filter	02
6	Reverse Osmosis	42
Total		146

3.34 DETAILS OF PLANT LOCATIONS AT LAHORE DIVISION

Details of locations of treatment plants in the specified areas of Lahore Division is attached as table given below in **Table 3-5:**

Table 3-5: Details of Plant Locations in the Lahore Division

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
1	KASUR DISTRICT RO PLANTS	Kot Radha Kishan	Miroli Uttar	RO	2.00
2	KASUR DISTRICT RO PLANTS	Pattoki	Chak No 42 Gopirai	RO	2.00
3	KASUR DISTRICT RO PLANTS	Pattoki	Tara Garh Chak 44	Chlorination + Sand + Activated Carbon Filter	2.00
4	SHEIKHUPURA DISTRICT RO PLANTS	Safdarabad	Chak 11	RO	2.00
5	SHEIKHUPURA DISTRICT RO PLANTS	Sheikhupura	Gurruanwala Gharbi	RO	2.00
6	SHEIKHUPURA DISTRICT RO PLANTS	Sheikhupura	Keran	RO	2.00
7	SHEIKHUPURA DISTRICT RO PLANTS	Sheikhupura	Wara Ghulab Sing	RO	2.00
8	DISTRICT KASUR DIRECT SUPPLY	Chunian	Muft Pura	Arsenic Filter	2.00
9	DISTRICT KASUR DIRECT SUPPLY	Kasur	Dholan Hithar	Chlorination + Sand + Activated Carbon Filter	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
10	DISTRICT KASUR DIRECT SUPPLY	Kasur	Hari Ke Nauval	Chlorination + Sand + Activated Carbon Filter	2.00
11	DISTRICT KASUR DIRECT SUPPLY	Kasur	Bhadur Pura	Chlorination + Sand + Activated Carbon Filter	2.00
12	DISTRICT LAHORE DIRECT SUPPLY	Lahore City	R/W/S Niaz Baig	Arsenic Filter	2.00
13	DISTRICT LAHORE DIRECT SUPPLY	Lahore City	R/W/S Shah Pur	Chlorination + Sand + Activated Carbon Filter	2.00
14	DISTRICT LAHORE DIRECT SUPPLY	Lahore City	Rural Water Supply Gopi Rai	Chlorination + Sand + Activated Carbon Filter	2.00
15	DISTRICT LAHORE DIRECT SUPPLY	Shalimar	R/W/S Lakho Dhair	Chlorination + Sand + Activated Carbon Filter	2.00
16	DISTRICT LAHORE DIRECT SUPPLY	Shalimar	Sharifpura	Chlorination + Sand + Activated Carbon Filter	2.00
17	DISTRICT NANKANA SB DIRECT SUPPLY	Sangla Hill	Choor Kotly 117 R.B	Chlorination + Sand + Activated Carbon Filter	2.00
18	DISTRICT NANKANA SB DIRECT SUPPLY	Shah Kot	Dala Naggal	Chlorination + Sand + Activated Carbon Filter	2.00
19	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Ferozewala	RWSS Faiz Pur khurd	Chlorination + Sand + Activated Carbon Filter	2.00
20	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Muridke	RWSS Jandiala Kalsan	Chlorination + Sand + Activated Carbon Filter	2.00
21	KASUR DISTRICT RO PLANTS	Kot Radha Kishan	Clarkabad	Chlorination + Sand + Activated Carbon Filter	2.00
22	SHEIKHUPURA DISTRICT RO PLANTS	Sheikhupura	4 Chak Risala	RO	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
23	DISTRICT KASUR DIRECT SUPPLY	Chunian	Ellahabad	Chlorination + Sand + Activated Carbon Filter	2.00
24	DISTRICT KASUR DIRECT SUPPLY	Chunian	Rosa Tiba	Chlorination + Sand + Activated Carbon Filter	2.00
25	DISTRICT KASUR DIRECT SUPPLY	Chunian	Maukal	Chlorination + Sand + Activated Carbon Filter	2.00
26	DISTRICT KASUR DIRECT SUPPLY	Chunian	Chak 18	Chlorination + Sand + Activated Carbon Filter	2.00
27	DISTRICT KASUR DIRECT SUPPLY	Chunian	Gohar Chak No.8	Chlorination + Sand + Activated Carbon Filter	2.00
28	DISTRICT KASUR DIRECT SUPPLY	Chunian	Kot Lashkar	Chlorination + Sand + Activated Carbon Filter	2.00
29	DISTRICT KASUR DIRECT SUPPLY	Chunian	Attari Jeet Singh	Chlorination + Sand + Activated Carbon Filter	2.00
30	DISTRICT KASUR DIRECT SUPPLY	Kasur	Mandi Usman Wala	Chlorination + Sand + Activated Carbon Filter	2.00
31	DISTRICT KASUR DIRECT SUPPLY	Kasur	Mhalam Kalan	Chlorination + Sand + Activated Carbon Filter	2.00
32	DISTRICT KASUR DIRECT SUPPLY	Kasur	Gohar Jagir	Chlorination + Sand + Activated Carbon Filter	2.00
33	DISTRICT KASUR DIRECT SUPPLY	Kasur	Guggar	Chlorination + Sand + Activated Carbon Filter	2.00
34	DISTRICT KASUR DIRECT SUPPLY	Kasur	Hussain Khan wala	Chlorination + Sand + Activated Carbon Filter	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
35	DISTRICT KASUR DIRECT SUPPLY	Kasur	Rajji Wala Arayan	Chlorination + Sand + Activated Carbon Filter	2.00
36	DISTRICT KASUR DIRECT SUPPLY	Kasur	Chah Aror Sing	Chlorination + Sand + Activated Carbon Filter	2.00
37	DISTRICT KASUR DIRECT SUPPLY	Kasur	Daulay wala	Chlorination + Sand + Activated Carbon Filter	2.00
38	DISTRICT KASUR DIRECT SUPPLY	Kasur	Gohar Hithar	Chlorination + Sand + Activated Carbon Filter	2.00
39	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Gehlan Chak 9	Chlorination + Sand + Activated Carbon Filter	2.00
40	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Ghuman Kay	Chlorination + Sand + Activated Carbon Filter	2.00
41	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Dholan Chak 7	Chlorination + Sand + Activated Carbon Filter	2.00
42	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Chak#14	Chlorination + Sand + Activated Carbon Filter	2.00
43	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Cheela Chak No.49	Chlorination + Sand + Activated Carbon Filter	2.00
44	DISTRICT LAHORE DIRECT SUPPLY	Lahore City	R/W/S Waris colony	Chlorination + Sand + Activated Carbon Filter	2.00
45	DISTRICT LAHORE DIRECT SUPPLY	Raiwind	Rural Water Supply Mohalanwal	Chlorination + Sand + Activated Carbon Filter	2.00
46	DISTRICT NANKANA SB DIRECT SUPPLY	Nankana Sahib	Burkhudar	Arsenic Filter	2.00
47	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Ferozewala	RWSS Sakhum	Chlorination + Sand +	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
				Activated Carbon Filter	
48	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Ferozewala	RWSSKot pindi das	Chlorination + Sand + Activated Carbon Filter	2.00
49	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Ferozewala	RWSS Javaid Nagar	Chlorination + Sand + Activated Carbon Filter	2.00
50	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Muridke	Rural Water Supply Scheme Dhakam pura	Chlorination + Sand + Activated Carbon Filter	2.00
51	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Sheikhupura	Rural Water Supply Scheme Jhabran	Chlorination + Sand + Activated Carbon Filter	2.00
52	SHEIKHUPURA DISTRICT RO PLANTS	Safdarabad	Bairwala	RO	2.00
53	DISTRICT KASUR DIRECT SUPPLY	Chunian	Saresar	Chlorination + Sand + Activated Carbon Filter	2.00
54	DISTRICT KASUR DIRECT SUPPLY	Chunian	Chak 17	Chlorination + Sand + Activated Carbon Filter	2.00
55	DISTRICT KASUR DIRECT SUPPLY	Kasur	Lukhney Key	Chlorination + Sand + Activated Carbon Filter	2.00
56	DISTRICT KASUR DIRECT SUPPLY	Kasur	Rasool Pur	Chlorination + Sand + Activated Carbon Filter	2.00
57	DISTRICT KASUR DIRECT SUPPLY	Kasur	Nand Ka Takia	Chlorination + Sand + Activated Carbon Filter	2.00
58	DISTRICT KASUR DIRECT SUPPLY	Kasur	Said Pur	Chlorination + Sand + Activated Carbon Filter	2.00
59	DISTRICT KASUR DIRECT SUPPLY	Kasur	Kotli Ray AbuBaker	Chlorination + Sand + Activated Carbon Filter	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
60	DISTRICT KASUR DIRECT SUPPLY	Kasur	Theh Shaikham	Chlorination + Sand + Activated Carbon Filter	2.00
61	DISTRICT KASUR DIRECT SUPPLY	Kasur	Noori Wala	Chlorination + Sand + Activated Carbon Filter	2.00
62	DISTRICT KASUR DIRECT SUPPLY	Kasur	Sheikh Pura Nau	Chlorination + Sand + Activated Carbon Filter	2.00
63	DISTRICT KASUR DIRECT SUPPLY	Kasur	Noor Pur Nehar	Chlorination + Sand + Activated Carbon Filter	2.00
64	DISTRICT KASUR DIRECT SUPPLY	Kasur	Bugri	Chlorination + Sand + Activated Carbon Filter	2.00
65	DISTRICT KASUR DIRECT SUPPLY	Kasur	Khai Hithar	Chlorination + Sand + Activated Carbon Filter	2.00
66	DISTRICT KASUR DIRECT SUPPLY	Kasur	Today Pur	Chlorination + Sand + Activated Carbon Filter	2.00
67	DISTRICT KASUR DIRECT SUPPLY	Kasur	Salamat Pura	Chlorination + Sand + Activated Carbon Filter	2.00
68	DISTRICT KASUR DIRECT SUPPLY	Kasur	Ratnay Wala	Chlorination + Sand + Activated Carbon Filter	2.00
69	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Bheo Asal	Chlorination + Sand + Activated Carbon Filter	2.00
70	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Ghandian Otar	Chlorination + Sand + Activated Carbon Filter	2.00
71	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Aulakh Bhonga	Chlorination + Sand + Activated Carbon Filter	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
72	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Kaween Blaka Singh	Chlorination + Sand + Activated Carbon Filter	2.00
73	DISTRICT LAHORE DIRECT SUPPLY	Model Town	R/W/S Yohanaabad	Chlorination + Sand + Activated Carbon Filter	2.00
74	DISTRICT LAHORE DIRECT SUPPLY	Model Town	Rural Water Supply Pandoki	Chlorination + Sand + Activated Carbon Filter	2.00
75	DISTRICT LAHORE DIRECT SUPPLY	Raiwind	Rural Water Supply Sundar	Chlorination + Sand + Activated Carbon Filter	2.00
76	DISTRICT NANKANA SB DIRECT SUPPLY	Nankana Sahib	Bara Ghar	Chlorination + Sand + Activated Carbon Filter	2.00
77	DISTRICT NANKANA SB DIRECT SUPPLY	Shah Kot	Chak No. 81RB	Chlorination + Sand + Activated Carbon Filter	2.00
78	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Muridke	Rural Water Supply Scheme Kot Abdullah	Chlorination + Sand + Activated Carbon Filter	2.00
79	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Shariq pur	Rural Water Supply Scheme Ghazi pur	Chlorination + Sand + Activated Carbon Filter	2.00
80	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Sheikhupura	Rural Water Supply Scheme 4 Chak Rasala	Chlorination + Sand + Activated Carbon Filter	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
1	KASUR DISTRICT RO PLANTS	Chunian	Dhos	RO	2.00
2	KASUR DISTRICT RO PLANTS	Chunian	Harse Naushahra	RO	2.00
3	KASUR DISTRICT RO PLANTS	Chunian	Kandu Ranggar	RO	2.00
4	KASUR DISTRICT RO PLANTS	Chunian	Lambe Khalsa	RO	2.00
5	KASUR DISTRICT RO PLANTS	Kot Radha Kishan	Rawal Jageer	RO	2.00
6	KASUR DISTRICT RO PLANTS	Kot Radha Kishan	Azamabad	RO	2.00
7	KASUR DISTRICT RO PLANTS	Pattoki	Chak 39 Awanwala	RO	2.00
8	KASUR DISTRICT RO PLANTS	Pattoki	Balair	RO	2.00
9	KASUR DISTRICT RO PLANTS	Pattoki	Chak No 20 Wan Radha Ram	RO	2.00
10	KASUR DISTRICT RO PLANTS	Pattoki	Nauthe Jagir	RO	2.00
11	KASUR DISTRICT RO PLANTS	Pattoki	Bharwar Kalan	RO	2.00
12	KASUR DISTRICT RO PLANTS	Pattoki	Chak 41 Khudian	RO	2.00
13	LAHORE DISTRICT RO PLANTS	Lahore	Dheerky	RO	2.00
14	LAHORE DISTRICT RO PLANTS	Raiwand	Budduke	RO	2.00
15	NANKANA SB DISTRICT RO PLANTS	Nankana	Kanwan Wali	RO	2.00
16	NANKANA SB DISTRICT RO PLANTS	Nankana	Bhuchoke Pur	RO	2.00
17	NANKANA SB DISTRICT RO PLANTS	Nankana	Pidd Pur	RO	2.00
18	NANKANA SB DISTRICT RO PLANTS	Nankana	Chak No 16/Gb Budometa	RO	2.00
19	NANKANA SB DISTRICT RO PLANTS	Sangla Hill	Chak No 41 (Marar)	RO	2.00
20	NANKANA SB DISTRICT RO PLANTS	Sangla Hill	Chak No 36/Rb (Baroy)	RO	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
21	NANKANA SB DISTRICT RO PLANTS	Sangla Hill	Chak No 121/Rb(Hanj hli)	RO	2.00
22	NANKANA SB DISTRICT RO PLANTS	Shahkot	Chak No 168 Karkan	RO	2.00
23	NANKANA SB DISTRICT RO PLANTS	Shahkot	Chak 82 (Rasul Pura)	RO	2.00
24	NANKANA SB DISTRICT RO PLANTS	Shahkot	Chak 33/Rb Darowali	RO	2.00
25	SHEIKHUPURA DISTRICT RO PLANTS	Feroze Wala	Kharin Wala	RO	2.00
26	SHEIKHUPURA DISTRICT RO PLANTS	Safdarabad	Moman Chak No 30	RO	2.00
27	SHEIKHUPURA DISTRICT RO PLANTS	Safdarabad	Manght	RO	2.00
28	SHEIKHUPURA DISTRICT RO PLANTS	Safdarabad	Rahmana Abad 10	RO	2.00
29	SHEIKHUPURA DISTRICT RO PLANTS	Sheikhupura	Khambianw als	RO	2.00
30	SHEIKHUPURA DISTRICT RO PLANTS	Sheikhupura	Chah Chando	RO	2.00
31	SHEIKHUPURA DISTRICT RO PLANTS	Sheikhupura	Nawan Kot	RO	2.00
32	DISTRICT KASUR DIRECT SUPPLY	Chunian	Gehlan Hithar	Chlorination + Sand + Activated Carbon Filter	2.00
33	DISTRICT KASUR DIRECT SUPPLY	Chunian	Jodh Singh	Chlorination + Sand + Activated Carbon Filter	2.00
34	DISTRICT KASUR DIRECT SUPPLY	Chunian	Talwandi	Chlorination + Sand + Activated Carbon Filter	2.00
35	DISTRICT KASUR DIRECT SUPPLY	Chunian	Shaam Kot	Chlorination + Sand + Activated Carbon Filter	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
36	DISTRICT KASUR DIRECT SUPPLY	Kasur	Atheel Pur	Fluoride Filter	2.00
37	DISTRICT KASUR DIRECT SUPPLY	Kasur	Maan	Chlorination + Sand + Activated Carbon Filter	2.00
38	DISTRICT KASUR DIRECT SUPPLY	Kasur	Naul Hithar	RO	2.00
39	DISTRICT KASUR DIRECT SUPPLY	Kasur	Nayyeke	Chlorination + Sand + Activated Carbon Filter	2.00
40	DISTRICT KASUR DIRECT SUPPLY	Kasur	Jaurra	Chlorination + Sand + Activated Carbon Filter	2.00
41	DISTRICT KASUR DIRECT SUPPLY	Kasur	Bhedian Kalan	Chlorination + Sand + Activated Carbon Filter	2.00
42	DISTRICT KASUR DIRECT SUPPLY	Kasur	Rao Khan Wala	RO	2.00
43	DISTRICT KASUR DIRECT SUPPLY	Kasur	Rasool Nager	Fluoride Filter	2.00
44	DISTRICT KASUR DIRECT SUPPLY	Kasur	Kaiser Gurh	Chlorination + Sand + Activated Carbon Filter	2.00
45	DISTRICT KASUR DIRECT SUPPLY	Kasur	Patto Kalan	Chlorination + Sand + Activated Carbon Filter	2.00
46	DISTRICT KASUR DIRECT SUPPLY	Kasur	Sanda Kalan	Chlorination + Sand + Activated Carbon Filter	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
47	DISTRICT KASUR DIRECT SUPPLY	Pattoki	Lambay Jageer	Chlorination + Sand + Activated Carbon Filter	2.00
48	DISTRICT LAHORE DIRECT SUPPLY	Lahore City	R/W/S Gulshan colony	Chlorination + Sand + Activated Carbon Filter	2.00
49	DISTRICT LAHORE DIRECT SUPPLY	Shalimar	R/W/S Padhana	Fluoride Filter	2.00
50	DISTRICT LAHORE DIRECT SUPPLY	Raiwind	R/W/S Chung	Chlorination + Sand + Activated Carbon Filter	2.00
51	DISTRICT LAHORE DIRECT SUPPLY	Raiwind	R/W/S Arrian	Chlorination + Sand + Activated Carbon Filter	2.00
52	DISTRICT NANKANA SB DIRECT SUPPLY	Nankana Sahib	More Khunda	Chlorination + Sand + Activated Carbon Filter	2.00
53	DISTRICT NANKANA SB DIRECT SUPPLY	Nankana Sahib	Chak No 5 G.B	Chlorination + Sand + Activated Carbon Filter	2.00
54	DISTRICT NANKANA SB DIRECT SUPPLY	Nankana Sahib	Massu	Chlorination + Sand + Activated Carbon Filter	2.00
55	DISTRICT NANKANA SB DIRECT SUPPLY	Nankana Sahib	Chak No 6 G.B	Chlorination + Sand + Activated Carbon Filter	2.00
56	DISTRICT NANKANA SB DIRECT SUPPLY	Nankana Sahib	Chak No.18GB	RO	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
57	DISTRICT NANKANA SB DIRECT SUPPLY	Sangla Hill	Chak No 46 R.B	Chlorination + Sand + Activated Carbon Filter	2.00
58	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Ferozewala	RWSS Khan pur Virkan	Chlorination + Sand + Activated Carbon Filter	2.00
59	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Ferozewala	RWSS Amanpura & Shamke	Chlorination + Sand + Activated Carbon Filter	2.00
60	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Sheikhupura	Rural Water Supply Scheme Kaloake	Chlorination + Sand + Activated Carbon Filter	2.00
61	DISTRICT SHEIKHUPURA DIRECT SUPPLY	Sheikhupura	Rural Water Supply Scheme Sahoki Mallian	Chlorination + Sand + Activated Carbon Filter	2.00
62	DISTRICT KASUR DIRECT SUPPLY	Chunian	Talwandi Adda	Chlorination + Sand + Activated Carbon Filter	2.00
63	DISTRICT KASUR DIRECT SUPPLY	Kasur	Roshan Bheela	Chlorination + Sand + Activated Carbon Filter	2.00
64	DISTRICT KASUR DIRECT SUPPLY	Kasur	Khereper Hithar	Chlorination + Sand + Activated Carbon Filter	2.00

Sr. No	District	Tehsil	Village	Recommendation	
				Type of Plant	Capacity m3/hr.
65	DISTRICT KASUR DIRECT SUPPLY	Kasur	Kelo Kalan	Chlorination + Sand + Activated Carbon Filter	2.00
66	DISTRICT KASUR DIRECT SUPPLY	Kasur	Bahmani Wala,	Chlorination + Sand + Activated Carbon Filter	2.00

3.35 POPULATION PROJECTION & WATER DEMAND FOR LAHORE DIVISION

Table 3-6: Population Projection & Water Demand for Lahore Division

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
KASUR DISTRICT RO PLANTS							
1	Chunian	Dhos	5,120	2.03	7,808	39.04	4.88
2		Harse Naushahra	2,567	2.03	3,915	19.58	2.45
3		Kandu Ranggar	19,809	2.03	30,209	151.05	18.88
4		Lambe Khalsa	2,820	2.03	4,300	21.50	2.69
5	Kot Radha Kishan	Rawal Jageer	2,983	2.03	4,549	22.74	2.84
6		Miroli Uttar	3,928	2.03	5,990	29.95	3.74
7		Azamabad	4,378	2.03	6,677	33.39	4.17
8	Pattoki	Chak No 42 Gopirai	3,771	2.03	5,752	28.76	3.59
9		Chak 39 Awanwala	5,309	2.03	8,097	40.48	5.06
10		Balair	6,680	2.03	10,187	50.94	6.37

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
11		Chak No 20 Wan Radha Ram	7,617	2.03	11,617	58.08	7.26
12		Nauthe Jagir	16,440	2.03	25,072	125.36	15.67
13		Bharwar Kalan	21,761	2.03	33,187	165.93	20.74
14		Rawal Jageer	4,189	2.03	6,389	31.94	3.99
15		Chak 41 Khudian	7,526	2.03	11,478	57.39	7.17
LAHORE DISTRICT RO PLANTS							
1	Lahore	Dheerky	2,331	3	4,337	21.69	2.71
2	Raiwand	Budduke	5,329	3	9,913	49.57	6.20
3		Sundar	16,653	3	30,980	154.90	19.36
NANKANA SB DISTRICT RO PLANTS							
1	Nankana	Kanwan Wali	3,680	1.38	4,907	24.53	3.07
2		Bhuchoke Pur	2,530	1.38	3,374	16.87	2.11
3		Pidd Pur	2,447	1.38	3,263	16.31	2.04
4		Chak No 16/Gb Budometa	2,484	1.38	3,312	16.56	2.07
5	Sangla Hill	Chak No 41 (Marar)	8,908	1.38	11,879	59.39	7.42
6		Chak No 36/Rb (Baroy)	7,712	1.38	10,285	51.42	6.43
7		Chak No 121/Rb(Hanjhli)	3,182	1.38	4,243	21.22	2.65
8	Shahkot	Chak No 168 Karkan	6,288	1.38	8,385	41.93	5.24
9		Chak 82 (Rasul Pura)	5,354	1.38	7,140	35.70	4.46
10		Chak 33/Rb Darowali	5,688	1.38	7,585	37.92	4.74
SHEIKHUPURA DISTRICT RO PLANTS							
1	Feroze Wala	Kharin Wala	13,322	2.22	21,127	105.64	13.20

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
2	Muridkay	Gunha Ourr	26,645	2.22	42,254	211.27	26.41
3	Safdarabad	Moman Chak No 30	4,663	2.22	7,394	36.97	4.62
4		Manght	9,992	2.22	15,845	79.23	9.90
5		Bairwala	2,998	2.22	4,754	23.77	2.97
6		Mangat	3,331	2.22	5,282	26.41	3.30
7		Rahmana Abad 10	2,664	2.22	4,225	21.13	2.64
8		Chak 11	3,997	2.22	6,338	31.69	3.96
9	Sheikhupura	Gurruanwala Gharbi	9,992	2.22	15,845	79.23	9.90
10		Keran	5,329	2.22	8,451	42.25	5.28
11		Khambianwals	2,664	2.22	4,225	21.13	2.64
12		4 Chak Risala	3,331	2.22	5,282	26.41	3.30
13		Chah Chando	2,664	2.22	4,225	21.13	2.64
14		Wara Ghulab Sing	7,993	2.22	12,676	63.38	7.92
15		Nawan Kot	13,322	2.22	21,127	105.64	13.20
UF PLANTS							
1	Kot Radha Kishan	Clarkabad	7,962	2.03	12,142	60.71	7.59
2	Pattoki	Tara Garh Chak 44	9,796	2.03	14,940	74.70	9.34
DIVISION LAHORE							
DISTRICT KASUR DIRECT SUPPLY							
1	Chunian	Gehlan Hithar	35,210	2.03	53,697	268.49	33.56
2		Jodh Singh	21,287	2.03	32,464	162.32	20.29
3		Talwandi	18,501	2.03	28,215	141.08	17.63
4		Ellahabad	15,995	2.03	24,393	121.97	15.25
5		Rosa Tiba	12,355	2.03	18,842	94.21	11.78
6		Maukal	10,192	2.03	15,543	77.72	9.71

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m ³ /D	m ³ /hr
			Nos.	(%)	Nos.	2041	2041
7		Saresar	9,492	2.03	14,476	72.38	9.05
8		Shaam Kot	9,142	2.03	13,942	69.71	8.71
9		Talwandi Adda	8,134	2.03	12,405	62.02	7.75
10		Chak 17	8,050	2.03	12,277	61.38	7.67
11		Kot Gama	6,594	2.03	10,056	50.28	6.29
12		Chak 18	4,270	2.03	6,512	32.56	4.07
13		Muft Pura	3,780	2.03	5,765	28.82	3.60
14		Gohar Chak No.8	3,129	2.03	4,772	23.86	2.98
15		Kot Lashkar	3,129	2.03	4,772	23.86	2.98
16		Attari Jeet Singh	3,122	2.03	4,761	23.81	2.98
1	Kasur	Dholan Hithar	12,460	2.03	19,002	95.01	11.88
2		Lukhney Key	10,731	2.03	16,365	81.83	10.23
3		Mandi Usman Wala	9,660	2.03	14,732	73.66	9.21
4		Atheel Pur	9,191	2.03	14,017	70.08	8.76
5		Maan	9,100	2.03	13,878	69.39	8.67
6		Rasool Pur	7,749	2.03	11,818	59.09	7.39
7		Naul Hithar & Hari Ke Naul	7,609	2.03	11,604	58.02	7.25
8		Nayyeke	7,133	2.03	10,878	54.39	6.80
9		Jaurra	6,531	2.03	9,960	49.80	6.23
10		Bhedian Kalan	6,356	2.03	9,693	48.47	6.06
11		Roshan Bheela	6,244	2.03	9,522	47.61	5.95
12		Rao Khan Wala	5,516	2.03	8,412	42.06	5.26
13		Nand Ka Takia	5,362	2.03	8,177	40.89	5.11
14		Mhalam Kalan	5,215	2.03	7,953	39.77	4.97
15		Sanda Chastana	5,201	2.03	7,932	39.66	4.96

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m ³ /D	m ³ /hr
			Nos.	(%)	Nos.	2041	2041
16		Khereper Hithar	5,187	2.03	7,910	39.55	4.94
17		Gohar Jagir	5,138	2.03	7,836	39.18	4.90
18		Said Pur	4,963	2.03	7,569	37.84	4.73
19		Kotli Ray AbuBaker	4,914	2.03	7,494	37.47	4.68
20		Theh Shaikham	4,816	2.03	7,345	36.72	4.59
21		Rasool Nager	4,774	2.03	7,281	36.40	4.55
22		Kaiser Gurh	4,718	2.03	7,195	35.98	4.50
23		Guggar	4,564	2.03	6,960	34.80	4.35
24		Noori Wala	4,557	2.03	6,950	34.75	4.34
25		Hussain Khan wala	4,193	2.03	6,395	31.97	4.00
26		Rajji Wala Arayan	4,137	2.03	6,309	31.55	3.94
27		Sheikh Ammad Kohna	4,046	2.03	6,170	30.85	3.86
28		Sheikh Pura Nau	4,046	2.03	6,170	30.85	3.86
29		Noor Pur Nehar	3,899	2.03	5,946	29.73	3.72
30		Patto Kalan	3,843	2.03	5,861	29.30	3.66
31		Bugri	3,696	2.03	5,637	28.18	3.52
32		Kelo Kalan	3,661	2.03	5,583	27.92	3.49
33		Bhadur Pura	3,647	2.03	5,562	27.81	3.48
34		Sanda Kalan	3,584	2.03	5,466	27.33	3.42
35		Chah Aror Sing	3,549	2.03	5,412	27.06	3.38
36		Khai Hithar	3,514	2.03	5,359	26.80	3.35
37		Today Pur	3,395	2.03	5,178	25.89	3.24
38		Bahmani Wala,	3,353	2.03	5,114	25.57	3.20
39		Salamat Pura	3,311	2.03	5,049	25.25	3.16

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
40		Daulay wala	2,926	2.03	4,462	22.31	2.79
41		Kacha Paka	2,919	2.03	4,452	22.26	2.78
42		Gohar Hithar	2,870	2.03	4,377	21.88	2.74
43		Ratnay Wala	2,695	2.03	4,110	20.55	2.57
1	Pattoki	Jumber Kalan & Khurd	13,986	2.03	21,329	106.65	13.33
2		Bheo Asal	13,006	2.03	19,835	99.17	12.40
3		Gehlan Chak 9	9,198	2.03	14,027	70.14	8.77
4		Lambay Jageer	7,420	2.03	11,316	56.58	7.07
5		Ghuman Kay	7,343	2.03	11,198	55.99	7.00
6		Dholan Chak 7	7,196	2.03	10,974	54.87	6.86
7		Ghandian Otari	6,790	2.03	10,355	51.78	6.47
8		Aulakh Bhonga	6,559	2.03	10,003	50.01	6.25
9		Kaween Blaka Singh	4,550	2.03	6,939	34.70	4.34
10		Chak#14	3,871	2.03	5,903	29.52	3.69
11		Cheela Chak No.49	2,975	2.03	4,537	22.69	2.84
DISTRICT LAHORE DIRECT SUPPLY							
1	Lahore City	R/W/S Niaz Baig	45,500	3.00	84,643	423.22	52.90
2		U/W/S/S Hanjarwal	21,266	3.00	39,561	197.81	24.73
3		R/W/S Gulshan colony	19,796	3.00	36,826	184.13	23.02
4		R/W/S Waris colony	17,220	3.00	32,034	160.17	20.02
5		R/W/S Shah Pur	14,343	3.00	26,682	133.41	16.68
6		Rural Water Supply Gopi Rai	9,814	3.00	18,257	91.28	11.41

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m³/D	m³/hr
			Nos.	(%)	Nos.	2041	2041
1	Model Town	R/W/S Yohanaabad	93,331	3.00	173,623	868.12	108.51
2		Rural Water Supply Pandoki	34,692	3.00	64,537	322.69	40.34
1	Shalimar	R/W/S Lakho Dhair	43,211	3.00	80,385	401.93	50.24
2		R/W/S Minhala	17,437	3.00	32,438	162.19	20.27
3		Sharifpura	14,966	3.00	27,841	139.21	17.40
4		R/W/S Padhana	11,165	3.00	20,770	103.85	12.98
1	Raiwind	R/W/S Raiwind	45,038	3.00	83,784	418.92	52.36
2		R/W/S Chung	42,917	3.00	79,838	399.19	49.90
3		Rural Water Supply Mohalanwal	37,982	3.00	70,658	353.29	44.16
4		Rural Water Supply Bath	21,042	3.00	39,144	195.72	24.47
5		Rural Water Supply Sundar	14,448	3.00	26,878	134.39	16.80
6		R/W/S Arrian	9,317	3.00	17,332	86.66	10.83
7		Rural Water Supply Mall	9,156	3.00	17,033	85.16	10.65
DISTRICT NANKANA SB DIRECT SUPPLY							
1	Nankana Sahib	More Khunda	14,952	1.38	19,939	99.69	12.46
2		Chak No 5 G.B	7,364	1.38	9,820	49.10	6.14
3		Nabi ur Peeran	7,049	1.38	9,400	47.00	5.87
4		Bara Ghar	5,327	1.38	7,104	35.52	4.44
5		Burkhudar	4,669	1.38	6,226	31.13	3.89
6		Massu	4,578	1.38	6,105	30.52	3.82
7		Chak No 6 G.B	4,249	1.38	5,666	28.33	3.54

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m³/D	m³/hr
				Nos.	(%)	Nos.	2041
8		Chak No.18GB	4,221	1.38	5,629	28.14	3.52
1	Sangla Hill	Choor Kotly 117 R.B	6,720	1.38	8,961	44.81	5.60
2		Chak No 46 R.B	4,445	1.38	5,927	29.64	3.70
3		Aliabad 112 R.B	3,381	1.38	4,509	22.54	2.82
1	Shah Kot	Dala Naggal	5,936	1.38	7,916	39.58	4.95
2		Chak No. 81RB	5,698	1.38	7,598	37.99	4.75
3		kot nizam din 184/RB	4,585	1.38	6,114	30.57	3.82
DISTRICT SHEIKHUPURA DIRECT SUPPLY							
1	Ferozewala	RWSS Khan pur Virkan	29,295	2.22	46,457	232.28	29.04
2		RWSS Amanpura & Shamke	7,770	2.22	12,322	61.61	7.70
3		RWSS Sakhum	7,560	2.22	11,989	59.94	7.49
4		RWSSKot pindi das	6,300	2.22	9,991	49.95	6.24
5		RWSS Javaid Nagar	5,600	2.22	8,881	44.40	5.55
6		RWSS Faiz Pur khurd	14,826	2.22	23,511	117.56	14.69
1	Muridke	Rural Water Supply Scheme Mano Abad	6,965	2.22	11,045	55.23	6.90
2		Rural Water Supply Scheme Dhakam pura	6,489	2.22	10,290	51.45	6.43
3		Rural Water Supply Scheme Kot Abdullah	4,403	2.22	6,982	34.91	4.36

PROVISION OF CLEAN DRINKING WATER BY PUNJAB AAB-E-PAK AUTHORITY (PHASE 1)- CENTRAL ZONE							
SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN LAHORE DIVISION							
DESIGN SHEET							
Sr. No.	Tehsil	Village/Mauza Name	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs operations
					2,041	m ³ /D	m ³ /hr
			Nos.	(%)	Nos.	2041	2041
4		RWSS Jandiala Kalsan	4,277	2.22	6,783	33.91	4.24
5	Shariq pur	Rural Water Supply Scheme Ghazi pur	5,565	2.22	8,825	44.13	5.52
1	Sheikhupura	Rural Water Supply Scheme Ferozwattoan	29,400	2.22	46,623	233.12	29.14
2		Rural Water Supply Scheme Jhabran	27,300	2.22	43,293	216.46	27.06
3		Rural Water Supply Scheme Kalohe	25,445	2.22	40,351	201.76	25.22
4		Rural Water Supply Scheme Sahoki Mallian	12,341	2.22	19,571	97.85	12.23
5		Rural Water Supply Scheme Mirza Virkan	10,780	2.22	17,095	85.48	10.68
6		Rural Water Supply Scheme 4 Chak Rasala	5,670	2.22	8,992	44.96	5.62

3.36 PROJECT DETAILS FOR SUPPLY, CONSTRUCTION AND INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN SAHIWAL DIVISION

The project will provide safe drinking water to the residents of Division Sahiwal. Markaz e Aab will be built in 113 villages where people will be able to get drinking water.

3.37 PROJECT LOCATION FOR SAHIWAL DIVISION

Sahiwal Division is one of the nine Divisions of Punjab province, Pakistan. In 2008, Sahiwal Division was reorganized into three districts: Sahiwal District, Okara District and Pakpattan District. In 1998, the population of Sahiwal was 6,271,247. Almost 28,956 acres of the division is forested.

The Project covers the 03 Districts of the Division Sahiwal which are mentioned below:

Districts	Area (km ²)	Population (2017)
District Sahiwal	3201	2,517,560
District Pakpattan	2898	1,823,687
District Okara	4377	3,039,139

Each District has population living in both rural and urban areas. The Project will cater to the rural areas under this project. Blown-up map of Sahiwal Division is shown below in **Figure 3-14** and is also attached as **Annexure III-C**.

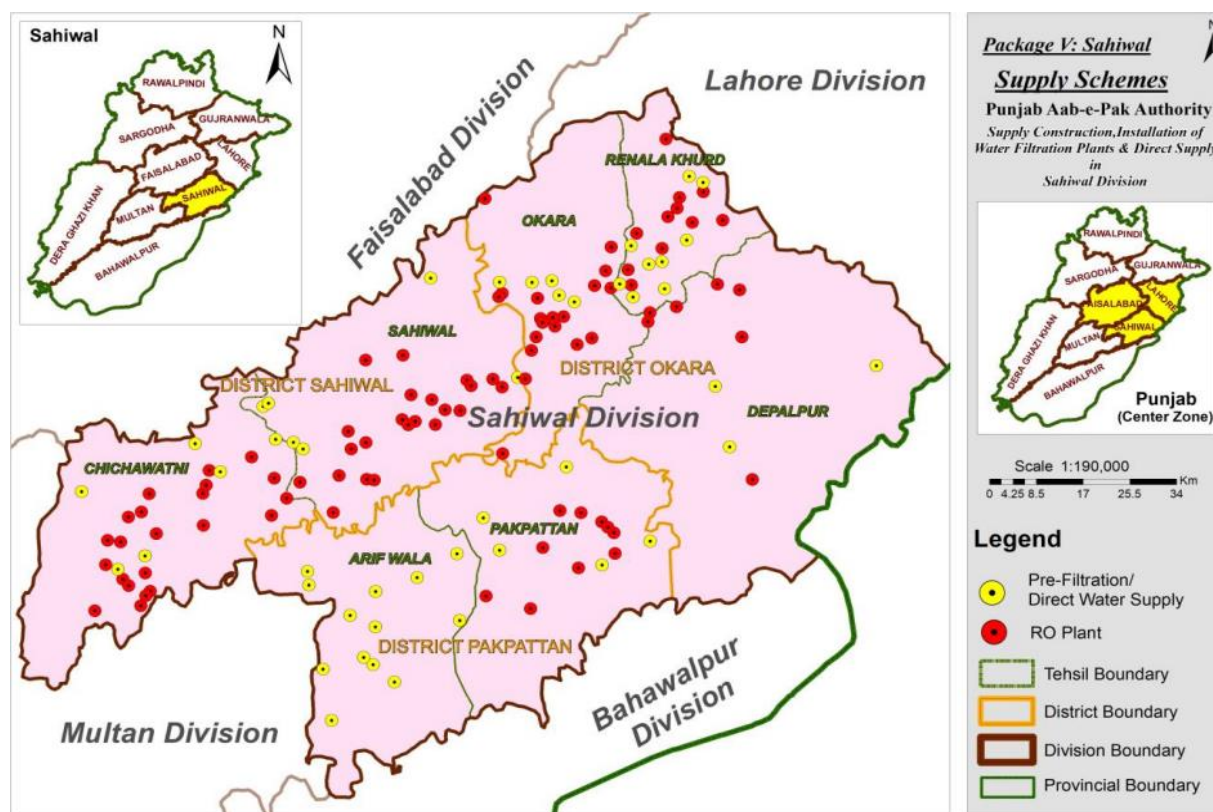


Figure 3-14: Map showing Division Sahiwal

3.38 DISTRICT WISE MAPS OF SAHIWAL DIVISION FOR INSTALLATION OF TREATMENT PLANTS

3.38.1 District Sahiwal

Sahiwal District, formerly known as Montgomery district, is a district in the Punjab province of Pakistan. In 2017, it had a population of 2,517,560 people, 16.27% of which were in urban areas. The city of Sahiwal is the capital of the district and the division.

The figure below shows the map of district Sahiwal with yellow and red points indicating the locations of Pre-Filtration/Direct Water Supply and RO plants respectively, in the district. **Figure 3-15.**

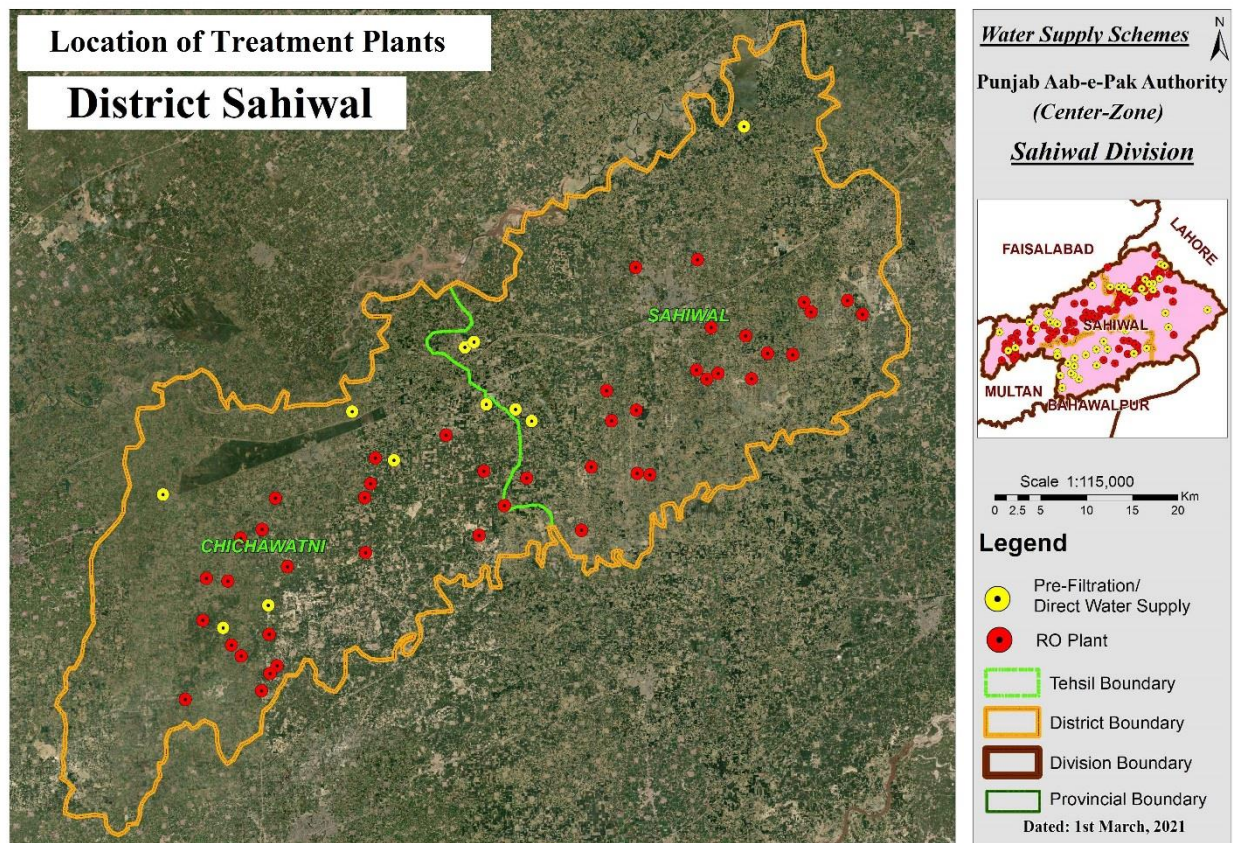


Figure 3-15: Map Showing District Sahiwal

3.38.2 District Pakpattan

Pakpattan is the hometown of Chisti's great saint, Baba Farid. "Ajodhan" was the original name of Pakpattan. After being used for the first time by Baba Farid Uddin Ganj Shakar, it was renamed Pakpattan. Pakpattan District is a district in Pakistan's Punjab province. Pakpattan is the district capital. According to the 2017 Pakistan census, it had a population of 1,823,687 people, 14% of whom were urban.

The figure below shows the map of district Pakpattan with yellow and red points indicating the locations of Pre-Filtration/Direct Supply and RO treatment plant respectively, in the district. **Figure 3-16:**

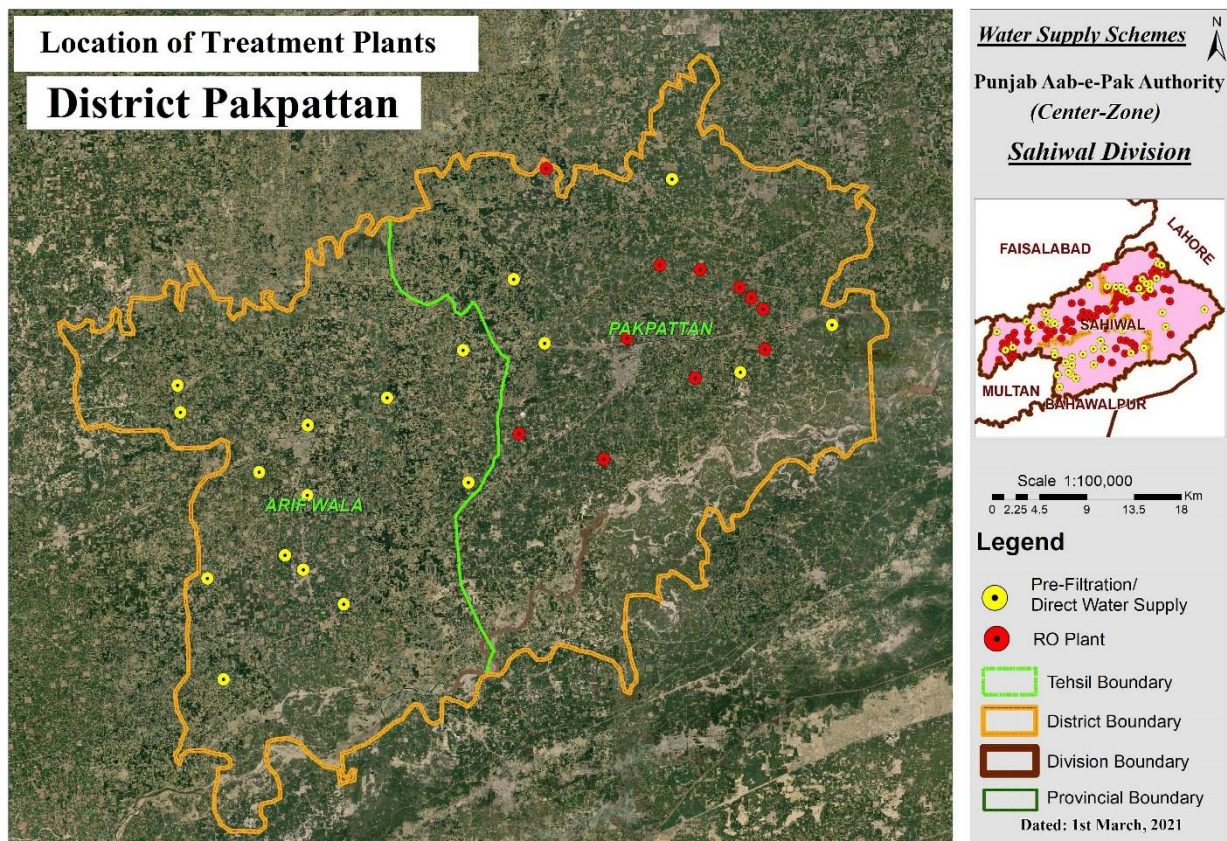


Figure 3-16: Map Showing District Pakpattan

3.38.3 District Okara

Okara is the capital of the Okara District in Pakistan's Punjab province. Okara is derived from the name Okaan, which is a type of tree. By population, it is Pakistan's 23rd largest city. And according to the 2017 census of Pakistan, it had a population of 3,039,139 people. The city is located southwest of Lahore, and Faisalabad is 100 kilometers away, bypassing the Ravi River. It is well-known for its cotton mills and agriculture-based economy.

The figure below shows the map of district Okara with yellow and red points indicating the locations of Pre-Filtration/Direct Supply and RO treatment plants respectively, in the district.

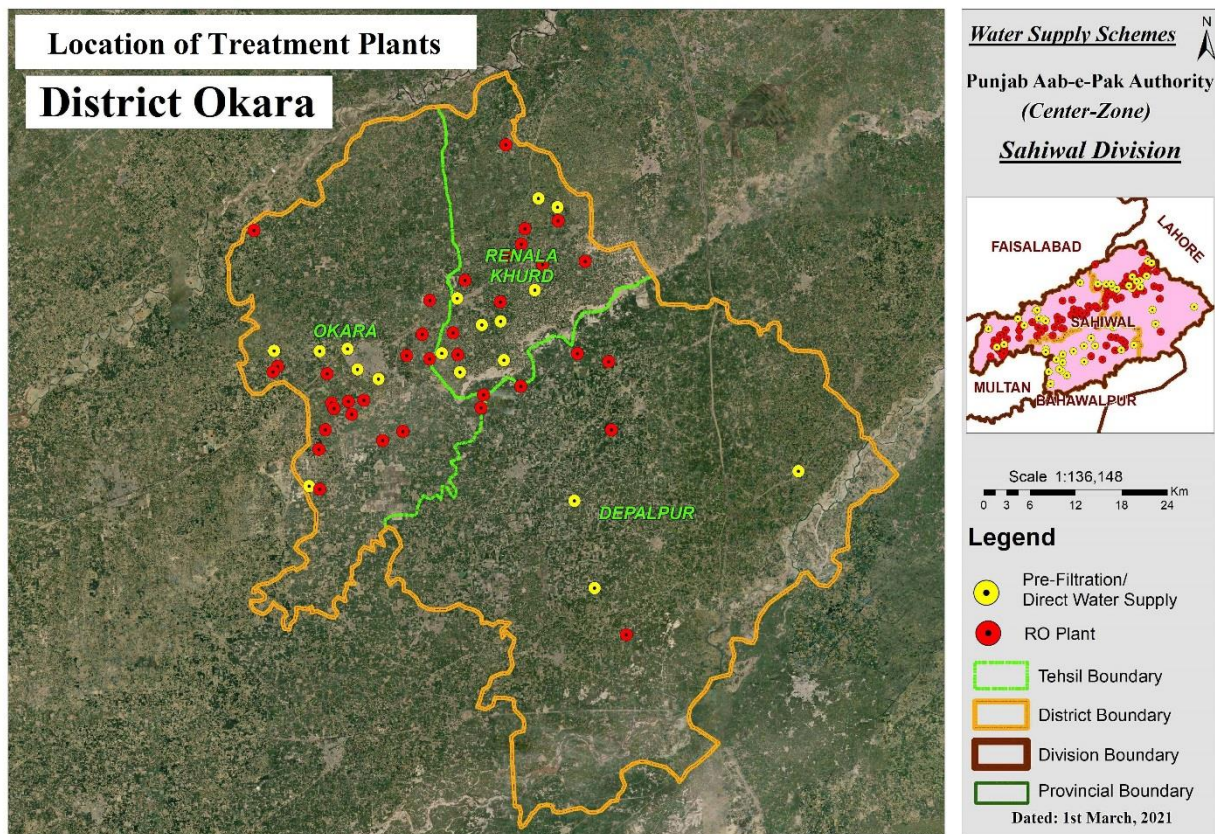


Figure 3-17: Map Showing District Okara

3.39 PROJECT SITE FEATURES (SAHIWAL): LAND USE, ROAD ACCESS, AND VEGETATION

Sahiwal Division is located at about 30.6 degrees north latitude and 73.1 degrees longitude in east central Pakistan in the Punjab region. It lies on the Pakistan national highway N-5 about halfway between Lahore and Multan. Sahiwal division is bordered by Faisalabad Division to the west; Lahore Division to the north; Bahawalpur Division and India to the east; and, Multan Division to south. Sahiwal division lies on the floodplain of two rivers. Ravi River lies to the west; and, Satluj River lies to the east. The dry Khushak Bias also passes through the Sahiwal Division, separating the Sahiwal District from the Pakpattan District. Almost 28,956 acres of the division is forested.

Sahiwal emerged as a major administrative and commercial town without a comprehensive plan. As a consequence, mixed land use is prevalent. From the oval shaped in the center of the town, roads diverge outwards towards residential and commercial areas that are largely mixed. Administrative buildings are situated even further at the fringes of the Old Town.

Out of the total area of Sahiwal, 55% of the area has good vehicular accessibility, and 20% is poor. As Sahiwal was originally a planned town, many of the roads are fairly wide and the transport infrastructure is generally adequate for existing requirements. No urban transport services are available except for motorcycles, rickshaws and auto rickshaws.

Most of the area of the Sahiwal Division is fertile with large forested trees. Vegetation area covered 87.07% of the total land area. Although, vegetation area has decreased between the years 1981 to 2021, there appears to be a negative change in vegetation. It was observed that during the 40 years, vegetation area and bare soil have changed to roads and build-up areas. Sahiwal is a major multi-crop area of Pakistan, and many pesticides companies do business here. Its main crops are wheat, cotton, sugarcane, maize, and rice. Main fruits are citrus, mangoes and guava. Sahiwal is growing day by day not only for vegetation growth but also for a large number of people from rural areas and further small urban areas.

3.40 SAFE DRINKING WATER SUPPLY STATUS IN SAHIWAL DIVISION

Groundwater is the sole source of portable water exploited in Sahiwal. Drinking water supply situation of Sahiwal is better as compared to the other cities. Groundwater of Sahiwal is good and is abstracted from the sandy deposits below 30 feet that vary from fine to coarser material having layers of calcareous kankar modified by limestone / sandstone weathering. The water table is present on average of 40-50ft below the ground level and upper level produce limited quantities of mineralized water. At depths of 450-500ft greater quantities of good quality ground water are available and this is where the city's supplies are delivered.

The water supply is based on groundwater and tube wells which are 46 in number. The water supply network covers 90% of the town and serves 90% of the total population.

The distribution system consists of 8 overhead reservoirs of 450,000 total capacity and the distribution is made of a looped network which is made of different types of materials including A.C, P.V.C, MS, and Duct Iron pipes. The sizes of the pipe vary from 3 to 12-inch diameter.

3.41 CHARACTERISTICS OF SELECTED AREA (SAHIWAL DIVISION)

During the first stage of Field surveys, water Samples have been collected from each village to reassure the quality of the water in all the Sahiwal Division. For validation of existing available data from the previous studies, the survey is conducted for water quality.

Water samples were collected from selected point by adopting proper sampling protocol and sent to the Laboratory for water quality analysis. For water testing the sampling data collection was carried out in one following selected location of this project "Aab-e-PAK" with mutual discussion and site visit of senior and junior environmentalist of consultant. **Green Engineering Consultant (GEC)** has carried out the "water analysis services for ECSP as per scope of work" under Punjab Aab-e-Pak Project to conform the standards & regulations. The methodology was comprised of these phases i.e., Sample Collection and Sample

Preservation, testing of water samples, preparation of monitoring & Analysis reports & Submission of Reports to ESCP.

Punjab Environmental Quality Standards PEQS for drinking water will be followed for ascertaining the quality of water for water quality standards. Treated water shall meet the water quality standards with mean concentrations at or below the maximum contaminant levels (MCL's). In order to check water quality of existing PHED borehole water in all the Districts of Sahiwal, Consultants suggested testing of following Water Quality Parameters in their Gap Analysis Report which was also concurred by PSPC during technical committee meeting & presentation. (Color, Odor, Taste, EC, pH, Turbidity, Alkalinity, Calcium, Chloride, Total Hardness, Nitrate, Potassium, Sodium, TDS, Chromium, Fluoride, Iron, Manganese, Arsenic, E-coli, Total Coliforms, COD).

The sample collection Team of **Green Engineering Consultant (GEC)** has collected the required drinking water sample from the selected points by adopting proper sampling protocol for appropriate measurement of water quality. The proper sampling criteria was adopted to cover the process of sampling, sampling size and volume, number of sampling locations, no of samples, type of sample, time interval, proper sampling containers, avoiding contamination and personal safety of collector. The sample obtained was also representative, reproducible, defensible and useful.

Water quality was monitored at one hundred and forty (**140**) selected locations to conduct a comparison of pollutants/contamination level with respective standards. One hundred and forty results show that the levels of parameters (TDS, Fluoride, Turbidity, Hardness, Arsenic, Nitrate & Microbial parameters) were out of limits of their respective standard. TDS and fluorides level were found very high in the tested water samples of Sahiwal Division. Main reason for these higher values is that, these water sources are contaminated and having high quality of soluble salts. Water analysis results show that the hardness, nitrates and microbiological parameters at some locations are within the limit of PEQS/WHO standards. Microbiological parameters testing results show that at some locations microbial contents are high because of contamination. Hence it was concluded from the analyzed results of collected water samples that this water is contaminated and not suitable for drinking use of public of Sahiwal Division. Installation and operation of water filtration plants is essential for provision of clean and healthy water for people of Sahiwal Division.

Detailed Water Quality Analysis lab reports are attached as an **Annexure IV-C**.

3.42 DESIGN SUMMARY FOR SAHIWAL DIVISION

The project will provide potable water to the people living in Sahiwal Division. Markaz- e-Aab will be constructed in 113 villages from where people can fetch the water for drinking purposes. Water supply schemes/Villages in Sahiwal Division supplied with drinking water are summarized below in **Table 3-7**.

Table 3-7: Design Summary for Sahiwal Division

Sr. No.	Type of Plant	No. of Plants
1	Direct Supply / Pre-filtration Plant (Chlorination, Sand & Activated Carbon Filter)	18
2	Direct Supply / Pre-filtration Plant (Chlorination, Sand & Activated Carbon Filter with arsenic removal filter)	01
3	Direct Supply / Pre-filtration Plant (Chlorination, Sand & Activated Carbon Filter with Fluoride removal filter)	01
4	Direct Supply / RO Plants	17
5	Pre-filtration Plant (Chlorination, Sand & Activated Carbon Filter) with Source development	24
6	Pre-filtration Plant with Plant (Chlorination, Sand & Activated Carbon Filter with Arsenic removal filter) with Source development	05
7	Pre-filtration Plant with Plant (Chlorination, Sand & Activated Carbon Filter with Fluoride removal filter) with Source development	02
8	Pre-filtration Plant with Plant (Chlorination, Sand & Activated Carbon Filter with Arsenic & Fluoride removal filter) with Source development	01
9	Reverse Osmosis with Source development	44
	Total	113

3.43 DETAILS OF PLANT LOCATIONS AT SAHIWAL DIVISION

Details of locations of treatment plants in the specified areas of Sahiwal Division is attached as table given below in **Table 3-8**:

Table 3-8: Details of Plant Locations at Sahiwal Division

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN SAHIWAL DIVISION				
DIVISION SAHIWAL				
S. No	Tehsil	Village	Recommendation	
			Type of Plant	Capacity
OKARA DISTRICT				
RO PLANTS				
1		23-D	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
2		Chak 18-D	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
3		Sodheke	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
4	Okara	Chak 28-4l	RO Plant	2 m3/hr
5		Chak 7-4l	RO Plant	2 m3/hr
6		Chak 29-4l	RO Plant	2 m3/hr
7		Chak 6-4l	RO Plant	2 m3/hr
8		Chak 10-4l	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
9		Chak 9-4l	RO Plant	2 m3/hr
10		Chak 23-4l	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
11		Chak 12-4l	RO Plant	2 m3/hr
12		Chak 44-2l	RO Plant	2 m3/hr
13		Chak 26-4l	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
14		Chak 47-3r	RO Plant	2 m3/hr
15		Chak 8-4l	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
16		Gogera Khas	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
17		Chak 34-2l	RO Plant	2 m3/hr
18	Renala Khurd	Chak 13 1l	RO Plant	2 m3/hr
19		Chak 15-1l	RO Plant	2 m3/hr
20		Chak 7-1al	RO Plant	2 m3/hr
21		Chak 21 Al	RO Plant	2 m3/hr
22		1/1-L	RO Plant	2 m3/hr
23		Chak 10-1al	RO Plant	2 m3/hr

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN SAHIWAL DIVISION				
DIVISION SAHIWAL				
S. No	Tehsil	Village	Recommendation	
			Type of Plant	Capacity
24		Chak 24-2l	RO Plant	2 m3/hr
25		Chak 9-1l	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
26		Chak 27 2l	RO Plant	2 m3/hr
27		Chak 23-1rb	RO Plant	2 m3/hr
28		Chak 5 Ra	RO Plant	2 m3/hr
29		L Plot (Lashariwala)	Sand Filter, Activated Carbon Filter, Arsenic and Fluoride Filter along with Chlorination	2 m3/hr
30		11/1-L	Sand Filter, Activated Carbon Filter, Fluoride Filter along with Chlorination	2 m3/hr
31		Chak 8-1al	RO Plant	2 m3/hr
UF PLANTS WITH FLOURIDE				
32	Renala Khurd	16/1-AL	RO Plant	2 m3/hr
33		5/1-AL	Sand Filter, Activated Carbon Filter, Fluoride Filter along with Chlorination	2 m3/hr
DISTRICT PAKPATTAN				
34	Pakpattan	Karampur Bhati	RO Plant	2 m3/hr
35		Chak 9sp	Sand Filter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2 m3/hr
36		Bari Rakh Pakpattan	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
37		72d Sayad Wala	Sand Filter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2 m3/hr
38		Chak 14sp	RO Plant	2 m3/hr
39		Chak 10sp	RO Plant	2 m3/hr
40		Chak 15sp	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
41		Tehi Jawand Sing	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
UF PLANTS				
42	Pakpattan	kani pur	RO Plant	2 m3/hr

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN SAHIWAL DIVISION				
DIVISION SAHIWAL				
S. No	Tehsil	Village	Recommendation	
			Type of Plant	Capacity
43		24sp	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
44		jora	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
DISTRICT SAHIWAL				
45	Chichawatni	51/12L	RO Plant	2 m3/hr
46		Chak No 58/12I	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
47		Chak No 87/12I	RO Plant	2 m3/hr
48		Chak No 57/12I	RO Plant	2 m3/hr
49		Chak No 56/12I	RO Plant	2 m3/hr
50		Chak No. 22/11I	RO Plant	2 m3/hr
51		Chak No 146/9I	RO Plant	2 m3/hr
52		10/11L	RO Plant	2 m3/hr
53		Chak No 46/12I	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
54		Chak No 11/11I	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
55		Chak No 159/9I	Sand Filter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2 m3/hr
56		Chak No 128/9I	RO Plant	2 m3/hr
57		Chak No 131/9I	RO Plant	2 m3/hr
58		Chak No 97/9I	Sand Filter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2 m3/hr
59		Chak No 61/5I (Baglana)	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
60		Chak No 153/9I	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
61		Chak No 94/9I	RO Plant	2 m3/hr
62		Chak No 49/5I	RO Plant	2 m3/hr
63		Chak No 105/9I	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
64		Chak No 59/5I	RO Plant	2 m3/hr

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN SAHIWAL DIVISION				
DIVISION SAHIWAL				
S. No	Tehsil	Village	Recommendation	
			Type of Plant	Capacity
65		Chak No 95/9I Mureed Kot	RO Plant	2 m3/hr
66		Chak No 116/9I	RO Plant	2 m3/hr
67		Chak No 117/9I (Kangniwala) (Ii)	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
68		Chak No 80/5I	RO Plant	2 m3/hr
69		Chak No 80/5r	RO Plant	2 m3/hr
70		Chak No 107/9I	RO Plant	2 m3/hr
71		Chak No 81/5I	Sand Filter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2 m3/hr
UF PLANTS WITH FLOURIDE				
72	Sahiwal	72/5 L	RO Plant	2 m3/hr
73		87/6 R	Sand Filter, Activated Carbon Filter, Fluoride Filter along with Chlorination	2 m3/hr
74		Chak No. 108/12 L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
75		Chak No. 160/9 L	RO Plant	2 m3/hr
76		Chak No. 56/A 12L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
DIVISION SAHIWAL				
DISTRICT OKARA				
DIRECT SUPPLY				
77	Depal pur	R/W/S/S Dharmywala	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
78		R/W/S/S Mandi Ahmadabad	RO Plant	2 m3/hr
79		R/W/S/S Qila Dewa Singh	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
80	okara	R/W/S/S 5/4-L	RO Plant	2 m3/hr
81		R/W/S/S 52/2-L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN SAHIWAL DIVISION				
DIVISION SAHIWAL				
S. No	Tehsil	Village	Recommendation	
			Type of Plant	Capacity
82	Renala Khurd	R/W/S/S 8,9/1L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
83		R/W/S/S 5,6/1-L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
84		R/W/S/S 18/1-L	RO Plant	2 m3/hr
85		R/W/S/S 14/1-L	Sand Filter, Activated Carbon Filter, Arsenic Filter along with Chlorination	2 m3/hr
DISTRICT PAKPATTAN				
86	Arifwala	Rural Water Supply Chak No.113/EB	RO Plant	2 m3/hr
87		Rural Water Supply Chak No.72/EB	RO Plant	2 m3/hr
88		Water Supply Scheme Chak Hama Rath	RO Plant	2 m3/hr
89		RWSS at Qaboola Town	RO Plant	2 m3/hr
90		Rural Water Supply Chak Shafi	RO Plant	2 m3/hr
91		Rural Water Supply 75/EB	RO Plant	2 m3/hr
92		Rural Water Supply Chak No.67/EB	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
93		Rural Water Supply Chak No.89/EB	RO Plant	2 m3/hr
94		Rural Water Supply 351/EB	RO Plant	2 m3/hr
95		Rural Water Supply Jewan Shah	RO Plant	2 m3/hr
96		Rural Water Supply Jamman Shah	RO Plant	2 m3/hr

SUPPLY CONSTRUCTION, INSTALLATION OF WATER FILTRATION PLANTS & DIRECT SUPPLY IN SAHIWAL DIVISION				
DIVISION SAHIWAL				
S. No	Tehsil	Village	Recommendation	
			Type of Plant	Capacity
97	Pakpattan	Water Supply Scheme Gobind Pur	RO Plant	2 m3/hr
98		Rural Water Supply Malka Hans.	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
99		Rural Water Supply Chak Kalyana	RO Plant	2 m3/hr
100		Rural Water Supply Chak No.32/SP	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
101		Rural Water Supply Pir Ghani	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
102		Rural Water Supply Ghulam Farid Maleka	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
DISTRICT SAHIWAL				
103	Chcicha Watni	RWWS 9/11L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
104		RWWS 110/7R	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
105		RWWS 54/12L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
106		RWWS 4/14L	RO Plant	2 m3/hr
107		RWWS 8/11L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
108		RWWS 88/12L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
109	Sahiwal	RWWS Harrapa	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
110		RWWS Noor Shah	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
111		RWWS 185/9L	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
112		RWWS 103/7R	Sand Filter, Activated Carbon Filter along with Chlorination	2 m3/hr
113		RWWS 142/9L	RO Plant	2 m3/hr

3.44 POPULATION PROJECTION & WATER DEMAND FOR SAHIWAL DIVISION

Table 3-9: Projected Population and Water Demand for Sahiwal Division

Population Projection and Water Demand for Sahiwal Division								
RO Plants								
Sr. No.	District	Tehsil	Village	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
						2,041	m3/D	m3/hr
						Nos.	2041	2041
1	Okara	Depalpur	23-D	3,161	1.63	4,439	22.20	2.77
2	Okara	Depalpur	Chak 18-D	3,604	1.63	5,061	25.31	3.16
3	Okara	Depalpur	Sodheke	2,108	1.63	2,960	14.80	1.85
4	Okara	Okara	Chak 28/4I	2,784	1.63	3,909	19.55	2.44
5	Okara	Okara	Chak 7-4I	4,347	1.63	6,104	30.52	3.82
6	Okara	Okara	Chak 29-4I	2,236	1.63	3,140	15.70	1.96
7	Okara	Okara	Chak 6-4I	8,522	1.63	11,967	59.84	7.48
8	Okara	Okara	Chak 10-4I	5,781	1.63	8,118	40.59	5.07
9	Okara	Okara	Chak 9-4I	3,846	1.63	5,401	27.00	3.38
10	Okara	Okara	Chak 23-4I	2,097	1.63	2,945	14.72	1.84
11	Okara	Okara	Chak 12-4I	4,885	1.63	6,860	34.30	4.29
12	Okara	Okara	Chak 44-2I	4,569	1.63	6,416	32.08	4.01
13	Okara	Okara	Chak 26-4I	4,493	1.63	6,310	31.55	3.94
14	Okara	Okara	Chak 47-3r	5,791	1.63	8,132	40.66	5.08
15	Okara	Okara	Chak 8-4I	2,051	1.63	2,880	14.40	1.80
16	Okara	Okara	Gogera Khas	12,279	1.63	17,243	86.22	10.78
17	Okara	Okara	Chak 34-2I	3,657	1.63	5,135	25.67	3.21
18	Okara	Renala Khurd	Chak 13 1I	4,153	1.63	5,832	29.16	3.65
19	Okara	Renala Khurd	Chak 15-1I	6,600	1.63	9,268	46.34	5.79
20	Okara	Renala Khurd	Chak 7-1al	5,886	1.63	8,265	41.33	5.17

Population Projection and Water Demand for Sahiwal Division								
RO Plants								
Sr. No.	District	Tehsil	Village	Populati on 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
						2,041	m3/D	m3/hr
						Nos.	2041	2041
21	Okara	Renala Khurd	Chak 21 Al	4,410	1.63	6,193	30.97	3.87
22	Okara	Renala Khurd	1/1-L	3,036	1.63	4,264	21.32	2.67
23	Okara	Renala Khurd	Chak 10-1al	6,849	1.63	9,619	48.09	6.01
24	Okara	Renala Khurd	Chak 24-2l	10,029	1.63	14,084	70.42	8.80
25	Okara	Renala Khurd	Chak 9-1l	5,549	1.63	7,792	38.96	4.87
26	Okara	Renala Khurd	Chak 27 2l	7,160	1.63	10,055	50.27	6.28
27	Okara	Renala Khurd	Chak 23-1rb	3,498	1.63	4,912	24.56	3.07
28	Okara	Renala Khurd	Chak 5 Ra	14,810	1.63	20,798	103.99	13.00
29	Okara	Renala Khurd	L Plot (Lashariwala)	12,302	1.63	17,276	86.38	10.80
30	Okara	Renala Khurd	11/1-L	4,982	1.63	6,997	34.98	4.37
31	Okara	Renala Khurd	Chak 8-1al	6,719	1.63	9,436	47.18	5.90
UF PLANTS								
32	Okara	Renala Khurd	16/1-AL	3,983	1.63	5,593	27.97	3.50
33	Okara	Renala Khurd	5/1-AL	5,553	1.63	7,798	38.99	4.87
34	Pakpattan	Pakpattan	Karampur Bhati	2,998	1.85	4,405	22.03	2.75
35	Pakpattan	Pakpattan	Chak 9sp	3,331	1.85	4,894	24.47	3.06
36	Pakpattan	Pakpattan	Bari Rakh Pakpattan	4,663	1.85	6,852	34.26	4.28
37	Pakpattan	Pakpattan	72d Sayad Wala	5,995	1.85	8,810	44.05	5.51
38	Pakpattan	Pakpattan	Chak 14sp	6,661	1.85	9,789	48.94	6.12
39	Pakpattan	Pakpattan	Chak 10sp	9,992	1.85	14,683	73.42	9.18

Population Projection and Water Demand for Sahiwal Division								
RO Plants								
Sr. No.	District	Tehsil	Village	Populati on 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
						2,041	m3/D	m3/hr
						Nos.	2041	2041
40	Pakpattan	Pakpattan	Chak 15sp	7,308	1.85	10,739	53.70	6.71
41	Pakpattan	Pakpattan	Tehi Jawand Sing	3,331	1.85	4,894	24.47	3.06
UF Plants								
42	Pakpattan	Pakpattan	kani pur	3,331	1.85	4,894	24.47	3.06
43	Pakpattan	Pakpattan	24sp	2,664	1.85	3,916	19.58	2.45
44	Pakpattan	Pakpattan	jora	2,998	1.85	4,405	22.03	2.75
District Sahiwal								
45	Sahiwal	Chichawatni	Chak 51/12I	5,348	1.65	7,541	37.70	4.71
46	Sahiwal	Chichawatni	Chak No 58/12I	5,095	1.65	7,184	35.92	4.49
47	Sahiwal	Chichawatni	Chak No 87/12I	5,608	1.65	7,908	39.54	4.94
48	Sahiwal	Chichawatni	Chak No 57/12I	5,318	1.65	7,499	37.50	4.69
49	Sahiwal	Chichawatni	Chak No 56/12I	3,624	1.65	5,110	25.55	3.19
50	Sahiwal	Chichawatni	Chak No. 22/11I	6,426	1.65	9,062	45.31	5.66
51	Sahiwal	Chichawatni	Chak No 146/9I	2,739	1.65	3,862	19.31	2.41
52	Sahiwal	Chichawatni	Chak No 10/11I	8,414	1.65	11,864	59.32	7.42
53	Sahiwal	Chichawatni	Chak No 46/12I	5,026	1.65	7,087	35.44	4.43
54	Sahiwal	Chichawatni	Chak No 11/11I	4,837	1.65	6,820	34.10	4.26
55	Sahiwal	Chichawatni	Chak No 159/9I	2,938	1.65	4,143	20.71	2.59
56	Sahiwal	Sahiwal	Chak No 128/9I	4,342	1.65	6,123	30.62	3.83
57	Sahiwal	Sahiwal	Chak No 131/9I	5,768	1.65	8,133	40.66	5.08

Population Projection and Water Demand for Sahiwal Division								
RO Plants								
Sr. No.	District	Tehsil	Village	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
						2,041	m3/D	m3/hr
						Nos.	2041	2041
58	Sahiwal	Sahiwal	Chak No 97/9I	2,679	1.65	3,777	18.89	2.36
59	Sahiwal	Sahiwal	Chak No 61/5I (Baglana)	5,857	1.65	8,259	41.30	5.16
60	Sahiwal	Sahiwal	Chak No 153/9I	5,699	1.65	8,036	40.18	5.02
61	Sahiwal	Sahiwal	Chak No 94/9I	4,175	1.65	5,887	29.44	3.68
62	Sahiwal	Sahiwal	Chak No 49/5I	2,725	1.65	3,842	19.21	2.40
63	Sahiwal	Sahiwal	Chak No 105/9I	3,900	1.65	5,500	27.50	3.44
64	Sahiwal	Sahiwal	Chak No 59/5I	3,127	1.65	4,410	22.05	2.76
65	Sahiwal	Sahiwal	Chak No 95/9I Mureed Kot	4,632	1.65	6,532	32.66	4.08
66	Sahiwal	Sahiwal	Chak No 116/9I	2,904	1.65	4,095	20.48	2.56
67	Sahiwal	Sahiwal	Chak No 117/9I (Kangniwala) (li)	4,739	1.65	6,683	33.42	4.18
68	Sahiwal	Sahiwal	Chak No 80/5I	3,002	1.65	4,234	21.17	2.65
69	Sahiwal	Sahiwal	Chak No 80/5r	6,205	1.65	8,750	43.75	5.47
70	Sahiwal	Sahiwal	Chak No 107/9I	4,231	1.65	5,966	29.83	3.73
71	Sahiwal	Sahiwal	Chak No 81/5I	2,333	1.65	3,290	16.45	2.06
72	Sahiwal	Sahiwal	72/5 L	4,653	1.65	6,561	32.81	4.10
73	Sahiwal	Sahiwal	87/6 R	6,615	1.65	9,328	46.64	5.83
74	Sahiwal	Chichawatni	Chak No. 108/12 L	7,440	1.65	10,491	52.46	6.56
75	Sahiwal	Chichawatni	Chak No. 160/9 L	3,992	1.65	5,629	28.15	3.52

Population Projection and Water Demand for Sahiwal Division								
RO Plants								
Sr. No.	District	Tehsil	Village	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
						2,041	m3/D	m3/hr
						Nos.	2041	2041
76	Sahiwal	Chichawatni	Chak No. 56/A 12L	3,455	1.65	4,872	24.36	3.04
Division Sahiwal								
Okara District								
Direct Supply								
Sr. No.	District	Tehsil	Name of Scheme					
77	Okara	Depalpur	R/W/S/S Dharmywalla	8,855	1.63	12,435	62.18	7.77
78	Okara	Depalpur	R/W/S/S Mandi Ahmadabad	22,659	1.63	31,820	159.10	19.89
79	Okara	Depalpur	R/W/S/S Qila Dewa Singh	5,600	1.63	7,864	39.32	4.92
80	Okara	Okara	R/W/S/S 5/4-L	19,733	1.63	27,711	138.56	17.32
81	Okara	Okara	R/W/S/S 52/2-L	7,917	1.63	11,118	55.59	6.95
82	Okara	Renala Khurd	R/W/S/S 8,9/1L	21,700	1.63	30,473	152.37	19.05
83	Okara	Renala Khurd	R/W/S/S 6/1-L	6,125	1.63	8,601	43.01	5.38
84	Okara	Renala Khurd	R/W/S/S 18/1-L	5,957	1.63	8,365	41.83	5.23
85	Okara	Renala Khurd	R/W/S/S 14/1-L	5,922	1.63	8,316	41.58	5.20
Pakpattan District								
86	Pakpattan	Arifwala	Rural Water Supply Chak No.113/EB	4,151	1.85	6,100	30.50	3.81
87	Pakpattan	Arifwala	Rural Water Supply	2,695	1.85	3,960	19.80	2.48

Population Projection and Water Demand for Sahiwal Division								
RO Plants								
Sr. No.	District	Tehsil	Village	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
						2,041	m3/D	m3/hr
						Nos.	2041	2041
			Chak No.72/EB					
88	Pakpattan	Arifwala	Water Supply Scheme Chak Hama Rath	1,624	1.85	2,387	11.93	1.49
89	Pakpattan	Arifwala	RWSS at Qaboola Town	19,068	1.85	28,021	140.11	17.51
90	Pakpattan	Arifwala	Rural Water Supply Chak Shafi	11,095	1.85	16,305	81.52	10.19
91	Pakpattan	Arifwala	Rural Water Supply 75/EB	6,790	1.85	9,978	49.89	6.24
92	Pakpattan	Arifwala	Rural Water Supply Chak No.67/EB	6,566	1.85	9,649	48.25	6.03
93	Pakpattan	Arifwala	Rural Water Supply Chak No.89/EB	6,090	1.85	8,950	44.75	5.59
94	Pakpattan	Arifwala	Rural Water Supply 351/EB	5,803	1.85	8,528	42.64	5.33
95	Pakpattan	Arifwala	Rural Water Supply Jewan Shah	5,516	1.85	8,106	40.53	5.07
96	Pakpattan	Arifwala	Rural Water Supply	5,516	1.85	8,106	40.53	5.07

Population Projection and Water Demand for Sahiwal Division								
RO Plants								
Sr. No.	District	Tehsil	Village	Populati on 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
						2,041	m3/D	m3/hr
						Nos.	2041	2041
			Jamman Shah					
97	Pakpattan	Pakpattan	Water Supply Scheme Gobind Pur	5,516	1.85	8,106	40.53	5.07
98	Pakpattan	Pakpattan	Rural Water Supply Malka Hans.	28,504	1.85	41,888	209.44	26.18
99	Pakpattan	Pakpattan	Rural Water Supply Chak Kalyana	12,705	1.85	18,671	93.35	11.67
100	Pakpattan	Pakpattan	Rural Water Supply Chak No.32/SP	5,460	1.85	8,024	40.12	5.01
101	Pakpattan	Pakpattan	Rural Water Supply Pir Ghani	4,592	1.85	6,748	33.74	4.22
102	Pakpattan	Pakpattan	Rural Water Supply Ghulam Farid Maleka	4,494	1.85	6,604	33.02	4.13
Sahiwal District								
103	Sahiwal	Chcichawatni	RWWS 9/11L	9,968	1.65	14,056	70.28	8.79
104	Sahiwal	Chcichawatni	RWWS 110/7R	9,450	1.65	13,326	66.63	8.33
105	Sahiwal	Chcichawatni	RWWS 54/12L	8,050	1.65	11,351	56.76	7.09
106	Sahiwal	Chcichawatni	RWWS 4/14L	6,867	1.65	9,683	48.42	6.05

Population Projection and Water Demand for Sahiwal Division								
RO Plants								
Sr. No.	District	Tehsil	Village	Population 2020	Growth Rate	Projected population	Water Demand per day @ 5 lpcd	Water Demand @ 8 hrs. operations
						2,041	m3/D	m3/hr
						Nos.	2041	2041
107	Sahiwal	Chcichawatni	RWWS 8/11L	6,181	1.65	8,716	43.58	5.45
108	Sahiwal	Chcichawatni	RWWS 88/12L	5,600	1.65	7,897	39.48	4.94
109	Sahiwal	Sahiwal	RWWS Harrapa	15,610	1.65	22,012	110.06	13.76
110	Sahiwal	Sahiwal	RWWS Noor Shah	11,312	1.65	15,951	79.76	9.97
111	Sahiwal	Sahiwal	RWWS 185/9L	7,651	1.65	10,789	53.94	6.74
112	Sahiwal	Sahiwal	RWWS 103/7R	5,992	1.65	8,449	42.25	5.28
113	Sahiwal	Sahiwal	RWWS 142/9L	5,425	1.65	7,650	38.25	4.78

3.45 TREATMENT OPTIONS FOR THE PROVISION OF SAFE DRINKING WATER SUPPLY IN THE DIVISIONS (FAISALABAD, LAHORE, SAHIWAL)

As the treatment is based on the quality of the source of water being used/delivered to the respective areas of the divisions. Hence, different types of treatment solutions are proposed considering the quality of the source of water and the treatment capacity of the type of plant to remove contaminants from the drinking water.

3.46 SELECTION OF PLANTS

Water quality of ground water will be analyzed by taking water samples from each site. TDS and other contaminants like Arsenic, Fluoride, Nitrates, bacterial etc. of each sample will be checked by the consultant and based on measured data along with the population statistics; the plant with appropriate treatment technology will be selected and installed at the identified villages.

3.47 SELECTION CRITERIA FOR PLANTS

The type of plant for a specific area is selected based on different factors like TDS of ground water, Contamination level, quality of existing water supply schemes and population of the area.

Considering the above stated factors, most suitable option for the desired area of population will be opted. **Table 3-10.**

Table 3-10: Selection Criteria for Plants

Type of Plant	Criteria
RO Plant	• Groundwater TDS>1000 mg/l • Groundwater TDS>1000 mg/l with other contaminants like Arsenic, Iron, Fluoride or Nitrate. • Significant Population
UF / PF Plant	• TDS < 1000 ppm • Other contaminants like colloids, bacteria, viruses etc. • Significant Population
UF / PF with Additional Filters	• TDS < 1000 ppm • Other contaminants like colloids, bacteria, viruses etc. • Other contaminants like Arsenic, Iron, Fluoride or Nitrate. • Significant Population
Conventional	• Groundwater TDS>>1000 mg/l with other contaminants like Arsenic, Iron, Fluoride or Nitrate. • Existing Bores along canals • Significant Population
SWTP	• Groundwater TDS>>1000 mg/l with other contaminants like Arsenic, Iron, Fluoride or Nitrate • Medium population range (from 4000 to 200,000)
Hand pump	• Water with organic contamination in Tribal/Remote/Scattered settlements (population size≤ 800)
Direct Supply to Markaz-e-Aab	• Sweet water zone • Existing water supply Schemes with possible contamination

3.48 SIZE AND LOCATION OF PLANTS

The size of the plant has been selected based on the population that plant could serve as per the Feasibility Study. As per the decision of the Governing body of the PAPA the villages having significant population have been selected. To provide maximum villages with drinking water facility plant size of 2000litre/hour RO & UF has been selected except for plants of 1000 liters/hr. and 500litre/hr. for tribal areas. Remaining plants have also been selected based on population to be served in respective areas.

In accordance with the criteria listed in the Feasibility Study, consultants and the Divisional & District Advisory Committees will make recommendations for plant locations. The data from the HUD & PHE Department served as the foundation for the short list of villages. In each district of Punjab, the areas with no existing infrastructure, high TDS and pollutants, and a sizable population were given priority during the project's initial phase.

3.49 SELECTION CRITERIA OF SITES FOR RO AND UF/PF PLANTS

Priorities have been given to brackish areas of Punjab. Reverse osmosis plants will be installed in the villages having TDS in ground water more than 1000mg/l as per WHO guidelines/Punjab Environmental quality standards for drinking water and population more than 2000 in 2020 (Projected population). UF will be installed if TDS less than 1000 and some other contaminants. UF with additional filter for Arsenic, Fluoride or Nitrates will be installed in case of any access value from WHO guidelines. UF Hand pump will be installed for population of 500 and source water (stream, pond).

3.50 SELECTION CRITERIA OF SITES FOR DIRECT SUPPLY FOR VILLAGES

Direct water supply will be installed only in sweet water areas of Punjab. Water supply lines from water source to the village will be laid and disinfected water will be provided through Aab-e-Pak Markaz having prefabricated room with storage tank and water taps.

3.51 DESIGN HORIZON

Design Horizon of all the drinking water facilities in all the divisions of Central Zone of Punjab i.e. Faisalabad, Lahore Sahiwal will be for the next 20 years i.e. for the year 2041.

3.52 MARKAZ-E-AABS

The main component of the project, Markaz-e-Aab, also called as Sahulat Centers, is where the locals of the area will go to receive clean water. In order to make it as easy as possible for individuals to take advantage of the facility, Markaz-e-Aabs have been designed in a special way. The most important thing about the Markaz-e-Aab is 24/7 access to drinking facility. Markaz e Aab is further classified for the prohibited area where the administration staff will be available to handle and manage the equipment and process and query any concerns of people related to facility or water.



3.52.1 Community Welfare & Support

All the human resource for Markaz-e-Aab will be hired from the local village where the Markaz-e-Aab will be established. A local villager having a bachelor's degree in science will be hired with proper training to handle the Markaz E Aab operations. This will serve as community support and assist us in securing the goodwill of the residents of the village.

3.53 OPERATION AND MAINTENANCE

A proper setup would be proposed consisting of engineers, sub-engineers, technical staff such as electricians, mechanics, plant operators, etc. for efficient operation and maintenance of the water supply system, which includes tube wells, water treatment plants, intermediate pumping stations, transmission mains and distribution network. Each part of the water delivery system will have clearly defined operational responsibilities for the staff.

For the appropriate maintenance of installed machinery at diverse facilities, maintenance schedules will be provided. It will provide instructions for routine maintenance as well as in the event of an emergency breakdown.

3.54 GENERAL DESIGN CRITERIA OF THE PROJECT

Provision of potable water to all rural population is a huge task that may be completed in phases. 1st Phase may be based upon urgent needs and relatively lesser time-consuming treatment facilities can be installed in highly brackish areas on priority basis.

Main points of design criteria are given in following **Table 3-11**.

Table 3-11: Design Criteria for the Project (based on WHO Guidelines 2017)

Sr. No.	Item Description	Value
1	Design period	20 years (2020-2040)
2	Drinking water to be delivered through Membrane filtration plants (WHO)	5 L/c/d
3	Drinking water (bulk supply) to be delivered through conventional/surface water treatment plants (Rapid sand filters) (WHO)	20L/c/d
4	Type of construction contract	EPC/BOQ
5	Drinking water standards	WHO Guidelines for Drinking Water Quality /Punjab Environmental Quality Standards for Drinking Water. Pakistan Standards for Bottled Drinking Water.
6	Water Supply Duration	8 Hours
7	Energy source	Mainly grid will be used. Solar Power if electricity is not available.

Most of the drinking water supply schemes may be developed using localized and customized solutions, regarding sources and supply options and sustainable O&M models. The quality of existing water sources, availability of infrastructure, population densities and level of community participation would determine the option.

3.55 MEMBRANE FILTRATION APPROACH

This type of treatment approach is used in the Divisions of **Faisalabad, Lahore and Sahiwal**. Under this option site-specific solution may be considered. Water quality of ground water will be analyzed by taking ground water samples from each village. Samples may be collected from hand pumps and/or existing tube wells located at close vicinity of the proposed Standalone plant. Plant type (RO and UF/ PF) will be decided according to ground water quality. General Design Criteria for RO and UF/PF is given below in the **Table 3-12**.

Table 3-12: General Design Criteria for RO and UF/PF

Parameter	Design Criteria
Location of Treatment Plant	Near source of water (Tube well)
Design Capacity	5 l/c/d
Water Source	
Source of water	Ground water
Operation Hours	4 hours (Minimum) - 8 hours (Maximum)
Type of Pump	Any type for the tube wells
Manned/Unmanned Operation	Manned Operation of pump and plant
Raw Water Storage Tank	
Capacity of Tank	1-2 hour of design flow rate
Population estimation	2017 census using geometric method for future projection covering 20 years design
Water Quality	
Water Quality	As per WHO guidelines for Drinking Water Quality (2017) /Punjab Environmental Quality Standards for Drinking Water (2016)
Control of Plant	Automated/ PLC Enabled
Backwash Mechanism for Membrane Filtration/ Sand Filter/ Activated Carbon and Other Filters	Automated
Treated Water Reservoir	
Capacity of Tank	8 hours of design capacity
Disinfection	
Type	Chlorination
Chemical	Sodium Hypochlorite
Energy	
Energy Source	Primary source is the Grid; Where grid energy not available, Solar Power will be used as a primary source.
Generator	Not Required
Monitoring and Control	
Monitoring Mechanism	Automated with manned supervision; SCADA with centralized supervision

3.56 WORKING OF PRE-FILTRATION PLANT

Prefiltration involves the use of a filter designed to remove particulate matter (dirt, sediment, etc.) from water. Filtration shall be carried out by pressure sand filters. The

filters are designed such that normal filtration rate shall not exceed (15 m³/h with all filters in operation). This velocity based on special filtration media silica sand. However; the filter outlet should have a wide range of opening. The purpose of the filter is to remove suspended solid matter from the clarifier treated water when operating on a downward constant flow principle.

3.56.1 Schematic Diagram of a UF/PF

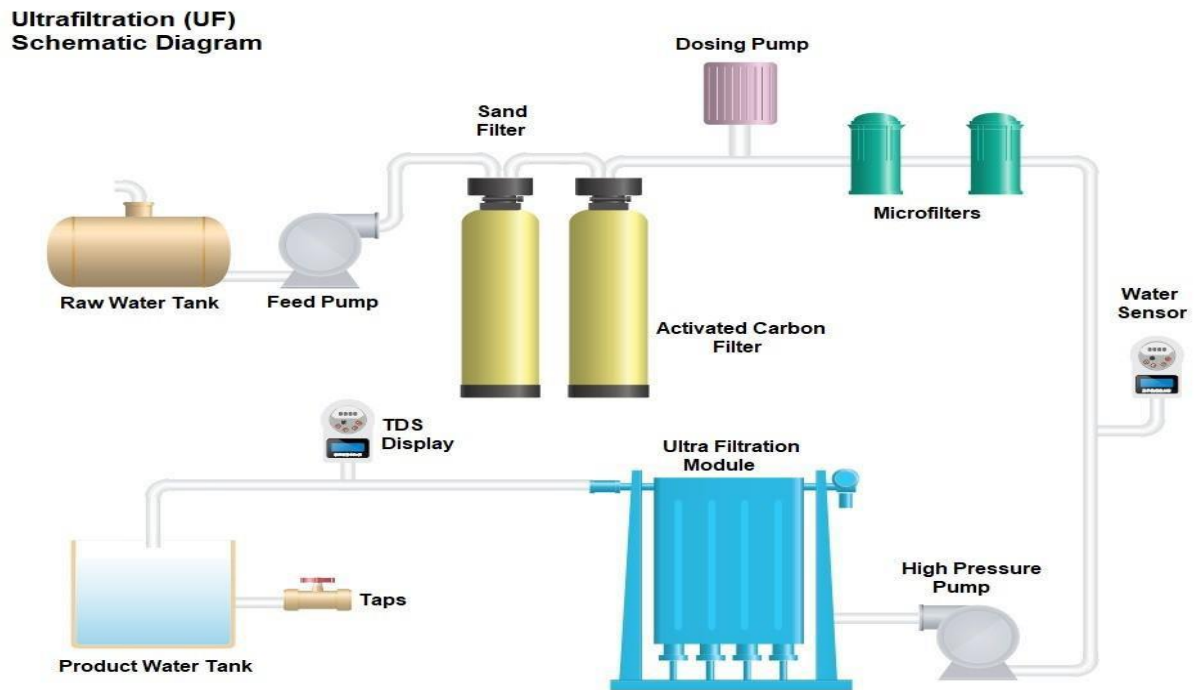


Figure 3-18: Schematic of typical UF/PF

3.56.2 Process Flow Scheme for Pre-Filtration

Process flow scheme suggested for the Pre-Filtration plants is shown below in Figure 3-19.

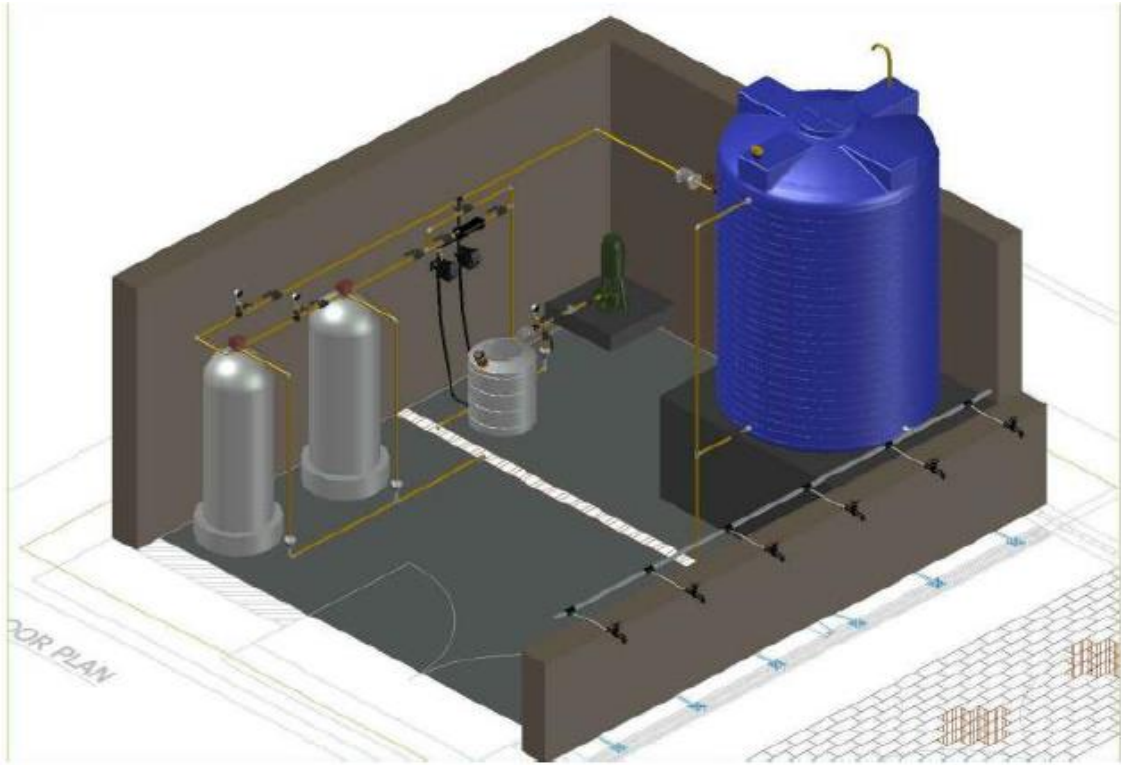


Figure 3-19: Process Flow Scheme for Pre-Filtration

3.56.3 Assumed Influent Characteristics for a UF / PF Plant

Table 3-13: Assumed Influent Characteristics

Parameters	Values	Units
pH	6.5~8.5	-
Temperature	20~25	C
Turbidity	<10	NTU
TDS	<800	mg/l
Arsenic	<0.01	mg/l
Chromium	<0.05	mg/l
Fluoride	<1.5	mg/l
Nitrate	<50	mg/l
TOC	<2	mg/l
Coliform	<500	cfu/100ml

3.56.4 Typical Calculations of Ultra Filtration / Pre-Filtration Plant (2000 L/h)

Table 3-14: Design Calculations of UF/PF Plant (2000 L/h)

Parameters	Values	Units
Flow Rate	2	m3/hr
Plant Operational time	8	h/d
Daily Flow Rate	16	m3/day
Sand Filter		
FILTER DESIGN		
Flow Rate	2	m3/hr
Velocity	15	m3/hr. m2
Area of the bed	0.136	m2
Dia of the bed	417	mm
Bed Depth From EBCT	3-5 minutes	min
Volume of the Media	0.09	m3
BACKWASH		
Backwash flow rate	39	m3/hr. m2
Free Board Area of total	50	%
Total Height of the Vessel	1.65	m
HEAD LOSS DURING SERVICE FLOW DOWNWARD FILTER		
Service Flow rate	6	GPM/ft2
Pressure Drop	0.29	Psi/ft of bed depth
Safety Factor	15	%
Pressure Drop through media	1.337	Psi
Sizes		
Dia (say)	18	inches
Height (say)	65	inches
Chlorine day Tank & Pump		
Dosing rate	02 + 03	ppm
Flow rate of water	2	m3/hr
Consumption of chlorine per liter	.005	ml/liter
Consumption per hour	10	ml/hr
Consumption per day	80	ml/day
Product Water Storage Tank		
Plant flowrate	2	m3/hr
HRT	2	hr
Volume of Raw water storage tank	2	m3/hr
Material	PE	
ACTIVATED CARBON FILTER		
ACTIVATED CARBON FILTER DESIGN		
Flow Rate	02	m3/hr

Parameters	Values	Units
Velocity	12	m3/hr. m2
Area of the bed	0.164	m2
Dia of the bed	457	mm
Bed Depth From EBCT	5	min
Volume of the Media	0.15	m3
BACKWASH		
Backwash flow rate	39	m3/hr. m2
Free Board Area of total	50	%
Total Height of the Vessel	65	Inches
HEAD LOSS DURING SERVICE FLOW DOWNWARD FILTER		
Service Flow rate	6	GPM/ft2
Pressure Drop	0.29	Psi/ft of bed depth
Safety Factor	15	%
Pressure Drop through media	1.337	Psi
Sizes		
Dia (say)	18	inches
Height (say)	65	inches

3.57 WORKING OF A RO (REVERSE OSMOSIS) PLANT

Reverse osmosis is the finest level of filtration available. The RO membrane acts as a barrier to all dissolved salts and inorganic molecules, as well as organic molecules. Water molecules, on the other hand, pass freely through the membrane creating a purified product stream. With a high- pressure pump, pressurized saline feed water is continuously pumped to the module system. Within the module, consisting of a pressure vessel (housing) and membrane elements, the feed water will be split into a low saline product, called permeate and a high saline brine, called concentrate or reject. A flow regulating valve, called concentrate valve, controls the percentage of feed water that is going to the concentrate stream, and permeate which will be obtained from the feed.

Two-Stage RO System

It is recommended by the water treatment designer to use Two-stage Type RO systems for RO plants. This type of Two Stage RO is an advanced form of typical one stage RO plants. In a two stage RO system, the concentrate from the first stage becomes the feed water to the second stage. The permeate water that is collected from the first stage is combined with the permeate from the second stages. Additional stages increase the recovery of the system.

A “pass” shall be seen as a standalone RO system. The difference between a single pass RO system and a double pass RO system is that with a double pass RO, the permeate from the first pass becomes the feed water to the second pass (or second RO) which ends up producing a much higher quality permeate because it has essentially gone through two RO systems. Typical diagram of a 2-Stage RO System is shown below in the **Figure 3-20**:

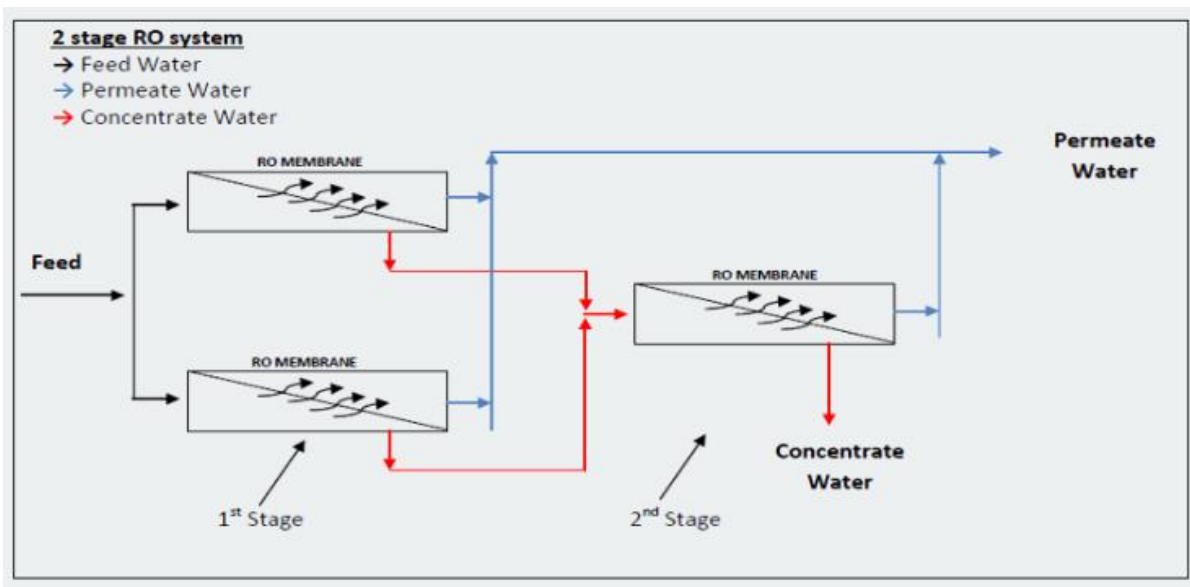


Figure 3-20: Working of Two-Stage RO System

3.57.1 Assumed Influent Characteristics for a RO Plant

Typical assumed characteristics for the design of RO plants are given in following Table 3-15:

Table 3-15: Characteristics of Influent of RO Plant

Parameters	Values	Units
pH	6 ~ 8.5	—
Temperature	20 ~ 25	C
Turbidity	<10	NTU
TDS for RO Plant Type 1	>1000 and <5000	mg/l
TDS for RO Plant Type 2	>5000 and 10000	mg/l
TOC	<2	mg/l
Coliform	<500	cfu/10

3.57.2 Schematic Diagram of Standalone RO Plant

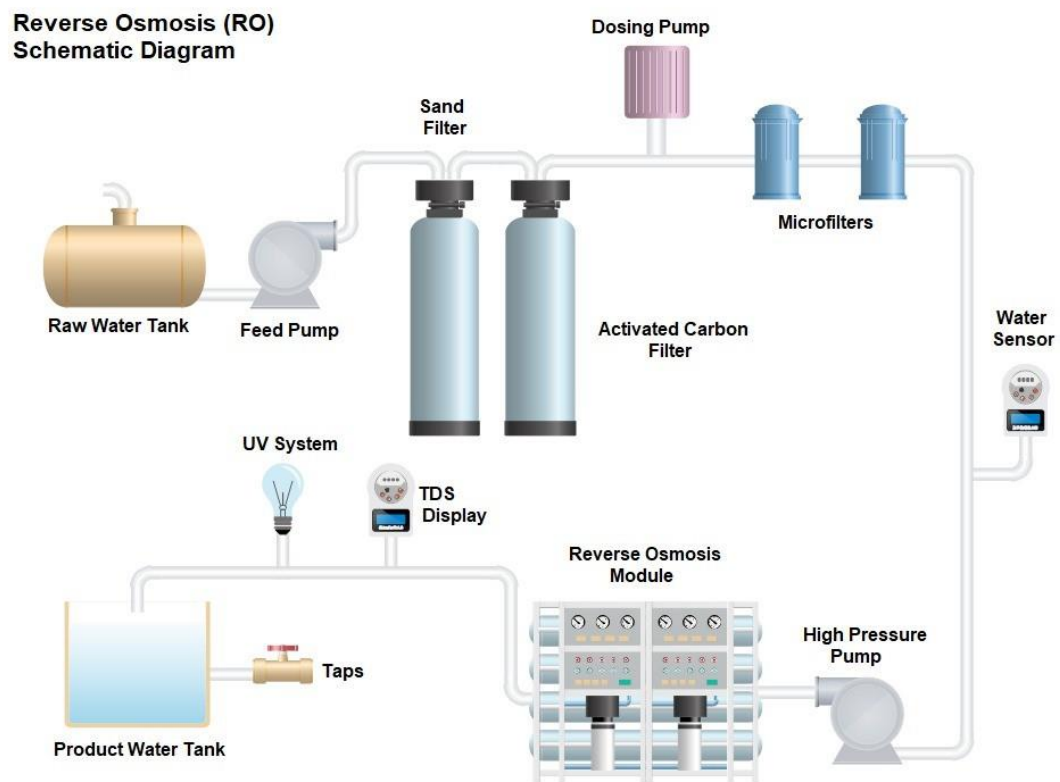


Figure 3-21: Flow diagram of standalone RO plant

3.57.3 Process Flow Scheme for RO Plant

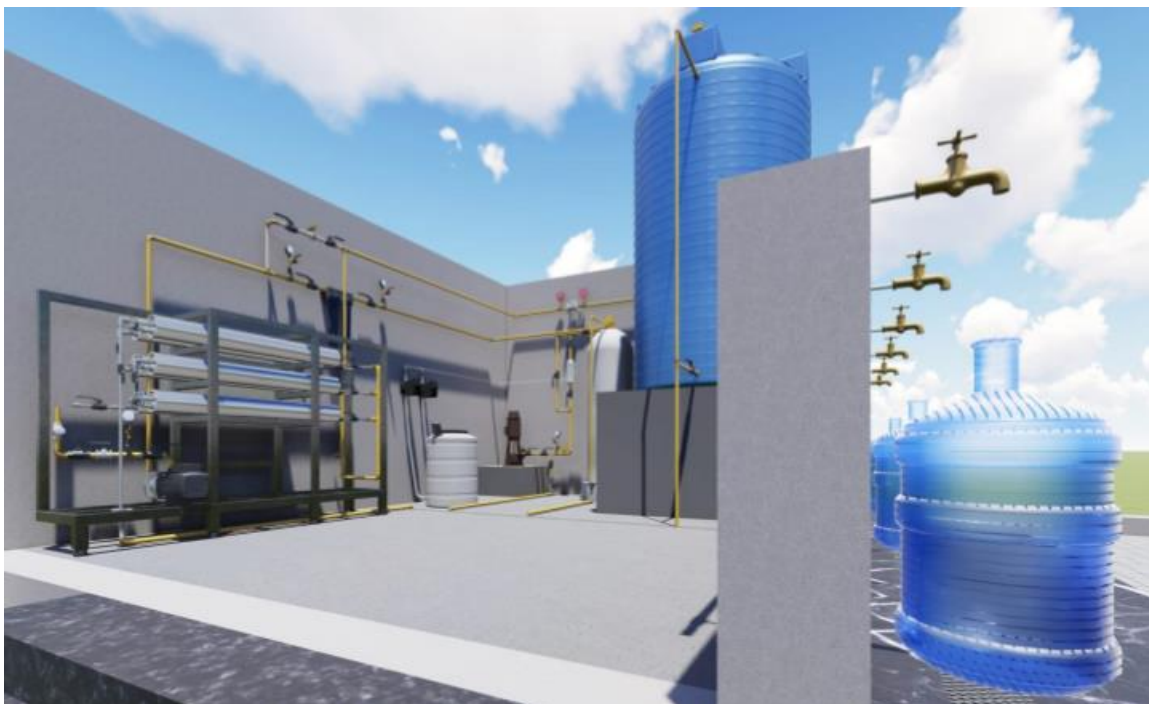


Figure 3-22: Process Flow Scheme for RO Plant

3.57.4 Typical Calculations of RO plant 2000 L/h

Table 3-16: Design Calculation of RO Plant

Parameters	Values	Units
Flow Rate	2	m3/hr
RO plant recovery	50-60	%
Feed Flowrate	4	m3/hr
Tube well /Pump		
Flowrate for RO	4	m3/Day
Assumed depth of water	150-300	ft
Total power required	1.25-2.5	KW
High Pressure Feed Pump		
Flowrate	Max-04	m3/hr
Feed pump flowrate with 10% safety margin	4.4	m3/hr
Control	VFD	
Pressure	>12	Bar(g)
Sand FILTER		
FILTER DESIGN		
Flow Rate	4	m3/hr
Velocity	15	m3/hr. m2
Area of the bed	0.136	m2
Dia of the bed	417	mm
Bed Depth From EBCT	3-5 minutes	min
Volume of the Media	0.17	m3
Backwash flow rate	39	m3/hr. m2
Free Board Area of total	50	%
Total Height of the Vessel	1.65	m
HEAD LOSS DURING SERVICE FLOW DOWNWARD FILTER		
Service Flow rate	6	GPM/ft2
Pressure Drop	0.29	Psi/ft of bed depth
Safety Factor	15	%
Pressure Drop through media	1.337	Psi
SIZES		
Dia (say)	24	inches
Height (say)	72	inches
Anti Scalent Tank		

Parameters	Values	Units
Dosing rate	5	ppm
Flow rate of water	4	m3/hr
Consumption of Anti Scalent per liter	0.005	ml/liter
Consumption per hour	20	mg/hr
Consumption per day	160	mg/day
Product Water Storage Tank		
Plant flowrate	2	m3/hr
HRT	2	hr
Volume of Raw water storage tank	2	m3/hr
Material	PE	
ACTIVATED CARBON FILTER		
ACTIVATED CARBON FILTER DESIGN		
Flow Rate	4	m3/hr
Velocity	Dec-15	m3/hr. m2
Dia of the bed	646	mm
Bed Depth From EBCT	04-May	min
Volume of the Media	0.24	m3
Backwash flow rate	30	m3/hr. m2
Free Board Area of total	50	%
Total Height of the Vessel	65	Inches
HEAD LOSS DURING SERVICE FLOW DOWNWARD FILTER		
Service Flow rate	5	GPM/ft2
Safety Factor	15	%
Pressure Drop through media	0.9	Psi
SIZES		
Dia (say)	24	inches
Height (say)	72	inches

3.58 SELECTION OF MOST SUITABLE OPTIONS

The most suitable options are provided as a list along with the locations of treatment plants in the project description of each division where treatment plants are being installed. The options selected are most suitable, environmentally sound and economically viable.

3.59 COST AND MAGNITUDE OF OPERATION

The total cost of the Project for each Division i.e. Faisalabad, Lahore and Sahiwal contain Supply, Construction, Installation of Water Filtration Plants and Direct Supply including with

Contingencies & Petty Charges, PRA Charges, Resident Supervision, Design Charges, and Media Campaign, New Electric Connection Charges, and O&M charges for 1 Year. The costs of the site facilities shall be deemed to be included in the corresponding in the Bill of Quantities (BOQ). The Contractor shall bear all the cost for completion of a satisfactory Operational and Performance Test including all power and water supply. Similarly, all costs of repairs shall be part of the Contractors annual remuneration. Details of Project cost for Faisalabad, Lahore and Sahiwal is given below.

Table 3-17: Cost Estimates for Faisalabad, Lahore and Sahiwal Division

Sub Head	GENERAL ABSTRACT OF COST	Amount (Rs.) in million
1	Supply, Construction, Installation of Water Filtration Plants and Direct Supply in Faisalabad Division + Other Related Charges	419.608
2	Supply, Construction, Installation of Water Filtration Plants and Direct Supply in Lahore Division + Other Related Charges	347.936
3	Supply, Construction, Installation of Water Filtration Plants and Direct Supply in Sahiwal Division + Other Related Charges	305.329
	Total Cost of the Project for Central Zone of Punjab (Faisalabad, Lahore, Sahiwal) with its Districts	1072.83

3.60 PROJECT DETAILS FOR SUPPLY, INSTALLATION & CONSTRUCTION OF SURFACE WATER TREATMENT PLANT AT RURAL AREA OF RENALA KHURD TEHSIL, OKARA, SAHIWAL

3.60.1 Purpose and Scope of the Project

The scope of this project is to provide a detailed treatment design program of selected Option i.e. **Renala Khurd** and the layout and design of a Surface water system of **10m³/hr.** capacity that would provide potable water to Markaz E Aabs. This Report documents that the proposed treatment system can deliver water complying with the WHO drinking water standards.

The works to be included in this section will include design, supply, installation connecting up, site testing & commissioning of all works for water treatment plant capable of treating 10 m³/hr. of Canal water.

3.60.2 Description of the Plant

The source of raw water will be Canal. The capacity of the plant is 10m³/hr. The water will be pumped to the treatment plant from 1/AL Jhand Wala Minor Branch Canals. The number of

operational hours of the plant is 8 hours per day. So, an intake water of 80m³ will be used by the treatment plant on daily basis. The proposed treatment option for Renala Khurd is most appropriate in terms of reliability, constructability, ease of operation, simple maintenance and most importantly, the cost.

A letter was written to the XEN of Irrigation Department (Renala Khurd, Okara) by Punjab Aab-e-Pak Authority to grant the NOC for water induction from canal and construction of surface water treatment plant. Letter is attached as **Annexure-VI**.

3.60.3 Objectives of Water Treatment

The objective of water treatment is to produce an adequate and continuous supply of pure and palatable water with the following characteristics.

- Clear
- Colorless
- Odorless
- Palatable
- Safe
- Reasonably Soft

3.60.4 Water Treatment Process

The basis for selecting treatment process is established by the characteristics of the raw water and the finished water quality goals. The Raw Surface Water from canal will go through a series of the following processes:

- a. Coagulation & Flocculation
- b. Sedimentation
- c. Filtration
- d. Disinfection

a) Coagulation and Flocculation

In the Coagulation/Flocculation process, very fine suspended solids and colloidal particles are caused to come together to form larger particles that can be settled and filtered out of the water. Colloidal solids are particles with a diameter of less than 0.01mm. These include fine silts, bacteria, color causing particles and viruses that might not settle for days, months or even years. Although individual particles cannot be seen with the naked eye, their combined effect is often seen as color or turbidity (cloudiness) in the water. These particles are small enough to pass through later treatment processes if not properly coagulated and flocculated. This could adversely affect not only the clarity of the water but its taste and odor, as well as the effectiveness of chlorine disinfection. Therefore, a chemical (coagulant) is added to the raw water that causes fine particles to bind together (flocculate) to form larger, fluffy clusters (floc) that can be removed by settling and filtering.

b) Sedimentation

Sedimentation is a solid-liquid separation that utilizes gravity to remove suspended solids used in water and wastewater treatment. These suspended solids, or particles, are

important to remove from water for several reasons. Some of these reasons include visibility impairment (aesthetic & safety reasons), disease transmission (bugs attach to particles that can then be ingested), and lastly because toxic materials can either exist as particles or can absorb to the particles.

c) Filtration

Removal of suspended solids by filtration plays an important role in the natural treatment of water as it percolates through the soil. It is also a major part of most water treatment.

- **Rapid Sand Filters**

Rapid sand filters can accommodate filter rates 40 times those of slow sand filters. Rapid sand filtration is the flow of water through a bed of granular media, normally following settling basins in conventional water treatment trains. The purpose of this filtration is to remove any particulate matter left over after flocculation and settling. The filter process operates based on two principles, mechanical straining and physical adsorption. Sand filtration is a "physical-chemical process for separating suspended and colloidal impurities from water by passage through a bed of granular material.

Rapid sand filtration is contrasted to slow sand filtration by increased flow rate, method of cleaning the filter bed. A rapid sand filter can operate up to 40 times faster than a slow sand filter. Rapid Sand Filters are cleaned often, usually daily, by reversing the flow of water through the entire filter bed, referred to as backwashing. Slow Sand Filters are cleaned less frequently by removal of the top layer of media.

d) Disinfection

Disinfection is a process of killing disease-causing microorganism, called pathogens present in water. On a small scale, disinfection is done by boiling of water. However, on a large scale, it is done using chemicals called disinfectants. Commonly used disinfectant is Chlorine and Chlorine compound (like bleaching powder, Sodium hypochlorite, Calcium hypochlorite, ozone etc.). Disinfection with chlorine is very popular in water and wastewater treatment because of its low cost, ability to form a residual, and its effectiveness at low concentrations.

3.60.5 Equipment Details

The plant and equipment as hereafter specified in greater detail shall generally include:

- i. Intake Pump
- ii. Chemical Tanks, Mixers and Dosing pumps
- iii. Catch Tank
- iv. Flash Mixing Tank
- v. Flocculation Tank
- vi. Lamella Plates Clarifier Tank
- vii. Pressurized Sand filtration.
- viii. Backwash Pumps
- ix. Disinfection System
- x. Control Panel
- xi. Instrument

Chemical Handling

The chemicals proposed to be employed in the treatment process shall include:

- a) PAC (up to 15 mg/l)
- b) Lime (up to 10 mg/l)

All the chemicals shall be stored in the chemical house (under roof) (out of scope) which shall have sufficient storage space for 30 days' supply of these chemicals at the average dosing rates. The chemicals shall be dosed in the solution form.

Solution Tanks

Solution tanks shall be provided each capable of holding 24 hours of supply of the concentrated solution at the estimated average dosing rates. Each tank shall be complete with inlet, outlet, and overflow and pipework fitted with diaphragm valves outlet strainers. Each tank shall be equipped with suitably powered agitators complete with all motors, supporting frames etc. All chemical dosing shall be carried out in the solution form from the chemical tank by means of dosing pumps.

- a) Dosing with PAC at maximum solution strength of 10% and a dosing rate infinitely variable up to 12 mg/l.
- b) Dosing with lime slurry to be at maximum slurry strength of 20% and dosing rate to be infinitely variable up to 10 mg/l.

Chemical Dosing Pumps

All dosing pumps shall be provided with 100% standby. Each pump shall be complete with suction and delivery pipework, isolating valves, and shall be adequately sized to conduct the requisite flow rates. Provision shall be made for fixing of this pipe work and valves in manner for ease in operation. The pipework and valves shall be so arranged that each dosing pump shall be able to draw solution from solution tank. Suitable arrangement shall also be made for connection of service water to both suction and delivery sides for flushing the pipework. Provision shall be made for adequate contacts in the control panel for indication lamps to show the pumps running and stopped. The contacts shall be so arranged as to stop the dosing pumps when the level in the reception tank low and also with low level in the chemical tank.

Chemical Pipework

All chemical solution and slurry pipework shall be corrosion proof, rigid. The pipework shall be laid and properly supported. PVC pipe of 25mm diameter will be used.

Mixing of Chemicals with Raw Water

The chemicals are proposed to be added in the flash mixer. Raw water after addition of chemicals shall over flow to flash tank. It is anticipated that turbulent flow in the flash mixer will ensure uniform dispersal of the coagulants. The arrangement is as shown in Process Flow Diagram.

3.60.6 Sedimentation and Clarification

Sedimentation and clarification shall be carried out in rectangular inclined plate settler as shown in the General Arrangement drawing. Settler shall be constructed capable to handling 10m³/h. Raw water which shall be fed to clarifier from the flash mixer through diffuser wall. The clarification rate in clarifier shall be 0.6m/h. The de-sludging arrangement shall be generally as per General Arrangement drawing. This shall be carried out through bottom manual valves. Radial weir plates shall be of the V-notch type constructed of 3 mm thick stainless-steel aluminum or GRP as specified and the suitable for mounting on the top water level of clarifier.

3.60.7 Filtration

Pressure Sand Filters -General

Filtration shall be carried out by pressure sand filters generally as shown in the drawings. The filters shall design such that normal filtration rate shall not exceed (6.0 m/h with all filters in operation). This velocity based on special filtration media silica sand. All equipment necessary for complete functioning of filters shall be as detailed herein. Under no circumstances shall the flow rate through any filter exceed 6.0 m/h. However; the filter outlet should have a wide range of opening. The purpose of the filter is to remove suspended solid matter from the clarifier treated water when operating on a downward constant flow principle.

Filter Media

WTS shall provide and place the filter media. The source used is local which has ability to work on design velocity.

Characteristics

- Silica sand effective size (95% silica) = 0.85 mm
- Uniformity coefficient = 1.3 - 1.7
- Density of sand media = 2.65 mg/l
- Porosity = 40 - 43%
- Sphericity = 0.7 – 0.8
- Hardness = 7

Filter Backwash

The filter backwash equipment shall be installed adjacent to the filters. The equipment supplied shall be suitable for cleaning the filters by upward flow of water.

Wash water Supply

Backwash water supply to filters during backwash and normal operation shall be supplied by electrically driven pump installed adjacent to the treated water tank. The pumps shall draw water from the treated water storage tank. There shall be 2 pumps. Each pump shall be capable of continuously supplying water at the requisite pressure and at sufficient flow rate to backwash one filter. Each pump shall be complete with pipework, isolating valves, non-return valves, pressure gauges etc. The pipework on suction and delivery sides shall also include flexible couplings to facilitate removal of pumps for maintenance.

Filter Valve Operations

All valves which require operation during the filter washing process shall be automatic multiport valve.

Backwashing

When the filter needs cleaning, the filter resistance increases and when it reaches a certain differential pressure the filter shall be backwashed automatically. It shall also be possible to automatically backwash the filters at regular time intervals, which shall be adjustable within wide ranges. The expansion of the filter bed during back washing is estimated normally at about 25% and maximum at about 40%. As there is always a certain breakage of the suitable flow shall be set according to actual field trials depending on the real sand delivered. The backwash water is taken from the treated water storage tank. The backwashing shall block at too low level in that tank in order to prevent backwash pumps running dry.

3.60.8 Chlorination**Chlorine System**

The equipment provided shall be complete with all necessary solenoid driven units pumps, pipework, valves, control panels, and any other items of equipment necessary to make the plant complete in every detail and in accordance with the Drawings and Specifications.

The chlorination system shall be of the liquid chlorine dosing and shall consist of chlorine dosing pumps, storage tank complete with all connection points, fittings and valves for chlorine supply.

One duty and one stand-by chlorine dosing pumps to inject chlorine into the contact tank.

3.60.9 Process Flow Scheme

Process flow scheme suggested for the treatment plants for Renala Khurd is shown below in the

Figure 3-23:

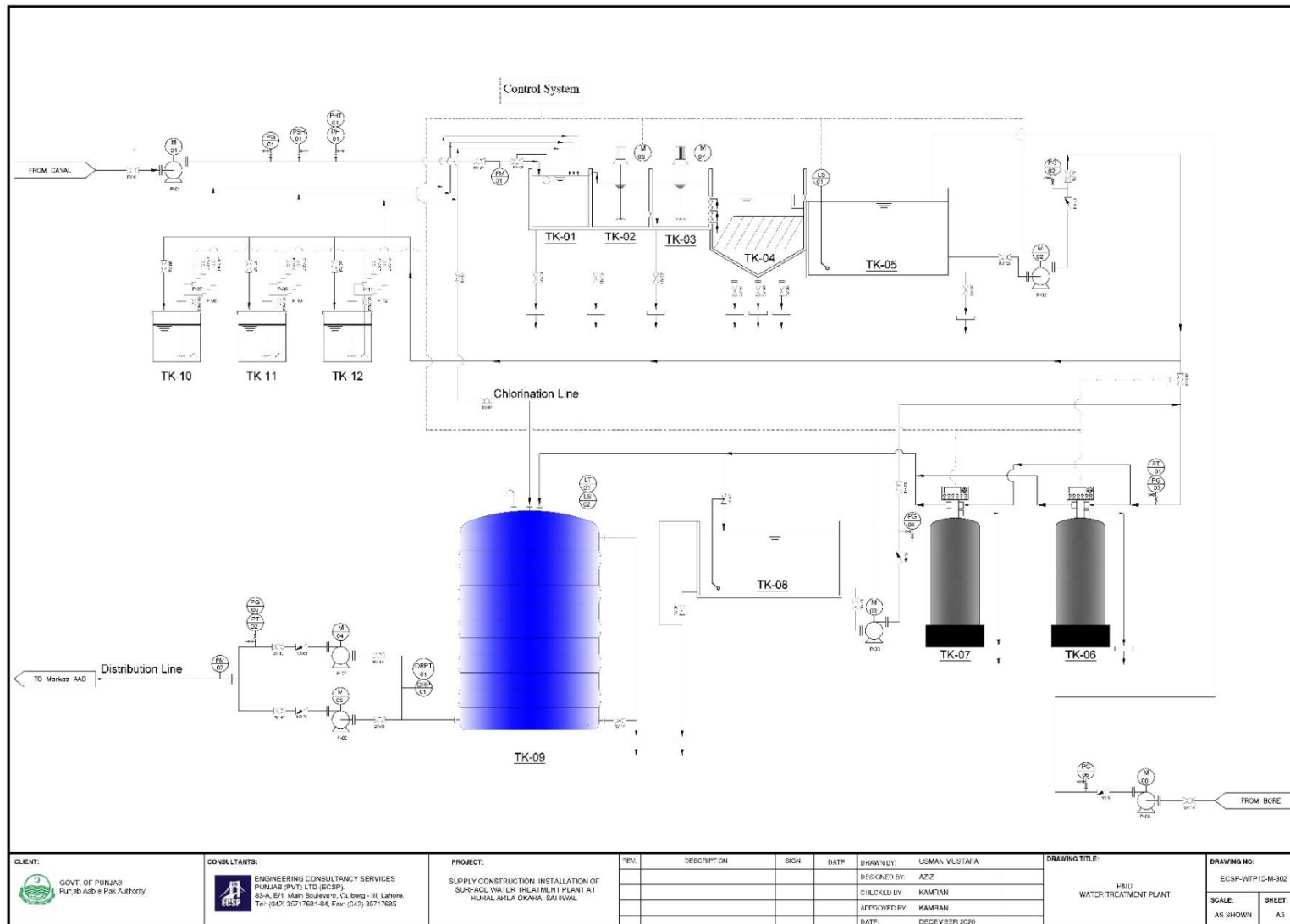


Figure 3-23: Process Flow Scheme for Renala Khurd

3.61 STATUS OF WATER QUALITY IN THE AREA

The area is proposed keeping in view the high TDS (nearly 11,000 ppm) and other contaminants like Arsenic in ground water and location near a canal. RO Treatment for such high TDS levels will be very costly and inefficient solution. Therefore, SWTP with Rapid Sand Filtration Technology is proposed to be installed.

3.62 PROJECT LOCATION FOR RENALA KHURD

The target area for this contract is Renala Khurd (Tehsil) of Okara District in Sahiwal Division of Punjab. Renala Khurd is a growing city in the Okara District in the northeast Punjab province of Pakistan. The city is the headquarters of Renala Khurd Tehsil, an administrative subdivision of the district. The city is about 116 kilometers (72 mi) from Lahore and 18 kilometers (11 mi) from the district capital city of Okara. It is southwest of Lahore on the national highway (GT Road) and on the Lahore Karachi main railway line. With a radius of 7 km, it is home to over 100,000 inhabitants.

The **Figure 3-24** given below shows the project area of Renala Khurd. The area bounded by the red colored line shows the two villages **25/1L** and **28/1L** that are under the contract of this project for the provision of water treatment facility of the two villages. Map of the project area is also attached as an **Annexure III-D**.



Figure 3-24: Map showing Project Area of Renala Khurd

3.63 SITE FEATURES OF RENALA KHURD

Renala Khurd is a growing city in the Okara District in the northeast Punjab province of Pakistan. The city is the headquarters of Renala Khurd Tehsil, an administrative subdivision of the district. The present combined population of the two villages of Renala Khurd under this project i.e. **25/1L** and **28/1L** as per the survey and calculation in the year 2020 was **8000** persons. The design period of the project is for next 20 years i.e. 2040. As per the growth rate, the projected population for the year 2040 for the area under this project will be **11,142** persons.

Renala Khurd is essentially an agricultural area, however there is small industry which is now called Military Farms located in the western side of the town. The oldest food company located in the North near under path is Mitchell's Fruit Farms Ltd. Renala Khurd is environmentally healthy town, surrounded by vast tracts of agricultural land. However, with the growth of population and increase in the urban transport the major chowks of the town are crowded and covered with smoke and dust. Therefore, the need for planned open spaces in the length and breadth of the town is needed.

3.64 CHARACTERISTICS OF THE SELECTED AREA

The shallow sub soil water of Renala Khurd town is brackish and unfit for human consumption. However, the water at deeper depth is good quality. Present source of water supply system in the town is canal shallow T/wells installed at the bank of LBD canal near town coupled with deep Tube wells installed (at depth of 240ft to 280ft) in the town.

A study was carried to assess the water quality at **Renala Khurd (Canal of Village 28/1L, Akhtarabad)** by Punjab Aab-e-Pak Project. Two different villages i.e. **25/1L** and **28/1L** were selected for collection of sample and testing of water quality. The sample collection Team of **Green Engineering Consultant** has collected the required water sample from the selected points by adopting proper sampling protocol for appropriate measurement of water quality. It was observed from the selected Two (02) locations of the lab reports that the levels of parameters (Arsenic, TDS, TSS, Fluoride, Sulphates) were out of the limits of their respective standards of WHO and PEQ's. TDS and Sulphate levels were found very high in the tested samples of Renala Khurd. Main reason behind these very high values are these sources are heavily contaminated and presence of high soluble salts.

Hence, it was concluded from the analysis results of the two respective locations that the water quality of the rural area of Renala Khurd is not suitable for drinking for its residents. Installation and operation of Filtration plants is essential for the provision of clean & healthy drinking for the people of Renala Khurd.

Detailed Water Quality Analysis lab reports are attached as an **Annexure IV-D**.

3.65 LAYOUT PLAN FOR THE PROVISION OF SAFE DRINKING WATER FOR RENALA KHURD

The target area for this contract is Renala Khurd Tehsil of Okara District in Sahiwal Division of Punjab. The area under this project to provide clean & safe drinking water for their respective inhabitants is 162.69 acres. A Methodology of clustering, dividing the distribution

system into sub-areas is used here. The location of Renala Khurd Tehsil within Okara District is indicated by the project area in the map shown below. **Figure 3-25.**

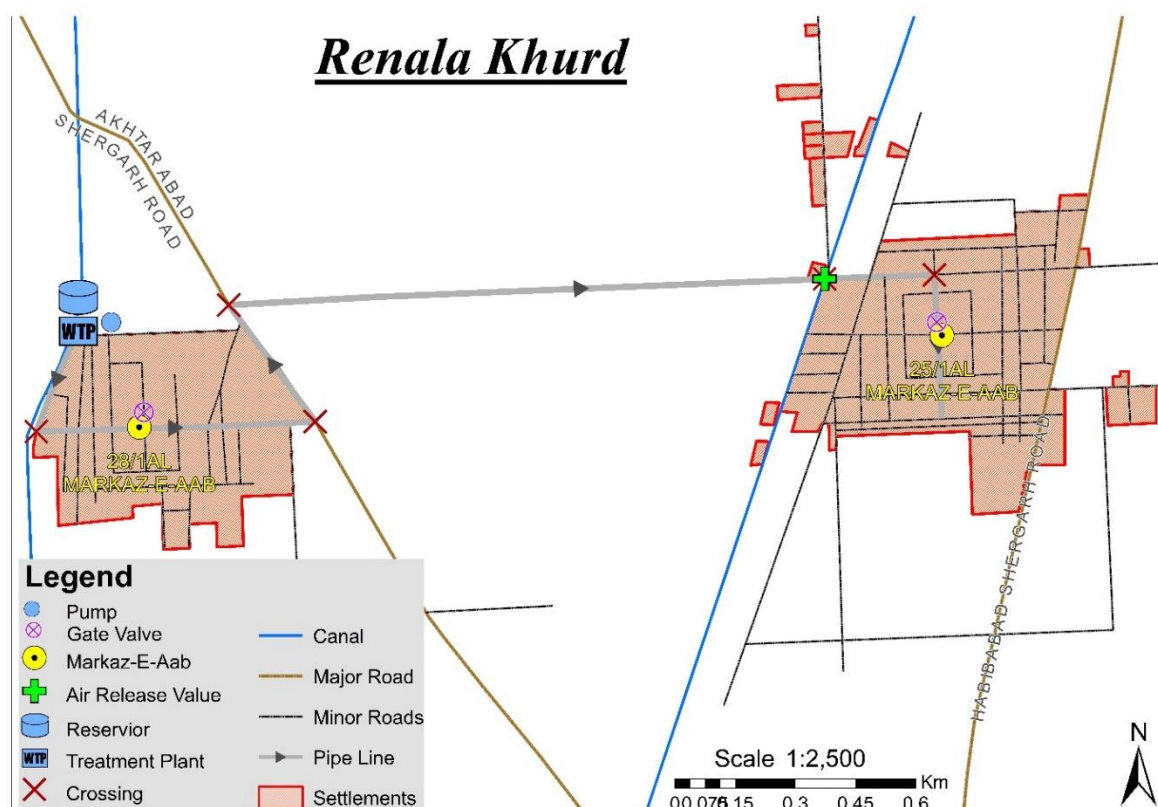


Figure 3-25: Map showing the Project Layout of Renala Khurd

The proposed Surface water supply system Tehsil Renala Khurd is based on the Canal water. In this scheme, raw water is pumped from Canal to the Surface treatment plant whose capacity will be **10 m³/hr** to remove unwanted contaminations from the water. The treated water is stored in the treated water storage and then pumped to the Markaz e Aab center which is located at center of the Villages Chak No 28/1AL & Chak No 25/1AL, through distribution network.

In dry season, a standby tube well will supply seepage water from a canal. Water will be pumped up from the tube well to the Surface Water Treatment Plant. to remove unwanted contaminations from the water. The treated water is stored in the treated water storage tank and then pumped to the Markaz e Aab center which is located at center of the Villages Chak No 28/1AL & Chak No 25/1AL, through distribution network.

3.66 DESIGN SUMMARY OF CLUSTER BASED WATER SUPPLY SCHEME OF RENALA KHURD

Table 3-18: Design Summary for Renala Khurd

Sr. No.	Item Description	Value
1	Area (Acre)	162.69 (Acre)
2	Projected Population for Year 2041	11,142

Sr. No.	Item Description	Value
3	Drinking water to be delivered to the residents	05 (liters/d/capita)
4	No. of plants	01
5	Total No. of tube wells	01
6	Total Length of 3 inches (DN90) diameter pipeline	3,700 (meters)
7	No. of 24,000-liter capacity Markaz E Aab	01
8	No. of 36,000-liter capacity Markaz E Aab	01
9	Total No. of Markaz E Aabs	02
10	Water Demand (@5-liters/day)	55,710 (lit/c/d)

3.67 SELECTION OF WATER SOURCE

Based on the result of the water quality test and observations of the Project target area and considering the sustainability of the water supply system, the recommended water source for this Project is to pump water from **1/AL Jhand Wala Minor Branch canals**.

3.68 DISPOSAL OF SLUDGE

The source of water in Renala Khurd is a nearby canal. Sludge left behind after treatment of canal water is mainly turbidity and muddy clay. The total amount of sludge produced as a result of water treatment is 2% of the feedwater which outcomes as 0.2m³/hr. The total number of Operating Hours of Plant are 8 hours per day. So, a total of 1.6m³ of sludge will be producing from this treatment plant on daily basis. This turbidity and muddy clay are non-toxic for the canal as the original concentration of turbidity remains the same in the canal. This muddy clay sludge is disposed-off directly back into the canal under the action of gravity from the treatment plant.

3.69 DESIGN CRITERIA OF SCHEME

Table 3-19: Design Criteria for Canal Surface Water Treatment Plant for Renala Khurd

Sr. No.	Parameter	Range of Typical Values
Bar Screen		
1	Clear spacing between bar	20 ~ 80 mm
2	Slope from vertical	0-30
3	Velocity through screen at max. flow	0.6 m/s
4	Maximum head loss (clogged screen)	0.76 ~ 1.52 m
Flash Mixer		
5	Detention Time	10s to 5 min
6	Velocity Gradient	700-1000 1/s

Sr. No.	Parameter	Range of Typical Values
Flocculation Tank		
7	Detention Time	20 to 60 min
8	Velocity Gradient	15 to 60 1/s
Sedimentation Tank		
9	Overflow rates	20 to 60 m ³ /m ² . d
10	Effective water depth	3 ~ 5 m
11	Detention time	2 to 4 hrs.
Rapid Gravity Filter		
12	Type of Filter	Influent controlled, constant rate, variable level
13	Filter Media	Sand
14	Filtration Rate	5 m/hr.
15	Bed Depth	0.5 ~ 1.5 m
16	Uniformity Coefficient	1.2 ~ 1.7
17	Effective size	0.45 ~ 1 mm
18	Specific gravity	>2.5
19	Backwash time	8-15 min
Chemicals		
20	Coagulant/ Flocculent	Alum/ ferric chloride/ PAC
21	pH adjustment	Lime Solution
22	Disinfection	Chlorination (Sodium Hypochlorite)

3.70 DESIGN CALCULATIONS

The following tables show the details of Village name, quantity of Markaz-e-Aabs with name, population of each Markaz E Aab with water demand and LLR capacity and quantity in each Markaz-e-Aab. **Table 3-20.**

Table 3-20: Details of Water Supply Scheme at Renala Khurd

Sr. No	Project	No. of Water Sources		WTP Capacity (m3/hr.)	No. of Markaz-e-Aabs Centers
		Canal	Standby Tube well		

1	Surface Treatment Plant	1	1	10	2
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3.71 LOWER LEVEL RESERVOIR (LLR) DETAILS

Table 3-21: LLR Details of Renala Khurd

Sr. No.	Village Name	Population at year 2020	Projected Population for the year 2041	Average Demand @5L/D	24,000 L/D	36,000 L/D
1	Chak No 28/1AL	3,000	4,178	20,891	1	
2	Chak No 25/1AL	5,000	6,964	34,819		1
Total		8000	11,142	55,710	1	1

3.72 LAND IDENTIFICATION DETAILS OF RENALA KHURD

Table 3-22: Land Identification of Renala Khurd

Sr. No.	Division	District	Tehsil	Name	Latitude	Longitude
1	Sahiwal	Okara	Renala Khurd	Treatment Plant Location	30.879794	73.708962
2	Sahiwal	Okara	Renala Khurd	28/1AL Markaz-e-Aab	30.877579	73.710440
3	Sahiwal	Okara	Renala Khurd	25/1AL Markaz-e-Aab	30.878894	73.731395

3.73 COST ESTIMATES FOR RENALA KHURD

Table 3-23: Cost Estimate for Renala Khurd

Sr. No.	General Abstract of Cost	Amount (Rs.) in Million
1.	SUPPLY CONSTRUCTION, INSTALLATION OF SURFACE WATER TREATMENT PLANT AT RURAL AREA OKARA, SAHIWAL	57.100

3.74 PROJECT DETAILS FOR SUPPLY, CONSTRUCTION & INSTALLATION OF CONVENTIONAL TREATMENT PLANT IN CHAK JHUMRA TEHSIL, FAISALABAD

3.74.1 Purpose & Scope of the Project

The scope of the Project is to provide a detailed treatment design program of Surface Water Treatment Plant of **35m³/hr.** capacity for the selected option i.e., **Chak Jhumra** and the layout and design of a potable water system that would provide water to Markaz E Aabs. This project will provide Water treatment system, which can deliver safe and potable water complying with the WHO drinking water standards.

3.74.2 Project Location for Chak Jhumra

The target area for this contract is Chak Jhumra (Tehsil) of Faisalabad District in Faisalabad Division of Punjab. Chak Jhumra Tehsil is an administrative subdivision (tehsil) of Faisalabad District. Headquarters of the tehsil is Chak Jhumra City. Population of Chak Jhumra Tehsil as per population census of 2017 was 332,966. Main population of the contract area is residing in small villages. The location of Chak Jhumra Tehsil – Cluster 1 within Faisalabad District is indicated by the project area in the map shown below. **Figure 3-26.** Project Map is also attached as **Annexure III-E.**

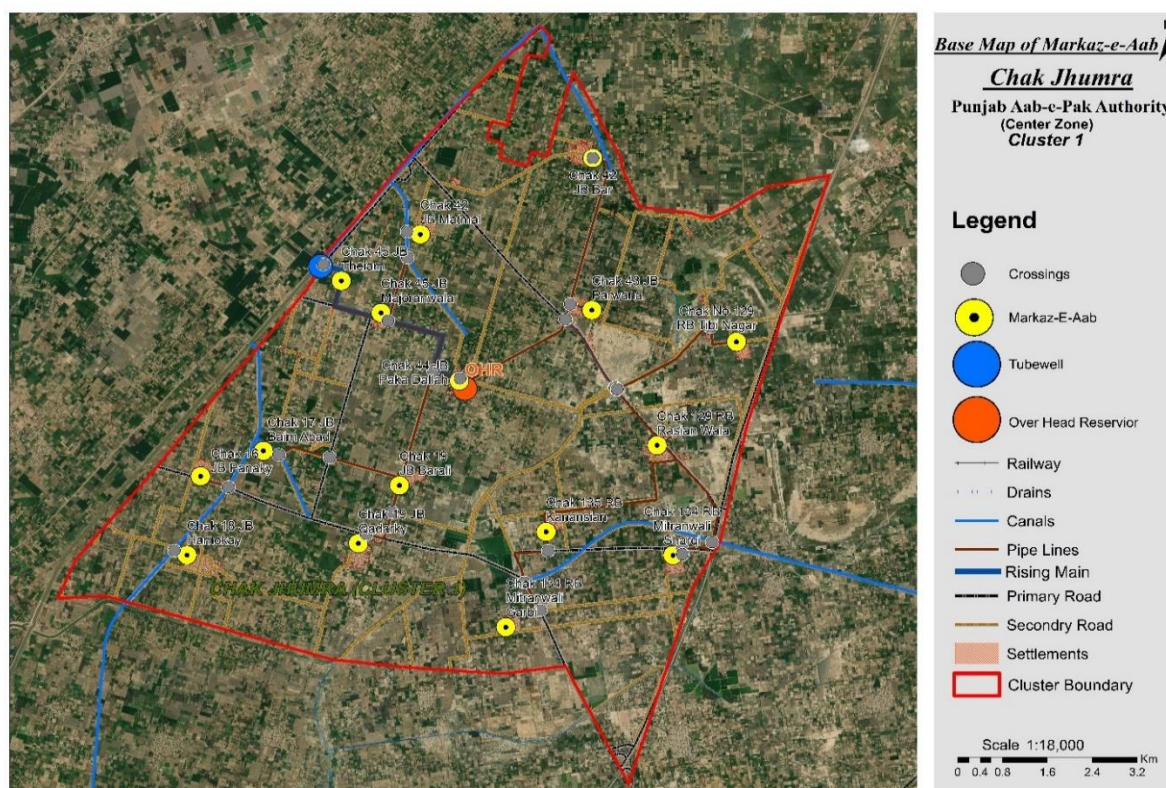


Figure 3-26: Map Showing Chak Jhumra

3.74.3 Description of the Plant

In Chak Jhumra, the tube wells are located along the canal and treatment plant is also planned to be constructed at the same location. The ground water (raw water) from the tube well is pumped and stored in raw water storage tank. From where raw water is pumped using feed pump and passed through pressure sand filters for the removal of suspended solids. Filtrate

from the sand filters is then passed through activated carbon filter for the removal of organic matter.

For the cleaning of sand filters and activated carbon filters backwash arrangement is provided using clean water. Separate backwash pumps are provided with variable speed drive to control the backwash flow rate. Each filter is designed to operate for 8 hours and backwashed on alternate days.

For the disinfection, water is transferred to the chlorine contact tank. Liquid sodium hypochlorite solution is proposed for maintaining residual chlorine at the discharge side of chlorine contact tank. Water free from chemical and organic contamination is stored in treated water storage tank. From here, treated water is pumped to overhead storage tank using horizontal surface centrifugal pump. Treated water from OHR is distributed to different Markaz-e-Aabs according to their demands within the cluster through piping network.

3.74.4 Equipment Details

3.74.4.1 Tube Well

Capacity of Vertical Turbine Pump

Ground water is pumped via submersible pump from tube well to raw water storage tank.

Parameter	Values
Capacity of submersible pump	35 m ³ /h

3.74.4.2 Pressure Sand Filter

Pressure sand Filtration involves the removal of particulate material suspended in the liquid through a filter bed comprises of granular medium. Vertical configuration is being used in our case. Starting at the bottom, 0.15 m gravel cover is provided over the top of laterals or nozzles. Above that 0.8 m of sand media is provided.

Filter Media

The detail of sand filter media is summarized in **Table:** as under:

Parameter	Values
Effective Size	0.5 mm
Uniformity Coefficient	1.4
Specific Gravity	2.65
Porosity	0.4
Total depth of Filter Bed	800 mm

Filter Backwash

Proper backwashing is a very important step in the operation of a filter. If the filter is not backwashed completely, it will eventually develop operational problems. If a filter is to operate

efficiently, it must be cleaned properly. Treated water is used for the backwash cycle and is taken from treated water tank.

Up flow water backwash is proposed for cleaning of clogged media during backwash operation. After the water level is lowered in the bed, backwash is activated and operated for 10 min at the rate of 37 m/hr. for the expansion of media bed by 40~50 percent.

Backwash rates are generally variable and depend on backwash water temperature, filter media characteristics, and backwash method. Water viscosity decreases with increasing temperature. Consequently, as backwash water temperature rises, drag forces on the media grains are reduced, and higher backwash rates are required to achieve a desired bed expansion.

3.74.4.3 Activated Carbon Adsorption

From the sand filter, the water is passed through the Activated Carbon Filter. It works via a process called adsorption, whereby pollutant molecules in the fluid to be treated are trapped inside the pore structure of the carbon substrate. Carbon filtering is commonly used for water purification and is one of the best adsorbents for organics in water. Due to its porous surface it can remove organics and color by adsorbing them in the pores area. It can reduce total organic carbon (TOC) by 30 to 90%.

3.74.4.4 Treated Water Storage Tank

Treated water storage tank is provided with one-hour storage capacity. Design calculations for treated water storage tank are presented in the below **Table** as under:

Parameter	Values for (35m³/h) Plant
HRT	1 hr.
Volume required	35 m ³
Total Height	2.8 m
Free Board	0.6 m
Water Depth	2.20 m
Width	2.8 m
Length	5.0 m
Volume Provided	31 m ³

3.74.5 Site Features of Chak Jhumra

Chak Jhumra Tehsil is an administrative subdivision (tehsil) of Faisalabad District. Headquarters of the tehsil is Chak Jhumra City. Chak Jhumra, is a town, railway junction, and Tehsil in Punjab of Division Faisalabad. Population of Chak Jhumra Tehsil as per population census of 2017 was 332,461.

Land Use Patterns, Road Access, Transportation and Vegetation is relatively same as the peri-urban areas of Faisalabad Division.

3.74.6 Characteristics of the Selected Area

A detail study was carried out by **Green Engineering Consultant (GEC)** to assess the water quality at Chak Jhumra by Punjab Aab-e-Pak Project. Water quality was monitored at sixteen (16) selected locations to conduct a comparison of pollutants/contamination level with the respective standards. It was observed from the selected 16 locations of the lab reports that the levels of parameters (Arsenic, TDS, TSS, Fluoride, Sulphates) were out of the limits of their respective standards of WHO and PEQ's. TDS and Sulphate levels were found very high in the tested samples of Chak Jhumra. Main reason behind these very high values are these sources are heavily contaminated and presence of high soluble salts. Water analysis results shows that Turbidity, Nitrates and microbiological parameters at some locations are within the limits of PEQ'S/WHO standards. At some locations of Chak Jhumra, microbiological contamination is high due to sewerage contamination.

Hence, it was concluded from the analysis results that the water quality of Chak Jhumra is not suitable for drinking for its residents. Installation and operation of Filtration plants is essential for the provision of clean & healthy drinking for the people of Chak Jhumra.

Detailed Water Quality Analysis lab reports are attached as an **Annexure IV-E**.

3.75 LAYOUT PLAN FOR THE PROVISION OF SAFE DRINKING WATER FOR CHAK JHUMRA

For large water-distribution systems fully detailed models result in a substantial amount of data, making it difficult to manage, monitor and control of water supply system and pressure regime. A possible way to cope with this difficulty is to gain insight to the system behavior by simplifying its operation using the methodology of clustering, dividing the distribution system into sub-areas. The entire area of Chak Jhumra Clusters – 1 is shown in **Figure 3-27** below.

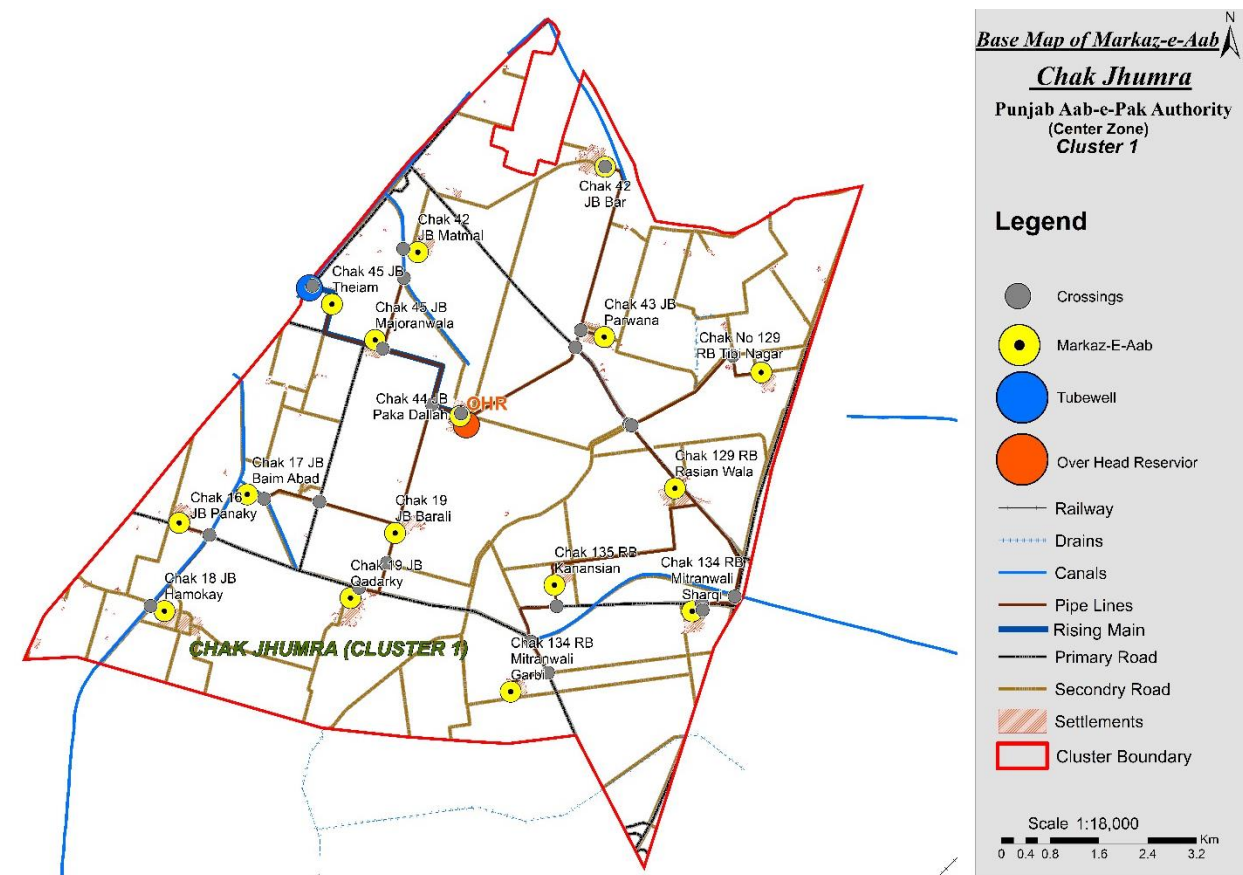


Figure 3-27: Map Showing Layout Plan for Chak Jhumra

The treatment solution opted for the population of Chak Jhumra is based on Conventional Treatment based approach which is described below.

3.76 CONVENTIONAL TREATMENT BASED APPROACH

In this approach, raw water is pumped from ground to the treatment plant to remove unwanted contaminations from the water. The treated water is stored in the treated water storage tank and then pumped to overhead tank, which is located at center of the cluster, from where treated water is distributed to Aab-e-Pak Centers through distribution network. This is also called **Cluster System**. The Figure given below shows the schematics of this approach. **Figure 3-28.**

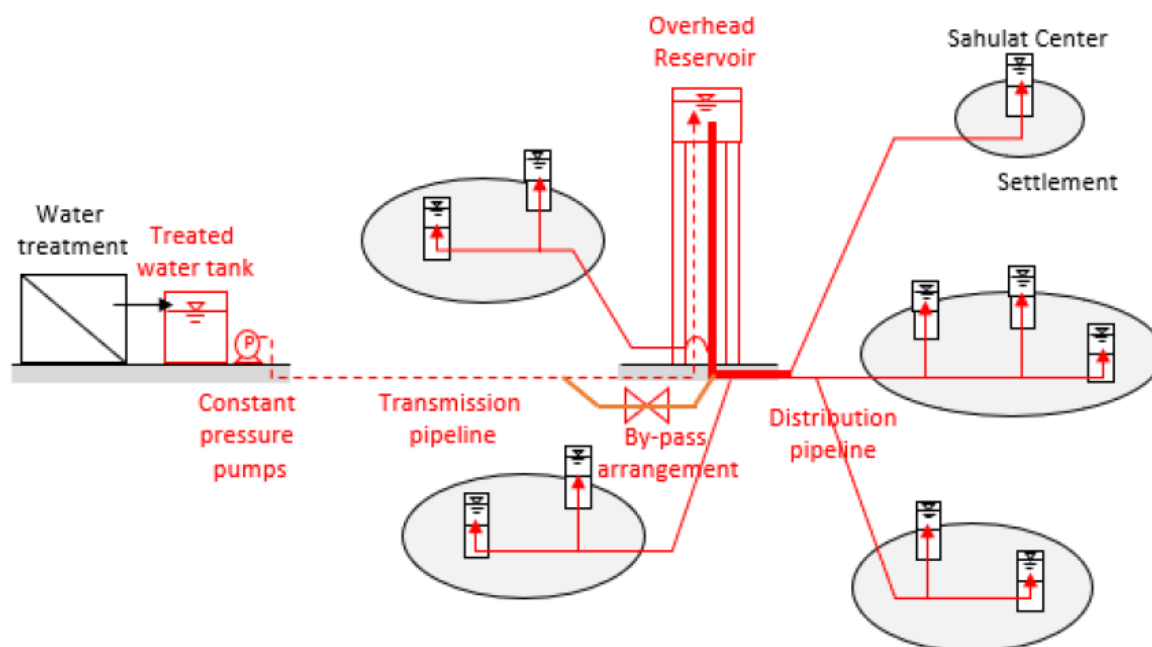


Figure 3-28: Conventional Treatment based solution

3.77 DISPOSAL OF REJECTED WATER

In this conventional treatment approach, almost all water is used only a little water is disposed only during the filling of water bottles at Markaz-e-Aabs. The whole water rejected during the process, accounts for 5% of the total intake water. This rejected water will be disposed into the Open Drains / sewers located at each Markaz-e-Aab. The rejected/disposed water is already treated one, hence there will be no issue in disposing it into the sewer drains

3.78 DESIGN SUMMARY OF CLUSTER BASED WATER SUPPLY SCHEME OF CHAK JHUMRA

Table 3-24: Design Summary for Chak Jhumra

Sr. No.	Item Description	Value
1	Area	(Acre) 460.994
2	No. of Settlements	91
3	Population (Year 2017)	41,357
4	Population (Year 2040)	57,329
5	Water Demand (@5-liters/day)	286,647

Sr. No.	Item Description	Value
6	No. of cluster-based plants	1
7	Total No. of tube wells	1
8	Total Length of Pipeline	(m) 52,988
9	No. of 12,000-liter capacity Markaz E Aab	04
10	No. of 18,000-liter capacity Markaz E Aab	06
11	No. of 24,000-liter capacity Markaz E Aab	04
12	No. of 36,000-liter capacity Markaz E Aab	02
	Total No. of Markaz E Aabs	16

3.79 DETAILS OF CLUSTER CJ-C-01

The following tables show the details of cluster name, quantity of Markaz-e-Aabs with name, population of each Markaz-e-Aab with water demand and LLR capacity and quantity in each Markaz E Aab. This cluster will supply clean and safe drinking water to the 16 villages of Chak Jhumra. The details of population and the type of treatment plant being installed on these 16 villages is given in the

Table 3-25 given below

Table 3-25: Details of Cluster CJ-01

Sr. No.	Village Name	Population 2017	G.R	Population 2040	Average Demand @5L/D	12,000 L/D	18,000 L/D	24,000 L/D	36,000 L/D
1	42 Jb Bar	5,110	1.43	7,084	35,418				1
2	42 Jb Matmal	2,494	1.43	3,457	17,286		1		
3	43 Jb Parwana	2,317	1.43	3,212	16,060		1		
4	45 Jb Theiam	3,266	1.43	4,527	22,637			1	
5	45 Jb Majoranwala	1,978	1.43	2,742	13,712		1		
6	44 Jb Paka Dallah	3,110	1.43	4,311	21,556			1	
7	129 RB Tiba Nagar	2,134	1.43	2,958	14,792		1		
8	129 RB Rasian Wala	2,876	1.43	3,986	19,931			1	
9	135 RB Kanandsain	1,941	1.43	2,690	13,451		1		
10	134 RB Mitranwali Sharqi	1,768	1.43	2,450	12,251	1			
11	134 RB Mitranwali Gharbi	1,368	1.43	1,896	9,480	1			
12	19 Jb Barali	3,493	1.43	4,842	24,210			1	
13	19 Jb Kadoky	1,509	1.43	2,092	10,459	1			
14	17 Jb Balamabad	1,273	1.43	1,765	8,823	1			
15	16 Jb Panakay	2,139	1.43	2,965	14,823		1		
16	18 Jb Homankay	4,582	1.43	6,352	31,759				1
Total		41,357		57,329	286,647	4	6	4	2

3.80 SUMMARY OF CLUSTER BASED FACILITIES FOR CHAK JHUMRA

Table 3-26: Summary of Cluster Based Facilities for Chak Jhumra

Sr. No.	Cluster No.	No. of Water Sources	WTP Capacity (m ³ /hr)	OHR		No. of Sahulat Centers
				Capacity (m ³)	Height (m)	
1	Cluster CJ-C-01	01	35	150	25	16

3.81 SELECTION OF WATER SOURCE

Based on the result of the ERS, and observations of the existing tube wells of the Project target area and considering the sustainability of the water supply system, the recommended water source for this Project is to tap fresh ground water from shallow layer close to major Jhang Branch canals.

In saline groundwater zone, due to seepage from a major Jhang Branch canals, a thin layer of fresh groundwater is created close to the canal. Where reasonable thickness of such layer is found, this fresh groundwater can be pumped out through shallow skimming tube wells and supplied to consumers after minor treatment. Skimming wells extract the overlying fresh groundwater without pumping the deep saline groundwater.

3.82 DESIGN CRITERIA FOR CHAK JHUMRA PLANT

Table 3-27: Design Criteria for Chak Jhumra Plant

Sr. No.	Parameter	Design Criteria	Remarks
1	Scheme type	Cluster Based	
2	Location of Treatment Plant	Near to Source of water (Vertical turbine well)	
4	Design population projection year	2040	
5	Design capacity	5 l/c/d	
6	Dispensation	5 l/c/d	
Water Source			
7	Source of water	Surface Seepage water	
8	Operation hours of pump	8 hours	Availability of Grid supply
9	Type of pump	Vertical turbine Pump for tube well	
10	Starting method of pump	Delta starter	
11	Manned-unmanned operation	Auto / Manned operation but operation of plant will be automatic through PLC	

Sr. No.	Parameter	Design Criteria	Remarks
Water Treatment Plant			
12	Water Quality	As per WHO guidelines	
13	Operation hours of plant	8 hours	
14	Control of plant	PLC/ Manual	
Pressure Sand Filter			
15	Filtration Rate	12 m ³ /hr	Water Filtration Practices
16	Backwash rate	35 m ³ /hr	
17	Backwash time	5 min	
18	Sand Characteristics	ES 0.5 mm	
		UC 1.4	
		Depth 0.8 m	
		SG ≥ 2.5	
19	Vessel	FRP	
20	Filtration (Loading) Rate	15	m/h
21	Service Flowrate	35	m ³ /h
22	Total Cross section Area required	2.45	m ²
23	Number of Sand Filters in operation	3	No.s
24	Design Diameter of Sand Filter	01	m
25	Dia Meter of Filter per filter	1.28	m
26	Design Height of Vessel Required	1.3	m
27	Height of Vessel	1.8	m
28	Empty Bed Contact time	>3	min
29	Bed depth	0.8	m
30	Height of media Bed	0.73	m
31	Gravel Bed Depth	200	mm
32	Total Weight of Gravel +Sand	1242	kg
33	Back wash flow rate / Sand Filter	35	m ³ /h
34	Bed Expansion	50	%
35	Free Board Area	50	%
36	Pressure Drop through media	0.001	Barg
37	Backwash time	5	min
38	Backwash type	Manual/ Time Based	

Sr. No.	Parameter	Design Criteria	Remarks
Activated Carbon Filter			
39	Filtration (Loading) Rate	12	m/h
40	Service Flowrate	35	m ³ /h
41	Total Cross section Area required	3.35	m ²
42	Number of Sand Filters in operation	3	No.s
43	Design bed Diameter of Activated Carbon Filter	1.1	m
44	Dia Meter of bed per filter	1.21	m
45	Design Height of Vessel Required	1.6	m
46	Height of Vessel	1.8	m
47	Empty Bed Contact time	>5	min
48	Bed depth	1.0	m
49	Height of media Bed	0.8	m
50	Gravel Bed Depth	200	mm
51	Total Weight of Gravel + Media	185	kg
52	Back wash flow rate / Sand Filter	35	m ³ /h
53	Bed Expansion	50	%
54	Free Board Area	50	%
55	Pressure Drop through media	0.006	Barg
56	Backwash time	5	min
57	Backwash type	Manual/ Time Based	
Treated Water Reservoir			
58	Capacity of tank	4	hr
Feed pump (to OHR)			
59	Operation hours of pump	8 hours	
60	Type of pump	Centrifugal Horizontal / Vertical pump	
61	Number of pumps	1 Op + 1 Standby	
62	Starting method of pump	VFD	
63	Design Head	08	Barg
64	Operating Head	05-06	Barg
65	Flow	35	m ³ /hr
Overhead Reservoir (OHR)			
66	Capacity of reservoir	4 hrs	

Sr. No.	Parameter	Design Criteria	Remarks
Markaz E Aab with Low level reservoir (LLR)			
67	Capacity of LLR	1 day	
Transmission/ DistributionSystem			
68	Terminal pressure	>0.5	barg
69	Velocity of flow in distribution pipe	1.5-2	m/s
70	Velocity of flow in transmission main	1.5-2	m/s
71	Pipe depth of cover	1	m
72	Minimum size of pipe	DN 90 (3 inches)	
73	Pipe material	HDPE	
74	SDR	17	
75	Hazen William Coefficient (C)	150	
Energy source			
76	Energy source	Primary Source is Grid	
Monitoring, control and recording system			
77	Monitoring mechanism	PLC/ Manual	

Parameter	Range of typical value	Ref
Sand Filter		
Filtration Rate	12 m/hr 12 ~ 20 m/hr 15 m/hr	[2] [6] [12]
Backwash rate	35 m/hr	[4,5]
Backwash time	5-10 min	[2]
Sand Characteristics	ES 0.45 - 1.0 mm	[2]
Parameter		
Silica sand effective size (95% silica)	0.85 mm	[2]
Uniformity coefficient	1.3 - 1.7	[2]
Depth Range	0.6 - 1.0 m	[2]
Specific Gravity	≥ 2.63	[2]
Porosity	40 - 43%	[2]
Density of sand media	2.65 mg/l	[2]
Sphericity	0.7 – 0.8	[2]

Parameter	Range of typical value	Ref
Hardness	7	[2]
Vessel material	FRP	
Empty Bed Contact Time (EBCT)	3-5 minutes	[6]
Base Material	Gravels	
Disinfection		
Type	Chlorination	
Chemical	Sodium Hypochlorite	
Activated Carbon Filter		
Filtration Rate	12 m/hr	[2]
	12 ~ 20 m/hr	[6]
	12 m/hr	[12]
Backwash rate	24-35 m/hr	[4,5]
Backwash time	5-10 min	[2]
Parameter	Range of typical value	Ref
	UC 1.2 - 1.7	[2]
	Depth 0.5 – 1.5 m	[2]
	SG $\geq$ 2.5	[2]
Vessel material	FRP	
Surface Area	500 m ² /g	
Empty Bed Contact Time (EBCT)	5-7 minutes	[6]
Base Material	NSF Certified Activated Carbon Media	
Effective Size	0.5 ~ 1.8 mm	[6]
Uniformity Coefficient	$\leq$ 1.9	[6]
Replacement	On depletion of the adsorption capacity	
Disinfection		
Type	Chlorination	
Chemical	Sodium Hypochlorite	

3.83 FLOW SCENARIO

Flow scenario for the design of water treatment plant and plant design capacities are calculated and summarized in the following **Table 3-28** as under:

Table 3-28: Flow Scenario for Water Treatment Plants

Parameters	Values for 35 (m ³ /h) plant	Units
Required treated water Flow Rate	35	m ³ /h
Plant Operational time	08	h/d
Daily Flow Rate	280	m ³ /d
Backwash Wastewater from Sand & Ac. Carbon Filter	17.5	m ³ /time
Total Raw Water required	297.5	m ³ /d
Plant Design Capacity	35	m ³ /h
Wastage	5.88	%/day

3.84 SCHEME FOR WATER DISTRIBUTION SYSTEM IN VILLAGES OF CHAK JHUMRA

For the water distribution scheme of Chak Jhumra, clean and filtered drinking water from surface water treatment plant will be pumped to the Over Head Reservoir (OHR). A distribution network of pipes in different villages will be laid which will fill the Lower Level Reservoir (LLR) in each Sahulat Center / Markaz-e-Aab point. And from the Markaz-e-Aab, people will collect the drinking water. This scheme is depicted in the **Figure 3-29** given below:

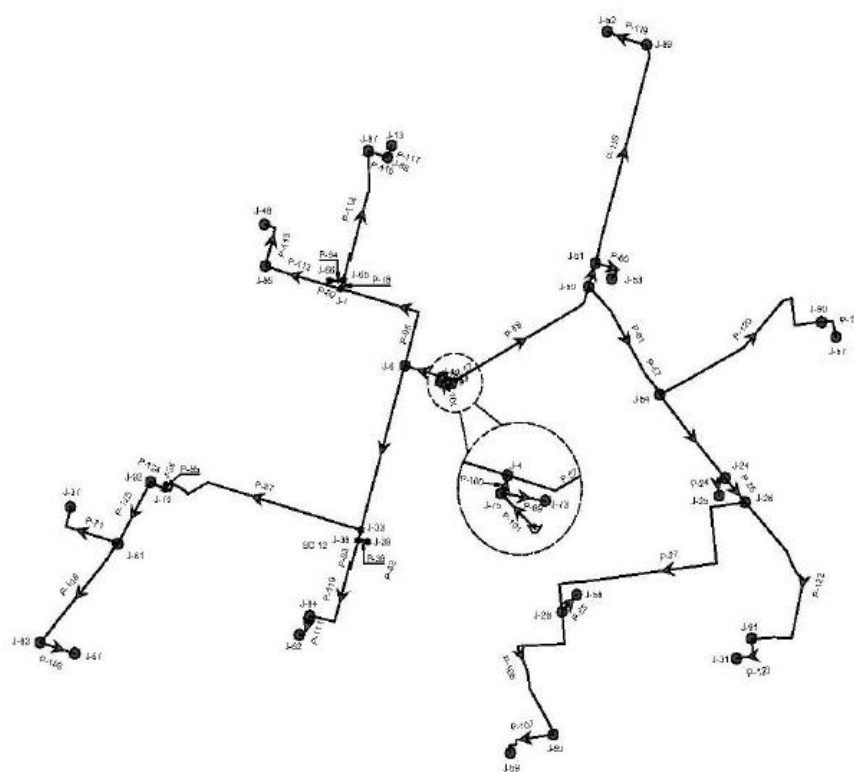


Figure 3-29: Map showing water distribution scheme of Chak Jhumra

3.85 COST ESTIMATES FOR CHAK JHUMRA

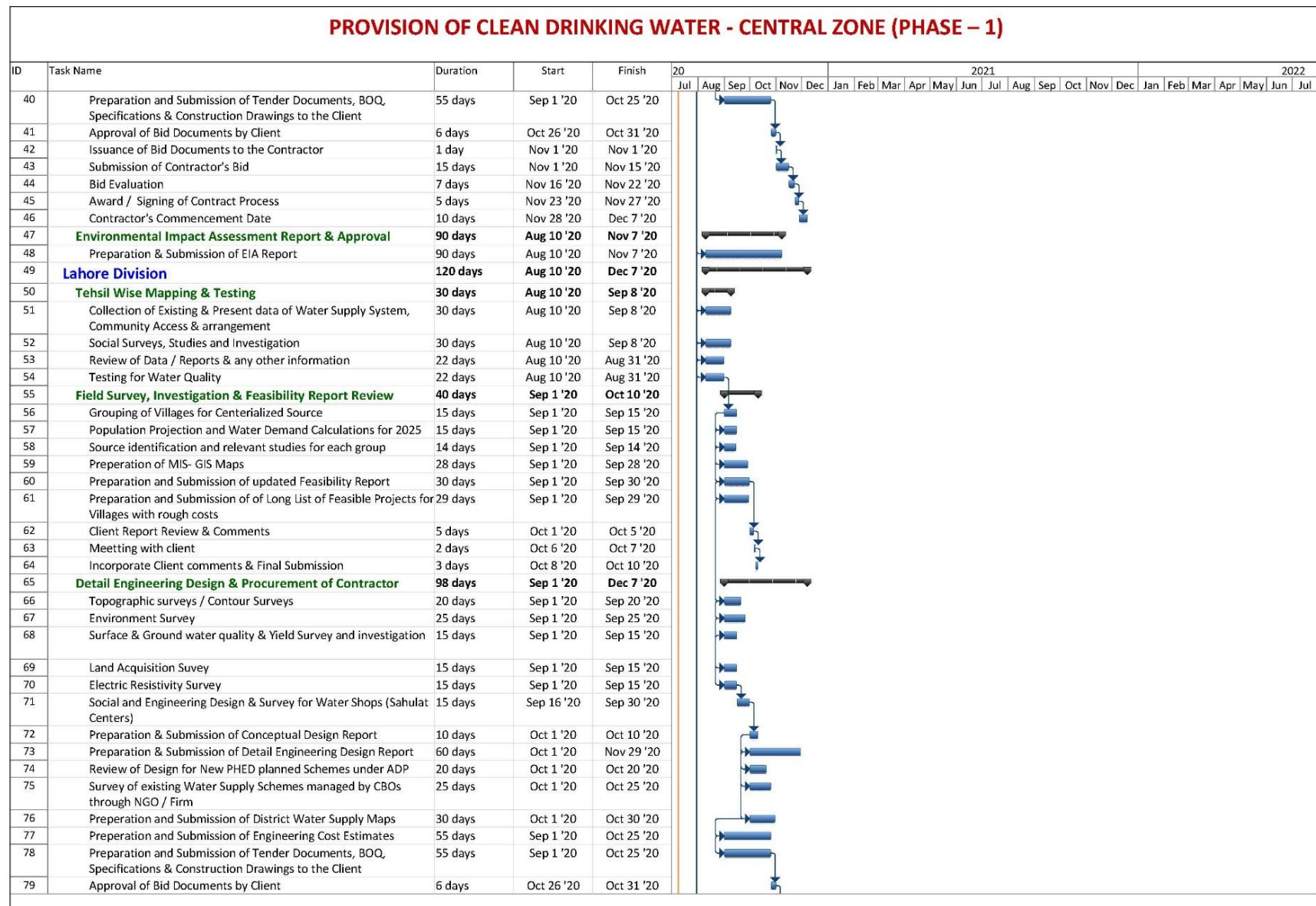
Table 3-29: Cost Estimates for Chak Jhumra

Sr. No.	General Abstract of Cost	Amount (Rs.) in Million
1.	SUPPLY CONSTRUCTION, INSTALLATION OF CONVENTIONAL TREATMENT PLAN IN CHAK JUMRAH TEHSIL FAISALABAD + Other Related Charges	142.252

3.86 SCHEDULE OF IMPLEMENTATION

Overall working and activity schedule for the Central Zone of Punjab i.e. Faisalabad, Lahore, Sahiwal Divisions, Chak Jhumra and Renala Khurd by Punjab Aab-e-Pak Authority is given below.

PROVISION OF CLEAN DRINKING WATER - CENTRAL ZONE (PHASE – 1)																																
ID	Task Name	Duration	Start	Finish	2021												2022															
					Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul			
1	PROVISION OF CLEAN DRINKING WATER Project - CENTRAL ZONE (PHASE – 1)	721 days	Aug 10 '20	Jul 31 '22																												
2	General Works	7 days	Aug 10 '20	Aug 16 '20																												
3	Commencement & Mobilization	7 days	Aug 10 '20	Aug 16 '20																												
4	Commencement Date of Consultancy Services	0 days	Aug 10 '20	Aug 10 '20																												
5	Mobilization & Kick of Meeting	7 days	Aug 10 '20	Aug 16 '20																												
6	Inception Stage	14 days	Aug 16 '20	Aug 30 '20																												
7	Inception Stage	0 days	Aug 16 '20	Aug 16 '20																												
8	Data Collection	4 days	Aug 17 '20	Aug 20 '20																												
9	Site visits / Meetings	3 days	Aug 21 '20	Aug 23 '20																												
10	Preparation & Submission of Inception Report	7 days	Aug 24 '20	Aug 30 '20																												
11	Faisalabad Division	120 days	Aug 10 '20	Dec 7 '20																												
12	Tehsil Wise Mapping & Testing	30 days	Aug 10 '20	Sep 8 '20																												
13	Collection of Existing & Present data of Water Supply System, Community Access & arrangement	30 days	Aug 10 '20	Sep 8 '20																												
14	Social Surveys, Studies and Investigation	30 days	Aug 10 '20	Sep 8 '20																												
15	Review of Data / Reports & any other information	22 days	Aug 10 '20	Aug 31 '20																												
16	Testing for Water Quality	22 days	Aug 10 '20	Aug 31 '20																												
17	Field Survey, Investigation & Feasibility Report Review	40 days	Sep 1 '20	Oct 10 '20																												
18	Grouping of Villages for Centralized Source	15 days	Sep 1 '20	Sep 15 '20																												
19	Population Projection and Water Demand Calculations for 2025	15 days	Sep 1 '20	Sep 15 '20																												
20	Source identification and relevant studies for each group	14 days	Sep 1 '20	Sep 14 '20																												
21	Preparation of MIS- GIS Maps	28 days	Sep 1 '20	Sep 28 '20																												
22	Preparation and Submission of updated Feasibility Report	30 days	Sep 1 '20	Sep 30 '20																												
23	Preparation and Submission of Long List of Feasible Projects for Villages with rough costs	29 days	Sep 1 '20	Sep 29 '20																												
24	Client Report Review & Comments	5 days	Oct 1 '20	Oct 5 '20																												
25	Meeting with client	2 days	Oct 6 '20	Oct 7 '20																												
26	Incorporate Client comments & Final Submission	3 days	Oct 8 '20	Oct 10 '20																												
27	Detail Engineering Design & Procurement of Contractor	98 days	Sep 1 '20	Dec 7 '20																												
28	Topographic surveys / Contour Surveys	20 days	Sep 1 '20	Sep 20 '20																												
29	Environment Survey	25 days	Sep 1 '20	Sep 25 '20																												
30	Surface & Ground water quality & Yield Survey and investigation	15 days	Sep 1 '20	Sep 15 '20																												
31	Land Acquisition Survey	15 days	Sep 1 '20	Sep 15 '20																												
32	Electric Resistivity Survey	15 days	Sep 1 '20	Sep 15 '20																												
33	Social and Engineering Design & Survey for Water Shops (Sahulat Centers)	15 days	Sep 16 '20	Sep 30 '20																												
34	Preparation & Submission of Conceptual Design Report	10 days	Oct 1 '20	Oct 10 '20																												
35	Preparation & Submission of Detail Engineering Design Report	60 days	Oct 1 '20	Nov 29 '20																												
36	Review of Design for New PHED planned Schemes under ADP	20 days	Oct 1 '20</																													



PROVISION OF CLEAN DRINKING WATER - CENTRAL ZONE (PHASE – 1)

ID	Task Name	Duration	Start	Finish	2021												2022											
					Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
80	Issuance of Bid Documents to the Contractor	1 day	Nov 1 '20	Nov 1 '20																								
81	Submission of Contractor's Bid	15 days	Nov 1 '20	Nov 15 '20																								
82	Bid Evaluation	7 days	Nov 16 '20	Nov 22 '20																								
83	Award / Signing of Contract Process	5 days	Nov 23 '20	Nov 27 '20																								
84	Contractor's Commencement Date	10 days	Nov 28 '20	Dec 7 '20																								
85	Environmental Impact Assessment Report & Approval	90 days	Aug 10 '20	Nov 7 '20																								
86	Preparation & Submission of EIA Report	90 days	Aug 10 '20	Nov 7 '20																								
87	Sahiwal Division	120 days	Aug 10 '20	Dec 7 '20																								
88	Tehsil Wise Mapping & Testing	30 days	Aug 10 '20	Sep 8 '20																								
89	Collection of Existing & Present data of Water Supply System, Community Access & arrangement	30 days	Aug 10 '20	Sep 8 '20																								
90	Social Surveys, Studies and Investigation	30 days	Aug 10 '20	Sep 8 '20																								
91	Review of Data / Reports & any other information	22 days	Aug 10 '20	Aug 31 '20																								
92	Testing for Water Quality	22 days	Aug 10 '20	Aug 31 '20																								
93	Field Survey, Investigation & Feasibility Report Review	40 days	Sep 1 '20	Oct 10 '20																								
94	Grouping of Villages for Centerialized Source	15 days	Sep 1 '20	Sep 15 '20																								
95	Population Projection and Water Demand Calculations for 2025	15 days	Sep 1 '20	Sep 15 '20																								
96	Source identification and relevant studies for each group	14 days	Sep 1 '20	Sep 14 '20																								
97	Preperation of MIS- GIS Maps	28 days	Sep 1 '20	Sep 28 '20																								
98	Preparation and Submission of updated Feasibility Report	30 days	Sep 1 '20	Sep 30 '20																								
99	Preparation and Submission of Long List of Feasible Projects for Villages with rough costs	29 days	Sep 1 '20	Sep 29 '20																								
100	Client Report Review & Comments	5 days	Oct 1 '20	Oct 5 '20																								
101	Meeting with client	2 days	Oct 6 '20	Oct 7 '20																								
102	Incorporate Client comments & Final Submission	3 days	Oct 8 '20	Oct 10 '20																								
103	Detail Engineering Design & Procurement of Contractor	98 days	Sep 1 '20	Dec 7 '20																								
104	Topographic surveys / Contour Surveys	20 days	Sep 1 '20	Sep 20 '20																								
105	Environment Survey	25 days	Sep 1 '20	Sep 25 '20																								
106	Surface & Ground water quality & Yield Survey and investigation	15 days	Sep 1 '20	Sep 15 '20																								
107	Land Acquisition Survey	15 days	Sep 1 '20	Sep 15 '20																								
108	Electric Resistivity Survey	15 days	Sep 1 '20	Sep 15 '20																								
109	Social and Engineering Design & Survey for Water Shops (Sahulat Centers)	15 days	Sep 16 '20	Sep 30 '20																								
110	Preparation & Submission of Conceptual Design Report	10 days	Oct 1 '20	Oct 10 '20																								
111	Preparation & Submission of Detail Engineering Design Report	60 days	Oct 1 '20	Nov 29 '20																								
112	Review of Design for New PHED planned Schemes under ADP	20 days	Oct 1 '20	Oct 20 '20																								
113	Survey of existing Water Supply Schemes managed by CBOs through NGO / Firm	25 days	Oct 1 '20	Oct 25 '20																								
114	Preperation and Submission of District Water Supply Maps	30 days	Oct 1 '20	Oct 30 '20																								
115	Preperation and Submission of Engineering Cost Estimates	55 days	Sep 1 '20	Oct 25 '20																								
116	Preparation and Submission of Tender Documents, BOQ, Specifications & Construction Drawings to the Client	55 days	Sep 1 '20	Oct 25 '20																								
117	Approval of Bid Documents by Client	6 days	Oct 26 '20	Oct 31 '20																								
118	Issuance of Bid Documents to the Contractor	1 day	Nov 1 '20	Nov 1 '20																								
119	Submission of Contractor's Bid	15 days	Nov 1 '20	Nov 15 '20																								
120	Bid Evaluation	7 days	Nov 16 '20	Nov 22 '20																								

PROVISION OF CLEAN DRINKING WATER - CENTRAL ZONE (PHASE – 1)

ID	Task Name	Duration	Start	Finish	20		2021												2022												
					Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul		
121	Award / Signing of Contract Process	5 days	Nov 23 '20	Nov 27 '20																											
122	Contractor's Commencement Date	10 days	Nov 28 '20	Dec 7 '20																											
123	Environmental Impact Assessment Report & Approval	90 days	Aug 10 '20	Nov 7 '20																											
124	Preparation & Submission of EIA Report	90 days	Aug 10 '20	Nov 7 '20																											
125	Construction Supervision of Central Zone (Faisalabad, Lahore & Sahiwal Division)	600 days	Dec 8 '20	Jul 30 '22																											
126	Mobilization of Staff on Site	10 days	Dec 8 '20	Dec 17 '20																											
127	Review Implementation Schedule of the Contractor	590 days	Dec 18 '20	Jul 30 '22																											
128	Provide Engineering Supervision to the Execution of all Tender Works	590 days	Dec 18 '20	Jul 30 '22																											
129	Preparing Construction Drawings	590 days	Dec 18 '20	Jul 30 '22																											
130	Making Measurements of the work done as basis for running Payments to the Contractor	590 days	Dec 18 '20	Jul 30 '22																											
131	Coduct factory and site tests as per specification	590 days	Dec 18 '20	Jul 30 '22																											
132	Check and verify the work quality and quantity of construction material used at site	590 days	Dec 18 '20	Jul 30 '22																											
133	Conduct tests on the different material to be used at site and keep records	590 days	Dec 18 '20	Jul 30 '22																											
134	Preparing of Variation Order resulting due to changes in he Design or scope etc. as per requirement of the Project	590 days	Dec 18 '20	Jul 30 '22																											
135	Determination / Evaluation of Extension of Time (EOT) claim as per project requirement	590 days	Dec 18 '20	Jul 30 '22																											
136	Prepare the monthly Quality & Enviornmental progress reports for the Employer & Punjab EPA	590 days	Dec 18 '20	Jul 30 '22																											
137	Supervising testing & Commissioning of the Completed works of the Scheme	590 days	Dec 18 '20	Jul 30 '22																											
138	Geting Rectified all the Defects through Contractor identified during the inspection and make the System Functional	590 days	Dec 18 '20	Jul 30 '22																											
139	Provide Monthly Progress monitoring Report related to Physical Environment & Financial of all subprojects	590 days	Dec 18 '20	Jul 30 '22																											
140	Meetings with Client / Contractor regarding progress, Issues and any other matters when required	590 days	Dec 18 '20	Jul 30 '22																											
141	Review of As-built Drawings of Facilities as prepared by Contractor and getting them finalized by the Contractors.	590 days	Dec 18 '20	Jul 30 '22																											
142	Verify IPC and Final Payments Certificate	590 days	Dec 18 '20	Jul 30 '22																											
143	Carry out Final Inspection of work before expiry of Defect Liability Period and submission fo final Completion report	590 days	Dec 18 '20	Jul 30 '22																											
144	Project Completion	1 day	Jul 31 '22	Jul 31 '22																											
145	Project Completion	1 day	Jul 31 '22	Jul 31 '22																											

CHAPTER 4 SOCIO-ENVIRONMENTAL BASELINE CONDITIONS

4.1 GENERAL

The baseline information is required for noting down the present environmental and social status of the project area because usually after the implementation of a new project, lots of current environmental features/social features are altered due to the implementation of a new project. Based on baseline information, the project interventions are assessed and mitigation measures are proposed. The baseline information also helps to indicate the specific issues to be discussed to some extent and being monitored after scheduled intervals during the construction and operational phase of the project. Therefore, the baseline data (i.e., physical, biological, and socio-economic parameters) related to the project area is described underneath. Information provided is based on primary and secondary data collected by site visits and desk studies respectively.

4.2 PHYSICAL ENVIRONMENT

The physical environment includes topography, geology, seismology, climate, soil, land use, and water resources. The existing information/conditions in the project area are briefly presented as under:

In this report we will be mostly discussing the overall Features of the Province Punjab, as the location of the project lies in the same province and similarly, other conditions like soil, climate, rainfall patterns, geology and etc. of the respective divisions under the PAPA project are similar to each other.

The Socio-Environment of Chak Jhumra Plant (Conventional Water Treatment for Supply of Clean Water to Sixteen Villages of Chak Jhumra) is considered same as Faisalabad Division as it is a Tehsil of Faisalabad Division. Similarly, the Socio-Environment of Renala Khurd (Surface Water Treatment Plant at Okara) is considered as same as that of Sahiwal Division.

4.3 TOPOGRAPHY

4.3.1 Topography (Faisalabad Division)

Faisalabad lies between longitude 73° and 74° East, latitude 30° and 31.5° North having an elevation of 605 feet from sea level. The total area of the Division Faisalabad is 17,917 square kilometers. It is sharing its boundaries with Hafizabad and Sheikhpura at North and Northeast while with Okara and Sahiwal towards east and southeast, and by Jhang and Toba Tek Singh towards West and Southwest. Although, there is no natural boundary between Faisalabad and adjoining districts. River Chenab flows about 30 km in the North West while River Ravi meanders about 40 km off the city in the South East. Lower Chenab canal is the main source of irrigation water, which meets the requirements of 80% of cultivated land. The topography is marked by valleys, local depression, and high ground.

4.3.2 Topography (Lahore Division)

Lahore is the capital of Pakistan's largest province, Punjab; with a population exceeding 10 million, it is a megacity and ranked as the country's second largest metropolis (after Karachi). Lahore lies between 31°45' N and 74°39' E, it is bounded on the north and west by the Sheikhpura District, on the east by Wagah, and on the south by Kasur District. The Ravi River flows on the northern side of Lahore. Lahore Division covers a total land area of 11,727-kilometer square.

4.3.3 Topography (Sahiwal Division)

Sahiwal Division is located at about 30.6 degrees north latitude and 73.1 degrees longitude in east central Pakistan in the Punjab region. It lies on the Pakistan national highway N-5 about halfway between Lahore and Multan. Sahiwal division is bordered by Faisalabad Division to the west; Lahore Division to the north; Bahawalpur Division and India to the east; and, Multan Division to south. Sahiwal division lies on the floodplain of two rivers. Ravi River lies to the west; and, Satluj River lies to the east. The dry Khushak Bias also passes through the Sahiwal Division, separating the Sahiwal District from the Pakpattan District. The total area of Sahiwal Division is 10,302 square kilometers. Almost 28,956 acres of the division is forested.

4.4 CLIMATE

4.4.1 Climate of Faisalabad Division

Faisalabad experiences semi-arid weather with hot, muggy summers and dry, chilly winters. June's average high and low temperatures are 45.5 °C and 26.9 °C, respectively. The average low and high temperatures in January are 19.4 °C and 4.1 °C, respectively.

The summer season starts in mid-April and continues until late October. May and June are the hottest months, while July, August and the first half of September can be oppressively humid, except for the days when it rains. June is the hottest month in Faisalabad, when conditions are dry and dust storms are common. The coldest month is January, which is also a dry month with significant foggy days. The fog is particularly dense at night and in early morning hours. The winter season starts in November and continues until early February. Spring begins after mid-February and lasts usually until late March, when temperatures begin to rise and conditions become drier and sunnier.

4.4.2 Climate of Lahore Division

Lahore has a five-season, semi-arid climate, with foggy winter (Nov 15–Feb 15) and rare wet western disturbances, pleasant spring (Feb 15–Apr 15), dusty summer (Apr–Jun) and rainy monsoon (Jul–Sep 16), and dry autumn (Sep 16 - Nov 14). June is the hottest month, with typical highs often exceeding 40°C (104°F). July is the wettest month, with lots of rain and evening thunderstorms that could produce cloudbursts. With heavy fog, January is the coolest month. The highest maximum temperature ever recorded in the city was 48.3 °C (118.9 °F) on May 30, 1944,

and 48 °C (118 °F) was recorded on June 9, 2007. The lowest temperature recorded in Lahore is –1°C, recorded on 13 January 1967.

4.4.3 Climate of Sahiwal Division

Sahiwal has a Semi-arid climate. More precisely, it is intermediate between a Desert climate and a Humid subtropical climate. Temperatures in Sahiwal vary between hot and very hot in summer and are mild in winters. In May, June and July, temperatures increase to maximums between 40 and 50 °C. In winter months, the temperature falls to minimums between 5 and 10 °C. Sahiwal lies on the edge of the Thar Desert at a low altitude and so, wet seasons are warm and dry seasons are cool. Sahiwal is also affected by the monsoon. Precipitation is very heavy in the monsoon, and dry during the rest of the year, with few or no months bringing moderate levels of precipitation.

4.5 RAINFALL PATTERN (FAISALABAD, LAHORE SAHIWAL)

The average annual rainfall in Faisalabad is just about 375 millimeters (14.8 in), and it is very seasonal, with nearly half of the yearly precipitation occurring in July and August during the monsoon season. In the rainy season, the currents are very strong. This leads to high floods in certain areas which do last for a number of days.

Rainfall in Lahore is at an intermediate level, coming in roughly 630 millimeters (24.8 inches) per year. In November, the driest month, it is 4 mm (0.2 in), and in July, the wettest, it is 200 mm (7.9 inches).

The annual average rainfall in Sahiwal is approximately 349 mm. Precipitation is very heavy in the monsoon, and dry during the rest of the year, with few or no months bringing moderate levels of precipitation.

4.6 SOIL CONDITIONS

The soil conditions of Central Zone of Punjab ranges from sandy loam to clayey. The soil is mostly fertile and fit for vegetation. The alluvial soil of this zone can be widely described as arid and brown soil or tropical arid brown soil.

The soil of Faisalabad Division consists of young stratified silt loam or very fine sandy loam which makes the subsoil weak in structure with common kankers at only five feet. The Major crops of Faisalabad are Wheat, Corn, Rice, Sugar Cane, Sun Flower and Oil seeds. The major fruits of the Faisalabad are Guavas, Mangoes, Citrus, Jaman, Banana and Lychee. While major vegetables are potatoes, Carrot, Turnip, Onion, Peas, Tomatoes and Chilies.

The land of Lahore is made of alluvial soil deposited by Ravi through ages. Lahore is plain alluvial land with a gentle slope towards south east. Its height above sea level ranges from 700 feet in north east to 680 feet in south west with a slope gradient of 1 foot per 5-10 kilometers. Lahore has fertile soil suitable for vegetation and plantation. Its soil and climatic conditions support all types of crops. The cropping pattern of Lahore also shifted from cash crops to food grain crops and vegetables to fulfill the needs of the city. Now the major cash crops like cotton and sugarcane

are not seen on the city profile. The agriculture area has been reduced significantly due to rapid urbanization and industrialization of the city.

Most of the area of the Sahiwal Division is fertile with large forested trees. Vegetation area covered 87.07% of the total land area. Although, vegetation area has decreased between the years 1981 to 2021, there appears to be a negative change in vegetation. It was observed that during the 40 years, vegetation area and bare soil have changed to roads and build-up areas. Sahiwal is a major multi-crop area of Pakistan, and many pesticides companies do business here. Its main crops are wheat, cotton, sugarcane, maize, and rice. Main fruits are citrus, mangoes and guava.

4.7 GEOLOGY

Punjab province of Pakistan is located in central-eastern region of the country. The word "**Punjab**" is a combination of the Persian words "**panj**" (five), and "**aab**" (water), giving the literal meaning of the "**Land of Five Rivers**". The five rivers which gave Punjab its name are Beas, Jhelum, Chenab, Ravi, and Sutlej. Punjab is the second-largest province of Pakistan by land area and the largest province by population. It is bordered by the Pakistani provinces of Khyber Pakhtunkhwa to the north-west, Baluchistan to the south-west and Sindh to the south, as well as Islamabad Capital Territory to the north-west and Autonomous state of AJK to the north. It shares an International border with the Indian states of Rajasthan and Punjab to the east and Indian-administered Kashmir to the north-east. The area of the project lies in the same region and hence has the similar geological conditions.

4.8 SEISMOLOGY

A moderate earthquake originating from the basement high in the Punjab plain could produce appreciable ground shaking at sites due to the thick alluvial deposits. According to the Seismic Zoning Map of Pakistan, the project area falls in Zone 2A, consequently, the structures should be designed by the requirement of seismic design after due consideration to other structural design parameters.

The figure given below shows the seismic map of Pakistan. **Figure 4-1**

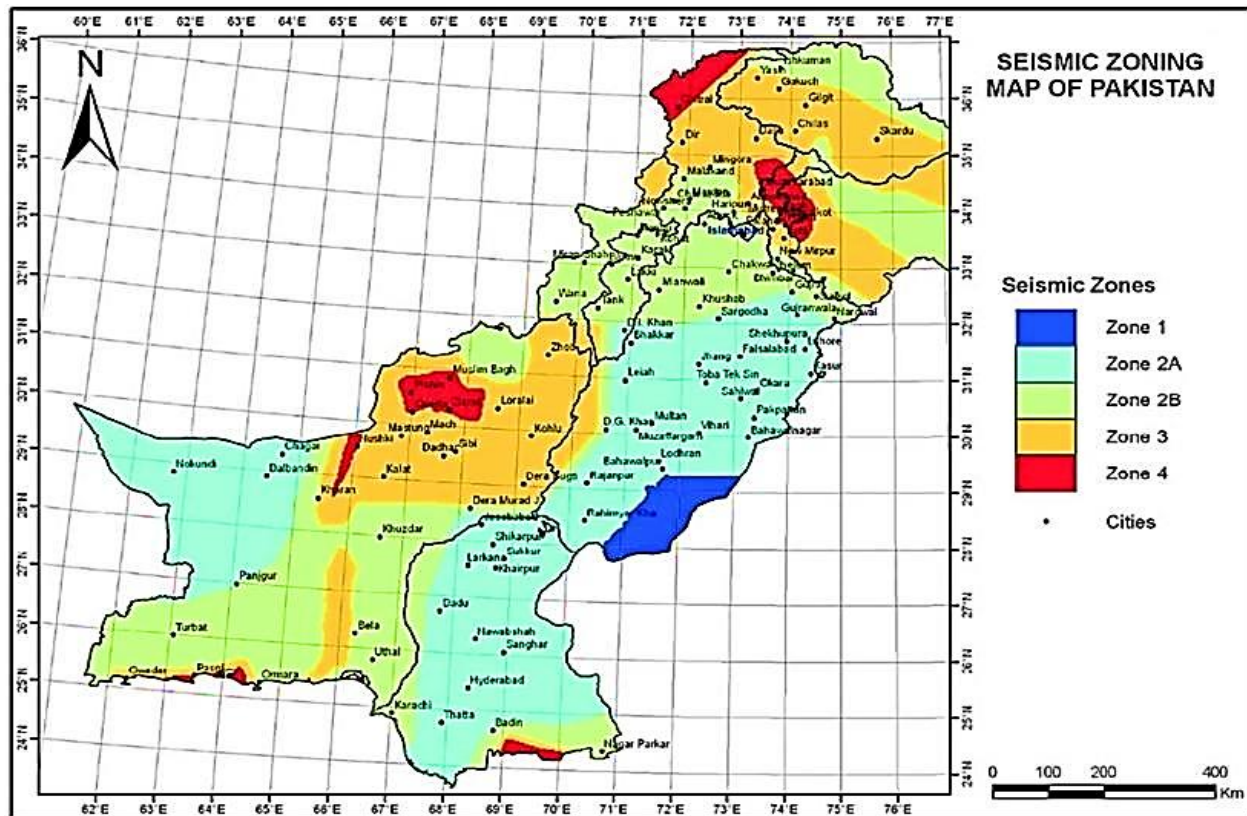


Figure 4-1: Seismic Map of Pakistan

4.9 WATER RESOURCES

Both types of water i.e. ground and surface are present in the overall the Punjab Province.

4.9.1 Surface Water

As the land of Punjab has five vast rivers. These rivers are connected through a vast network of canals which irrigate the project area. Most of the agricultural land is cultivated through these canals. Some of the major canals are Lower Chenab Canal, Lower Jhelum Canal, Upper Jhelum Canal, Upper Chenab Canal and Lower Bari Doab Canal. There are also some small tributary canals present in the divisions of the project area which are also used for irrigation.

In this project, only Tehsil Renala Khurd will take water from the nearby canal which will be used for drinking purpose after the treatment. The recommended water source for Renala Khurd is from 1/AL Jhand Wala Minor Branch canals.

4.9.2 Ground Water

Ground Water is also present in the project area. Ground Water is mostly used for drinking purposes. But the quality of groundwater is not up to the desired limits due to the presence of arsenic and other harmful pollutants present in the ground water. However, it is also used for irrigation on those areas where a nearby canal is not present. People use tube wells to extract ground water for irrigation purposes.

In this project, PAPA (Punjab Aab-e-Pak Authority) is planning to use existing boreholes to extract ground water which will be used for drinking purposes after the treatment. In some areas, direct supply is used and similarly, in some areas, water will be supplied for drinking purposes through existing water supply schemes present in those areas.

4.10 BIOLOGICAL ENVIRONMENT

The biological component of the area includes the flora and fauna of the project area.

Detail information of the project area is provided as under:

4.10.1 Flora

The Punjab province has five large forests. The name of the forests are Changa Manga Forest, Pabbi Range Forest, Lehi Nature Reserve, Lohi Bher Forest and Takhat Pari Forest. No part of the any forest comes under project area.

4.10.1.1 Forest Trees

The project lies in the central zone of Punjab. The whole area is reported to be native vegetation of the Indus basin system. There is no any potential threat to the flora of the project area as no tree is going to be cut for the project.

The major forest trees of the project area are presented in the **Table 4-1**.

Table 4-1: Common Trees of the Project Area

Sr. No.	Common Name	Scientific Name
1	Kikar	Acacia Nilotica
2	Sheesham	Dilbergia Sisso
3	Amaltas	Cassia fistula
4	Neem	Azadirachia Indica
5	Bur	Solanum rostratum
6	Peepal	Ficus religiosa
7	Sumbul	Bombax Ceiba
8	Sufayda	Eucalyptus
9	Jhand	Prosopis Cineraria

4.10.1.2 Fruit Trees

Fruit trees are often planted by the farmers of native land by themselves as well as the concerned government departments. The major fruit trees of the project area are presented in **Table 4-2**.

Table 4-2: Major Fruit Trees of the Project Area

Sr. No	Common Name	Scientific Name
1	Mango	Mangifera indica
2	Jammun (BlackBerry)	Syzygium cumini
3	Bairyee	Ziziphus mauritiana
4	Guava	Psidium Guajava
5	Kinoo	Kinnow (Malta)

4.10.2 Fauna

In the project area due to urbanization and intensification of agricultural crop production activities, loss of forest spots, and hunting the wildlife has been decreased considerably. However, various types of animals are found surrounding the project area according to existing environmental conditions suitable for their survival. In the project area, which is away from urban centers, some of the common animals found are rabbits jackals, foxes, and caracal cats. The other species found in the area are different types of snakes, tortoises, frogs, toads, etc.

In the area, different species of birds like peacock, storks, purple, Morhen (Jal-kukar), crows, sparrows, grey partridge, black partridge, dove, etc. are commonly found. Generally, some species are vanishing with time in the area. But there is no potential threat to the fauna resulting from the project activities.

4.11 ENVIRONMENTAL ANALYSIS

Green Engineering Consultant has been engaged to carry out for the water quality analysis of the project area in the Central Zone of Punjab with the divisions of Faisalabad, Lahore and Sahiwal. Details of the laboratory results are attached as **Annexure-IV**.

4.12 WATER QUALITY ANALYSIS OF FAISALABAD DIVISION

A study was conducted to assess the Water quality of Faisalabad Division under Punjab Aab e-Pak project. Water quality was monitored at one hundred and Sixty-Two (162) selected locations to conduct a comparison of pollutants/contamination level with respective standards.

In order to check water quality of existing PHED borehole water in Faisalabad Division. Water Quality was evaluated on the basis of some principles like Color, Odor, Taste, EC, pH, Turbidity, Alkalinity, Calcium, Chloride, Total Hardness, Nitrate, Potassium, Sodium, TDS, Chromium, Fluoride, Iron, Manganese, Arsenic, E-coli, Total Coliforms and COD. Results show that the levels of parameters (TDS, Fluoride, Turbidity, Hardness, Arsenic, Nitrate & Microbial parameters) were out of limits of their respective standard. TDS, fluorides and Arsenic level were found very high in the tested water samples of Faisalabad Division Main reason for these higher values is that, these water sources are contaminated and having high quality of soluble salts Considering the lab results, there is a need to provide proper water treatment facilities for the people of Faisalabad Division to achieve better living standards.

Overall Lab Results of Water Quality are also given in the **Annexure IV-A**.

	Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD	
Drinking Water Sampling & Testing for Faisalabad Division			

Report 4: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	150, Chiniot	GEC Report No:	GEC-ENV-P-094/20-R-1638
Coordinates:	31°30'38.00"N, 72°52'27.00"E	Sample Identification:	ECSP-DW-287
Sampling Source:	Electric Pump	Sample Collection Date:	January 22, 2021
Source Depth:	450 ft	Report Issue Date:	February 18, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameters</u>	Turbidity	NTU	0.11	< 5	< 5
	Total hardness as CaCO ₃	mg/l	38.3	< 500	---
	TDS	mg/l	178	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Taste	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Color	TCU	5	15	15
	pH	-	7.3	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	0.01	< 0.05	0.01
	Fluoride	mg/l	0.11	< 1.5	1.5
	Nitrate	mg/l	0.23	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	Feacal Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	0	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: All the parameters are within limit according to Punjab Environmental Quality Standards.

Note: This report is not valid for court.

Sample Analyzed by:

Chief Chemist:

Head of Env Lab:

Nabila Shabbir

Asma Khalid

Muhammad Umair

 Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD 
	Drinking Water Sampling & Testing for Faisalabad Division

Report 14: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	112 JB Ramdewali, Faisalabad Sadar	GEC Report No:	GEC-ENV-P-094/20-R-1648
Coordinates:	31°35'39.00"N, 73°4'28.00"E	Sample Identification:	ECSP-DW-297
Sampling Source:	Electric Pump	Sample Collection Date:	January 22, 2021
Source Depth:	60 ft	Report Issue Date:	February 18, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameter</u>	Turbidity	NTU	0.12	< 5	< 5
	Total hardness as CaCO ₃	mg/l	62.4	< 500	---
	TDS	mg/l	895	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Taste	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Color	TCU	6	15	15
	pH	-	7.6	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	0.005	< 0.05	0.01
	Fluoride	mg/l	0.72	< 1.5	1.5
	Nitrate	mg/l	2.01	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	Faecal Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	0	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: Some of the parameters are out of limit according to Punjab Environmental Quality Standards.

Note: This report is not valid for court.

Sample Analyzed by:

Chief Chemist:

Head of Env Lab:

Nabila Shabbir

Asma Khalid

Muhammad Umair

 Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD 
	Drinking Water Sampling & Testing for Faisalabad Division

Report 34: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	89 GB, Jaranwala	GEC Report No:	GEC-ENV-P-094/20-R-1668
Coordinates:	31°12'56.00"N, 73°10'37.00"E	Sample Identification:	ECSP-DW-317
Sampling Source:	Electric Pump	Sample Collection Date:	January 26, 2021
Source Depth:	40 ft	Report Issue Date:	February 18, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameters</u>	Turbidity	NTU	0.67	< 5	< 5
	Total hardness as CaCO ₃	mg/l	76.2	< 500	---
	TDS	mg/l	1156	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Non Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Taste	-	Non Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Color	TCU	7	15	15
	pH	-	7.6	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	BDL	< 0.05	0.01
	Fluoride	mg/l	1.23	< 1.5	1.5
	Nitrate	mg/l	12.32	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	11	Must not be detectable	Must not be detectable
	Feecal Coli Form	Cfu/100ml	5	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	2	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: Some of the parameters are out of limit according to Punjab Environmental Quality Standards.

Note: This report is not valid for court.

Sample Analyzed by:

Chief Chemist:

Head of Env Lab:

Nabila Shabbir

Asma Khalid

Muhammad Umair

4.13 WATER QUALITY ANALYSIS OF CHAK JHUMRA

A study was conducted to assess the Water quality of Chak Jhumra under Punjab Aab-e-Pak Project. In the study, water samples were collected from Sixteen (16) villages of Chak Jhumra. The observed results for water quality parameters are compared to the Punjab Environmental Quality Standards (PEQS) and the World Health Organization (WHO) standards. Water Analysis Results shows that the turbidity, nitrates and microbiological contents at some locations are within the limit of PEQs standards. However, at some locations microbial content is very high which is due to sewerage contamination. Hence, it was concluded from the lab results of Chak Jhumra that the water is not fit for drinking. Installation and operation of water filtration plant is necessary for the people of Chak Jhumra to sustain a healthy life.

Detailed Water Analysis Quality Reports of Chak Jhumra are attached as **Annexure IV-E**.

Summary of Water Quality Analysis at Chak Jhumra

A summary of water quality analysis using the TDS level as a parameter to check the water quality of Chak Jhumra is given below in the Table:

Locations	TDS (mg/l)	PEQs (mg/l)
Chak 134-RB Gharbi	1094	1000
Chak 19-JB Qadarky	730	1000
Chak 19-JB Barali	1490	1000
Chak 18-JB Hamoky	913	1000
Chak 18-JB Balmabad	729	1000
Chak 18-JB Panaky	1402	1000
Chak 18-JB Majoranwala	895	1000
Chak 18-JB Theme	923	1000
Chak 18-JB Matmal	830	1000
Chak 18-JB Bar	1660	1000
Chak 18-JB Paka Dhalla	1470	1000
Chak 43-JB Parwana	1272	1000
Chak 129-RB Tibinagar	1055	1000
Chak 129-RB Rasianwala	1623	1000
Chak 134-RB Mitranwali Sharqi	1060	1000
Chak 135-RB Kanansian	1360	1000

4.14 WATER QUALITY ANALYSIS OF LAHORE DIVISION

A study was conducted to assess the Water quality of Lahore Division under Punjab Aab e-Pak project. In the study, water samples were collected from One hundred sixty-four (164) different locations in the Lahore Division. The observed results for water quality parameters are compared to the Punjab Environmental Quality Standards (PEQS) and the World Health Organization (WHO) standards. The results show that the parameters (TDS, Fluoride, Turbidity, Hardness, Arsenic, Nitrate, and Microbial parameters) were above their respective limits. TDS and fluoride levels were found to be extremely high in Lahore Division water samples tested. The main reason for these higher values is that these water sources are contaminated and have high soluble salt quality.

Considering the lab results, there is a need to provide proper water treatment facilities for the people of Lahore to achieve better living standards.

Detailed Water Quality Analysis lab reports are attached as **Annexure IV-B**.

 Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD 
	Drinking Water Sampling & Testing for Lahore Division

Report 35: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	Bhedian Kalan, Kasur	GEC Report No:	GEC-ENV-P-094/20-R-1235
Coordinates:	31.063022, 74.527145	Sample Identification:	ECSP-DW-154
Sampling Source:	House Hold WS Water	Sample Collection Date:	January 15, 2020
Source Depth:	Not Applicable	Report Issue Date:	January 19, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameters</u>	Turbidity	NTU	0.33	< 5	< 5
	Total hardness as CaCO ₃	mg/l	31.7	< 500	---
	TDS	mg/l	195	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Taste	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Color	TCU	6.3	15	15
	pH	-	7.8	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	BDL	< 0.05	0.01
	Fluoride	mg/l	0.34	< 1.5	1.5
	Nitrate	mg/l	5.4	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	6	Must not be detectable	Must not be detectable
	Feacal Coli Form	Cfu/100ml	2	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	1	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: Some of the parameters are out of limit according to Punjab Environmental Quality Standards.

Note: This report is not valid for court.

Sample Analyzed by:



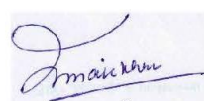
Nabila Shabbir

Chief Chemist:



Asma Khalid

Head of Env Lab:




Muhammad Umair

	Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD	
Drinking Water Sampling & Testing for Lahore Division			

Report 99: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	Chak No 16/GB, Budometa, Nankana Sab	GEC Report No:	GEC-ENV-P-094/20-R-1299
Coordinates:	31.4955, 73.472255	Sample Identification:	ECSP-DW-218
Sampling Source:	Electric Pump	Sample Collection Date:	January 14, 2021
Source Depth:	50 Feet	Report Issue Date:	January 19, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameter</u>	Turbidity	NTU	0.77	< 5	< 5
	Total hardness as CaCO ₃	mg/l	112.6	< 500	---
	TDS	mg/l	2017	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Taste	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Color	TCU	6.6	15	15
	pH	-	7.3	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	0.031	< 0.05	0.01
	Fluoride	mg/l	0.34	< 1.5	1.5
	Nitrate	mg/l	4.1	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	Feacal Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	0	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: All the parameters are within limit except TDS according to Punjab Environmental Quality Standards.

Note: This report is not valid for court.

Sample Analyzed by:



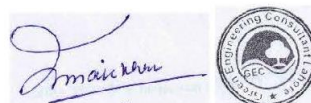
Nabila Shabbir

Chief Chemist:



Asma Khalid

Head of Env Lab:



Muhammad Umair

 Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD  Drinking Water Sampling & Testing for Lahore Division
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Report 137: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	Nawan Kot, Sheikhpura	GEC Report No:	GEC-ENV-P-094/20-R-1337
Coordinates:	31.606697, 73.874153	Sample Identification:	ECSP-DW-256
Sampling Source:	Electric Pump	Sample Collection Date:	January 09, 2020
Source Depth:	95 Feet	Report Issue Date:	January 19, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameter</u>	Turbidity	NTU	1.13	< 5	< 5
	Total hardness as CaCO ₃	mg/l	697.5	< 500	---
	TDS	mg/l	3325	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Taste	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Color	TCU	6.4	15	15
	pH	-	7.6	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	0.081	< 0.05	0.01
	Fluoride	mg/l	2.21	< 1.5	1.5
	Nitrate	mg/l	15.9	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	Feacal Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	0	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: Some of the parameters are out of limit according to Punjab Environmental Quality Standards.

Note: This report is not valid for court.

Sample Analyzed by:



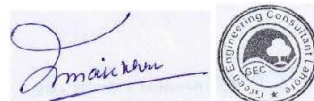
Nabila Shabbir

Chief Chemist:



Asma Khalid

Head of Env Lab:



Muhammad Umair

4.15 WATER QUALITY ANALYSIS OF SAHIWAL DIVISION

A study was carried out to test the water quality was monitored at one hundred and forty (140) selected locations to conduct a comparison of pollutants/contamination level with respective standards. One hundred and forty results show that the levels of parameters (TDS, Fluoride, Turbidity, Hardness, Arsenic, Nitrate & Microbial parameters) were out of limits of their respective standard. TDS and fluorides level were found very high in the tested water samples of Sahiwal Division. Main reason for these higher values is that, these water sources are contaminated and having high quality of soluble salts.

Hence it was concluded from the analyzed results of collected water samples that this water is contaminated and not suitable for drinking use of public of Sahiwal Division. Installation and operation of water filtration plants is essential for provision of clean and healthy water for people of Sahiwal Division.

Detailed Lab Water Quality Analysis reports of Sahiwal Division are attached as **Annexure-IV-C**.

 Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD 
	Drinking Water Testing For Sahiwal Division

Report 7: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	Chak 28/4I, Okara	GEC Report No:	GEC-ENV-P-094/20-R-1808
Coordinates:	30.704461 73.382190	Sample Identification:	ECSP-DW-452
Sampling Source:	Electric Pump	Sample Collection Date:	January 19, 2021
Source Depth:	80 ft.	Report Issue Date:	March 01, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameters</u>	Turbidity	NTU	0.13	< 5	< 5
	Total hardness as CaCO ₃	mg/l	517.3	< 500	---
	TDS	mg/l	2079	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Taste	-	Not-Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Color	TCU	7	15	15
	pH	-	7.4	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	0.025	< 0.05	0.01
	Fluoride	mg/l	2.37	< 1.5	1.5
	Nitrate	mg/l	21.9	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	Feacal Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	0	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: Some of the parameters are out of limit according to Punjab Environmental Quality Standards.

Note: This report is not valid for court.

Sample Analyzed by:



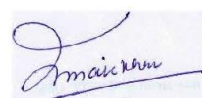
Nabila Shabbir

Chief Chemist:



Asma Khalid

Head of Env Lab:




Muhammad Umair

	Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD	
		Drinking Water Testing For Sahiwal Division	

Report 125: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	Rural Water Supply Malka Hans, Pakpattan	GEC Report No:	GEC-ENV-P-094/20-R- 1926
Coordinates:	-	Sample Identification:	ECSP-DW-570
Sampling Source:	Electric Pump	Sample Collection Date:	January 21, 2021
Source Depth	100 ft.	Report Issue Date:	March 01, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameter</u>	Turbidity	NTU	0.18	< 5	< 5
	Total hardness as CaCO ₃	mg/l	28.5	< 500	---
	TDS	mg/l	181	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Acceptable	Acceptable/Non- Acceptable	Acceptable/Non- Acceptable
	Taste	-	Acceptable	Acceptable/Non- Acceptable	Acceptable/Non- Acceptable
	Color	TCU	7	15	15
	pH	-	7.3	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	BDL	< 0.05	0.01
	Fluoride	mg/l	0.22	< 1.5	1.5
	Nitrate	mg/l	1.34	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	Feacal Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	0	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: All the parameters are within limit according to Punjab Environmental Quality Standards.

Note: This report is not valid for court.

Sample Analyzed by:



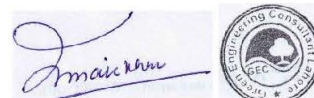
Nabila Shabbir

Chief Chemist:



Asma Khalid

Head of Env Lab:



Muhammad Umair

 Green Engineering Consultant	ENGINEERING CONSULTANCY SERVICES PUNJAB (PVT) LTD 
	Drinking Water Testing For Sahiwal Division

Report 140: Drinking Water Analysis Report

Client Name:	Engineering Consultancy Services Punjab Pvt. Ltd	GEC Job Reference:	P-GEC-ENV-094/2020
Village Name:	RWWS 142/9L, Sahiwal	GEC Report No:	GEC-ENV-P-094/20-R-1941
Coordinates:	-	Sample Identification:	ECSP-DW-585
Sampling Source:	Electric Pump	Sample Collection Date:	January 25, 2021
Source Depth	60 ft.	Report Issue Date:	March 01, 2021

Analysis Results

Type	Parameter	Unit	Result	PEQS	WHO Standards
<u>Physical Parameter</u>	Turbidity	NTU	0.86	< 5	< 5
	Total hardness as CaCO ₃	mg/l	78.5	< 500	---
	TDS	mg/l	942	< 1000	< 1000
	TSS	mg/l	0	-	---
	Odour	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Taste	-	Acceptable	Acceptable/Non-Acceptable	Acceptable/Non-Acceptable
	Color	TCU	6	15	15
	pH	-	7.4	6.5-8.5	6.5-8.5
<u>Chemical Parameters</u>	Arsenic	mg/l	0.005	< 0.05	0.01
	Fluoride	mg/l	0.56	< 1.5	1.5
	Nitrate	mg/l	12.7	< 50	50
<u>Microbiological Parameters</u>	Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	Feacal Coli Form	Cfu/100ml	0	Must not be detectable	Must not be detectable
	E Coli	Cfu/100ml	0	Must not be detectable	Must not be detectable

APHA: American Public Health Association

BDL: Below Detection Limit

ND: Not Detectable

PEQS: Punjab Environmental Quality Standards

Remarks: All the parameters are within limit according to Punjab Environmental Quality Standards.

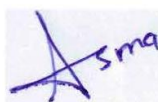
Note: This report is not valid for court.

Sample Analyzed by:



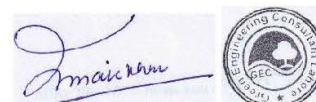
Nabila Shabbir

Chief Chemist:



Asma Khalid

Head of Env Lab:



Muhammad Umair

4.16 WATER QUALITY ANALYSIS OF RENALA KHURD

Detailed Surface Water Quality of Canal at Renala Khurd is attached as **Annexure IV-D**.

 Green Engineering Consultant	Engineering Consultancy Services Punjab (Pvt.) Ltd  Surface Water Testing at Canal of Village 28/ 1L, Akhtarabad, Okara
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Surface Water Analysis Report

Name of Client	Engineering Consultancy Services Punjab (Pvt.) Ltd.
Concerned Person	Mr. M. Fahad
GEC Reference	P-GEC-ENV-090/2020
GEC Report No	GEC-ENV-P-090/20-R-918
Client Mailing Address	83 A/E-I Main Blvd Gulberg, Block A Block E I Gulberg III, Lahore, Punjab
Type of Services	Surface Water Analysis
Date of Collection	December 05, 2020
Identification	ECSP-SW-018-A
Location	28/ 1L, Akhtar Abad, Okara, Pakistan
Report Date	December 16, 2020

Physical Parameters

Parameters	Unit	Results	PEQS	Reference Method
Temperature	°C	19.0	40±3	-
pH	-	7.5	6.5-8.5	APHA-4500 H ⁺ B
TDS	mg/l	162	3500	APHA-2500 C
TSS	mg/l	15	200	APHA-2540 D
Total Hardness	mg/l	40	N.G	APHA-2540 C
Turbidity	NTU	9.0	N.G	APHA-2130 B
DO	mg/l	6	N. G	APHA-4500-O G
Settling Time	hrs	2	N. G	-
Dry Sludge*	g/l	1.5	N. G	-
Wet Sludge*	g/l	6.1	N. G	-

Microbiological Parameters

Parameter	Unit	Results	PEQS	Reference
Total Coli Form	CFU/100ml	0	Must not be detectable	APHA-9222 B
Total Colony Count	CFU/100ml	0	Must not be detectable	APHA-9215 B
Faecal E. coli	CFU/100ml	0	Must not be detectable	APHA-9222 D
Faecal Streptococci	CFU/100ml	0	Must not be detectable	APHA-9230 C

APHA: American Public Health Association

BDL: Below Detection Limit

PEQS: Punjab Environmental Quality Standards

N.G: Not Given in PEQS

* After coagulation and flocculation

Remarks: All of the Parameters are in Limit according to Punjab Environmental Quality Standards.

Note: This report is not valid for court

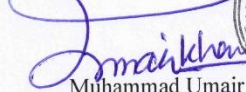
Sample Analyzed By:


 Nabila Shabbir

Chief Chemist:


 Asma Khalid

Head of Env Lab:


 Muhammad Umair





Green Engineering Consultant

Engineering Consultancy Services Punjab (Pvt.) Ltd

Surface Water Testing at Canal of Village 28/ 1L,
Akhtarabad, Okara**Surface Water Analysis Report**

Name of Client	Engineering Consultancy Services Punjab (Pvt.) Ltd.
Concerned Person	Mr. M. Fahad
GEC Reference	P-GEC-ENV-090/2020
GEC Report No	GEC-ENV-P-090/20-R-919
Client Mailing Address	83 A/E-I Main Blvd Gulberg, Block A Block E I Gulberg III, Lahore, Punjab
Type of Services	Surface Water Analysis
Date of Collection	December 05, 2020
Identification	ECSP-SW-018-A
Location	28/ 1L, Akhtar Abad, Okara, Pakistan
Report Date	December 16, 2020

Chemical Parameters

Parameter	Unit	Results	PEQS	Reference
COD	mg/l	92	150	APHA-5220 B
BOD	mg/l	36	80	APHA-5210 B
Fluorides	mg/l	4.7	10	APHA 4500 F- C
Nitrates	mg/l	10.2	N. G	APHA-4500NO3 B
Nitrites	mg/l	0.5	N. G	APHA-4500NO2 B
Nitrogen	mg/l	12.0	N. G	APHA 4500NO3 B, APHA 4500 NO2 B, APHA 4500 Norg B
Oil & Grease	mg/l	3	10	USEPA method 1664
Total Toxic metals	mg/l	0.65	2.0	-
Total Organic Carbon	mg/l	17.2	N. G	HACH-10129
Anionic Detergents	mg/l	3.2	20	APHA 5540 C
Chloride	mg/l	24.9	1000	APHA-4500 B
Ammonia	mg/l	2.1	40	APHA 4500 NH3 C,
Cyanide	mg/l	BDL	1.0	APHA 4500 CN E
Alkalinity	mg/l	5	N. G	APHA-2310 B, APHA-2320 B
Total volatile dissolved solids	mg/l	3	N. G	APHA-2540 E
Phosphorus	mg/l	2.9	N. G	APHA-4500P B+C
Fertilizers	mg/l	11.3	N. G	APHA-4500P B+C
Pesticides	mg/l	BDL	0.15	USEPA-8081A
Carbonates	mg/l	12	N. G	APHA-2340 A
Bi-Carbonates	mg/l	7	N. G	APHA-2340 A
Sulphide	mg/l	1.2	1.0	APHA 4500 S2- E
Chlorine	mg/l	0.2	N. G	APHA-4500Cl- B
Sulphur as Sulphide & sulphates	mg/l	21.4	N. G	-

4.17 SOCIO-ECONOMIC ENVIRONMENT

Socio-economic environment depicts the social standing of a class of people or a group. It is measured as a combination of educational and health facilities, quality of life, population and culture. As the area of the project lies in the Central Zone of Punjab; the socio-economic status of the project area is overall the same. The socio-economic environment is discussed collectively for the Central Zone of Punjab with divisions of Faisalabad, Lahore and Sahiwal.

4.18 ADMINISTRATIVE DIVISION

The project is planned according to the administrative divisions of Central Zone of Punjab with their districts. The divisions along with their respective districts is shown below in the **Table 4-3**.

Table 4-3: Administrative Divisions of Central Zone of Punjab

Sr. No.	Name of Division	Name of Districts
1	Faisalabad	District Faisalabad
		District Jhang
		District Toba Tek Singh
		District Chiniot
2	Lahore	District Lahore
		District Kasur
		District Nankana Sahib
		District Sheikhupura
3	Sahiwal	District Sahiwal
		District Okara
		District Pakpattan

4.19 POPULATION

All of the divisions of Central Zone of Punjab have population living in both urban and rural areas. Population data according to the census 2017 is given below in the **Table 4-4**.

Table 4-4: Population data of the Project Area (Central Zone)

Sr. No.	Name of Division	Name of Districts	Population (2017)
1	Faisalabad	District Faisalabad	7,873,910
		District Jhang	2,743,416
		District Toba Tek Singh	2,190,015
		District Chiniot	1,369,740
	Total Population of Faisalabad Division		14,177,081
2	Lahore	District Lahore	11,126,285
		District Kasur	3,454,996
		District Nankana Sahib	1,356,374
		District Sheikhpura	3,460,426
	Total Population of Lahore Division		19,398,081
3	Sahiwal	District Sahiwal	2,517,560
		District Okara	3,039,139
		District Pakpattan	1,823,687
	Total Population of Sahiwal Division		7,380,386

4.20 EDUCATIONAL INSTITUTES

Central Punjab is considered as the most educated and literate part of the country where a vast number of schools, colleges and universities are present.

Faisalabad has the distinction of being a seat of world-famous Agricultural University and equally renowned Agricultural Ayyub Research Institute besides the Punjab Medical College there are several other colleges like Commerce College, Textile College, Superior Science College, Poly-Technical College, and others. The overall literacy rate of Faisalabad is 60%.

Lahore is called the city of colleges. Ancient universities and colleges are present here like University of the Punjab, Government College University, Forman Christian College, Government Diyul Singh College and many others. Students from all over the country comes to these institutes for higher educational studies. The overall literacy rate of Lahore is 73%.

Similarly, Sahiwal has also many educational institutes but the rate of literacy is quite low i.e. 60.7% in urban areas and 33.8% in rural areas. Some of the educational institutes in Sahiwal are University of Sahiwal, Sahiwal Medical College, The City School, Divisional Public School and College and many others.

4.21 HEALTH FACILITIES

According to the data provided by the Punjab Health Initiative Management Company (PHIMC), there are total 35 number of empaneled (Public and Private) hospitals in Faisalabad Division, 138 in Lahore Division; as Lahore being the most populated Division of the Province, and 32 number of hospitals in the Sahiwal Division. All of these health facilities include Tehsil Headquarter Hospitals, District Headquarter Hospitals with other government and private hospitals in the respective divisions.

4.22 QUALITY OF LIFE VALUE

The concept of quality-of-life value can provide ways of explaining and understanding human behavior, belief system, values, and ideologies, as well as particular culturally specific personality types. The combination of the new and old culture is found in the Project area, although the young generation is fond of modern culture. The majority of the population follows the Islamic tradition, which is well practiced in the rural areas has high moral values in the society.

The food of the citizens is very simple. Wheat, maize, and rice are the staple food grains. Meat and vegetables like Spinach, Peas, Carrot, Potatoes, Lady Finger are also consumed by well-to-do families. Tea is popular all over the Study Area. Bread (Roti) is generally baked in Tandoor or on simple Tawa. The use of Desi Ghee, milk, and Lassi is very popular in rural areas, which is available abundantly.

The culture of the Central Punjab is mainly of rural type and overall Punjabi culture prevails in the respective districts of the divisions i.e. Faisalabad, Lahore and Sahiwal. Most of the population is Muslims and wear according to the old subcontinent traditions i.e. Shalwar Kameez. Both genders like to wear Shalwar Kameez. Some people of nomadic origin may be in the villages using Tehmat (Dhoti) & Kurta instead of Shalwar Kameez, the same case is with both men and women. The use of ornaments among females is also common. The females decorate themselves with ear-ring, necklaces, and Cherries (bangle), especially on festive occasions or marriages.

Marriage is a special happy occasion in the family, which is performed with all its charms by singing and dancing. The persons of the family and adjacent locality are invited by the bridegroom's family and are entertained with delicious meals. The bride's parents donate the dowry to the girl for equipping her new house. The joint family system is predominant in the Project Area and gradually shifting to the nuclear family system.

4.23 POTABLE WATER SCENARIO IN CENTRAL ZONE OF PUNJAB

A field survey was conducted in the Divisions of Faisalabad, Lahore and Sahiwal. The results of outcomes are shown in the pictorial representation of graphs.

The ground water of Faisalabad is mostly brackish, people living in the center of the city have hired a service of a water tanker. These water tankers collect water from the existing tube wells and deliver it to the users at their homes. While in other areas, where people are less privileged and water quality is not appropriate and unfit for drinking; people rely on different sources i.e. they use handpumps located at nearby canal, stream or well.

Lahore has a big ground water reservoir, but the quality of this water is declining due to contamination of infiltration and making it unfit for drinking. People living in the city have mostly hired a private water supply scheme. These private water supply schemes have installed a domestic filtration plant from which they supply drinking water to the residents in 19-liter water bottles at their homes. They charge an amount of Rs.130/- to Rs.180/- per bottle. While other people go to a nearby filtration plant installed by the government to fetch drinking water.

The water quality of Sahiwal is better as compared to Faisalabad and Lahore. People use mostly ground water for drinking purpose and some have hired a private water supply scheme to deliver water at their door step. While people living in the rural areas mostly rely on handpumps installed at a nearby canal and streams.

4.23.1 Drinking Water Supply Scheme in the Area

During the field surveys, it was found out that there exist no water supply schemes in most of the identified areas where installation and construction of treatment plants are proposed. While in areas, where there exist any water supply schemes; the quality of water is inappropriate and unfit for drinking. **Figure 4-2.**

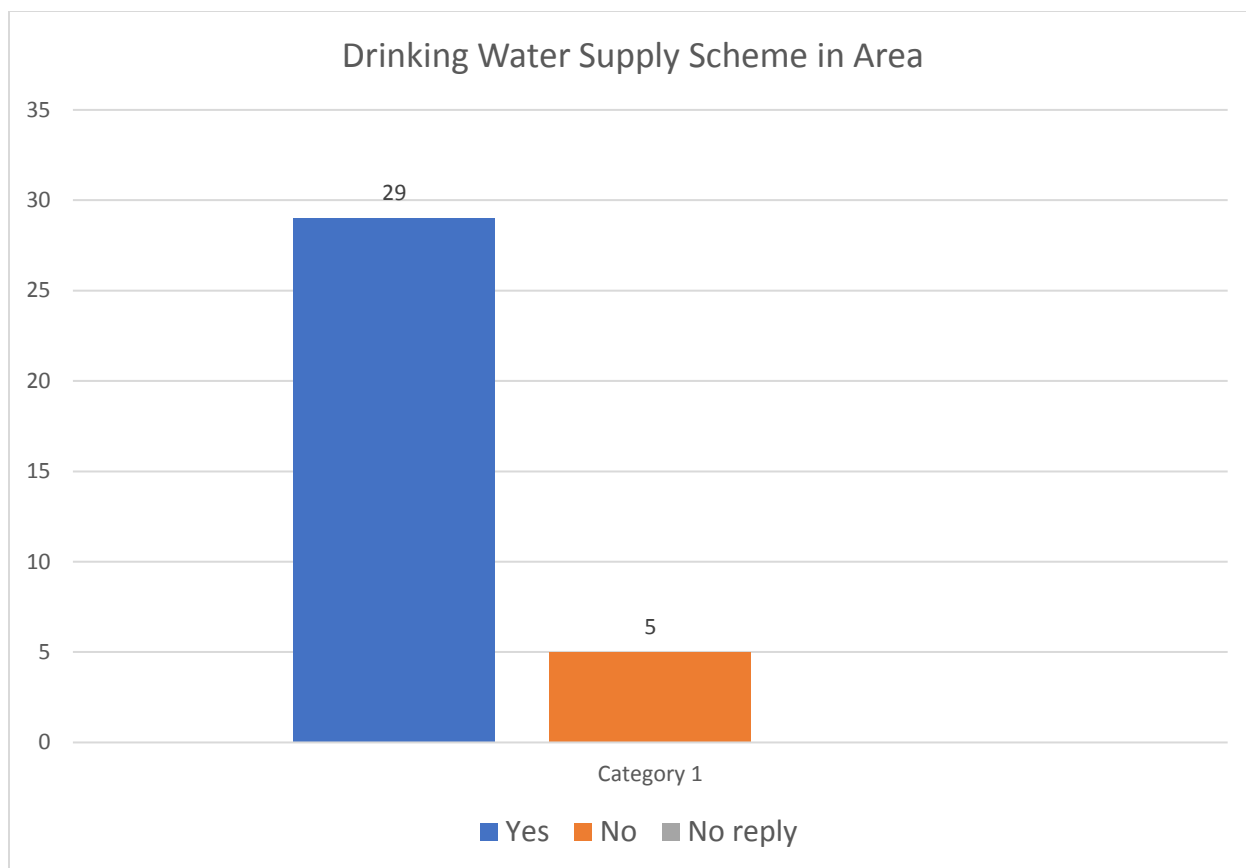


Figure 4-2: Drinking Water Supply Scheme in Area

4.23.2 Source of Drinking Water

It was observed during the field surveys that mostly people fetch water from hand pumps or motorized pumps installed at their homes. Some people go to a nearby water filter plant installed by the government, while only a few have hired a private water supply scheme which delivers water at their home. **Error! Reference source not found..**

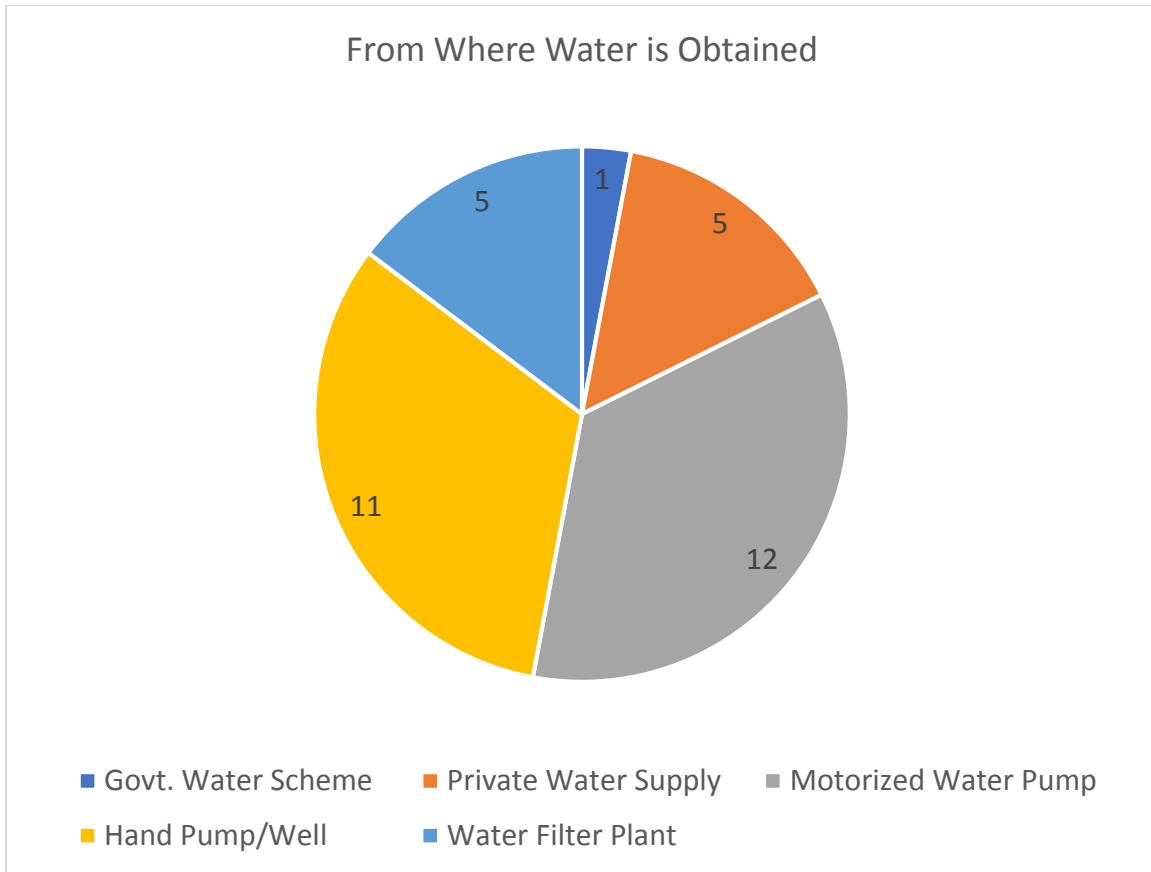


Figure 4-3: From Where Water is Obtained?

4.23.3 Distance Covered to Fetch Water

Most of the people cover an average distance of 2 kilometers to fetch water, while some people cover 1 km, depending upon the distance of treatment plant from their homes. **Figure 4-4.**

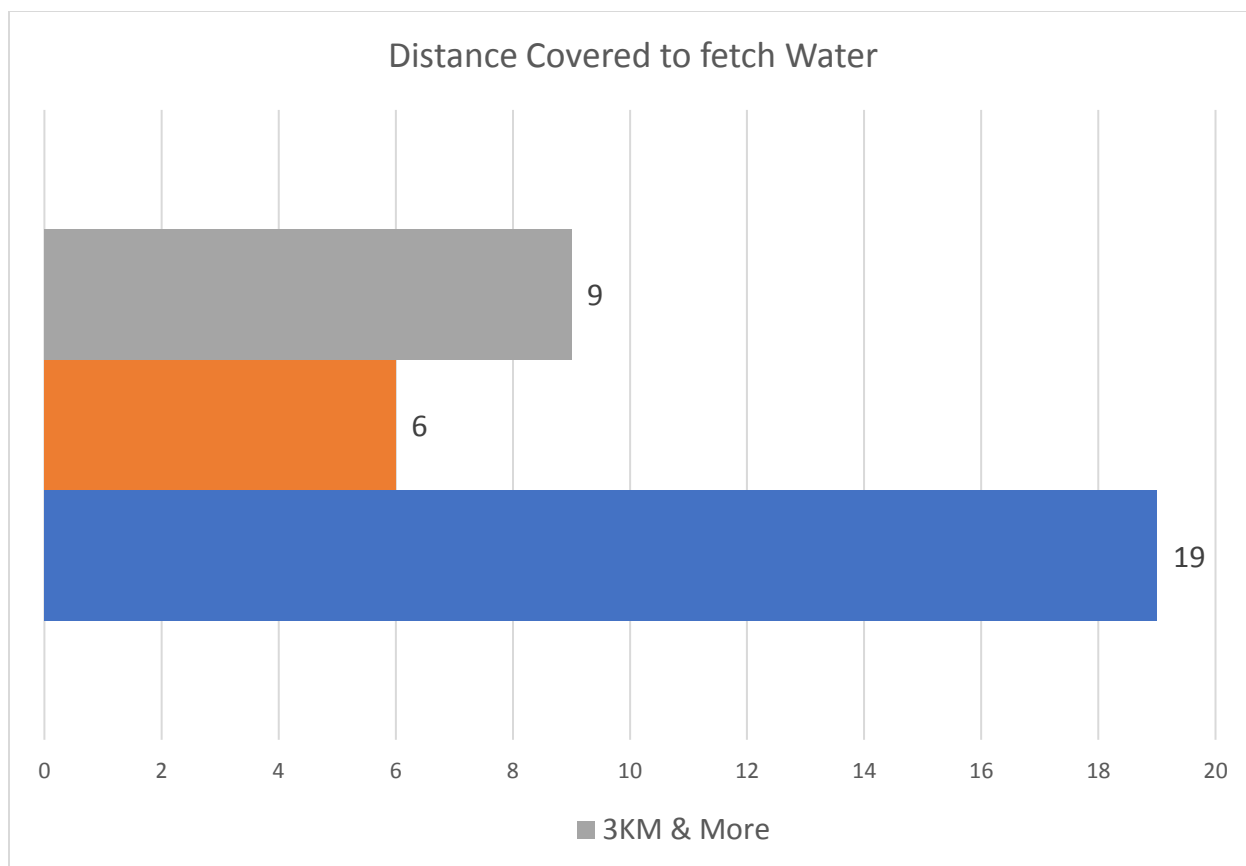


Figure 4-4: Distance Covered to Fetch Water

4.23.4 Who Fetches Water?

Men and women both take part in fulfilling the responsibility of fetching. In villages and rural areas, this duty is performed by mostly women. Adult females of a community go in groups to fetch water from water plant or stream. While men perform this duty by using a motor bike ride. **Figure 4-5.**

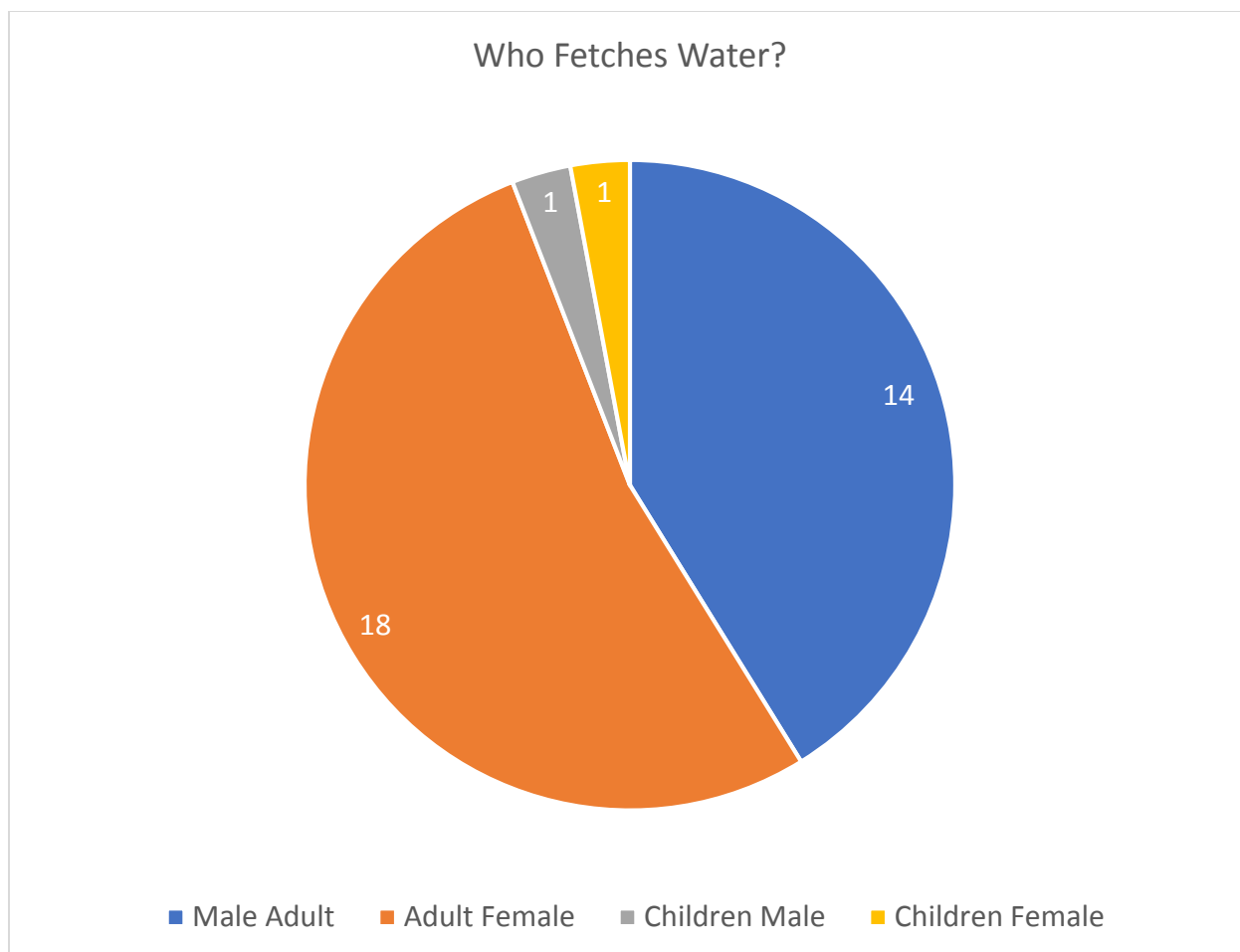


Figure 4-5: Who Fetches Water?

4.24 SOCIO-ECONOMIC PROFILE OF PROJECT AREA (FAISALABAD DIVISION)

The field survey (including interviews, focus group discussions, census, and area profile) was carried out to collect the socioeconomic data from the various stakeholders which include; general public, residents, and government departments to accomplish the baseline information, which will provide the basis for subsequent monitoring and evaluation studies. The demographic features include; the information on the household's profile, occupation and literacy status of the population, and civic facilities availability residing in the project area. The information relating to the demographic profile of the people in the Faisalabad Division is described below.

Field surveys conducted in the Faisalabad Division for the prediction of Socio-Economic Profile of the area are attached as **Annexure V-B**.

4.24.1 Age Groups (Faisalabad Division)

During the field survey, the ages of the consulted population were recorded. The people interviewed for the socio-economic assessment belong to different age groups i.e., 18-30 years, 31- 40 years, 40-50 years, and 50-60+ years **Figure 4-6**.

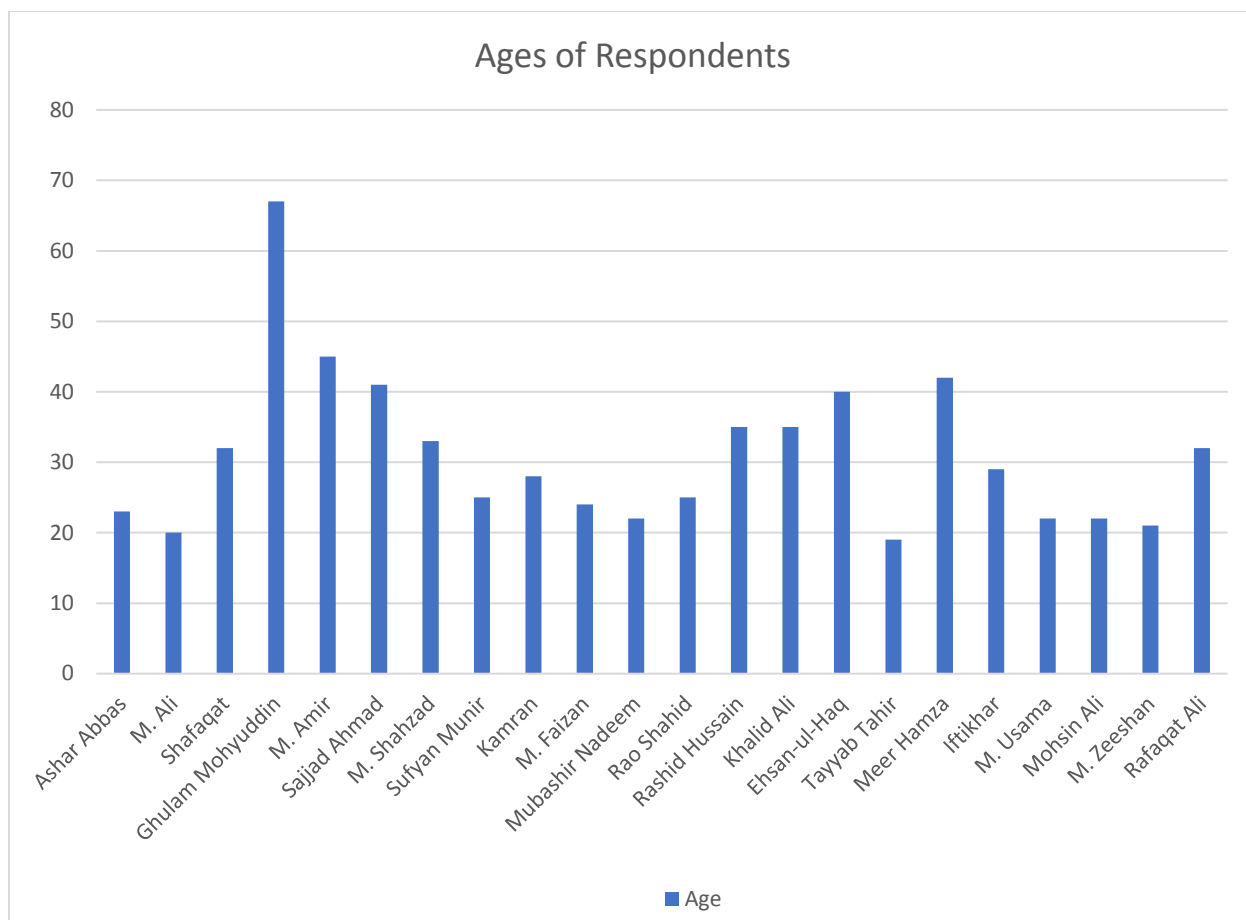


Figure 4-6: Graph Showing the ages of the respondents in Faisalabad Division

4.24.2 Employment Status (Faisalabad Division)

During the survey, it was noted that the people of Faisalabad Division are involved with diverse kinds of occupation. The respondents had occupation of Agriculturist, Shopkeeper, High School Student, Engineer, Tailor, Security Guard and many others. **Figure 4-7.**

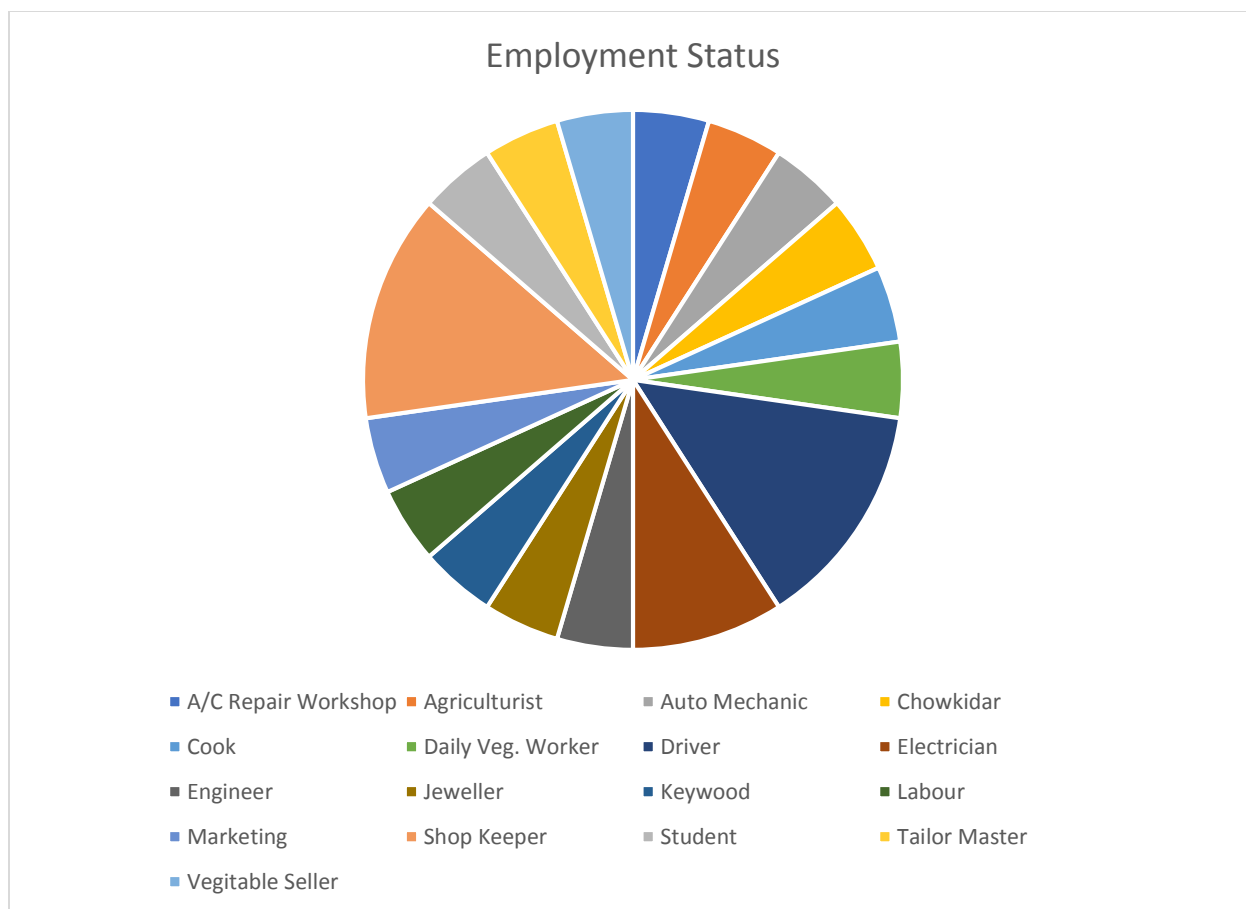


Figure 4-7: Graph Showing Employment Status of Respondents of Faisalabad Division

4.24.3 Availability of Civic Facilities (Faisalabad Division)

4.24.3.1 Gas Supply

Gas Supply is available in almost 65% of the Project area of Faisalabad Division, while rest of the area do not have this facility. People use gas and LPG cylinders for cooking purposes.

Figure 4-8.

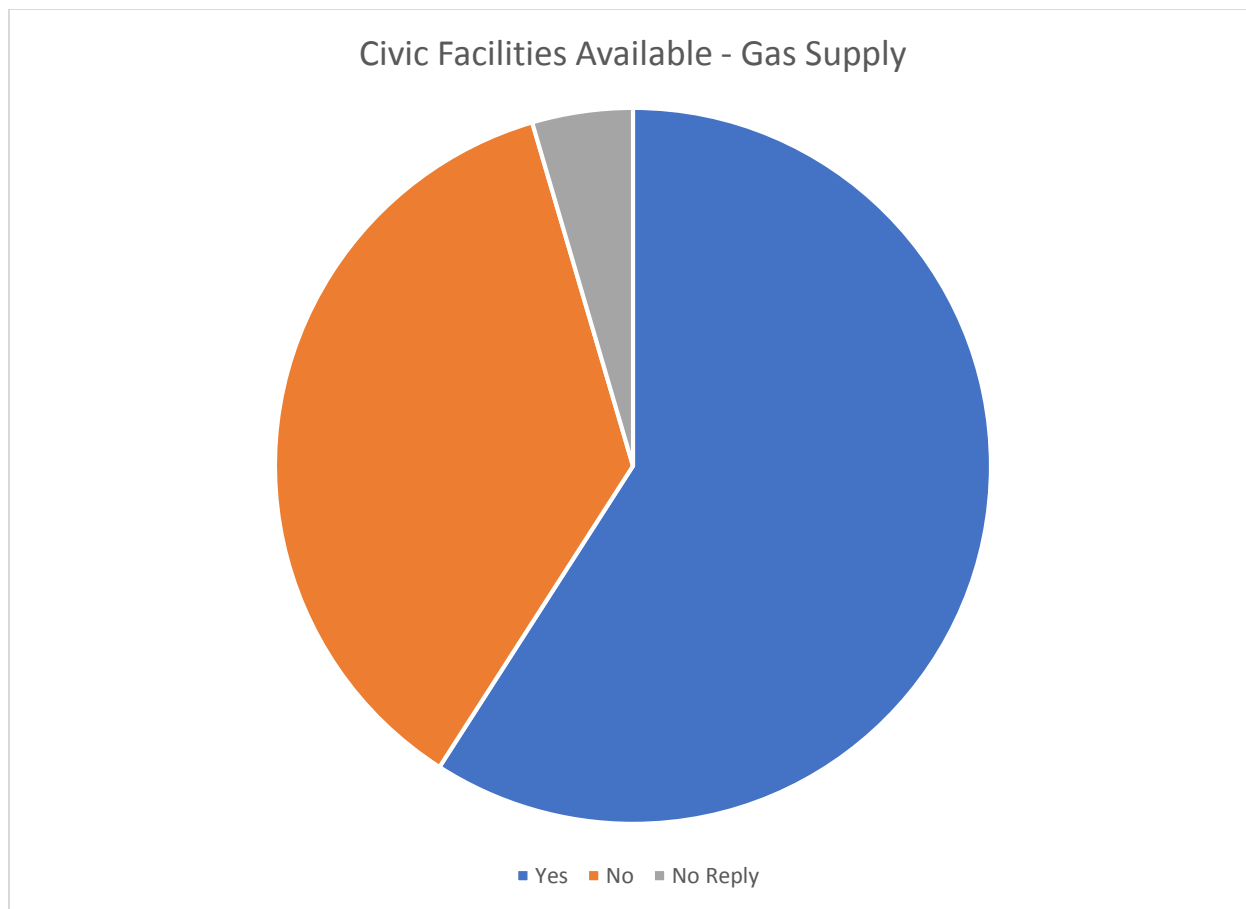


Figure 4-8: Graph Showing Gas Supply Availability in Faisalabad

4.24.3.2 Solid Waste Management

In Faisalabad, 62% of the population have nominal Solid Waste Management, while the rest of 38% of the population have poor availability of Solid Waste Management. **Figure 4-9.**

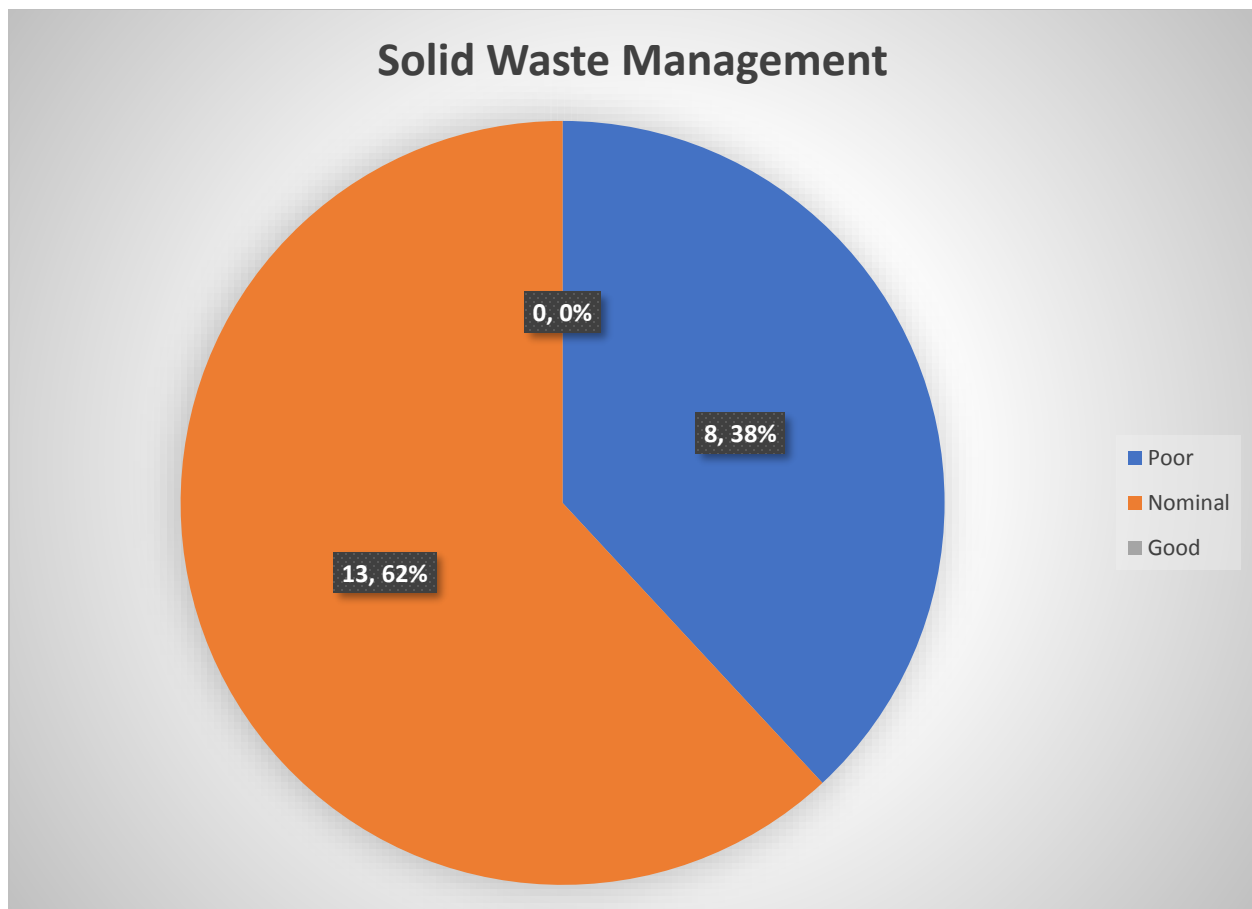


Figure 4-9: Graph Showing availability of Solid Waste Management in Faisalabad

4.24.4 Project Acceptance (Faisalabad Division)

Approximately 100% of the respondents of Faisalabad Division thought that this project should be implemented. In their opinion, the development of the project will create new job opportunities for locals residing near the project area and it will help to improve the economic, social, and living conditions of the area. The respondents also provided the mitigation measures like certified contractors must be hired for the selected site development, a proper landscape management plan must be implemented and the management of the generated wastewater & solid waste should be done. The respondents said if mitigation measures will be implemented efficiently, they would have no objection. **Figure 4-10.**



Figure 4-10: Graph Showing Project acceptance in the Faisalabad Division

4.24.5 Willingness to Pay

During the field survey, it has been asked if the people are willing to pay the bill to authorities for the improved services of Clean Drinking Water. Almost 60% of the respondents didn't agree to pay the bill for better services. While 40% of the respondents agreed to pay for clean drinking water supply. **Figure 4-11.**

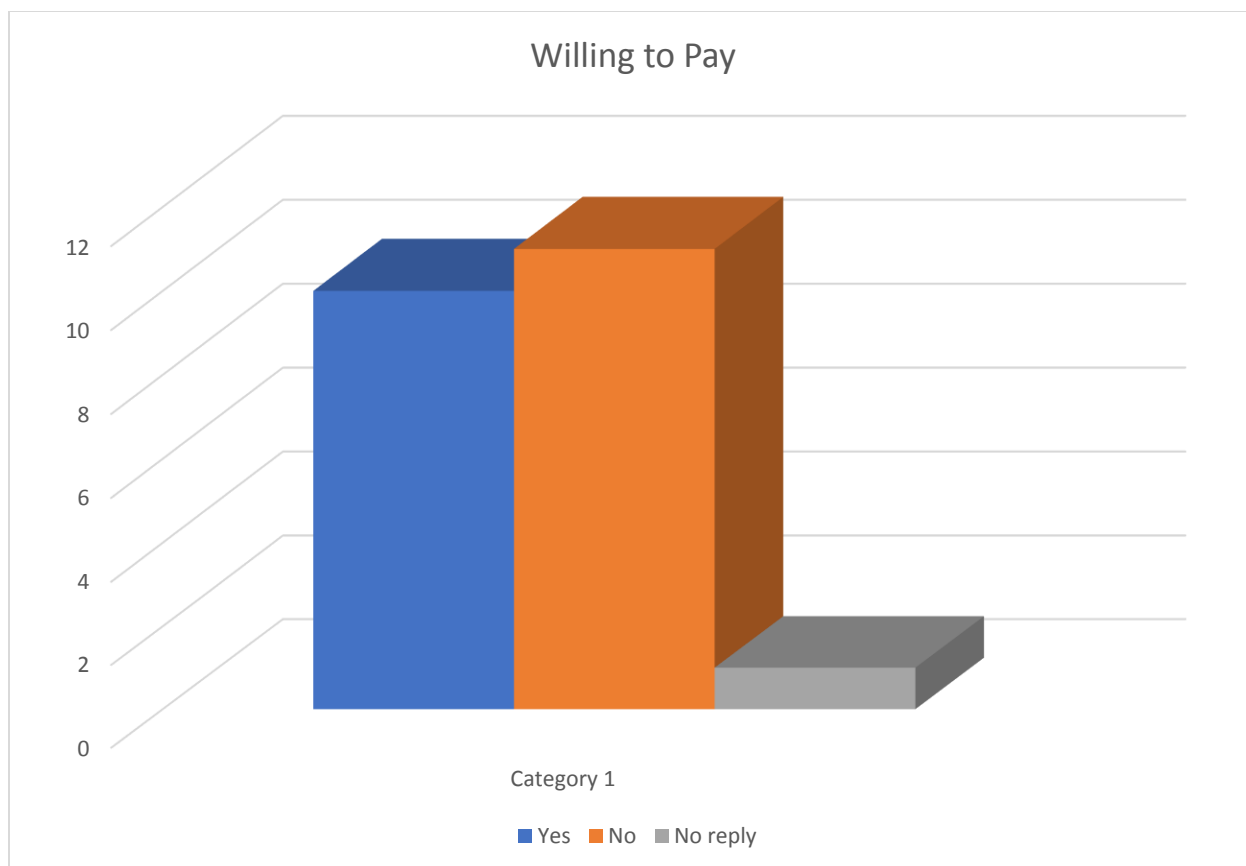


Figure 4-11: Graph showing Willingness to pay for Clean Drinking Water Supply

4.25 SOCIO-ECONOMIC PROFILE OF PROJECT AREA (LAHORE DIVISION)

Similarly, in Lahore Division the field survey (including interviews, focus group discussions, census, and area profile) was carried out to collect the socioeconomic data from the various stakeholders which include; general public, residents, and government departments to accomplish the baseline information, which will provide the basis for subsequent monitoring and evaluation studies. The information relating to the demographic profile of the people in the Lahore Division is described below.

Field surveys conducted in the Lahore Division for the prediction of Socio-Economic Profile of the area are attached as **Annexure V-B**.

4.25.1 Age Group (Lahore Division)

During the field survey in Lahore Division, the ages of the consulted population were recorded. The people interviewed for the socio-economic assessment belong to different age groups i.e., 18-30 years, 31- 40 years, 40-50 years, and 50-60+ years. **Figure 4-12**.

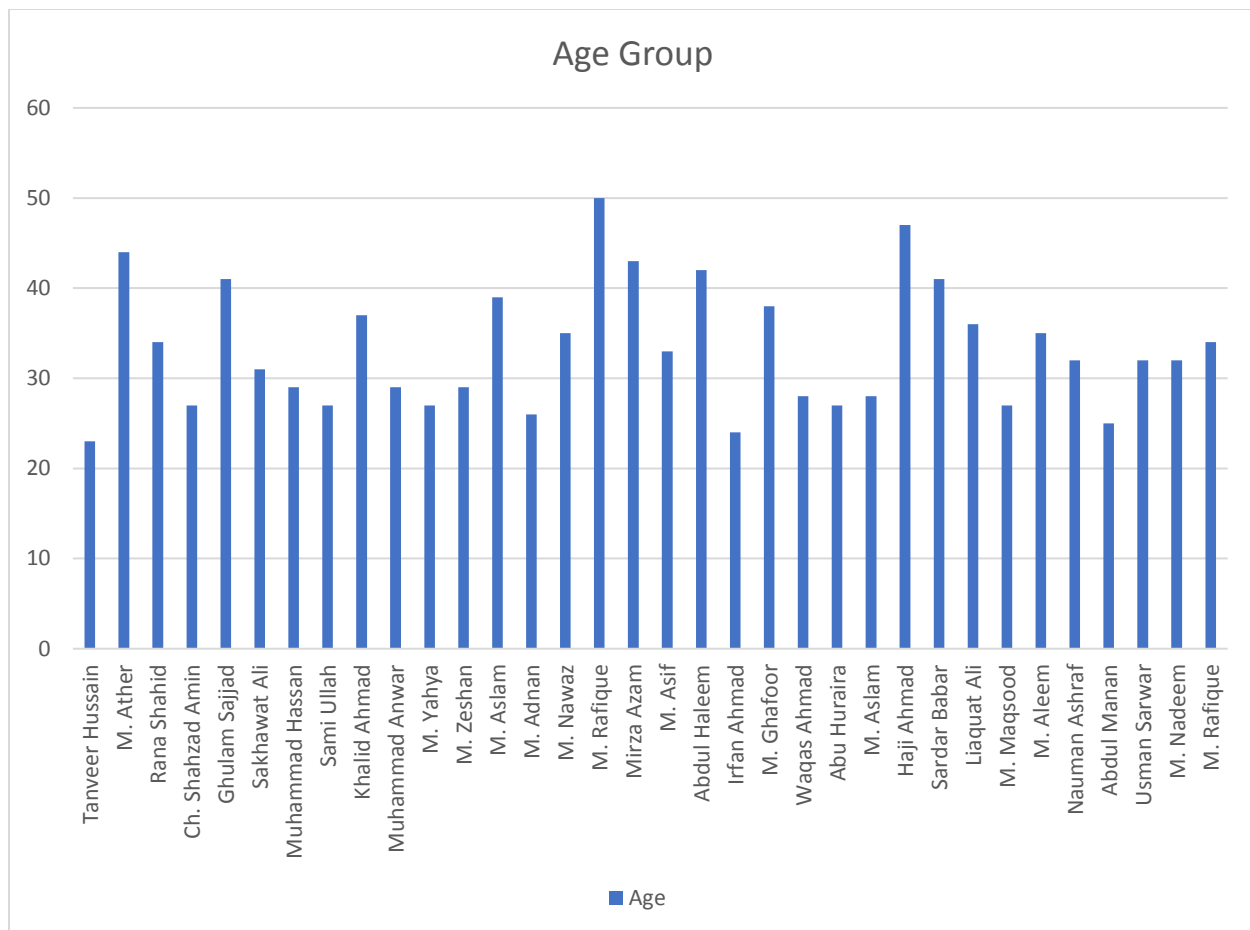


Figure 4-12: Graph Showing the ages of the respondents in Lahore Division

4.25.2 Employment Status (Lahore Division)

During the field survey in Lahore Division, it was found out that the 23% of the respondents have their own business, 32% of the respondents have private jobs, 24% of the respondents are related to the agriculture sector while rest of the respondents are related to mechanic, watchman, teacher and etc. **Figure 4-13.**

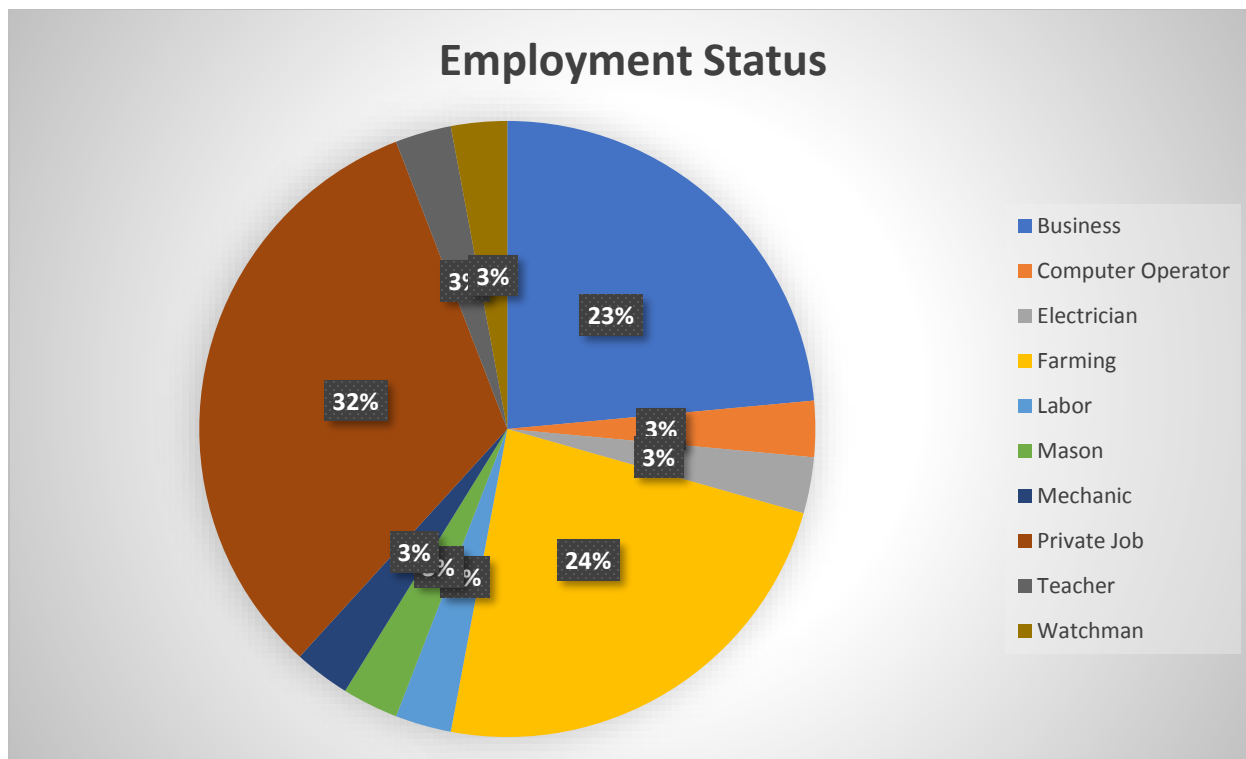


Figure 4-13: Graph Showing Employment status of respondents in Lahore Division

4.25.3 Availability of Civic Facilities (Lahore Division)

4.25.3.1 Gas Supply

Gas Supply is available to 74% of the population of the Project area of Lahore Division, while rest of the 26% of the population of the project area do not have this facility. People use gas and LPG cylinders for cooking purposes. **Figure 4-14.**

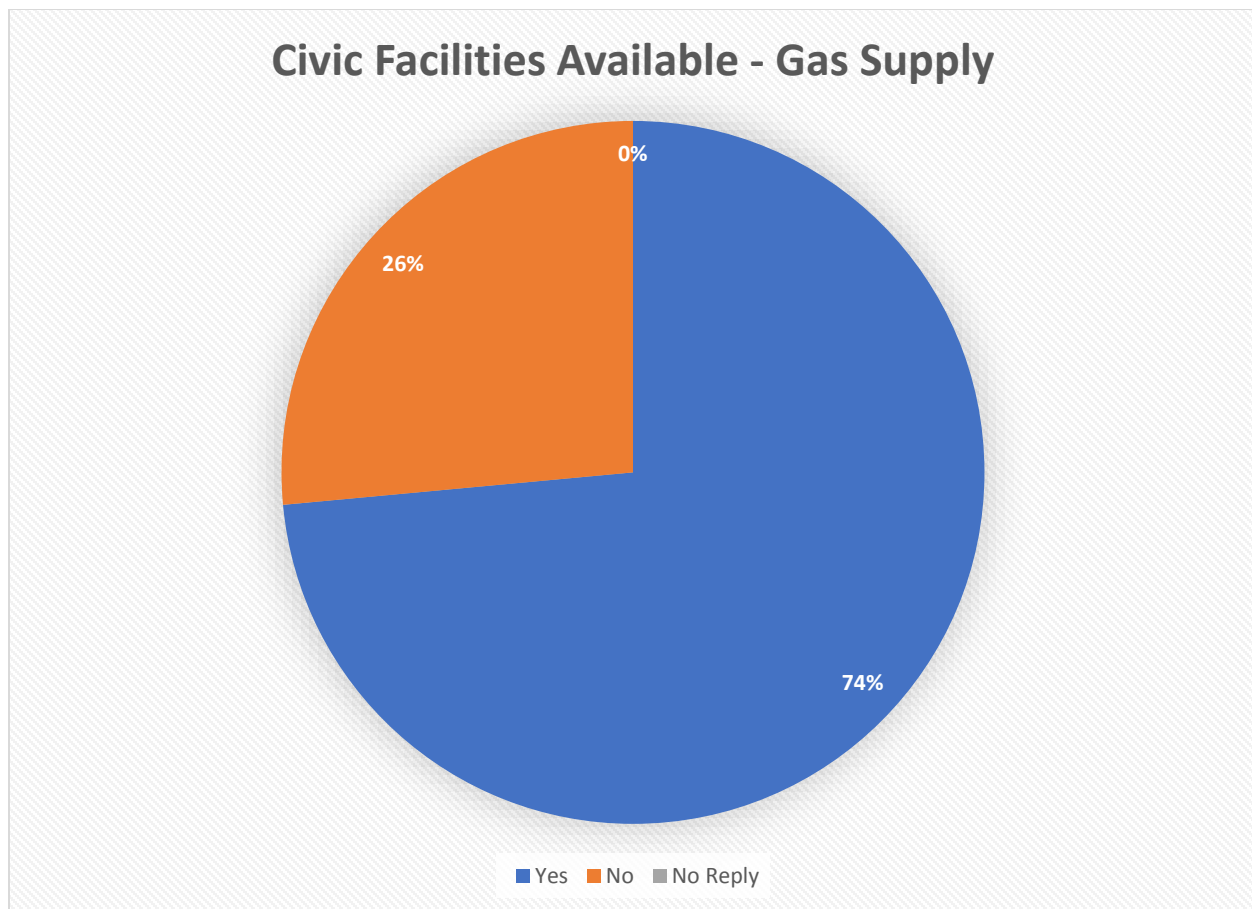


Figure 4-14: Graph Showing Availability of Gas Supply in Lahore Division

4.25.3.2 Solid Waste Management

Good Solid Waste Management facility is available to only 6% of the population of the Lahore Division, 35% of the population have nominal solid waste management facility available, while the rest of the 59% of the population have poor solid waste management facility available to them. **Figure 4-15.**

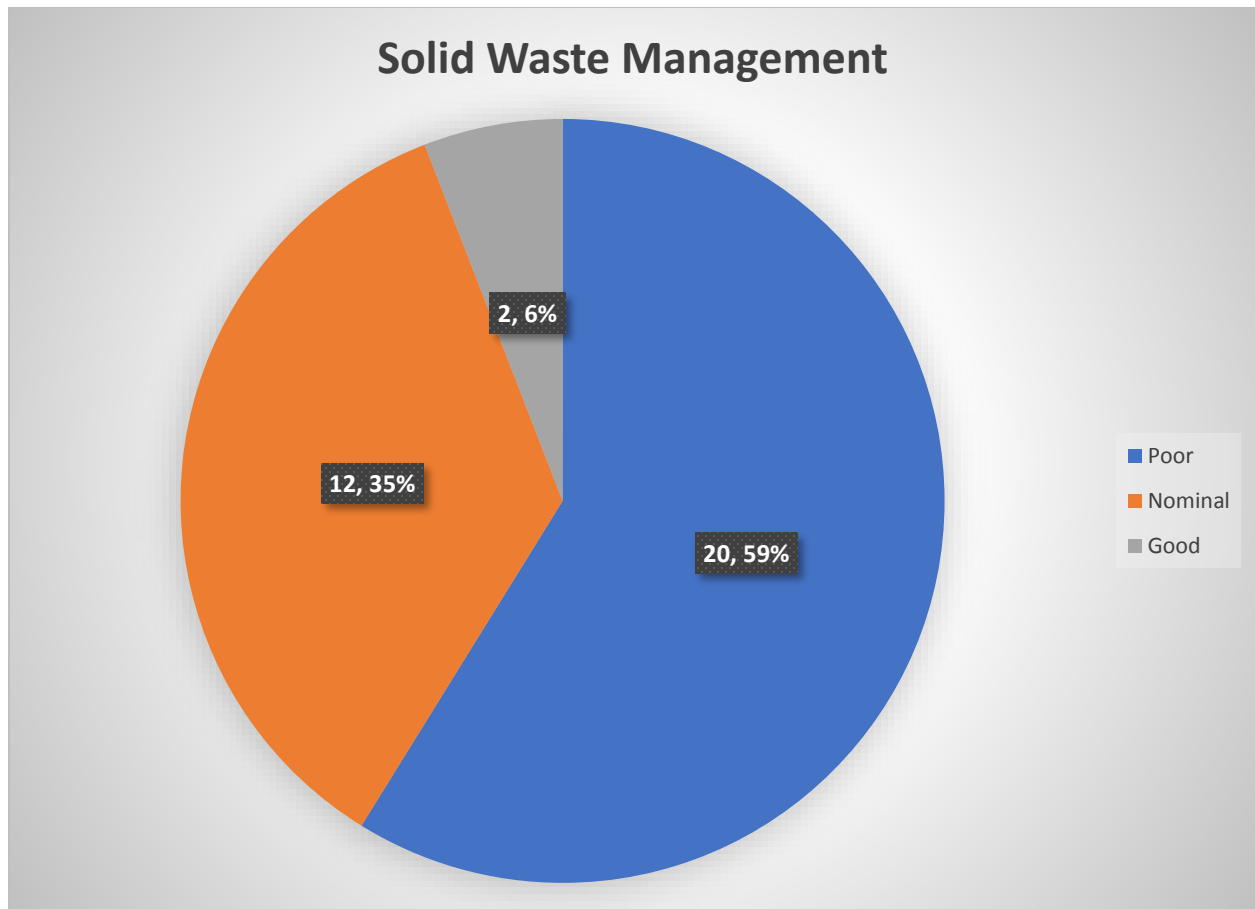


Figure 4-15: Availability of Solid Waste Management Facility in Lahore Division

4.25.4 Project Acceptance (Lahore Division)

The project is highly accepted in the Lahore Division. Only 1% of the respondents were against the project and 99% of the respondents highly appreciated the project, as this project will enhance the quality of life for the people of Lahore Division. **Figure 4-16.**

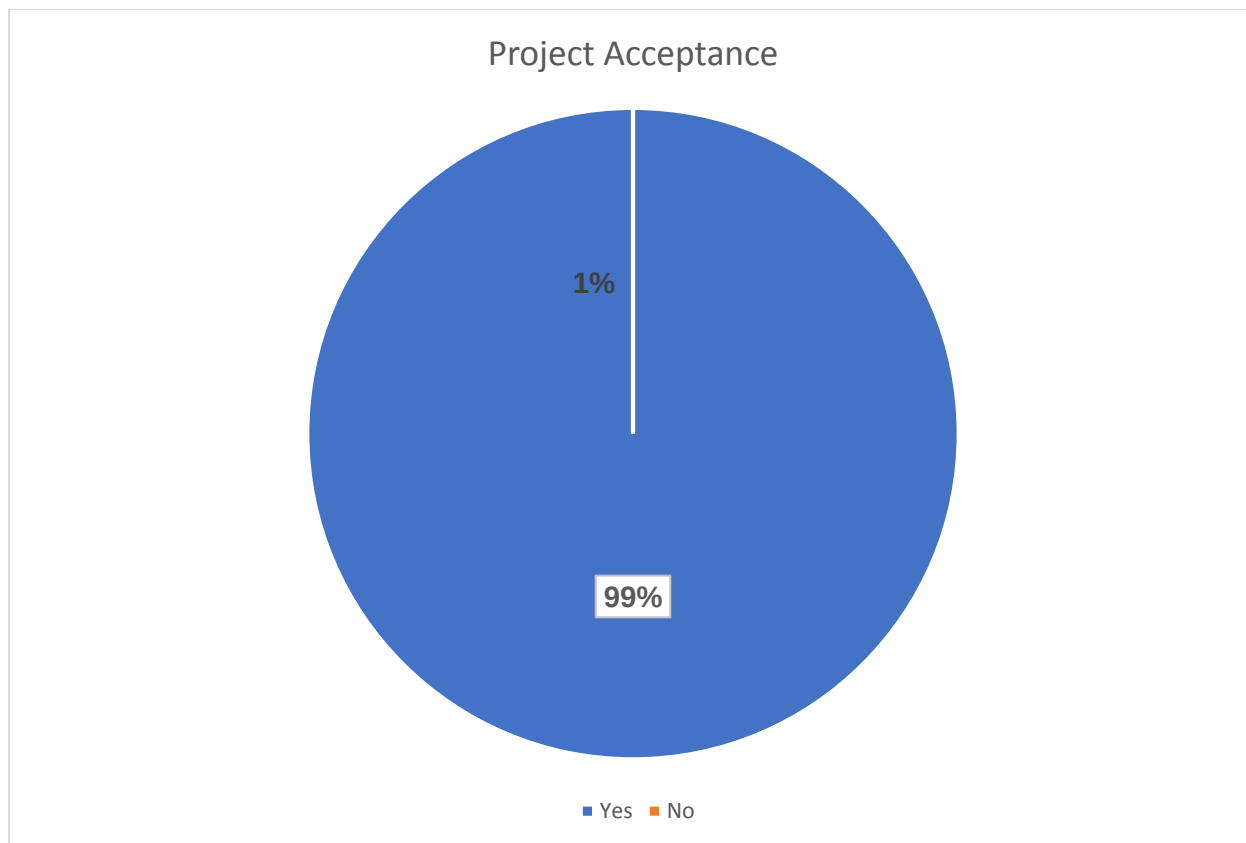


Figure 4-16: Graph Showing Project Acceptance in the Lahore Division

4.25.5 Willingness to Pay

During the field survey in Lahore Division, it was asked to the respondents if they are willing to pay for the improved drinking water supply services; 70% of the respondents agreed to pay for the drinking water supply services, while rest of the 30% respondents didn't agree to pay for it. **Figure 4-17.**

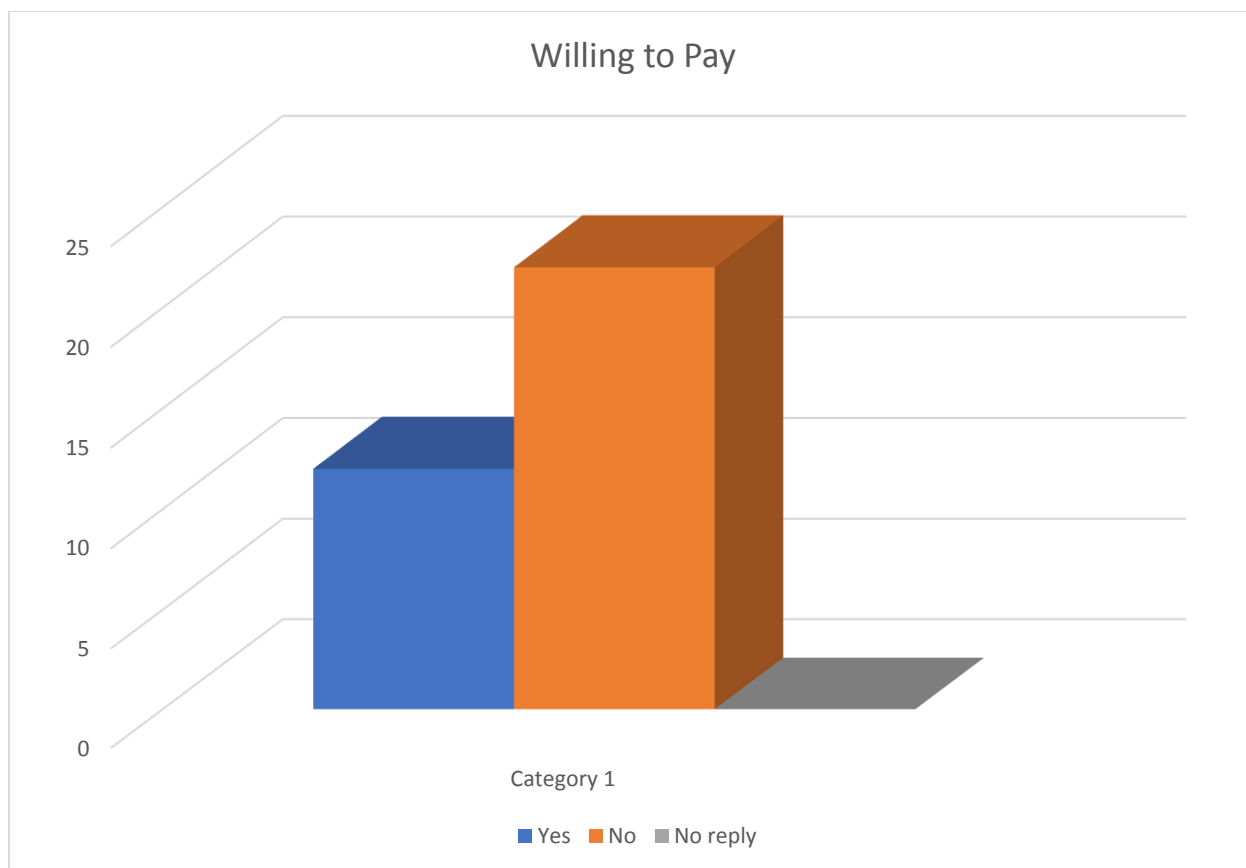


Figure 4-17: Graph Showing Willingness to pay in Lahore Division

4.26 SOCIO-ECONOMIC PROFILE OF PROJECT AREA (SAHIWAL DIVISION)

Just like as in Faisalabad and Lahore, interviews were also conducted in the Sahiwal Division to collect the socioeconomic data from the various stakeholders which include; general public, residents, and government departments to accomplish the baseline information, which will provide the basis for subsequent monitoring and evaluation studies. The information relating to the demographic profile of the people in the Sahiwal Division is described below.

Field surveys conducted in the Sahiwal Division for the prediction of Socio-Economic Profile of the area are attached as **Annexure V-B**.

4.26.1 Age Groups (Sahiwal Division)

During the field survey in Sahiwal Division, the ages of the consulted population were recorded. The people interviewed for the socio-economic assessment belong to different age groups i.e., 18-30 years, 31- 40 years, 40-50 years, and 50-60+ years. **Figure 4-18.**

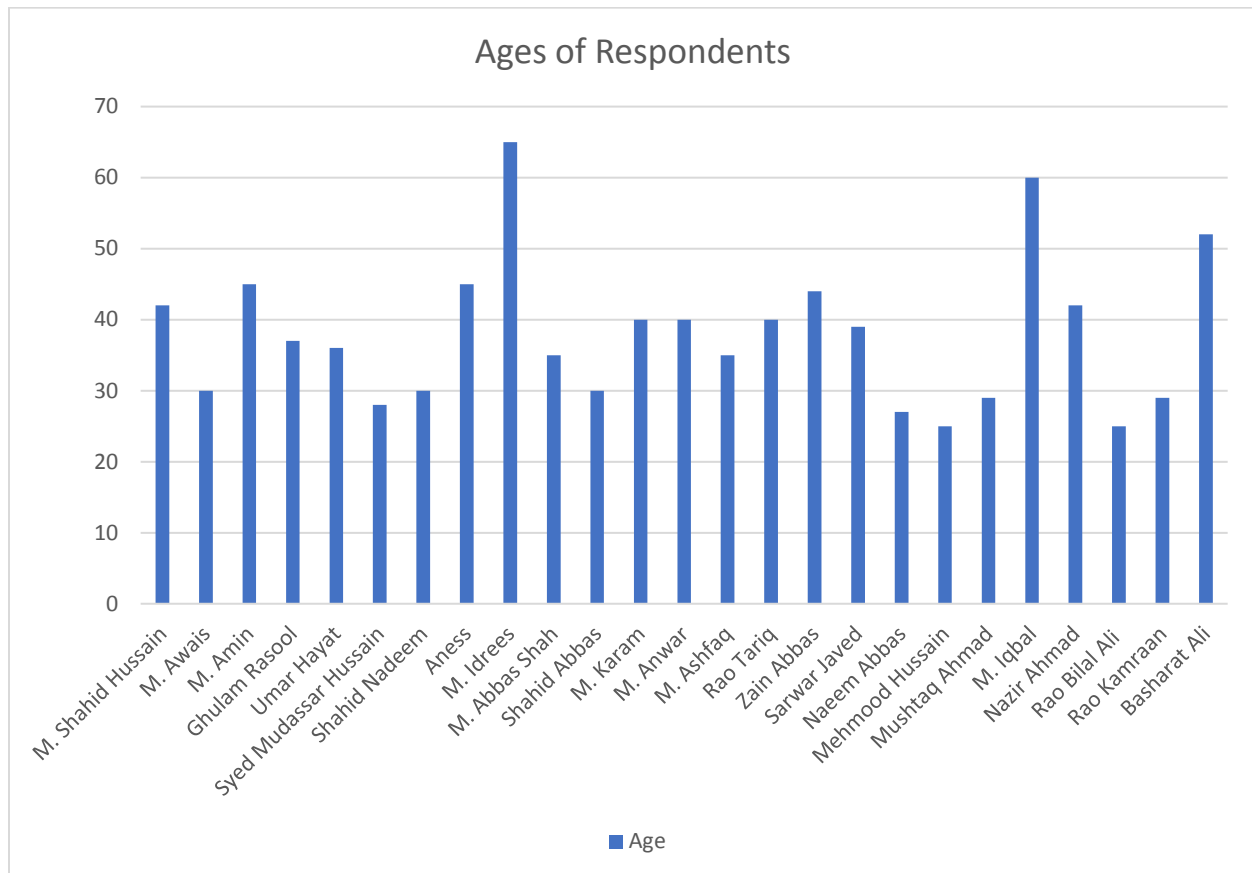


Figure 4-18: Ages of the respondents in the Sahiwal Division

4.26.2 Employment Status (Sahiwal Division)

In Sahiwal Division, 32% of the respondents are related to the agriculture sector, 28% of the respondents are shopkeeper, 8% of the respondents have private jobs while rest of the respondents are related to the electrician, labor, teacher and etc. **Figure 4-19.**

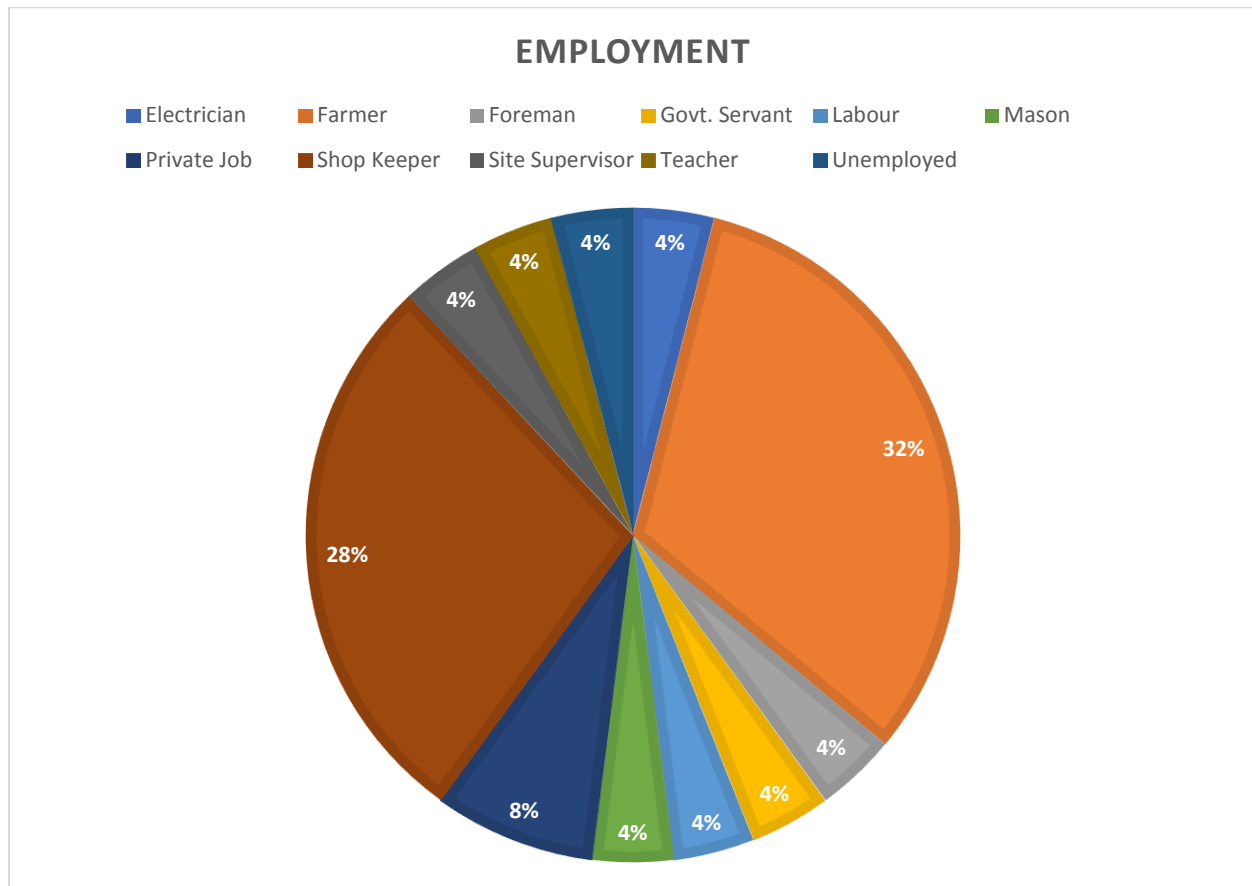


Figure 4-19: Graph Showing the Employment Status of Sahiwal Division

4.26.3 Availability of Civic Facilities (Sahiwal Division)

4.26.3.1 Gas Supply

Almost 75% of the population of Sahiwal Division do not have gas supply available to them. People use gas and LPG cylinders for cooking purposes. Some people in rural area use indigenous method of lighting fire for cooking purposes. While 25% of the population of Sahiwal Division have this civic facility of gas supply available to them. **Figure 4-20.**

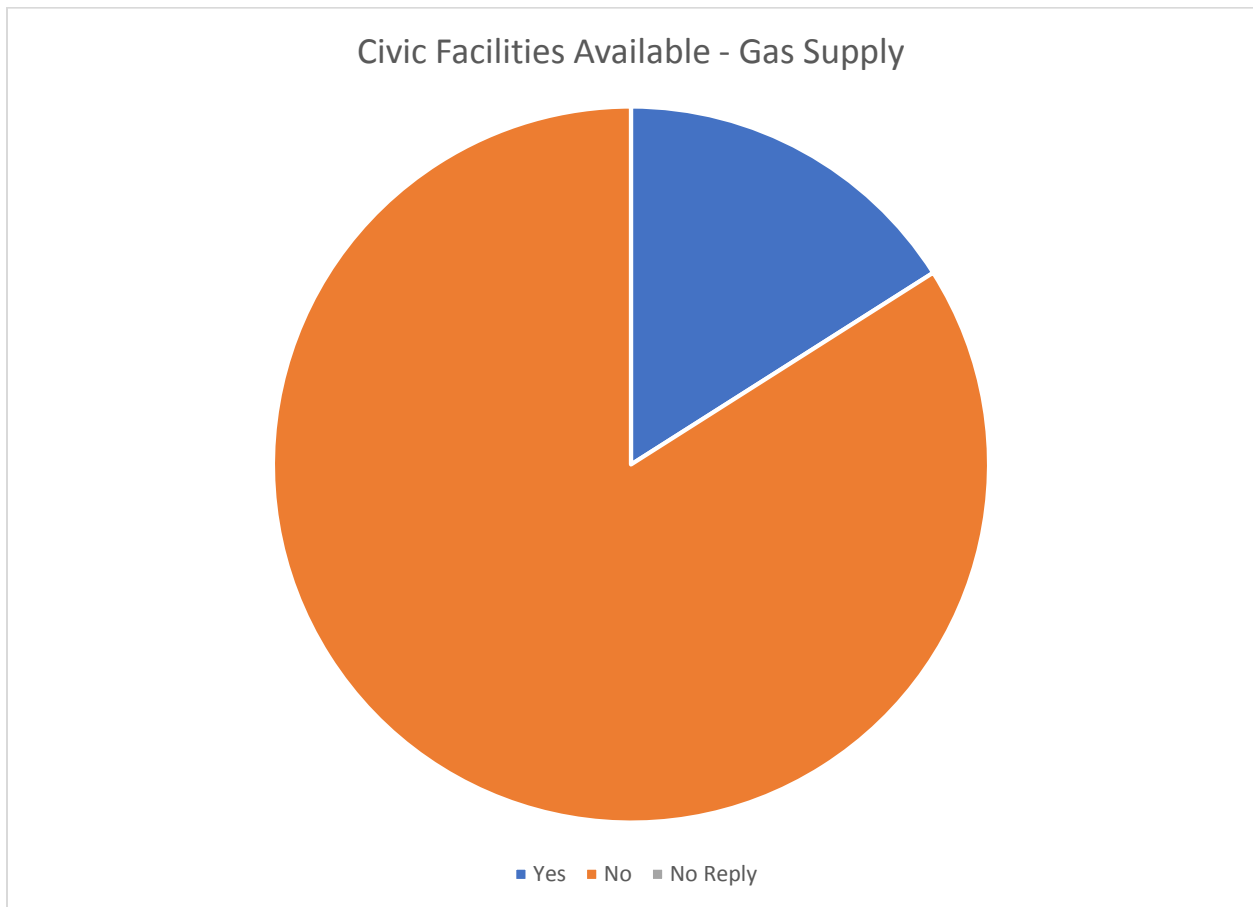


Figure 4-20: Graph Showing Availability of Gas Supply in Sahiwal Division

4.26.3.2 Solid Waste Management

79% of the population in Sahiwal Division have nominal solid waste management facility available to them, while rest of the 21% of the population of Sahiwal Division have poor solid waste management facility available to them. **Figure 4-21.**

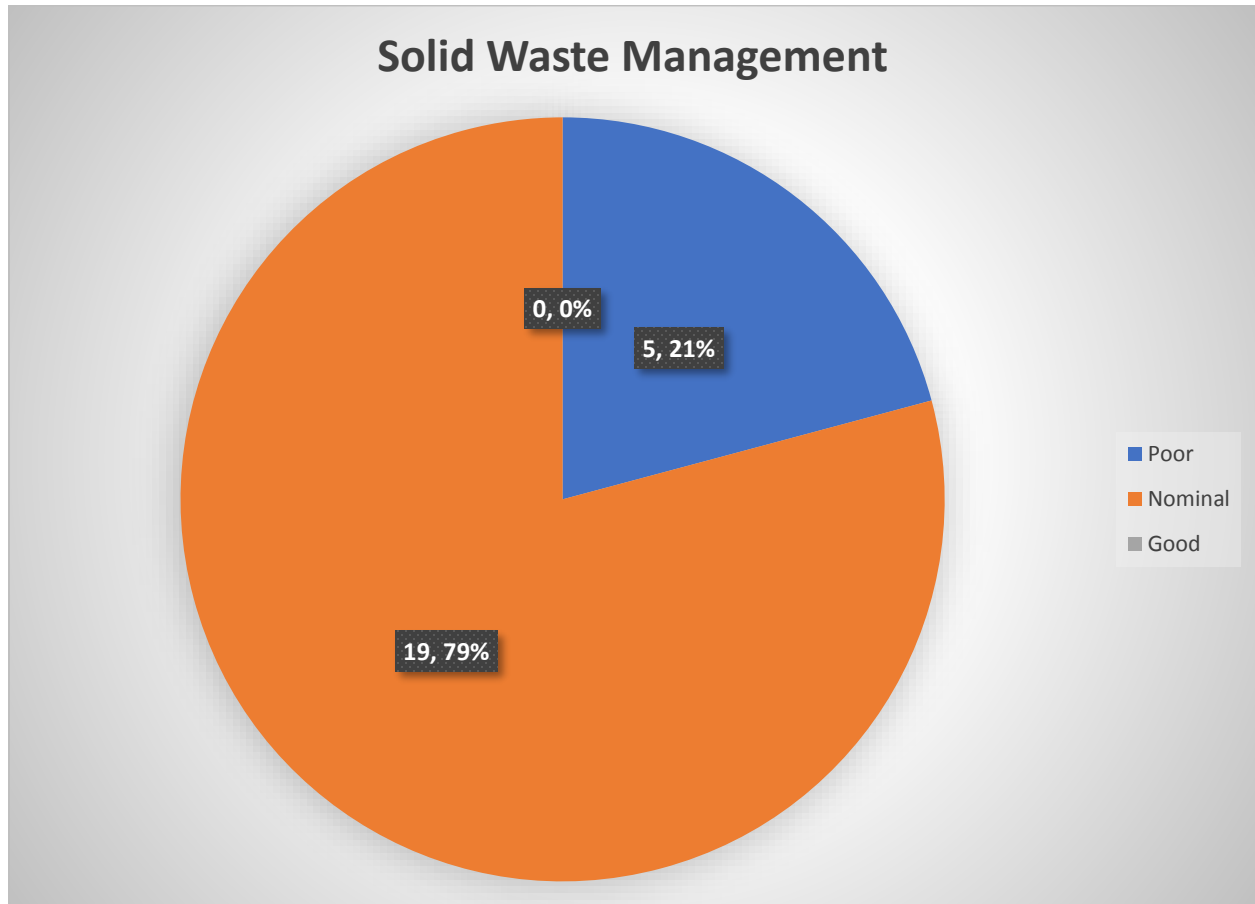


Figure 4-21: Availability of Solid Waste Management Facility in Sahiwal Division

4.26.4 Project Acceptance (Sahiwal Division)

This project is highly appreciated by the people of Sahiwal Division. Almost all i.e. 100% of the respondents were in favor of the project as this project will enhance the quality of life for the people of Sahiwal Division. **Figure 4-22.**



Figure 4-22: Graph Showing Project Acceptance in Sahiwal Division

4.26.5 Willingness to Pay

During the field survey in Sahiwal Division, it was asked to the respondents if they are willing to pay for the improved drinking water supply services; 60% of the respondents didn't agree to pay the bill for improved water supply services, while 40% of the respondents agreed to pay for clean drinking water supply services. These people spend an average amount of Rs.1600/- on clean drinking water. They are willing to pay Rs.1500/- per month for improved water supply services. While the other 60% of the people gave review that their income is quite low and they cannot bear any more expenses. **Figure 4-23.**

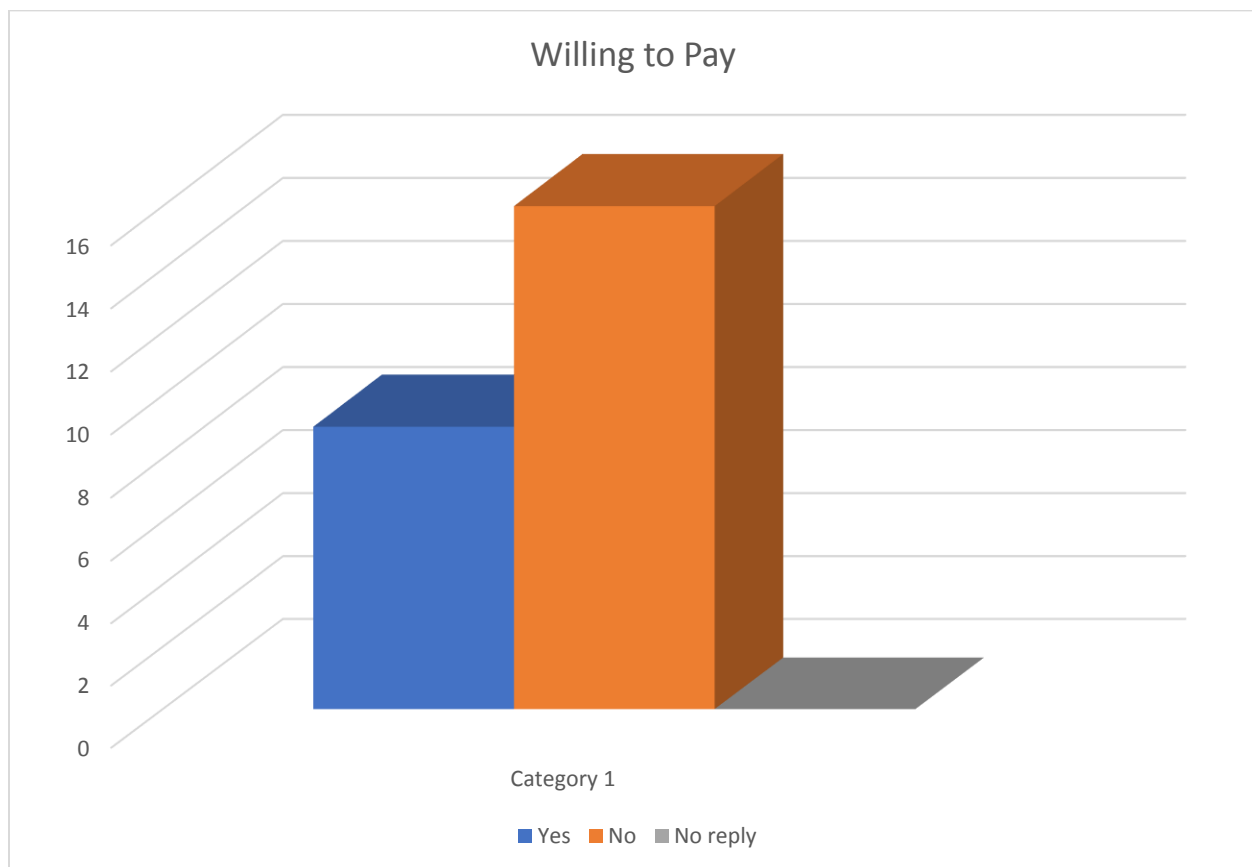


Figure 4-23: Graph Showing willingness to pay in Sahiwal Division

4.27 ARCHAEOLOGICAL OR HISTORICAL SITES IN THE PROJECT AREA

Since Water Treatment plants and Markaz-e-Aabs require a very small area for installation and construction, it was found out during the field surveys in the Divisions of Faisalabad, Lahore and Sahiwal that no archeological or historical site falls under the Area of Influence (AOI) of the project which is 500 meters both ways at every identified location for the construction of Treatment Plants and Markaz-e-Aabs in the respective Divisions of Central Zone of Punjab.

CHAPTER 5 IMPACT ASSESSMENT AND MITIGATION MEASURES

This section identifies the potential impacts anticipated relating to the location and design during the construction and operation phases of the project on physical, ecological, and socio-economic domains of the environment. EPA Punjab Guidelines require that an Environmental Assessment should evaluate impacts due to the location, design, construction, and operation of the project. Construction and operation are the two activities in which the project interacts physically with the environment, so they are the two activities during which the environmental impacts occur. In assessing the effects of these processes, therefore, all potential impacts of the project are identified, and mitigation is devised for any negative impacts. A project impact evaluation matrix has been developed to evaluate the potential impacts of the proposed project. Since the proposed project falls under 'Schedule II' which describes that such projects are likely to cause medium-level severity adverse environmental impacts however all adverse impacts can be mitigated by applying engineering techniques with best management practices.

5.1 ENVIRONMENTAL IMPACT CHARACTERIZATION

During the EIA Study of the Project, the predicated environmental impacts were carefully characterized. There are different categories of impact characterization including the following:

- Nature (direct/indirect)
- Duration of impact (short term, medium term, long term)
- Geographical extent (local, regional)
- Timing (project phase)
- Reversibility of impact (reversible/irreversible)
- Likelihood of the impact (certain, likely, unlikely)
- Impact consequence severity (severe, moderate, mild)
- Signification of impact (High, medium, low)

The above aspects of environmental impacts characterization are defined in **Table 5-1**. After the characterization, appropriate mitigation measures were identified, to minimize, if not eliminate, the adverse impacts associated with Project activities.

Table 5-1: Impact Characterization

Sr. No.	Categories	Characteristics
1	Nature	Direct: The environmental parameters are directly affected by the project construction or operation. Indirect: The environmental parameter changes as a result of alteration in another parameter.
2	Duration	Short-term: The impacts that last only during the construction of the proposed Project e.g., noise from the construction activities.

Sr. No.	Categories	Characteristics
		Medium-term: lasting for a period of a few months to a year the project before naturally reverting to the original condition such as loss of vegetation due to clearing of the campsite, contamination of soil or water by fuels or oil. Long term: lasting for a period much greater than medium-term impact before naturally reverting to the original condition such as loss of soil due to erosion.
3	Geographical Extent	The geographical extent may be local or regional (spatial dimension).
4	Timings	Pre-construction (designing), Construction and Operational
5	Reversibility	Temporary: The impacts that don't cross the ecosystem threshold value of resilience. Permanent: The impacts that exceed the ecosystem threshold value of resilience i.e., a community that cannot come back to its original stage without external aid.
6	Likelihood	Certain: Impact anticipated occurring under extreme circumstances. Likely: Impact will probably occur under less extreme circumstances. Possibly: Impact may occur during different stages of the project. Unlikely: Impact could occur during many stages of the project. Rare: Impact may occur but only under exceptional circumstances.
7	Consequence of Severity	Major: When an activity causes irreversible damage to a unique environmental feature; causes a decline in abundance or change in distribution over more than one generation of an entire population of species of flora or fauna; has long-term effects (period of years) on socio-economic activities of significance or regional level. Moderate: When an activity causes long-term (period of years), reversible damage to a unique environmental feature; causes reversible damage or change in abundance or distribution over one generation of a population of flora or fauna; has short-term effects (period

Sr. No.	Categories	Characteristics
		of months) on socio-economic activities of significance on a regional level. Minor: When an activity causes short-term (period of few months) reversible damage to an environmental feature; slight reversible damage to a few species of flora or fauna within a population over a short period; has short term (period of months) effects on socio-economic activities of local significance. Negligible: When no measurable damage to the physical, socio-economic, or biological environment above the existing level of public concern; and conformance with legislative of statutory requirements.
8	Impacts based on Significance	The impact may be categorized as high, medium, or low. Based on the consequence, likelihood, reversibility, geographical extent, duration, level of public concern; and conformance with legislative of statutory requirements.

5.2 IMPACT ASSESSMENT PROCEDURE

To identify the significance of an impact, it is important to distinguish between two concepts: **sensitivity and magnitude**. As far as possible, the sensitivity and magnitude of the impacts are described concerning legal requirements, accepted scientific standards or accepted impact assessment practice, and/or social acceptability. Where no known or published “standard” criteria exist for determining the magnitude of effects, already established professional criteria and best practices or techniques used and clearly described.

5.3 PROJECT AREA OF INFLUENCE

Environmental impacts have been identified within the Project Area of Influence; which lies within 100 m on both ways from the boundary of the proposed construction facilities. Therefore, the identification of Project impacts and recommendations of mitigation measures will be limited within those areas.

5.4 IMPACT EVALUATION

The Impact screening checklist and Project impact evaluation matrix have been developed (**Table 5-2**) to evaluate the potential impacts of the proposed Project based on set procedures of environmental guidelines of the EPA-Punjab. 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 Pre-construction (planning and design), construction, and operational phase 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. For the assessment of impacts, the project impact evaluation matrix is used by dividing the project action into different phases (planning, design, construction, and operations). The Project impact evaluation matrix is shown in **Table 5-2**.

Table 5-2: Impact Matrix

Sr.No	Parameters		Pre-Construction Phase	Construction Phase	Post-Construction/ Execution Phase
1	Ecological Environment				
1.1	Avifauna (Birds)		N/A	0T	N/A
1.2	Trees		N/A	-1P	+1P
1.3	Endangered Species		N/A	N/A	N/A
1.4	Fauna		N/A	N/A	N/A
1.5	Aquatic life		N/A	N/A	N/A
1.6	Crop Cutting		N/A	N/A	N/A
2	Physical Environment				
2.1	Land Use		N/A	-1T	N/A
2.2	Climate Change		N/A	0T	0P
2.3	Ground depletion	Water	N/A	0T	+1P
2.4	Ground Quality	Water	N/A	0T	0P
2.5	Surface Quality	Water	N/A	0T	N/A
2.6	Air Quality		0T	-1T	0P
2.7	Noise		0T	-1T	0P
2.8	Solid Waste Management		0T	-1T	N/A
3	Socio-Economic Environment				
3.1	Loss of Electricity/Sui-gas Transmission lines		N/A	N/A	N/A
3.2	Loss of water and sewerage distribution pipelines		N/A	-1T	+1P
3.3	Loss of telephone lines		N/A	N/A	N/A
3.4	Accessibility infrastructure Roads/Railways		N/A	-1T	N/A
3.5	Loss of Assets		N/A	N/A	N/A
3.6	Aesthetic		0T	-1T	+1P
3.7	Quality of Life		N/A	-1T	+2P
3.8	Mosques		N/A	N/A	N/A
3.9	Monuments		N/A	N/A	N/A
3.10	Employment Opportunities		0T	+1T	N/A
3.11	Public Health		N/A	-1T	+2P

Key:

+ = Positive
 - = Negative
 3 = High
 2 = Medium
 1 = Low
 1 = Negligible
 P = Permanent
 T = Temporary

5.5 POSITIVE ENVIRONMENTAL IMPACTS

Mostly in developing countries, the residents are deprived of proper WASH (Water, Sanitation, and Hygiene) facilities. In Pakistan, residents are also underprivileged due to the isolation of these basic municipal services. This Project is one of the milestones to improve the health of the people as well as accessibility by the provision of potable, clean and safe water in the Divisions of Faisalabad, Lahore and Sahiwal as per provincial, national, and international goals to provide better sanitation facilities. The environmental and social impacts of this proposed project are low to moderate, not of high intensity. Therefore, execution of this proposed project seems beneficial for the residents of the Central Zone of Punjab if proper mitigation actions will be taken at different stages of the project execution which are proposed in the mitigation plan. Enlisted below are a few of the positive impacts of the project:

- The countable benefits from the project are the employment opportunities that will be created. People will be employed at the site in all the phases of the project. The project has employed the people right from the planning through to the assessment. Others to be employed are the contractor, the supervisors, and the construction workers during the construction phase and the management staff during the operation phase.
- Employment will improve the living standards of the employees and their families as they will be able to acquire basic needs from the income that they will earn from the employment.
- It is helpful for the provision of safe and clean potable water to the residents of the project area because the survey shows that currently, available drinking water is not fulfilling the needs as well as water quality standards.
- It is beneficial to improve the public health as well as to save the life of this project area by reducing the induction probability of waterborne diseases such as hepatitis, diarrhea, dysentery, cholera, Guinea worm disease, typhoid etc.
- It will improve the quality of life of the citizens because of many factors like ease of accessibility, good quality water provision, safe disposal of Wastewater and many more.
- People will be served with clean and hygienic potable water through Markaz-e-Aabs which will be constructed at a very close distance from their home (within 1 km of distance) from their home, which is the actual objective of this project.

5.6 ADVERSE ENVIRONMENTAL IMPACTS

Besides positive environmental impacts, several adverse environmental could also be assessed when the proposed project is implemented. Almost all adverse environmental impacts will be temporary, thus short-term mitigations are required. Following is a brief account of the impacts.

Physical Impacts: Like excavation, inducing loss of land for cultivation, noise, and dust emission temporarily during construction. The range of impacts is normal in the area, where plants and other infrastructures are going to be constructed.

Biological Impacts: Such as degradation of habitats by excavation & dumping of earth materials. Often like in such Project, will only have local impacts in the project area.

Economic and Social Impacts: Such as disturbance to traffic flow, free movement, business, affecting the social cohesion of a community. Although the scope of impacts is limited, but sometimes an area might be affected from an aspect even far away.

5.7 PRE-CONSTRUCTION IMPACTS

The impacts associated with the Project siting (before construction begins) are those which relate to its location along with the future extension and distribution network. These impacts are different from those which are associated with the Project's construction and operation phases, in the sense that the construction and operation impacts are associated with the activities such as land clearing, waste disposal, whereas the project siting impacts relate to the mere presence of a facility at the given location. For the proposed project, the following two aspects of the Project site will be considered:

- Project site, land use, and design
- Visual Impacts (aesthetic value)

5.7.1 Land Use & Design

The impact area is that territory, where effects will occur, the Project impact area is defined as the area where the infrastructure will be replaced/ extended/ installed. The scope of impact and its characteristics depend upon the final area selected after the detailed design stage. However, as confirmed in the reconnaissance meeting with the client, all of the project area lands are government-owned and no land acquisition is required. Therefore, the impact is of low insignificance. The nature of this impact is direct, irreversible and the duration will be long term.

5.7.2 Mitigation Measures

This impact can be mitigated by taking the following measures:

- All project components will be provided as per respective design standards.
- Proper Landscaping after collection of relevant data to identify the sensitivity of the area to erosion, instability, and contamination.
- Appropriate measures will be taken to ensure the stability of design structures. Consideration of the inclined slopes, drainage in the distribution network should be made about stability and future maintenance programs should be planned to maintain and repair sensitive soil areas, slope retaining areas, and provision of soil protective planting.

5.7.3 Visual Impacts

Visual impacts can have a long-lasting impact on the aesthetics of the area. It is essential to maintain the existing natural landscape and vegetation, if present, of the Project area. As this natural landscape has an aesthetic value although not of very significant importance, without any doubt, is a valuable asset of the area. The development of the Project can potentially damage the natural landscape and thus it will result in visual impact. The nature of this impact is direct and irreversible, the duration will be short term and the extent will be localized.

5.7.4 Mitigation Measures

The following measures should be taken to reduce the visual impacts of the current project:

- Prepare and follow an appropriate plantation plan in the project area including planting methods, maintenance, and schedule.
- Adopt manners that minimize the changes in the topography, landscaping, and damage to vegetation.

5.8 SOCIO-ECONOMIC ENVIRONMENT

There are no adverse impacts on the socio-economic conditions of the residents of the project area. As there will be no impact on public infrastructure or livelihoods on a long-term basis, however, a few minor temporary impacts might occur during the construction phase.

5.9 CONSTRUCTION PHASE IMPACTS

The construction phase will be the most significant part of the Project concerning environmental disturbances since most of the impacts are likely to take place during this period. Various construction activities will invariably intervene in the existing environmental conditions, which may have impacts on the physical, biological and social environment of the area and nearby communities. Such impacts include the following:

5.10 PHYSICAL ENVIRONMENT

5.10.1 Soil Erosion and Contamination

Significant excavation is expected for the project to rehabilitate the water, sewer, and drainage pipelines. While every effort should be made to minimize the excavation by optimizing the cutting and filling operations. This may lead to erosion due to the loosening of topsoil. Excavation of soil may alter the topography and may also lead to topsoil erosion. This impact would be of moderate significance.

5.10.2 Mitigation Measures

By adopting the following measures, the impact would be finally of low significance:

- Erosion control measures such as ramming of topsoil immediately after excavation and silt controls will be provided to minimize erosion;
- Construction work will not be carried out during heavy monsoon rains;
- It will be ensured that no soil is left unconsolidated after completion of work;
- Photographic record will be maintained for pre-project, during-construction, and post-construction condition of the sites;
- Monitoring during the project execution will ensure compliance with the above mitigation measures and their adequacy;
- Prepare material borrowing and disposal plan;
- Keep a photographic record (before, during, after) for borrow and disposal areas;
- Ditches or borrow pits that cannot be fully rehabilitated will be landscaped.

5.10.3 Air Quality Degradation

The movement of motor vehicles/ large machinery for earthmoving activities produces toxic dust emissions. Furthermore, the project traffic flows may cause dust and gaseous emissions off non-metalled/ unpaved road tracks directly affecting the ambient air quality of residential villages (within +/-100m COI). Local settlements near the location of the construction site may come under direct air quality impacts of activities such as excavation of trunk sewers or disposal station site (Stockpiles associated emissions), development of concrete working platform (Dust emissions) by heavy bulldozers; and Project Traffic transporting raw materials along with manpower to construction camps or construction site.

Construction machinery and Project vehicles will release exhaust emissions, containing Carbon Monoxide (CO), Oxides of Sulfur (SO_x), Oxides of Nitrogen (NO_x), and Particulate Matter (PM_{2.5}). These emissions can deteriorate the ambient air quality near the Project site. Furthermore, construction activities such as excavation, land leveling, filling, and vehicular movement on unpaved tracks may also cause fugitive dust emissions. The nature of this impact will be direct but short-term. The geographical extent of the impact will be locally-based and reversible.

5.10.4 Mitigation Measures

- All temporary services and access roads to be water sprinkled on regular basis (twice a day) to minimize dust generation.
- All vehicles, equipment, and machinery used in construction to be regularly maintained to ensure the pollution emission levels as per Punjab Environmental Quality standards (PEQs) Air quality standards.
- Control of vehicular speed and strictly follow the specified speed limit.

5.10.5 Residual Impacts

The above measures will reduce the magnitude of the adverse impacts on the ambient air quality. The significance of the residual impacts on the air quality is expected to be low.

5.10.6 Noise and Vibration

The construction activities at the work site may generate noise nuisance as high as 85 decibels, (A distance of 350 m to 400 m is needed to reach the PEQS daytime guideline level of 55 dBA for residential receptors). Noise and vibration will be generated by the construction machinery and vehicles during construction activities. Noise emissions will also be generated from other on-site mechanical equipment (vibrations, drilling, etc.). It is likely to affect the Project area, particularly the nearby settlements and agricultural areas. The nature of impact is direct and the duration is short-term. The geographical extent of the impact is local and reversible.

5.10.7 Mitigation Measures

- Vehicles, equipment, and other machinery to strictly follow the noise standards as specified in PEQs. The noise levels should be monitored regularly and levels should be maintained within the PEQS level i.e. >80 dB;

- Vehicles and equipment used will be fitted as applicable with silencers or mufflers and properly tuned and maintained to minimize noise pollution;
- Noise measurement to be carried out at locations and schedules specified as per EMMP to ensure the effectiveness of mitigation measures; and Construction activities will not be carried out at night.

5.10.8 Health and Safety of Workers

The Project is located very close to the residential communities that may pose safety hazards to the local population living nearby. The Project components or construction activities impose a varying degree of safety hazards, which may be attributed to different factors, e.g., road accidents, fire incidents, failure of heavy machinery or equipment, etc.

The public health issues related to the Project location are the possibility of contamination of local drinking water resources, facilitation of transmission of disease, and dust emissions during the construction phase. The anticipated health impacts are classified into the following categories:

- **Disease Transmission:** The labor work crew may bring with them a multitude of communicable diseases including coronavirus, malaria, tuberculosis, influenza, hepatitis, HIV, etc. The standing water and poor waste management near the campsites may provide a breeding ground for vectors of diseases to multiply and infect the local population.
- **Dust Allergy:** One of the main problems, people might face is dust allergy, which is a form of air pollution and may lead to the problem of difficulty breathing among the laborers and nearby residents.
- **Eye and Respiratory Diseases:** Construction workers and people in close vicinity of project sites may become susceptible to eye infections, redness, itchiness, and respiratory diseases due to their routine exposure to dust and exhaust emissions on site. Various respiratory diseases such as Pneumonia, Bronchitis may also occur due to prolonged exposure times.
- **Physical Injuries:** Injuries or loss of life could occur primarily by occupational-related accidents or natural disasters. Activities such as land clearing, earthworks, handling of electric generators and equipment, construction of facilities, installation of machinery may pose threat to various occupational hazards e.g., falling, tripping, slipping, electrocution, burns, cuts, etc. to the workers on-site as well as road users.
- **Psychological Disorders:** Some workers may suffer from depression and anxiety disorders due to bad working and accommodation conditions or their relationships with fellow workers. The psychological well-being of some members of the communities may be affected due to disturbances created by the Project activities. Excessive illumination at the construction site may potentially cause light pollution, creating a public nuisance. The nature of this impact will be direct and indirect at the same time. The duration will be spread across short to medium term and geological extent will be local, with a reversible potential.

5.10.9 Mitigation Measures

- Contractor will ensure the provision of medicines, First Aid Kits, and Emergency vehicles at workplaces;

- The work site should be kept clean and provided with adequate facilities like potable water and sanitation;
- The local community will be educated regarding the safety hazards at the site via awareness campaigns;
- The mitigation measures discussed under air quality deterioration, soil and water contamination will address the public health concerns as well. Inter-alia, routine health screening and training of the contractor's employees should be ensured;
- Provision of training and education of workers at the site of emergency response procedures is also important to enable them to encounter the risks associated with physical injuries. Mitigation measures for workers' psychological disorders include devotion to best management standards regarding working conditions. Also, the laborers should be vaccinated for immunization against communicable diseases including coronavirus;
- Protective fencing will be fixed around the construction site. Unauthorized access within the construction area will not be allowed; Vehicle speed limits of 30 km/hr. around the project site will be enforced;
- Appropriate light diffusers and reflectors will be used, if required, to minimize the public nuisance of glare;
- Elaboration of contingency planning in case of major accidents;
- Appropriate Personal Protective Equipment (PPE) will be provided to the workers to reduce health hazards;
- Warning signboards, sign markings, access restrictions will be displayed on the construction site to avoid risks of accidents. A separate Traffic management plan should be developed and implemented by the Contractor to reduce the likelihood of major accidents or injuries to personnel; and
- The traffic movement would be strictly managed by posting an appropriate number of wardens to avoid accidents and on-road hazards, especially in rainy and fog weather.

5.10.10 Residual Impacts

There will be a moderate level of the residual impact of safety hazards associated with vehicular traffic and construction activities. The residual public health and nuisance issues will be quite negligible and reversible after the effective implementation of the mitigation measures.

5.11 BIOLOGICAL ENVIRONMENT

There is no risk to the trees as there would be no tree cut for the construction and installation of treatment plants. Only those pieces of lands are selected which are already barren for new construction sites. During the construction activities only, the Contractor's workers may damage the vegetation and trees for use as firewood for cooking requirements. The nature of the impact will be direct; duration will be from medium to long term. The geological extent will be local and reversible.

5.11.1 Mitigation Measures

- Small green areas in and around various structures as local landscape plans, should be set aside, where ornamental shrubs will be grown;
- Use of firewood and shrubs for cooking and execution of work to be prohibited;
- The contractor will assure provision of LPG to avoid use of wood;

- During construction, the sprinkling of water in the project site and on the stockpiles of sand and earth should be made a regular practice and preferably be carried out 2 times a day;
- The removed vegetation cover will be vigorously reinstated and re-vegetated to the original conditions.

5.11.2 Residual Impacts

If vegetation on the project sites is re-grown, and a restriction is imposed on cutting of trees for cooking purposes then the impacts would be short term and reversible. If the necessary mitigation measures are taken then the impact would be low to medium.

5.12 SOCIAL ENVIRONMENT

5.12.1 Impact on Local Population

During the construction phase, the local population will be affected by the construction of activities in several ways. Some of these are mentioned below:

- The general mobility of the public using the tracks may be hindered. Inhabitants will have to bear the noise and dust problems.
- Construction activities may inhibit the agricultural or business facilities in the adjoining areas.
- Insecurity may occur for the local population due to the contractor's labor at the site.
- Public health may also get affected by fugitive dust, noise, and smoke.
- Non-native workforce and local community may get into conflicts due to different cultural backgrounds.
- The nature of these impacts is both direct and indirect simultaneously. They will be ranging from short-term to medium-term within a local geological extent and both reversible and sometimes irreversible types.

5.12.2 Mitigation Measures

The mitigation measures for the social impacts on the local community are enlisted below:

- Temporarily, the Contractor should select specific timings for heavy machinery operation to cause the least disturbance to the population considering their peak movement hours.
- Effective construction controls may be made by the Contractor to avoid inconvenience to the population due to noise, smoke, and fugitive dust.
- Haul-trucks carrying concrete, aggregate, and sand fill materials will be kept covered with tarpaulin to help contain construction materials being transported to the site.
- The Contractor should warn the workers not to involve in any theft activities or to cause disturbance/ harassment of women at the project area and if anyone would be involved in such types of activities, he will have to pay the heavy penalty and would be handed over to police.
- Similarly, at the time of hiring laborers/ workers, the Contractor has to take care that the workers should be of good repute and should be familiar with specific requirements for working.
- After the implementation of the above-mentioned mitigation measures, there will be a negligible level of residual impact.

5.13 GENDER ISSUES

Conflicts may occur due to the intrusion of men in the nearby settlements. The nature of these impacts will be indirect and short-term based. The geological extent will be local and in a reversible manner.

5.13.1 Mitigation Measures

- Location of Contractor's camp should be carefully selected to avoid conflicts with the local people of aforementioned residential areas.
- Contractor will warn the staff strictly not to involve in any unethical activities and to respect the social norms and restrictions, particularly concerning local women.

5.14 INDIGENOUS PEOPLE AND VULNERABLE SOCIAL GROUPS

No indigenous people have been identified in the Project Area and hence no impact is envisaged on such groups.

5.15 RELIGIOUS, CULTURAL AND HISTORICAL SITES

All project-related activities must be carried out at a reasonable distance from religious, cultural, and historical sites if any. During the survey, there is no such site found near the project site.

If the project activities are needed to be done in front or close vicinity of sensitive receptors like masjid school, college, or hospital, then the utmost care should be taken to avoid any negative social impacts and proper mitigation measures, as described above, must be followed.

5.16 OPERATIONAL PHASE IMPACTS

5.16.1 Physical Environment

5.16.1.1 Impact on Water Resources Quality and Quantity

Water source for treatment plants in most of the locations will be ground water in this project. The populations of the project area already use ground water for their daily activities. The ground water is collected through hand pumps and motor-pumps/donkey pumps for their daily activities. Ground water will be depleted by using as source intake in treatment plants, because community will only use treated water for drinking purposes as well as not treated water for other domestic purposes.

The groundwater is contaminated by chemical and biological contaminants. Thus, treatment of this water will lead to a positive impact on health of the local community. However, there is negative impact envisaged on ground water depletion which requires mitigation accordingly. This is considered as a significant negative impact is associated with this project.

5.16.1.2 Mitigation Measures

- Water conservation plan should be prepared and implemented properly during whole life cycle of the project to rectify the issue of water depletion.
- One of the most effective ways to address the issue of groundwater depletion is to find alternative sources of water.

- Proper water extraction monitoring will be carried out to stop extraction of excess water from the ground.

5.16.2 Biological Environment

During operational phase, project activities will interact with different components of the environment. This interaction may result into the following adverse impacts:

- Damage to flora and fauna
- Water contamination
- Groundwater Overuse (Water Table Reduction)
- Noise pollution
- Induced vehicular traffic movement
- Safety hazards, public health and nuisance

However, the magnitude of the above impacts is likely to be lower as compared to the construction phase.

- To ensure harmony of the Project with the environment, the management will implement sound environmental management practices to effectively handle the basic environmental issues, including: Any accidental oil/ fuel spillage to be cleared and its disposal ensured;
- Maximum tree plantation as applicable and feasible, by selecting suitable species to absorb emissions. Plantation of suitable species will help the overall aesthetics of the area as well as nurture the oxygen needed for a clean environment;
- Continuous monitoring of water table and water quality;
- Maintenance of water distribution network to avoid any leakage;
- Speed restriction of vehicles in rural settlements area;
- Minimizing the use of horns by placing sign boards and imposing fines;
- Proper Traffic Management Plan and implementation (Traffic challan would be imposed if vehicles discharge excessive smoke or noise);
- Noise and public nuisance abatement; and
- Air quality management and control.

5.16.3 Socio-Economic Environment

Project operation will have following positive impacts on socio-economic environment of the Project area:

- Land price will escalate in the vicinity of Treatment Plants and Markaz e Aabs.
- People will be more productive and avail more business opportunities.
- Water-borne diseases in the project area will decrease.
- Overall benefits of better health and access to clean drinking water will get a boost.

The nature of these impacts will be both direct and indirect with a long-term irreversible effect. The geological extent will remain local limited to the surrounding areas.

5.16.3.1 Mitigation Measures

- Since most of the socioeconomic impacts are positive, therefore no mitigation measures are required.

- Proper water collection facilities, street lights and sign boards would be provided at appropriate Markaz e Aabs.
- Improved facilities will out-weigh the negative factors as it would help to maintain reduced health related problems and more productive environment in the community's centers.

5.17 POTENTIAL ENVIRONMENT ENHANCEMENT MEASURES

The project is an environment enhancement measure in itself as part of providing clean drinking water. The project will enhance the living quality of the surrounding areas of Markaz-e-Aabs.

5.18 EQUIPMENT MAINTENANCE DETAILS

All mobile heavy equipment is being used as construction machinery have been categorized here as vehicles which also include general vehicles used for transportation during the construction process. As per motor vehicle regulation 15 of PEPA 2000, a maintenance schedule will be chalked out by the contractor immediately after mobilization.

CHAPTER 6 ENVIRONMENTAL MITIGATION & MONITORING PLAN (EMMP)

6.1 GENERAL

This Chapter provides an overall approach for managing and monitoring the environmental issues and describes the institutional framework and reporting mechanism to implement the Environmental Management and Monitoring Plan (EMMP) for the Provision of Clean Drinking Water by Punjab Aab-e-Pak Authority Project.

6.2 OBJECTIVES OF THE EMMP

The EMMP has been prepared with the following objectives:

- Provide the details of the project impacts along with the proposed mitigation measures, and a corresponding implementation schedule.
- Define the roles and responsibilities of the project proponent, contractor, and supervisory consultants in order to effectively communicate environmental issues among them.
- Frame a monitoring mechanism, reporting frequency, auditing mechanism and identifying monitoring parameters to ensure that all the mitigation measures are completely and effectively implemented.
- Define the requirements necessary for documenting compliance with EMMP and communicating it to all the concerned regulatory agencies.
- Periodic review of the Environmental Management Plan to allow for improvement,
- Ensure that all stakeholder concerns are addressed if any,
- Identify environmental as well as social training requirements at various levels.

6.3 PURPOSE & NEED OF THE EMMP

Primarily, the purpose of this EMMP is to serve as a quick reference for the consultants, contractors as well as the Proponent to implement the proposed mitigation measures effectively and to monitor the overall environmental performance of the project. Furthermore, to house the procedure, which the proponent follows to implement and maintain this EMMP. The need for the EMMP is mentioned as follows:

- Ensure that attention is paid to the actual environmental effects arising from construction, and operation of the proposed project;
- Ensure that anticipated impacts are maintained within the levels predicted;
- Ensure that unanticipated impacts are managed or mitigated before they become a problem; and
- Ensure that environmental management brings about real environmental benefits and achieves environmental sustainability, rather than the Environmental Approval Process being a mere paper chase to secure a development approval.

6.4 SCOPE OF THE EMMP

The scope of the EMMP includes the following phases of the project:

- Planning and Design Phase;
- Implementation and Construction Phase; and
- Operation Phase.

All the activities performed during these phases will be controlled and monitored according to this EMMP.

6.5 COMPONENTS OF EMMP

These are the relative components of the Environmental Management & Monitoring Program (EMMP).

- Environmental Mitigation & Monitoring Plan
- Site Restoration Plan
- Institutional Arrangement for Implementation of EMMP
- Environmental and Social Training to raise awareness, and;
- EMMP Cost

6.6 ENVIRONMENTAL MITIGATION & MONITORING PLAN

This plan is also known as a matrix which identifies the environmental impacts of **Provision of Clean Drinking Water by Punjab Aab-e-Pak Authority Project** in the **Central Zone of Punjab** during the construction and operation stages and establishes the linkages between the environmental and social impacts, mitigation strategy and the agencies responsible for execution. The EMMP presented in **Table 6-1** identifies the following:

- The mitigation measures recommended in EIA.
- The person/organization directly responsible for adhering to or executing the required mitigation measures.
- The person/organization responsible for ensuring and monitoring adherence to the mitigation measures.
- The parameters which will be monitored to ensure compliance with the mitigation measures.
- The timing at which the mitigation or monitoring has to be carried out.

ECSP	Engineering Consultancy Services Punjab
PAPA	Punjab Aab-e-Pak Authority
SC	Supervisory Consultants
CC	Construction Contractor

Table 6-1: Environmental Mitigation & Monitoring Plan for Provision of Clean Drinking Water in Central Zone of Punjab

Sr. No.	Anticipated Impacts	Mitigation Measure	Responsibility		Action/Monitoring Parameter/Monitoring Method
			Execution	Monitoring	
Construction Stage					
Physical Environment					
1. SOIL	• Soil erosion may take place in the camp areas as a result of improper runoff drawn from the equipment washing. • Soil contamination may take place due to the generated solid waste at camp site in addition to oil spillage and use of chemicals at site. • Scarified/scraped materials, which are not disposed of properly, may contaminate soil resources.	• Good engineering practices should be adopted by Contractors, which will help to control soil erosion both at the construction sites, particularly at camp areas and overhead structures. • Soil contamination can be curtailed by reducing the oil spill in the camp as well as at project construction areas, proper solid waste management and placing chemical containers in caissons.	CC	PAPA / SC	• Equipment washing method and frequency to be regulated/controlled. Vegetation to control erosion. • Placement of solid waste storage containers at camp sites. • Collection and disposal into dedicated waste containers. • Preventive Maintenance of construction vehicles.

Sr. No.	Anticipated Impacts	Mitigation Measure	Responsibility		Action/Monitoring Parameter/Monitoring Method
			Execution	Monitoring	
		The Contractor is required to impart proper training to his workforce in the storage and handling of obnoxious materials, like furnace oil, diesel, petrol and chemicals, etc., that can potentially cause soil contamination.			
2. Ground water	- Due to construction activities i.e., drilling, excavation and dumping of soil, chemicals, oil, lubricants, detergents, etc. surface water and ground water quality can be slightly deteriorated. - Sewage is generated from the construction camps. This may contaminate surface and groundwater, if not disposed of properly. - Due to the construction activities of the proposed Treatment Plants the existing hydrology of the Project Area may get disrupted, which	- Construction camps should be developed in area having natural drainage and its sewage will be disposed-off using septic tank. - Construction should be done only on the required land and with minimum disturbance so that the natural drainage will be prevented. - Avoid accidental spills of oils and lubricants through good practice and develop emergency response plans and	CC	PAPA / SC	- Provision of Septic tank/soakage pit in Camps. - Emergency Response Procedures in case of Accidents or spillage.

Sr. No.	Anticipated Impacts	Mitigation Measure	Responsibility		Action/Monitoring Parameter/Monitoring Method
			Execution	Monitoring	
	mainly includes disturbance in existing drainage of the site.	procedures.			
3. Air, Noise, Vibration	- A Number of machineries and equipment is in operation for the construction of Markaz-e-Aabs and Water Treatment Plants like excavators, dumping trucks, graders, haul trucks etc. generating noise, particulate matter (PM10), smoke, dust, CO, and NOx in the ambient air which may deteriorate the air quality and cause impacts on human health. - Due to movement of trucks and other vehicles noise and vibration may increase and residents of the nearby settlements may get affected especially at night time.	- Tuning of vehicles should be made mandatory to reduce the emissions of NOx, CO, Hydrocarbons (HC) and PM. - Equipment and vehicles powered with diesel should be well maintained to minimize particulate emissions. - Haul-trucks carrying, earth, sand, aggregate and other materials should be kept covered during transportation of materials and during storage on site, with tarpaulin to contain the construction materials being transported within the body of each carrier between the sites. - The fugitive dust emission will be a problem for the nearby settlements, flora and fauna which will be	CC	SC	- Regular tuning of construction equipment and vehicles. - Covering of construction material with tarpaulin. - Vehicles Emissions Reports. - Checking of Water Spraying. - Temporary fence is in place.

Sr. No.	Anticipated Impacts	Mitigation Measure	Responsibility		Action/Monitoring Parameter/Monitoring Method
			Execution	Monitoring	
		mitigated by sprinkling of water. Also, main access roads and exposed terrain should be sprayed by water trucks to minimize the dust. Build temporary corrugated fence			
Ecological Environment					
1. Fauna	Load noises during construction activities near forest may disturb the wild life especially bird species.	Avoid loud noise during construction activities.	CC	PAPA / SC	Monitoring of construction activities.
2. Habitat	Due to the construction in the project site, direct, indirect or temporary damages will occur from site excavation and clearance and dumping spoils in other habitats.	The dredged spoil created during the construction of the project should properly be disposed in order to avoid habitat damage or amplified fragmentation.	CC	PAPA / SC	- Waste Management Plan. - Monitoring of construction activities.

Sr. No.	Anticipated Impacts	Mitigation Measure	Responsibility		Action/Monitoring Parameter/Monitoring Method
			Execution	Monitoring	
Social Environment					
1.	- During the construction phase, the general mobility of the population using the roads in and around the Project Area will be hindered. - People will face the noise and dust problems during the construction phase. - Insecurity problems may arise for the local population due to the Contractor's workers during the construction phase.	- Effective construction controls may be made by the Contractor to avoid inconvenience to the population due to noise, smoke and fugitive dust. - Temporarily, the Contractor should select specific timings for heavy machinery operation so as to cause least disturbance to the population considering their peak movement hours. - Instill a traffic management plan that provides enough signage and detours	CC	SC / PAPA	- Timing of vehicle movement to be noted. - Checking of Traffic Management Plan.
2.	Due to the proposed Project activities, houses, mosques and shrines existing in and around the Project Area may get affected indirectly due to noise and dust.	This indirect impact of dust and noise can be reduced by sprinkling water and reducing the noisy activities during the prayer timings.	CC	S C / PAPA	- Water Sprinkling should be checked. - Regular Environmental Monitoring of Noise should be carried out.

Sr. No.	Anticipated Impacts	Mitigation Measure	Responsibility		Action/Monitoring Parameter/Monitoring Method
			Execution	Monitoring	
3.	- The safe disposal of all solid waste shall be practiced so as to prevent the attraction, harborage or breeding of insects or rodents, and to eliminate conditions harmful to public health or which create safety hazards, odors, unsightliness or public nuisance. - Construction activities, particularly excavation and movement of haul trucks and machinery may prove dangerous for the safety of the workers as well as for local residents.	- Contractor will ensure the provision of medicines, first aid kits, emergency vehicles, etc. at the work place. - Compliance with the safety precautions for construction workers as per International Labour Organization (ILO) Convention No. 62 will be ensured by the Contractor. - Training of workers in the construction safety procedures, environmental awareness, and equipping all construction workers with safety boots, helmets, gloves, ear plugs, and protective masks, and monitoring their proper and sustained usage.	CC	SC / CC	- Solid Waste Management Plan. - Checking of Health and Safety Measures at Project Site. - Monitoring the training sessions and evaluating their effectiveness

Sr. No.	Anticipated Impacts	Mitigation Measure	Responsibility		Action/Monitoring Parameter/Monitoring Method
			Execution	Monitoring	
Operational Stage					
1.	There will be high noise level due to the pumping, generators and machinery operations which may have negative impacts on human health of workers and public.	- Proper, adequate and timely maintenance of equipment through lubrication, repair and replacement of parts to keep the noise levels within the prescribed limits of PEQs. - Providing the workers with suitable hearing protection like ear cap, or earmuffs and training them in their use. - Sound barriers can be placed for the enclosure of Pump machinery in order to control the noise levels within the prescribed limits. This mitigation will be adopted at the treatment plants which are close to the settlements.	PAPA	EPA	- Regular Monitoring of Noise Level at Project Sites. - Proper equipment maintenance

Sr. No.	Anticipated Impacts	Mitigation Measure	Responsibility		Action/Monitoring Parameter/Monitoring Method
			Execution	Monitoring	
2.	There might be leakage in the joints of Water Supply at Markaz-e-Aabs due to frequent turning off and on of water taps.	Proper maintenance should be provided. Pipe joints and Water Supply taps should be regularly monitored for leakage.	PAPA	CC	Regular monitoring of Water Supply Line and Taps.
3.	Water Quality from treatment plants maybe reduced after some years due to deposition of ultra-fine particles inside filter plants and Water Treatment plants.	Proper maintenance and cleaning of filtration and water treatment plants should be provided to ensure maximum life of the equipment installed.	PAPA	SC	Monitoring of water quality at Markaz-e-Aabs at regular intervals.

6.7 INSTITUTIONAL ARRANGEMENTS FOR IMPLEMENTATION OF EMMP

The main institutions involved in the implementation and management of EMMP will be as follows:

- Punjab Aab-e-Pak Authority (PAPA)
- Supervisory Consultants (SC)
- Construction Contractor (CC)
- Punjab Environmental Protection Agency (Punjab-EPA)
- Local Government Departments and Municipal Corporations of the Districts in the respective Divisions

Punjab Aab-e-Pak Authority (PAPA) will mainly be responsible for the implementation of EMMP in consultation with the supervisory consultants and other relevant departments as mentioned in above list and submit regular Environmental Compliance Report on monthly basis during construction and operational phase to EPA-Punjab.

EPA-Punjab is responsible for monitoring of overall project progress in terms of Environmental Mitigation and Management Plan and other environmental parameters that sets in this document. Local Government Departments are responsible for solid waste management.

6.8 ROLES AND RESPONSIBILITIES

As the institutional strengthening activities are necessary to facilitate implementation of EMMP, thus roles and responsibilities of various institutions are discussed below:

6.8.1 Construction Stage

During the construction stage, Construction Contractor (CC) will be mainly responsible for the execution of the mitigation measures. Supervisory Consultants (SC) will be responsible for the monitoring of the compliance with top supervision by the Punjab Aab-e-Pak Authority (PAPA) designated staff as defined in EMMP.

6.8.2 Operation Stage

During the operational stage of the project, role of CC and SC will gradually decrease. During this phase of the project, implementation of recommendations of EMMP and its supervision will be the responsibility of PAPA with top supervision of Punjab-EPA as defined in EMMP.

6.9 SITE RESTORATION PLAN

The main areas considered for site restoration are surrounding areas of Markaz-e-Aabs and Water Treatment Plants that are to be installed and constructed at their designated sites in the Divisions of Faisalabad, Lahore and Sahiwal in the Central Zone of Punjab including Conventional Water Treatment Plant at Chak Jhumra, Faisalabad and a Surface Water Treatment Plant at Renala Khurd, Okara District. Location of these sites are already identified in the Chap # 3, Project Description.

Following measures would be taken to restore the site to its original state.

- All temporary structure or camp site will be dismantled and sites will be restored to their original conditions.
- Necessary landscaping will be done as required to restore the site by planting native trees.
- The construction sites will be covered with the original soil and revegetation will be done, wherever required.
- All the concrete and other material will be cleared and disposed-off according to the waste management plan. The fences and construction sign boards will also be removed.
- There shall be no cutting of trees during the construction of the project. If due to any uncertain reason, a tree is to be removed then 10 number of same trees will be planted against 1 uprooted tree, after the completion of the construction.

6.10 SITE WASTE MANAGEMENT PLAN

The site waste management plan for the proposed project emphasizes on the procedure of how to dispose construction waste. The project Contractor should not start construction work until they have an approved Solid Waste Management Plan (SWMP) in place. The SWMP corresponds to the following topics:

- Type of waste produced at construction site;
- Procedure for waste disposal i.e. reuse, recycle, landfill etc.; and
- Address and issue permit to where waste is transported for disposal or further treatment.
- Liaise with waste management department.

6.11 COMMUNICATION & DOCUMENTATION

Communication and documentation are an essential part of the EMMP. The Proponent of the proposed project is Punjab Aab-e-Pak Authority (PAPA); thus, implementation and monitoring requirements of environmental impact mitigation and monitoring measures will be met by the proponent through consultant/contractor. For this purpose, an Environmental Management Committee (EMC) will be constituted. This committee will comprise of Environmental Managers from Project Management Unit (PMU) and Project Management Consultant (PMC), while Site Inspector will be provided by the Construction Contractor. EMC of this project will take overall responsibility for undertaking and coordinating the mitigation and monitoring measures identified during the pre-construction and construction phases. The Proponent in consultation with the consultants and concerned government agencies will ensure that the mitigation and monitoring measures for the operation and maintenance phases are adequately transferred. The key features of such mechanism are discussed as under:

6.11.1 Data Recording and Maintenance

The standard format of all forms used for data recording should be followed. It should correspond to the database into which all the gathered information will be placed. Checkboxes are used as much as possible to facilitate data entry.

6.11.2 Meetings

To have first-hand information following meetings will take place during the construction phase of the project, such as the kick-off meeting, daily, weekly, quarterly and monthly meetings. The purpose of these meetings will be to discuss the conduct of the operation, non-

compliances noted by the environmental supervisor and recorded in the form of a daily environmental checklist and incorporate them in the monthly report.

6.11.3 Reporting Mechanism

The Supervision Consultant (SC)/EMC staff will prepare monthly and final reports on environmental and social issues. The list of distribution of these reports is provided in the given below **Table**:

Sr. No.	Report	Prepared by	Reviewed by	Distributed by
1	Monthly	Environmental Inspector of Prospect Consultants	Environmental Specialists of Supervision Consultants (SC)/EMC	EMC
2	Final	Environmental Inspector of Prospect Consultants	Environmental Specialists of Supervision Consultants (SC)/EMC	EMC

6.12 GRIEVANCE REDRESS MECHANISM

A Grievance Redressal Committee (GRC) shall be established to address environmental and social concerns and grievances of the Affected Persons, concerned community members and other relevant stakeholders. This mechanism can receive and facilitate the resolution of the concerns or grievances of people who believe they have been adversely affected by the project's environmental and social impacts or the people who believe that their interests are at risk due to the project including construction and operations activities. There is also a provision for the protection of complainants from retaliation and the right to remain anonymous, if requested, to receive and facilitate the resolution of the affected people's concerns and grievances regarding the project's impacts. Measures are identified to mitigate resettlement and livelihood impacts to be caused due to implementation of the project.

Affected Persons (APs) facing temporary business interruption and resettlement and other stakeholders will be kept informed of EMMP and project implementation activities during project implementation. Care will always be taken to prevent grievances rather than going through a redress process. This can be achieved through careful implementation, by ensuring full participation and consultation with the APs and other stakeholders, and by establishing extensive communication and coordination between the communities, the Project Management Unit (PMU) and Punjab Aab-e-Pak Authority.

The Grievance Redressal Committee (GRC) held meetings with the Community members of the project area with the purpose to address any issues arising from the Affected Persons (APs). It was further briefed that APs can lodge complaints verbally with the contractor. In case contractor fails to redress verbal complaint, written complaints would be placed in the compliant register. Consultant will inspect complaint register twice a week and redress them in consultation with APs and Contractor. If the complaint is not resolved, PMC will forward the complaint to project level Grievance Redress Committee (GRC). GRC is bound to address the complaint within fifteen days. In case GRC is unable to redress the grievance, APs have a right to pursue it in court of law.

The Proposed composition of GRC is as under:

Sr. No.	Designation	Role/Status
1	Director Project Management Unit (PMU) "Provision of Clean Drinking Water by Punjab Aab-e-Pak Authority (Phase-I) Central Zone"	Chair
2	Deputy Director-PMU- Provision of Clean Drinking Water by Punjab Aab-e-Pak Authority (Phase-I) Central Zone	Member (also act as secretary of the Committee)
3	Staff of EMC	Members
4	Resident Engineers – Consultants	Member
5	Chief Resident Engineer – Contractor	Member

6.12.1 Community Complaint Register

A "**Community Complaint Register (CCR)**" at project sites has already placed at PMU. The register includes the information as date, name and address of complainant and description of complaints and will enter the complaints in a date covering the information of name and address of complaint, description of complaints, action taken, status of redress of complaints and reasons in complaint is not resolved. will inspect complaint register twice a week. Even if there is no complaint, the staff will meet frequently particularly with the APs and the local people residing in the surrounding of project area in general, to discuss their views and suggestions on the issues occurring in the implementation of the project.

The Community Complaint Register will be maintained by the consultant environmental inspector at the camp site to document all complaints received from the project area. In the social complaint register, the measures taken to mitigate the complaints will also be recorded. The final report will be communicated to the Project Manager

6.13 ENVIRONMENTAL MANAGEMENT AND MONITORING COST

Implementation of the commendations of the EIA at the construction stage is the sole responsibility of the contractor and the monitoring activities will be carried out by the SC. The expense of planting trees, monitoring, reporting, and solid waste management will all be included in the environmental budget. Only a few shrub species will be removed from the site during the development phase and the area will be re-vegetated with the local trees. The cost for environmental monitoring will be a part of the contract document with the Contractor. It must be noted that environmental costs will not be a separate entity because all of its components will be addressed in the bidding document under various heads of account. For instance, tree plantation will be a part of landscaping; infrastructure repair will be covered under rehabilitation work, and so forth.

The tentative cost for these components and various others has been estimated in the breakup of implementation of EMMP. The total estimated cost of EMMP for this project is **PKR 85.07**.

Million (Approximately) during the pre-construction, construction stage, and operation Stage. The breakdown cost of the project phase-wise is calculated and is presented in **Table 6-2**:

Table 6-2: Total Estimated Cost of Implementation of EMMP

Sr. No.	EMP Parameters	Unit Cost	Design Phase		Construction Phase (3 Years)		After Construction (Yearly Cost)		Total (PKR in Million)
			Times	Cost	Times	Cost	Times	Cost	
1.	Environmental Monitoring & Laboratory Testing of Water Samples	6500	1 x 399	2593500	-	-	4 x 399	10374000	12.9 Million
2.	Internal Environmental Auditing & Reporting Review								
	Environmental Manager Salary (3 Environmental Managers, i.e. One for each Division)	90,000/- per Month	-	-	3 x 36	9720000	3 x 12	3240000	12.96 Million
	Site Inspector Salary (11 Site Inspectors, i.e. One for Each District)	45,000/- per Month	-	-	11 x 36	17820000	11 x 12	5940000	23.76 Million
3.	Media Chemical Dosing and etc.	3000	-	-	-	-	4 x 399	4788000	4.78 Million
4.	Environmental Health & Safety								
	Medical Screening of Workers	3000	800	2400000	-	-	-	-	2.4 Million
	Handling of Solid Waste	1000/- per Month per Site	-	-	36 x 399	14364000	12 x 399	4788000	19.15 Million
	Health & Safety of Workers	10,000/- per worker	-	-	1 x 800	8000000	-	-	8 Million
5.	Contingency	2% of total	-	99870	-	739528	-	582600	1.42 Million
Total									85.07 Million

CHAPTER 7 STAKE HOLDERS CONSULTATION

7.1 GENERAL

In the process of planning, design, and execution of any project, the proper consultation with the project area people is vital and plays a significant role in achieving the cooperation, spreading awareness and inclusion of local population. An important aspect of the Environmental Impact Assessment (EIA) process is the early participation of the public. The public consultations, conducted as part of Environmental and Social Assessment have reshaped certain projects by identifying some adverse/negative environmental and social impacts, hence increasing the chances of success and long-term goals achievement.

7.2 CONSULTATION OBJECTIVES

The broad objective of project people consultations and participation is to take the project area people in confidence about the impacts of the project, addressing their concerns, if any, about the project during different stages and activities. The main/specific objectives of public participation and consultations are:

- Ensure public and community active participation.
- Ensure public confidence in the administration of the project.
- Provide the community access to environmental information to the area's people.
- Increase transparency, people's understanding, and their involvement in decision-making.
- Promote sustainability for Government-funded projects.
- Ensure broad-based participation of people in development projects/ activities.
- Achieve desired goals and impacts.

7.3 IDENTIFICATION AND CONSULTATIONS WITH STAKEHOLDERS

The project potential stakeholders are the project affected/project area people, who reside or own businesses or land subject to expropriation due to project activities. The other important stakeholders identified include the local Government representatives and Government officials of the relevant departments like the Environmental Protection Department (EPD), Water and Sanitation Agency (WASA), Development Authorities of the Divisions, Public Health Engineering Department, Municipal Corporation, Irrigation Department, interested NGO/ CBO and general people.

7.4 POINTS DISCUSSED

During the process of consultation, the important points explained and discussed with the participants were as under: -

- Objectives of the project.
- Existing water quality of the area.
- Plan of the Punjab Aab-e-Pak Authority for the Provision of Clean Drinking Water for the people of Central Zone of Punjab.

- Possible / expected impacts of the projection area.
- Suggestions for improvement in the project.

During this process, the objectives and scope of the work, expected benefits and adverse impacts, if any, were clearly explained. The potential affectees / beneficiaries contacted are as under:

7.5 STATUTORY BODIES / LOCAL GOVERNMENT OFFICIALS

The main points of consultations with secondary stakeholders are provided below:

Mr. Syed Yasir Ali Abidi (Deputy Director), WASA Lahore

- Sustainability of the Clean Drinking Water Supply facilities should be ensured after the commissioning of the project.
- PAPA should also run awareness campaign which encourage the general public to use only clean water for drinking purpose.
- PAPA should introduce some kind of monthly billing system for the usage of clean drinking water from Markaz-e-Aabs to meet the operation and maintenance costs.
- It must be ensured that water from Markaz-e-Aabs is used for drinking purpose only.
- A security guard must be appointed at each water treatment facility to control theft incidents.
- Treated Water should be validated to check required concentration is achieved
- Quality of water at Markaz-e-Aabs should be validated by performing periodic lab tests by collection of samples.

Figure 7-1 shows the stakeholders Consultation with Deputy Director, WASA Lahore



Figure 7-1: Stakeholders Consultation in process with WASA

**Mr. Naseem-Ur-Rehman Shah (Director Environmental Impact Assessment),
Environmental Protection Department, Punjab**

- Cleaning of filters should be done at regular intervals to maintain the desired water quality at Markaz-e-Aabs
- Hydrological study for the availability of groundwater should be done to ensure the continuous supply of clean drinking water up to the design life of the project.
- There are tracers of Arsenic and Fluoride in some areas of Punjab, so proper type of filters should be used to remove Arsenic and Fluoride contamination from the water.
- Proper Operation and Maintenance should be applied to the Treatment plants and Markaz-e-Aabs to provide continuous water supply to the residents of respective areas.
- There should be strict implementation of EMMP and it should must be transparent.
- Testing of water samples should be done from SGS certified and TTI approved laboratories.

Figure: 7-2 shows the Stakeholders consultation with the Director EIA, Environmental Protection Department of Punjab



Figure 7-2: Stakeholders Consultation in process with EPD, Punjab

Ms. Memoona (Assistant Director, Agriculture Officer) Agriculture Department of Punjab

- The location of treatment plant and Markaz-e-Aabs must be at suitable places such that people could easily access them on walking distance from their homes.
- There should be proper maintenance of Clean Drinking Water Facilities so that the life of these facilities could be sustained.
- Quality of drinking water at treatment plants should be maintained.
- Schedule of availability of water supply must be followed.
- A cold-water chiller should also be placed at each Markaz-e-Aab to provide chilled water in summer season for the public.

Figure 7-3 shows the Stakeholders consultation with the Agriculture Department of Punjab.



Figure 7-3: Stakeholders Consultation in Process with Agriculture Department, Punjab

Mr. Wasim Haider, Executive Engineer (Civil), Indus Telemetry, WAPDA House, Lahore

- Presence of a technically skilled person is necessary at each treatment plant to handle any malfunction or troubleshooting of the system.
- Entrance of general public should be prohibited to enter the control room of treatment plants. Public should have access to Markaz-e-Aabs only.
- Proper protocols for the collection and transportation of water samples for laboratory testing should be followed.
- Water Treatment technology should be adopted at each location according to the present water quality of that area.
- A room should be provided to the guard at each Treatment plant/Markaz-e-Aab for his residence.
- Feedback mechanism from general public should be developed in order to check the viability of the project.
- A survey should also be conducted from the local clinics to check whether this project is helpful in eliminating the water borne diseases.

Figure 7-4 shows the Stakeholders consultation with the Executive Engineer, WAPDA House, Lahore.



Figure 7-4: Stakeholders Consultation in Process with Executive Engineer, WAPDA House

**Mr. Sohaib Ahmed, (XEN) Balloki Head Works (1/AL Jhand Wala Minor Brach Canal),
Irrigation Department of Punjab**

A meeting was held between XEN of Balloki Head Works and Chief of Environment (ECSP) for the stakeholder's consultation for the project of Supply, Construction and Installation of Surface Water Treatment Plant at Renala Khurd, Okara, Sahiwal.

- Irrigation Department of Punjab was unaware of this initiative of Punjab Aab-e-Pak Authority.
- However, the staff of the department was very cooperative & supportive. They were in favor of the project as this project will provide clean drinking water to the local community.
- The client should obtain NOC from the Irrigation Department of the Punjab.
- The client must be bound to restore the site to its original state after the completion of construction.
- Punjab Aab-e-Pak Authority must allocate a budget for the horticulture of the site.



Figure 7-5: Stakeholder's Consultation in Progress with the Irrigation Department of the Punjab

Mr. Zahoor Hassan, Deputy Secretary (Technical) Housing Urban Development & Public Health Engineering Department (HUD & PHED), Punjab

Mr. Zahoor Hassan was in favor of the project and appreciated the initiative by Punjab Aab-e-Pak Authority to provide Clean Drinking water facilities, especially to the rural areas of Punjab. He further gave comments that:

- This project will raise the living standards of the unprivileged communities as people will be able to perform better in their life.
- Pressure on hospitals will reduce significantly, as more than 70% of the diseases spread due to drinking of contaminated or polluted water.
- The filtration plants should be in reach of every resident of area.
- In case of land acquisition from the public, the client should provide resettlement to the land owners.
- The client should develop a proper operating and maintenance schedule to run the plants, and must follow the prescribed procedures.
- The construction contractor must be bound to provide proper personal protective equipment to the workers.



Figure 7-6: Stakeholders' Consultation in Progress with HUD/PHED

CHAPTER 8 CONCLUSION & RECOMMENDATIONS

8.1 CONCLUSION

The installation of Clean Drinking Water Supply Facilities by Punjab Aab-e-Pak Authority in the Central Zone of Punjab will bring about some significant positive Impacts while moderate to minor adverse impacts on the physical, ecological, and socio-economic environment of the project area. These Impacts have been identified and possible mitigation measures for the adverse impacts have been provided. Generally speaking, the project will have short-term reversible impacts with minor to moderate magnitude, but there are long term positive impacts of this project. The execution of the project will surely reduce the outbreak of waterborne diseases and consequently will improve the health and living condition of the people of the project area. Some Important Impacts of the project area are provided as under:

- A step towards, prime duty of the government, provision of safe drinking water to every civilian of the Province.
- In the project area where the facilities for the provision of clean drinking water supply will be installed and constructed, no protected areas, wildlife sanctuary, or any environmentally sensitive areas are present.
- Not a single place was found in the project area which is archaeologically preserved or declared/ possessing a cultural heritage Site.
- The impacts like Soil Erosion, Dust Problem, Soil Disposal, Waste Generation, Higher Noise levels during Construction, Enhanced Traffic problems, and health problems are temporary and can be controlled and mitigated by taking necessary action by the proper implementation of the EMMP.
- The Environmental Management and Monitoring Plan (EMMP) has been prepared to identify the impacts of the project activities, mitigation measures required for adverse impacts, and different agencies responsible for the implementation.

8.2 RECOMMENDATIONS

In the EIA Report, some comprehensive mitigation measures have been identified to minimize/ nullify the adverse impacts and enhance the positive impacts of the project. The major recommended measures are summarized as below:

- The contractor's construction and labor camps should be established at least 500m away from the settlements. The camps should be having a boundary wall and proper drainage system and an effective waste management system.
- Environmentally sustainable engineering practices should be followed to control soil erosion, solid waste management, water contamination, air pollution, noise levels, etc.
- Local plants and trees must be planted at every location of the construction site of the project.
- The affected utility services due to construction activities should be rehabilitated by the contractor.
- Water quality should be monitored regularly keeping in view the PEQS. The EMMP should be followed strictly by the contractor.

- Educate the beneficiaries of the project that Markaz-e-Aabs has been established for the provision of clean drinking water only. People should avoid careless use of such a precious resource and not to use this clean drinking water for cleaning, bathing and other domestic uses.
- In case of heavy rains, an emergency plan using all the available machinery and manpower must be there to avoid ponding.
- The Proponent should submit this EIA report immediately to **EPA-Punjab** for issuance of necessary Environmental Approval (NOC); before proceeding further into the construction activities.

CHAPTER 9 REFERENCES

- <https://bos.punjab.gov.pk/system/files/PDS%202022.pdf>
- https://epd.punjab.gov.pk/checklists_iee_eia_projects
- <https://www.pbs.gov.pk/content/final-results-census-2017>
- <https://faisalabaddivision.punjab.gov.pk/>
- https://lahoredivision.punjab.gov.pk/division_profile
- <https://sahiwaldivision.punjab.gov.pk/>
- <https://sdpi.org/sdpiweb/publications/files/Impact-of-Safe-Drinking-Water-and-Sanitation-on-Water-Born-Diseases-in-Pakistan.pdf>
- https://www.researchgate.net/publication/281741257_Modelling_Land_use_Patterns_of_Lahore_Pakistan_using_Remote_Sensing_and_GIS
- https://assets.publishing.service.gov.uk/media/5c6c2b4be5274a72be398f0a/502_Water_Sanitation_and_Hygiene_in_Pakistan.pdf
- <http://web.ndma.gov.pk/publications/BuildingcodeofPakistanwithseismicprovision.pdf>
- <https://www.pbs.gov.pk/content/brief-census-2017>