Initial Environmental Examination Report

Project Number: 46526-007
Loan Number: 3562-PAK
Date: July 2020

Punjab Intermediate Cities Improvement Investment Project

IEE for Sahiwal Wastewater Treatment Plant

Prepared by Project Management Unit of PICIIP, Government of Punjab, Pakistan

Punjab Intermediate Cities Improvement Investment Program (PICIIP)

Sahiwal Component

TA 8683 (PAK)

Initial Environmental Examination

Part 2: Sahiwal Wastewater Treatment Plant

July 2020

Prepared by PMU - PICIIP for the Asian Development Bank (ADB)

CURRENCY EQUIVALENTS

As of 26th July 2020	Currency Unit – Pak Rupees (Pak Rs.)
Pak Rs 1.00 = $ 0.00595	US$1.00 = Pak Rs. 168

CONVERSIONS

1 meter = 3.28 feet

1 hectare = 2.47 acre

Acronyms

ADB	Asian Development Bank
CIU	City Implementation Unit
CDIA	Cities Development Initiative for Asia
PICIIP	Punjab Intermediate Cities Improvement Investment Program
PMU	Project Management Unit
SPS	Safeguard Policy Statement
EA	Executing Agency
EIA	Environment Impact Assessment
EPA	Environmental Protection Agency
ESCF	Environment Screening and Categorization Form
EMP	Environmental Management Plan
IA	Implementing Agency
GoP	Government of Pakistan
IEE	Initial Environmental Examination
LAA	Land Acquisition Act (of 1984)
LARP	Land Acquisition and Resettlement Plan
Leq	Equivalent sound pressure level
NEQS	National Environmental Quality Standards
O&M	Operation & Maintenance
PC	Public consultation
PEPA	Punjab Environmental Protection Agency
PEPAct	Pakistan Environment Protection Act 1997
RP	Resettlement Plan
REA	Rapid Environmental Assessment
WATSAN	Water supply and Sanitation
WWTP	Wastewater treatment plant

Table of Content

1 Introduction 20

1.1 Overview 20

1.2 Purpose, Scope and Context of IEE Study 20

2 Policy and Legal Framework 26

3 Project Description 42

3.1 Project Description 42

3.2 Scope of WWTP Works 42

3.3 Project Need 45

3.4 Project Design Parameters 46

3.5 Project Components 50

3.6 Project Construction Schedule 61

3.7 Construction Camps and Work Force 61

3.8 Machinery Requirement 61

3.9 Climate Risks from Project 62

4 Description of Environment 77

4.1 Physical Resources 77

4.1.1 Sahiwal City Geography 77

4.1.2 Natural and Climate Conditions of Sahiwal 78

4.1.3 Ambient Air Quality 81

4.1.4 Noise Levels 81

4.1.5 Seismicity 85

4.1.6 Surface Water 86

4.1.7 Groundwater 88

4.2 Ecological Resources 89

4.2.1 Flora of the Area 89

4.2.2 Fauna of the Area 91

4.2.3 Protected areas / National Sanctuaries 93

4.3 Socio-Economic Development 94

4.3.1 Land Use and Settlements Pattern 95

4.3.2 Agriculture and Livestock 98

4.3.3 Power 99

4.3.4 Industrial Activity 99

4.3.5 Water Supply Service 100

4.3.6 Sewerage System Service 100

4.3.7 Solid Waste Management 100

4.3.8 Transport 101
4.4 Social Resources 102
4.4.1 Employment and Unemployment 103
4.4.2 Educational Services 104
4.4.3 Health Facilities 104
4.4.4 Harappa Archaeological Site as a Tourist Attraction 105
4.5 Socioeconomic Condition 105
4.5.1 Settlements Profile 105
4.5.2 Conflict Resolution Mechanism 105
4.5.3 Public Health 106
4.5.4 Cultural and Religious Resources 106
4.5.5 Religion 106
4.5.6 Language Spoken 106
4.5.7 Castes and Minority Groups 106
4.5.8 Educational Status 106
4.5.9 Economic Conditions of the Study Area 107
5 Analysis of Alternatives 109
5.1 Overview 109
5.5 Options of Reuse of Treated Effluent for Agriculture 121
5.6 Options for Biogas Management 122
5.7 Options for Sludge Use 123
6 Potential Environmental Impacts and Mitigation Measures 126
6.1 Methodology for impact screening 126
6.2 Design/Pre-Construction Phase 127
6.2.1 Lack of integration of IEE/EMP requirements into Construction bid documents 128
6.2.2 Material Haul Routes 128
6.2.3 Contractor's Environmental Safeguards Capacity 129
6.2.5 Cultural Heritage & Religious Sites, Social Infrastructure 130
6.2.6 Land Acquisition and Resettlement Impacts 130
6.3 Construction Phase 130
Impact Screening Matrix 130
6.3.2 Community Health and Safety 134
6.3.4 Noise 144
6.3.5 Hazardous and Non-Hazardous Waste Management 146
6.4 Impacts Associated with Operation of WWTP 150
6.4.6 Lower loads on Ecosystems 157

6.4.7 Generation and Use of by-products i.e. Sludge for Agriculture 157
6.5 Cumulative Impacts 158
6.6 Indirect and Induced Impacts 158
7 Environmental Management Plan & Institutional Requirements 159
7.1 Introduction 159
7.2 Environmental Management Plan (EMP) 159
7.3 Objectives of EMP 159
7.4 Environmental Management/Monitoring and Reporting 160
7.5 Institutional Arrangements 160
7.5.1 Role of LG&CDD 160
7.5.2 Role of PMU 161
7.5.3 Role of Municipal Corporation (MC) 161
7.5.4 Role of City Implementation Unit (CIU) 161
7.5.5 Role of the ADB 161
7.5.6 Role of Project Contractor 162
7.6 Monitoring Parameters 162
7.7 Environmental Training 163
7.7.1 Capacity Building and Training 163
7.8 Environmental Management Costs 185
8 Public Consultation and Information Disclosure 188
9 Grievance Redressal Mechanism 192
10 Conclusion and Recommendations 196

Annexures

Annexure A	**Photographs of public consultations**
Annexure B	**Environment Screening & Categorization Forms (ESCF)**
Annexure C	**Occupational Health and Safety Plan**
Annexure D	**Emergency Response Plan**
Annexure E	**Archaeological 'Chance Find' procedure**
Annexure F	**Dust Management Plan**
Annexure G	**Site Specific EMP (SSEMP) Guide & Template for Guidance to Contractor**
Annexure H	**Ambient Laboratory Monitoring**

List of Figures

Figure 1.1: Location of Sahiwal City in District Sahiwal 23

Figure 1.2: Location of Proposed WWTP 24

Figure 3.1: Sensitive Receptor Map of WWTP 64

Figure 3.2: Proposed WWTP Site 65

Figure 3.3: WWTP inlet, outlet, and bypass channel layout Plan 66

Figure 3.4: WWTP Process Flow Diagram 67

Figure 3.5: WWTP Hydraulic Profile 68

Figure 3.6: AP, FP & MP Plan and Section 69

Figure 3.7: AP-01 & FP-01 Plan and Section 70

Figure 3.8: AP-02 to AP-10 Plan and Section 71

Figure 3.9: FP-02 to FP-10 Plan and Section 72

Figure 3.10: Collection Chamber Plan and Section 73

Figure 3.11: Inlet Channel and Outlet Channel - Section 74

Figure 3.12: Interconnection detail between AP and FP 75

Figure 3.13: Interconnection detail between FP and MP 76

Figure 4.1: Location Map of Sahiwal 78

Figure 4.2: Wind Rose for Sahiwal 81

Figure 4.3: Map of Monitoring Location 82

Figure 4.3: Seismic Zoning Map of Pakistan 86

Figure 5.1: Layout of proposed WWTP Sites for Sub-Zone 1 (A) and Sub-Zone 1(B) in Option 1 114

Figure 5.2: Layout of proposed WWTP Site for Zone-1 (Northern Part) in Option 2 115

Figure 5.3: Sludge treatment and disposal costs 124

Figure 6.1: Corridor of Impact of AirBorne Impacts from WWTP 156

Figure 8.1: Grievance Redressal Mechanism…….....54

List of Tables

Table 1.1: Environmental Guidelines and Regulations……26

Table 1.2: ADB Policy Principles…….29

Table 1.3: IFC Work Environment Noise limits…….31

Table 1.4: Comparison of International and local Air Quality Standards……..32

Table 1.5: Comparison of International and Local Noise Standards…….34

Table 1.6: Sensitive Receptor Mapping…….56

Table 1.7:: Assessment to determine Associated Facility……...……94

Table 1.8: Mean Monthly Maximum and Minimum Temperature of Sahiwal district……...97

Table 1.9: Meteorological Data, Mean Monthly Precipitation of Sahiwal district…….....97

Table 1.10: Ambient Air Quality Monitoring Results (24 hrs) at Two Locations in Project Area……..100

Table 1.11: Comparison of ambient air quality results versus applicable Air Quality standards…….100

Table 1.12: Ambient Noise Monitoring Results (24 hrs) at Two locations in Project Area……..101

Table 1.13: Meteorological Data, Mean Monthly Relative Humidity ……..…….102

Table 1.14: Wastewater Quality Analysis……...…….104

Table 1.15: Name of Trees……....106

Table 1.16: Name of Shrubs and Herbs……..106

Table 1.17: Name of Grasses……..….106

Table 1.18: Species Wise Tree Distribution……...….107

Table 1.19: Names of Mammals…….....107

Table 1.20: Names of Reptiles…….....107

Table 1.21: Names of Amphibians……..…….....108

Table 1.22: Names of Birds……..…….108

Table 1.23: Average Yield of Agricultural Crops……...…….109

Table 1.24: Land Use Distribution in Sahiwal……...…….……11 2

Table 1.25: Social Economic Indicators Summary…….116

Table 1.26: Educational Level of the Respondents…….....121

Table 1.27: Distribution of Household Members by Occupation…….……...121

Table 1.28: Distribution of Households by Average Monthly Household Income……122

Table 1.29: Housing Type…….…….....…….....122

Table 1.30: Merits and demerits of Pipes…….....125

Table 6.31: 'Activity Wise' Screening of possible Impacts during Design/Pre-Construction phase…….....130

Table 1.32: Screening of Possible Impacts during Construction Phase…….……..135

Table 1.33: Control measures for Fugitive Dust emissions…….……..……139

Table 1.34: Construction Equipment Noise Ranges, dB(A)…….…….……143

Table 1.35: Environmental Management Plan…….……..155

Table 1.36: 'Pre-Construction' Environmental Monitoring Plan for Baseline Development…….173

Table 1.37: Construction Phase Monitoring Requirements…….174

Table 1.38: Capacity Development and Training Programme……175

Table 1.39: Annual Cost Estimates for 'Pre-Construction Phase' Environmental Monitoring…….177

Table 1.40: Annual Cost Estimates for 'Construction Phase' Environmental Monitoring…….....177

Table 1.41: Estimated Costs for EMP Implementation…….....178

Table 1.42: Capacity Development and Training Programme for Project Contractor(s)……179

EXECUTIVE SUMMARY

Project Overview

1. This is the Initial Environmental Examination report (IEE) for the Wastewater Treatment Plant (WWTP) to be developd in the North zone of Sahiwal, Punjab province of Pakistan. A map of the project area is provided as **Figure ES-1**.

2. This document has been prepared as an update to the umbrella IEE assessment[1] prepared in July 2017, which covered all water supply and sanitation (WATSAN) works to be conducted in Sahiwal city. This document focuses solely on the proposed scope of works to be conducted under 2 Lots for development of the WWTP and contains the EMP, which shall be implemented by the Contractor to mitigate any potential impacts and shall be used by the PMU and ADB for compliance monitoring.

Project Need

3. At present, Sahiwal city is urgently in need of a WWTP as presently, no treatment plant is available for treatment of sewage in the project area of Sahiwal City. The raw sewage is being directly disposed of into the canals, seepage drain and in agricultural fields in outskirts of the city. This practice is environmentally unsafe and a violation of Punjab Environmental Protection Act;

   Furthermore, the disposal of untreated wastewater into water bodies/ agriculture fields is causing contamination of the water and food chain and several associated environmental and health issues;

Study Methodology

4. Primary and secondary data has been collected and used to assess the environmental impacts of the proposed WWTP development. Extensive due diligence visits were conducted to the project area for the proposed works from April'20 to June'20 to examine the project area and to assess the baseline in order to evaluate whether there are any key receptors that will need to be considered during the project works to prevent any long term and irreversible impacts.

5. Detailed baseline monitoring in the project area to assess potential impacts on air quality and noise levels has been conducted and presented in this study. This IEE report highlights all potential environmental impacts associated with the WWTP project and recommends mitigation measures. Any environmental impacts

[1] https://www.adb.org/projects/documents/pak-46526-007-iee-2

associated with the project need to be properly mitigated, through the existing institutional arrangements described in this report.

6. The activities to be conducted under the two Lots in the North zone of Sahiwal city were screened for potential impacts at the design/pre-construction, construction and operation phases of the WWTP. This 'activity wise' screening enabled to obtain a clear picture of the expected level of impacts resulting from the different activities and helped identify required mitigation measures to mitigate them to within acceptable limits as per local and international applicable regulations. A detailed environmental management and monitoring plan was developed to ensure compliance to the proposed measures during the project development.

7. The screening matrices for the key issues that have been identified during the different project development stages across the two Lots are provided in the **Tables ES-1** to **ES-3** below.

Public Consultation Process

8. Detailed and extensive consultations with different key stakeholders have been conducted to date, consisting of the local communities and local businesses located in the project area, different public sector line departments etc. and their comments/concerns/suggestions were obtained. The details of the persons consulted are provided as **Annexure A**.

9. The key comments and concerns raised as a result of the consultations are as follows:

- Public safety should be on top priority during construction.
- The traffic should be managed properly during the WWTP development.
- As the existing water and sanitation is not in a good condition, so this sub-project should be executed on urgent basis with due diligence.
- There should be awareness campaigns to guide public in a way that they may start discouraging the wastage of water and throwing the garbage in sewer lines.
- The Contractor should comply with the mitigation measures proposed in the Environmental and Management and Monitoring Plan (EMMP) and HSE compliance policy.
- Contractor's activities should be confined to minimize any inconvenience to the public.
- Dust produced due to construction activities may create different health problems, therefore water sprinkling should be carried out regularly to suppress the dust emissions;
- During construction, labour force movement should be controlled so that activities of the community are not disturbed;
- The participants/representatives also stressed the need for timely completion of the project.

- The movement of the heavy machinery should be controlled to avoid harm to other associated properties/structures;
- Grievance redressal mechanism (GRM) at the PMU level should be formalized to address any complaints from the stakeholders at site.
- Awareness campaigns by using Print, Electronic and Social media are highly required to create civic sense among masses.

Analysis of Alternatives

10. A number of different alternatives were also assessed as follows:

- **'No Project' Option:** It was concluded considering the urgent need for the development of a wastewater treatment plant for Sahiwal city, the project must be developed and the 'No Project' option is not viable.
- **Selection of Wastewater Treatment Technology:**
- **Site Selection Analysis:**
- **Biogas Management Alternatives:**
- **Options for Use of Sludge:**
- **Options for Use of treated Effluent:**

Land Acquisition & Resettlement

11. The proposed project site for the WWTP development is located on publicly owned land and thus no land acquisition and/or resettlement will be required.

Conclusion & Recommendations

12. The implementation of the existing EMP in its true letter and spirit shall ensure any potential impacts are managed and no long-term significant impacts take place during the construction works at the WWTP site.

13. During the operation phase of the WWTP, mostly positive impacts are expected in order to effectively manage and treat the wastewater being generated from Sahiwal city while any potential impacts resulting from the operation of the WWTP will be managed by implementation of the proposed mitigation measures and conducting the required monitoring of the treated effluent quality being discharged into the Ravi River as well as the ground water quality in the project area.

14. As a result of this IEE study, it has been determined that any adverse or harmful impacts shall be effectively mitigated through implementation of necessary measures

and through regular monitoring. The project falls under the Category 'B' of ADB's Guidelines and thus an IEE has been prepared for the proposed WWTP project.

Table ES-1: 'Activity Wise' Screening of possible Impacts during Design/Pre-Construction phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Lack of integration of IEE/EMP requirements into Construction bid documents	Likely	Moderate	Medium
2	Material Haul Routes	Likely	Moderate	Medium
3	Improper location of worker camps leading to improper disposal of solid waste and sewage and privacy issues for residents in project area.	Likely	Moderate	Medium
4	Contractor's Environmental Safeguards Capacity	Likely	Moderate	Medium

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

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

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Excavated Material (Earthworks) Disposal	Certain	Major	Significant
2	Degradation of air quality due to construction works	Certain	Major	Significant
3	Potential accidents and injuries to communities in project area during construction works	Likely	Major	Medium
4	Injuries to workers from lack of necessary training and/or not using PPEs etc.	Likely	Major	Medium
5	High noise levels from construction activities	Likely	Major	Medium
6	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Moderate	Medium
7	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium
8	Soil Erosion and Sedimentation	Likely	Moderate	Medium
9	Soil Contamination	Likely	Moderate	Medium
10	Employment Conflicts	Likely	Moderate	Medium
11	Communicable diseases	Likely	Moderate	Medium
12	Vegetation and Wildlife	Unlikely	Moderate	Low

	Loss			
13	Historical/Archaeological Sites	Unlikely	Moderate	Low

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

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

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Possible Emergencies and Plant Failure	Unlikely	Major	Medium
2	Odor generation	Likely	Major	Medium
3	Improper Disposal of Sludge	Unlikely	Major	Medium
4	Disease Vector Generation & Transmission	Likely	Major	Medium
5	Improvements in Public Health	Positive impacts expected		
6	Lower Loads on Ecosystem	Positive impacts expected		
7	Generation and use of byproducts i.e. Sludge for agriculture	Positive impacts expected		

Critical Risk Level

Significant Risk Level

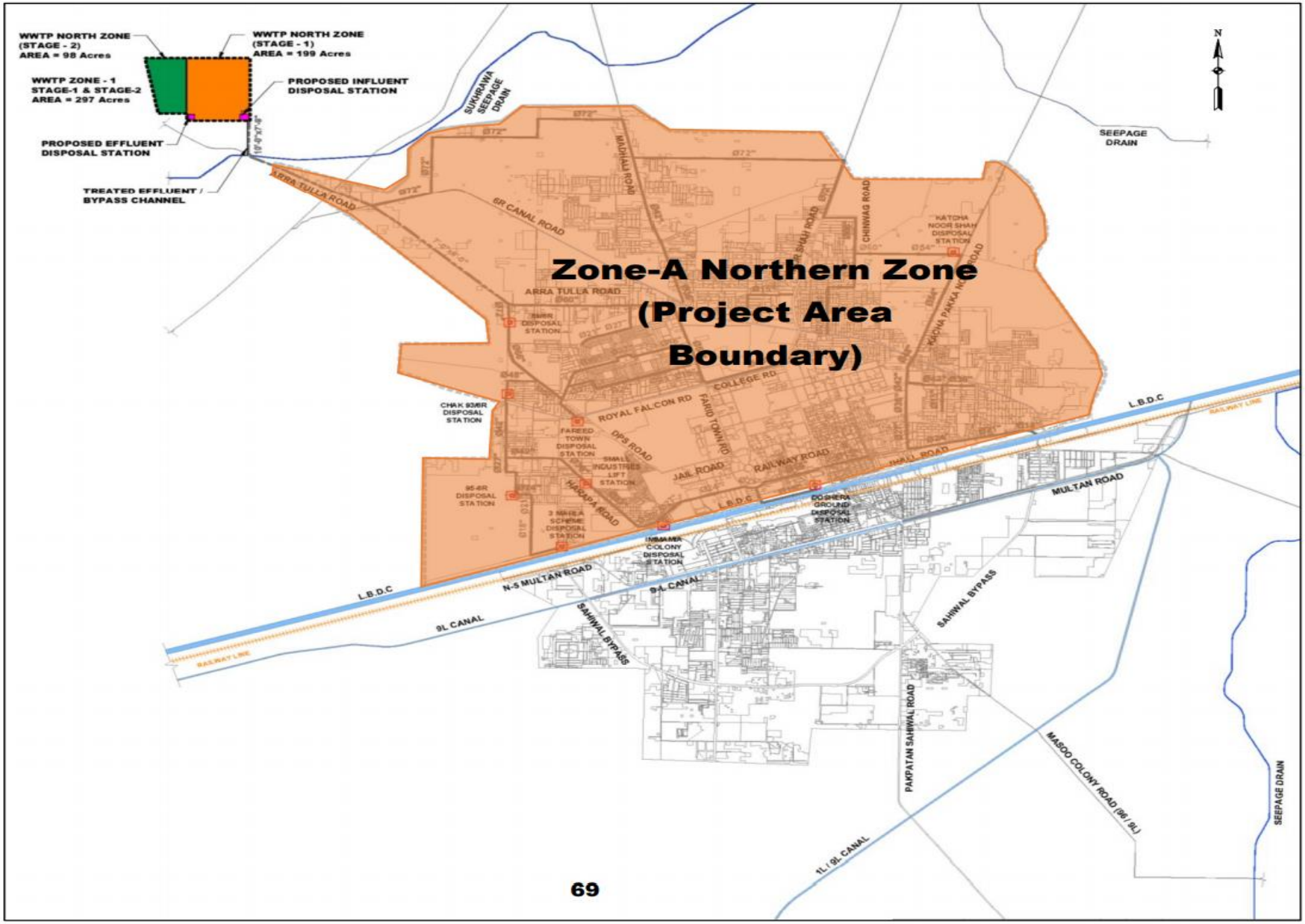
Medium Risk Level

Low Risk Level

Positive Impacts

.

Figure ES-1: Project Area Map



1 Introduction

1.1 Overview

15. The Asian Development Bank (ADB) and the Cities Development Initiative for Asia (CDIA) are partnering with the Government of Punjab Province (GoPP), to undertake the Punjab Intermediate Cities Improvement Program (PICIIP).

16. The PICIIP aims to improve the quality of urban services available in selected cities in Punjab Province (city populations between 250,000 and 1,000,000). Urban infrastructure development is an important component of the PICIIP. The duration of the program will be six years. Funding will be accessed in phases. The PICIIP's overall budget is US$500 million, to be disbursed in phases.

17. The first phase will fund investments in the intermediate cities of Sialkot and Sahiwal. Major projects planned for Sahiwal city are water supply improvement; sewerage and drainage improvement, sewage treatment plant, green spaces development and transport routes improvement.

18. This IEE document focuses solely on the scope of works of the Construction of Wastewater Treatment Plant (WWTP) in North Zone, Sahiwal and assesses any potentially significant impacts and proposes required mitigation measures, which shall be implemented by the Contractor and monitored by the PMU and ADB using the EMP.

19. This is the Part 2 i.e. WWTP development of the WATSAN landscape for Sahiwal with Part 1 consisting of the proposed water and sewage piping networks and associated infrastructure already covered under a separate IEE study.

1.2 Purpose, Scope and Context of IEE Study

20. The scope of works to be conducted under this activity consist of:

Lot –1: Construction of Wastewater Treatment Plant (up to Secondary Level Treatment)

21. Lot-1 will provide treatment up to secondary level to only meet the inland waters requirement of PEQS (excluding winter months) without considering reuse of treated effluent for irrigation purposes. In this case, the treated effluent from the WWTP will be directly discharged to Sukhrawa seepage drain which will act as just conveyance channel rather than a recipient body and ultimately discharge the treated effluent into River Ravi.

Lot –2: Tertiary Wastewater Treatment and treated effluent conveyance system for irrigation reuse

22. A summary of WWTP components in Lot-1 and Lot-2 is presented below as **Table 1.1**.

Table 1.1: WWTP Components – Lot 1 and Lot 2

Sr. No.	Components	LOT-1	LOT-2
1	**Sewage Conveyance Work**		
a)	Collection Chamber	1	
b)	Inlet Channel	1	
2	**Sewage Treatment Works**		
a)	Anaerobic Ponds	10	
b)	Facultative Ponds	10	
c)	Maturation Ponds		**10**
3	**Auxiliary Facilities**	1	
a)	Access/Internal Roads	1	
b)	Substation Building	1	
c)	Staff / Operator Quarter	1	
d)	Laboratory and Administration Building	1	
e)	Main Gate and Guard Room	1	
f)	Buffer Zone (Thick Plantation) all around WWTP	1	
4	**Treated Effluent Collection and Conveyance Works**		
a)	Treated Effluent Channel	1	
b)	Treated Effluent Pumping Station for reuse in Irrigation Network		**1**
c)	Treated Effluent Conveyance System		**1**

23. The proposed locations for conducting these works are shown in **Figures 1.1** to **1.3** below**.**

24. According to ADB's Safeguard Policy Statement (SPS) 2009, a Rapid Environmental Assessment (REA) Checklist was prepared for the proposed WWTP works. The Pakistan Environmental Protection Agency's "Guidelines for the Preparation and Review of Environmental Reports (2000)" were also consulted. Based on the limited scope of the works, this sub-project has been classified as Category 'B'.

25. The conditions (as per ADB SPS 2009) provided in the table below MUST ALL BE fulfilled if the WATSAN works are to be considered an Associated Facility (AF) to the proposed WWTP. The assessment is provided in the **Table 1.2** below.

Table 1.2: Assessment to determine Associated Facility

	Condition	Comment
1	Separately financed by the borrower or third party?	No, it is also being financed by ADB along with the other WATSAN works.
2	Viability and existence of the AF depends exclusively on the WWTP sub-project?	Yes, as the WWTP will be handling and treating the sewerage from the infrastructure to be developed through the WATSAN works.
3	Goods and services of AF are essential to successful operation of the WWTP sub-project	Yes, since without the WWTP, the sewerage being input into the WATSAN infrastructure cannot be treated and disposed off in an environmentally sustainable manner in accordance with applicable national guidelines.

26. Since all three conditions above have NOT been satisfied, thus it is concluded that the WWTP is not an associated facility to the proposed WATSAN sub-projects.

Figure 1.1: Location of Sahiwal City in District Sahiwal

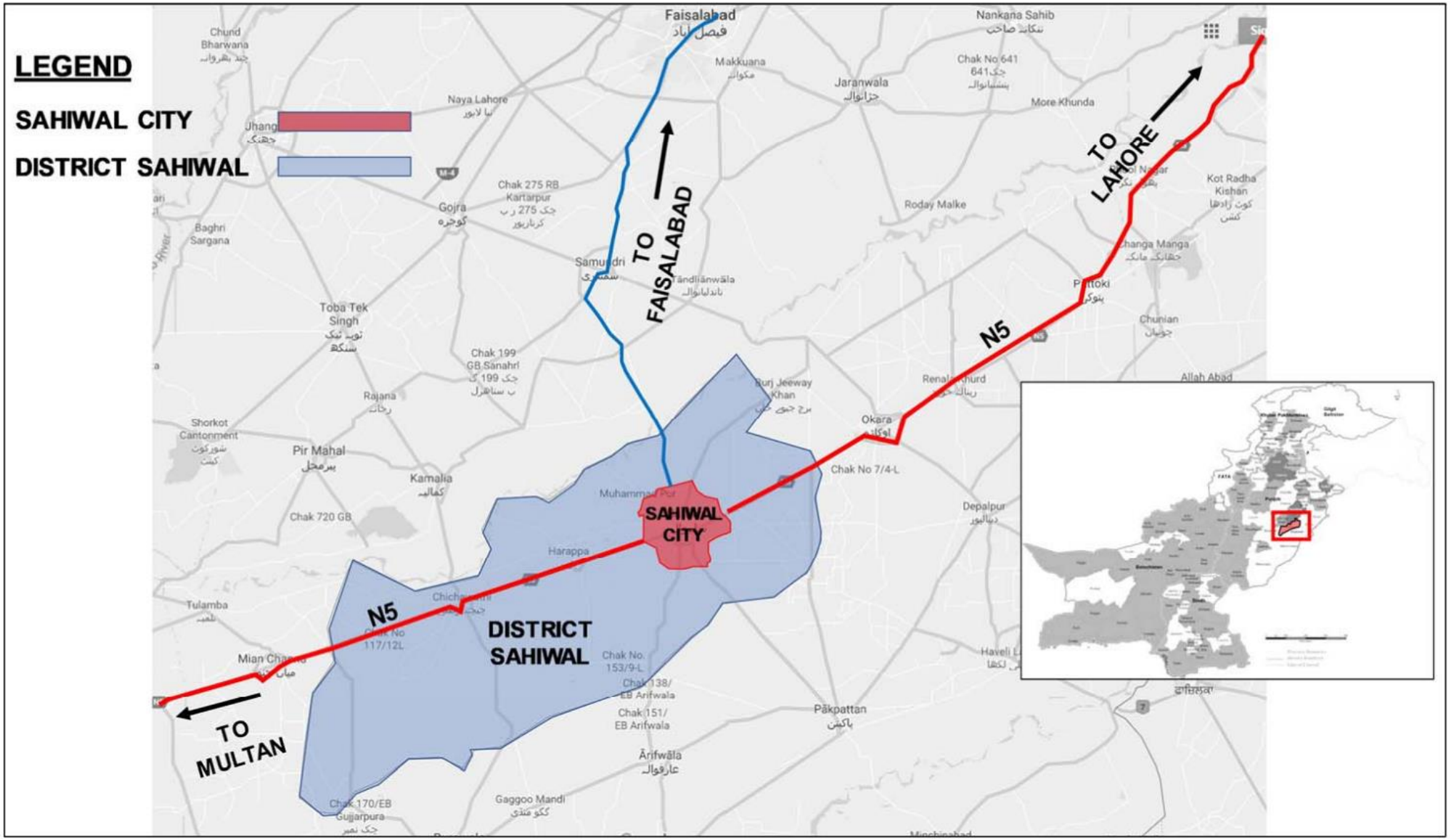


Figure 1.2: Location of Proposed WWTP

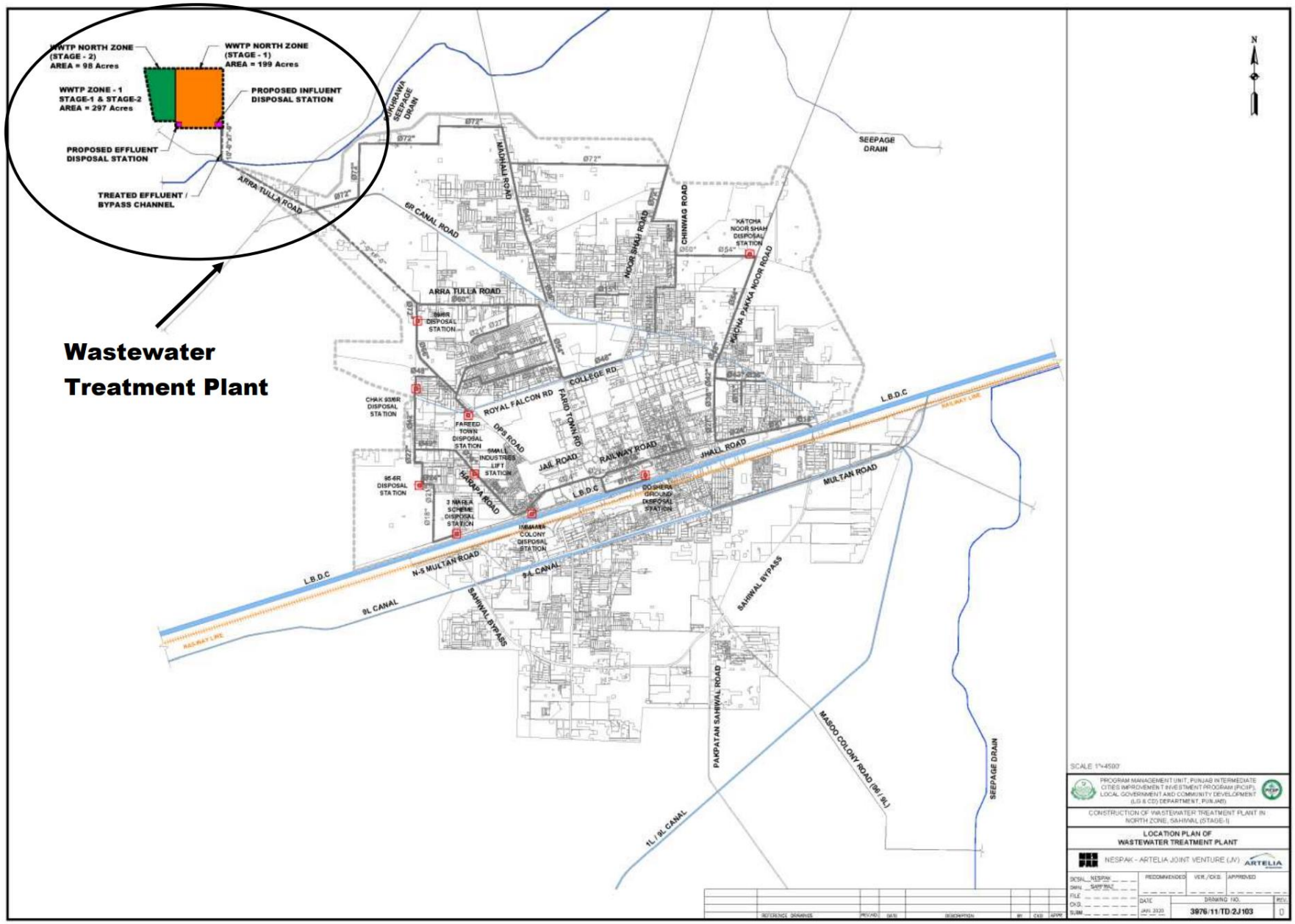
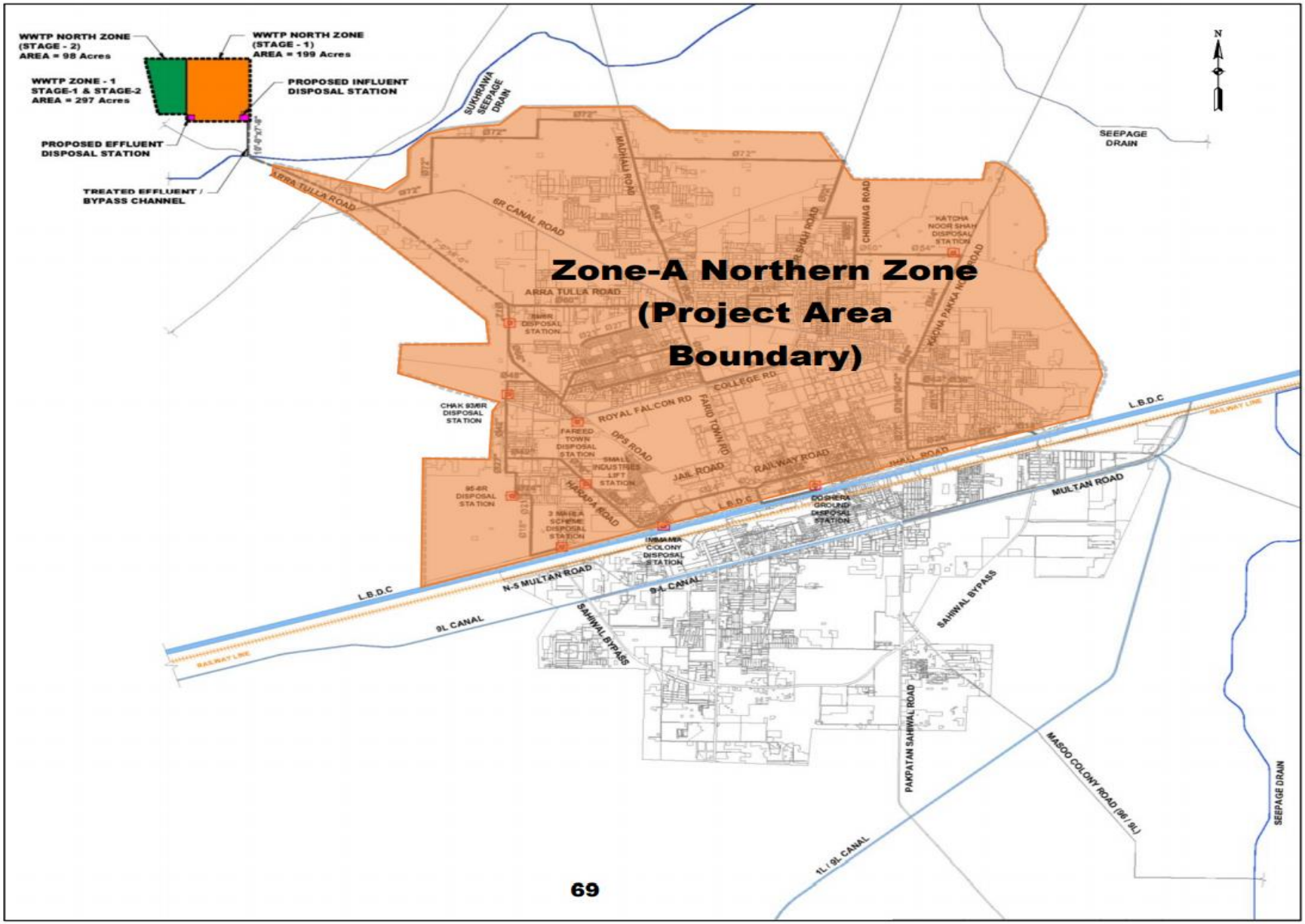


Figure 0.3: Another Location Map of the proposed WWTP



2 Policy and Legal Framework

2.1 General

27. This section provides an overview of the policy framework and national legislation that applies to the proposed WWTP in Sahiwal North zone. The project will comply with all national legislation relating to the environment in Pakistan, and will obtain all the regulatory clearances required from the financing agency, ADB.

2.2 National Policy and Legal Framework

28. The Pakistan National Conservation Strategy (NCS) that was approved by the federal cabinet in March 1992 is the principal policy document on environmental issues in the country (EUAD/IUCN, 1992). The NCS outlines the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed WWTP development are pollution prevention and abatement and increasing energy efficiency while conserving biodiversity.

29. Prior to the adoption of the 18th Constitutional Amendment, the Pakistan Environmental Protection Act (PEPA) 1997 was the governing law for environmental conservation in the country. Under PEPA 1997, the Pakistan Environmental Protection Council (PEPC) and Pak EPA were primarily responsible for administering PEPA 1997. Post the adoption of the 18th Constitutional Amendment in 2011, the subject of environment was devolved and the provinces have been empowered for environmental protection and conservation.

2.3 Regulations for Environmental Assessment, Pakistan EPA

30. Under Section 12 (and subsequent amendment) of the PEPA (1997), a project falling under any category specified in Schedule I of the IEE/EIA Regulations (SRO 339 (I0/2000), requires the proponent of the project to file an IEE with the concerned provincial EPA. Projects falling under any category specified in Schedule II require the proponent to file an EIA with the provincial agency, which is responsible for its review and accordance of approval or request any additional information deemed necessary.

2.4 Regulatory Clearances, Punjab EPA

31. In accordance with provincial regulatory requirements, an IEE/EIA satisfying the requirements of the Punjab Environmental Protection Act (2012) is to be submitted to Punjab environmental protection agency (PEPA) for review and approval, and subsequent issuance of NOC before the commencement of construction.

2.5 Guidelines for Environmental Assessment, Pakistan EPA

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

- Guidelines for the Preparation and Review of Environmental Reports, Pakistan, EPA1997;
- Guidelines for Public Consultations; Pakistan EPA May 1997;

2.6 National Environmental Quality Standards (NEQS) 2000

33. The National Environmental Quality Standards (NEQS), 2000, specify the following standards:

- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment facilities, and the sea (three separate sets of numbers);
- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources;
- Maximum allowable concentration of pollutants (two parameters) in gaseous emissions from vehicle exhaust and noise emission from vehicles;
- Maximum allowable noise levels from vehicles;

34. These standards apply to the gaseous emissions and liquid effluents discharged by construction machinery.

2.7 Other Environment Related Legislations

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

Table 2.1: Environmental Guidelines and Regulations

Legislation/Guideline	Description
National Environmental Policy (2005) (NEP)	NEP is the primary policy of Government of Pakistan addressing environmental issues. The broad Goal of NEP is, “to protect, conserve and restore Pakistan’s environment in order to improve the quality of life of the citizens through sustainable development”. The

Legislation/Guideline	Description
	NEP identifies a set of sectoral and cross-sectoral guidelines to achieve its goal of sustainable development. It also suggests various policy instruments to overcome the environmental problems throughout the country.
The Forest Act (1927)	The Act empowers the provincial forest departments to declare any forest area as reserved or protected. It empowers the provincial forest departments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce, quarrying and felling, lopping and topping of trees, branches in reserved and protected forests. No protected forest is situated in the project area for the WWTP works.
Punjab Wildlife Protection Ordinance, 1972	It empowers the government to declare certain areas reserved for the protection of wildlife and control activities within in these areas. It also provides protection to endangered species of wildlife. As no activities are planned in these areas, no provision of this law is applicable to the proposed WWTP works.
The Antiquities Act (1975)	It ensures the protection of Pakistan's cultural resources. The Act defines "antiquities" as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GOP to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the subproject proponents are obligated to ensure that no activity is undertaken in the proximity of a protected antiquity, report to the Department of Archaeology, GOP, any archaeological discovery made during the course of the project.
Pakistan Penal Code (1860)	It authorizes fines, imprisonment or both for voluntary corruption or fouling of public springs or reservoirs so as to make them less fit for ordinary use.
NATIONAL ENVIRONMENTAL AND CONSERVATION STRATEGIES	
National Conservation Strategy	Before the approval of NEP, the National Conservation Strategy (NCS) was considered as the Government's primary policy document on national environmental issues. At the moment, this strategy just exists as a national conservation program. The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas.
Biodiversity Action Plan	The plan recognizes IEE/EIA as an effective tool for identifying and assessing the effects of a proposed operation on biodiversity.
INTERNATIONAL CONVENTIONS	
The Convention on Conservation of Migratory Species of Wild Animals (1981.21)	The Convention requires countries to take action to avoid endangering migratory species. The term "migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. The parties are also required to promote or cooperate with other countries in matters of research on migratory species. There are no endangered species of plant life or animal life in the vicinity of the proposed project areas for the WWTP works.
Convention on	The convention requires Pakistan to impose strict regulation (including penalization, confiscation of the specimen) regarding trade

Legislation/Guideline	Description
International Trade in Endangered Species of Wild Fauna and Flora (1973)	of all species threatened with extinction or that may become so, in order not to endanger their survival further.
International Union for Conservation of Nature and Natural Resources Red List (2000)	Lists wildlife species experiencing various levels of threats internationally. Some of the species indicated in the IUCN red list are also present in the wetlands of Pakistan.

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

36. The ADB's SPS 2009 requires that environmental considerations be incorporated into ADB funded projects to ensure that the project will have minimal environmental impacts and be environmentally sound. Occupational health & safety of the local population should also be addressed as well as the project workers as stated in SPS. A Grievance Redress Mechanism (GRM) to receive application and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance is also established.

37. All loans and investments are subject to categorization to determine environmental assessment requirements. Categorization is to be undertaken using Rapid Environmental Assessment (REA) checklists, consisting of questions relating to (i) the sensitivity and vulnerability of environmental resources in project area, and (ii) the potential for the project to cause significant adverse environmental impacts. Projects are classified into one of the following environmental categories:

38. **Category A**: A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA) is required.

39. **Category B**: A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE) is required.

40. **Category C**: A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

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

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

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

2.10 ADB's Accountability Mechanism Policy 2012

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

2.11 Implications of ADB's safeguard policies on proposed project

44. The objectives of ADB's safeguards are to:
    - avoid adverse impacts of projects on the environment and affected people, where possible;
    - minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
    - help borrowers/clients to strengthen their safeguard systems.

45. ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:
    - environmental safeguards,
    - involuntary resettlement safeguards, and
    - Indigenous Peoples safeguards.

46. The objective of the environmental safeguards is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. ADB's policy principles are summarized in **Table 2.2** below.

Table 2.2: ADB Policy Principles

	Policy principle	Summary
1	Screening and categorization	Screening process initiated early to determine the appropriate extent and type of environmental assessment.
2	Environmental assessment	Conduct an environmental assessment to identify potential impacts and risks in the context of the project's area of influence.
3	Alternatives	Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts, including no project alternative.
4	Impact mitigation	Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts. Prepare an environmental management plan (EMP).
5	Public consultations	Carry out meaningful consultation with affected people and facilitate their informed participation. Involve stakeholders early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation. Establish a grievance redress mechanism.
6	Disclosure of environmental assessment	Disclose a draft environmental assessment in a timely manner, in an accessible place and in a form and language(s) understandable to stakeholders. Disclose the final environmental assessment to stakeholders.
7	Environmental management plan	Implement the EMP and monitor its effectiveness. Document monitoring results, and disclose monitoring reports.
8	Biodiversity	Do not implement project activities in areas of critical habitats.

9	Pollution prevention	Apply pollution prevention and control technologies and practices consistent with international good practices. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges. Avoid the use of hazardous materials subject to international bans or phaseouts.
10	Occupational health and safety Community safety.	Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities
11	Physical cultural resources	Conserve physical cultural resources and avoid destroying or damaging them. Provide for the use of "chance find" procedures.

2.12 IFC Sector Specific Guidelines on Water & Sanitation

47. The relevant clause applicable to discharge of treated wastewater from a centralized wastewater treatment facility is as follows:

48. ''Design, construct, operate, and maintain wastewater treatment facilities and achieve effluent water quality consistent with applicable national requirements or internationally accepted standards and consistent with effluent water quality goals, based on the assimilative capacity[2] and the most sensitive end use of the receiving water.[3]''

49. A comparison of the PEQS water quality discharge standards for inland waters with the FAO guidelines for threshold levels of trace elements in the wastewater being discharged for use in crop production is provided as **Table 2.6** below. It is important to mention here that based on an extensive literature review, it has been concluded that major international institutions such as the WHO/IFC, USEPA etc. do not have

[2] The assimilative capacity of the receiving water body depends on numerous factors including, but not limited to, the total volume of water, flow rate, flushing rate of the water body and the loading of pollutants from other effluent sources in the area or region. A seasonally representative baseline assessment of ambient water quality may be required for use with established scientific methods and mathematical models to estimate potential impact to the receiving water from an effluent source.

[3] https://www.ifc.org/wps/wcm/connect/0d8cb86a-9120-4e37-98f7-cfb1a941f235/Final%2B-%2BWater%2Band%2BSanitation.pdf?MOD=AJPERES&CVID=jkD216C

any standard set of pre-defined wastewater quality standards in place. Only guidance notes are provided in order to support the process of determining the applicable wastewater quality discharge parameters based on the specific operational modalities of the WWTP.

50. In the case of the proposed WWTP, the selection of the PEQS national standards for treated wastewater discharge from the WWTP into the River Ravi is based on the following factors:

- In the case of national approval, the PEQS will always be applicable and will be used as the applicable standard for treated wastewater discharge from the WWTP. However, the ADB SPS requires the use of 'most stringent' standards/guidelines between the national and international standards, with the IFC general and sector specific guidelines considered globally acceptable. As mentioned in Para 48 above, the first part of the IFC relevant guideline requires the use of: '*…applicable national requirements* ***or*** *internationally accepted standards…*'. Since there are no specific wastewater discharge guidelines available from IFC that would be applicable to the proposed WWTP, thus there is no other option but to use the national, PEQS, treated wastewater discharge standards for inland waters.
- Furthermore, the second part of the IFC applicable guideline mentions the '…*assimilative capacity and the most sensitive end use of the receiving water* …', which in this case will be the River Ravi. Based on the secondary data of water quality analysis of the River Ravi[4], it can be concluded that it is significantly polluted with a high pollution load and key pollutant parameters exceeding atleast four times the applicable limits based on samples taken from the river water body at different locations[5]. Thus, considering the present status of the assimilative capacity of the receiving water body in this case i.e. River Ravi, once the WWTP operation commences, the use of the national treated wastewater discharge standards i.e. PEQS is not expected to result in any adverse impact on the water quality and ecology of the River Ravi.
- The national PEQS standards for treated wastewater discharge can be achieved by using comparatively simple and low-cost wastewater stabilization pond technology. The application of EU and US standards is unfeasible due to unaffordable operation and maintenance cost, caused by using more advanced

[4] https://www.deswater.com/DWT_abstracts/vol_85/85_2017_132.pdf

[5] http://publications.muet.edu.pk/research_papers/pdf/pdf124.pdf

technologies. This rationale has been used for adopting a flexible approach during the process of selection of discharge standards as can also be observed based on projects developed in other countries, such as Vietnam.[6]

- Furthermore, the national PEQS standards on discharge 'Into Inland Waters' are considered sufficient for reusing the treated wastewater for irrigation purposes.

2.13 Comparison of International and Local Environmental Legislations

51. The ADB SPS requires application of pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards. The SPS states that when host country regulations differ from these standards, the EA will achieve whichever is more stringent.

52. In order to select the most stringent standards applicable, a mix of local (NEQS) and international (IFC) regulations have been selected. The IFC Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental, Noise Management has noise level guidelines for daytime and nighttime, which are applicable. It shall be ensured that all necessary noise mitigation measures are implemented to minimize the noise levels in the project area.

53. The **Table 2.3** presents IFC workplace noise standards that are applicable to the construction workers. It should also be noted that IFC EHS guidelines advise that where existing ambient noise levels already exceed thresholds, the project should not result in an increase of more than 3 dB over existing ambient noise at the nearest receptor location off-site.

54. A comparison of applicable local and international guidelines for ambient air quality has been provided in **Table 2.4** below. In the case of most pollutants, the NEQS standards for ambient air quality are more stringent in comparison to USEPA and WHO/IFC standards. The applicable and most stringent parameters for each respective pollutant are highlighted in green.

55. Similar to the standards for air quality, the comparison of noise standards provided in **Table 2.5** clearly shows that NEQS standards for noise are more stringent in comparison to the IFC standards. The only exception is the daytime noise level standard for Industrial areas where the IFC standard is more stringent (70 dB(A)) in

[6] http://documents1.worldbank.org/curated/en/715941468320695559/pdf/ACS77120WP0P1303600Box385206B00PUBLIC0.pdf

comparison to NEQS (75 dB(A)) and so for this particular parameter, the IFC standard will be used. Apart from this one exception, the NEQS standards have been used for the proposed WWTP development project.

56. As far as regulations regarding other environmental parameters are concerned such as acceptable effluent disposal parameters, the local regulations i.e. NEQS take precedence over any other international regulations such as IFC.

Table 2.3: IFC Work Environment Noise limits

Type of Work, workplace	IFC General EHS Guidelines
Heavy Industry (no demand for oral communication)	85 Equivalent level L_{eq},8h
Light industry (decreasing demand for oral communication)	50-65 Equivalent level L_{eq},8h

Table 2.4: Comparison of International and local Air Quality Standards*

Pollutants	USEPA		WHO/IFC		Pak. NEQS	
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard
SO_2	3 hrs 1 hr	0.5 ppm 75 ppb	24 hr 10 min	20 ug/m^3 500 ug/m^3	Annual Mean 24 hrs	80 ug/m^3 120 ug/m^3
CO	8 hrs 1 hr	9 ppm (11 mg/m^3) 35 ppm (43 mg/m^3)	-	-	8 hrs 1 hr	5 mg/m^3 10 mg/m^3
NO_2	Annual Mean 1 hr	100 ug/m^3 (53 ppb) 100 ppb	1 yr 1 hr	40 ug/m^3 200 ug/m^3	Annual Mean 24 hrs	40 ug/m^3 80 ug/m^3
O_3	8 hrs	0.07ppm (148 ug/m^3)	8 hrs	100 ug/m^3	1 hr	130 ug/m^3
TSP	-	-	-	-	Annual Mean 24 hrs	360 ug/m^3 500 ug/m^3
PM_{10}	24 hrs	150 ug/m^3	1 yr	20 ug/m^3	Annual Mean	120 ug/m^3

			24 hr	50 ug/m^3	24 hrs	150 ug/m^3
$PM_{2.5}$	Annual Mean 24 hrs	15 ug/m^3 35 ug/m^3	1 yr 24 hr	10 ug/m^3 25 ug/m^3	Annual Average 24 hrs 1 hr	15 ug/m^3 35 ug/m^3 15 ug/m^3

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

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

Table 2.5: Comparison of International and Local Noise Standards

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

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

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

Table 2.6: Environmental Quality Standards for Municipal & Liquid Industrial Effluents (mg/l - unless otherwise specified)[7]

S/No.	Parameter	PEQS Standards (Wastewater discharge Into Inland Waters)	FAO Guidelines for Threshold Levels of Trace Elements for Agriculture Use[8]	EU Council Directive, 91/271/EEC, Urban Wastewater Discharge directive[9]
1	Temperature or Temperature Increase	≤3°C	-	-
2	pH Value	6-9	-	-
3	BOD at 20°C	80	-	25
4	COD	150	-	125
5	TSS	200	-	35
6	TDS	3500	-	-
7	Grease and Oil	10	-	-
8	Phenolic compounds (as phenol)	0.1	-	-
9	Chloride	1000	-	-
10	Fluoride	10	1.0	-
11	Cyanide	1.0	-	-

[7] https://epd.punjab.gov.pk/system/files/Punjab%20Environmental%20Quality%20Standards%20for%20Muncipal%20And%20Liquid%20Industrial%20Effluents%20final_0.pdf

[8] http://www.fao.org/3/T0551E/t0551e04.htm

[9] https://www.adb.org/sites/default/files/project-document/60815/42408-033-aze-iee-05.pdf

12	An-ionic detergents	20	-	-
13	Sulfate	600	-	-
14	Sulfide	1.0	-	-
15	Ammonia	40	-	-
16	Pesticides	0.15	-	-
17	Cadmium	0.1	0.01	-
18	Chromium (trivalent and hexavalent)	1.0	0.1	-
19	Copper	1.0	0.2	-
20	Lead	0.5	5.0	-
21	Mercury	0.01	-	-
22	Selenium	0.5	0.02	-
23	Nickel	1.0	0.2	-
24	Silver	1.0	-	-
25	Total Toxic Metals	2.0	-	-
26	Zinc	5.0	2.0	-
27	Arsenic	1.0	0.1	-
28	Barium	1.5	-	-
29	Iron	8.0	5.0	-

30	Manganese	1.5	0.2	-
31	Boron	6.0	-	-
32	Chlorine	1.0	-	-

1

3 Project Description

3.1 Project Description

57. The specific information on the proposed construction of WWTP in Sahiwal North zone (Stage-1) are provided below.

58. The sensitive receptor map for the proposed WWTP is provided as **Figure 3.1** below and the list of sensitive receptors and their respective distances from the project site is provided as **Table 3.17** below**.**

59. The proposed WWTP site consists of agricultural fields spread over an area of 199 acres. The natural elevation of the WWTP site varies from 525 to 544 feet. Also, the Sukhrawa drain is flowing on the southern side of the proposed WWTP site at a distance of about 1900 ft (about 0.6 km). This seepage drain is ultimately connected with the river Ravi.

3.2 Scope of WWTP Works

60. The general step wise sequence of activities to be conducted under each of the two Lots are described below. It shall be ensured that staging of activities takes place to manage any potential impacts, including traffic management issues.

- **Site Preparation Works**[10]

61. In this step, the site is made level through earth works and filling, to ensure that a stable levelled surface is available for conducting the next steps of the construction activity.

- **Access to Site through temporary road works**

62. If no suitable access roads are available to reach the proposed site, it shall be ensured that required access is created through necessary clearing and earth works, as necessary, to ensure that a clear access way to the site is available.

- **Piling Work**

63. Pilling work for all structures will be carried out at ground elevation of EL ±0.00 m. Concrete pile of 400 mm × 400 mm (n = 6150), and 300 mm × 300 mm (n = 10) are proposed for foundation of each facilities. Concrete pile shall be driven by diesel hammer.

- **Excavation Work**

[10] https://openjicareport.jica.go.jp/pdf/11650314_05.PDF

64. Excavation work shall be conducted mainly by backhoe. Clamshell shall be applied for excavation depth is more than GL - 5.00m. Excavated soil is transported by dump truck and kept in the treatment site. Excavated soil is also used for backfilling material.

- **Civil Works**

65. The civil works cover the substructure design and the architectural works cover the superstructure design. All structures are designed by reinforced concrete except the effluent pipe, whichh will be constructed by pre-cast concrete.

66. Structure work of the wastewater treatment plant is to construct reinforced concrete structures of treatment facilities.

67. Main facilities to be constructed are as follows:

a) Lift Pumping Station
b) Wastewater Treatment Plant
c) Disinfection Tank
d) Water Supply Facility
e) Effluent Pipe
f) Pipe Gallery
g) Substructure of Main Building
h) Substructure of Blower Building
i) Substructure of Dewatering Building
j) Gravity Thickener
k) Compost Plant Facilities
l) Connection Pipe
m) Landscape Works
n) Sanitary Sewer
o) Conveyance Sewer
p) Temporary Works

68. Concrete placing shall be conducted by concrete pump machine. Concrete structures shall be constructed in combination with mechanical and electrical equipment installation.

- **Mechanical Works**
- **Electrical Installation**
- **Storm Water Drainage**
- **WWTP Landscaping**

69. The cross-section drawings of the proposed WWTP is provided below as **Figures 3.3** to **3.5**.

70. Based on the geotechnical investigations conducted by the EPCM consultant, it has been recommended that composite liner shall be used for the construction of the WWTP to control leakage/migration of contaminants from the impoundment into underlying soil/groundwater. The components of the composite liner will be:

- Compacted soil liner
- Geo-membrane (HDPE)
- Protective soil cover

71. The recommendations regarding the composite liner for the proposed WWTP have been developed considering the sub-surface ground conditions. Generally, cohension-less soils are present below the pond base level with GWT depth at around 12 meters (39 feet) below NSL.

72. It is pertinent to mention that in modern/robust practice, flexible membrane liner (FML) are specified in addition to clay liners as a fool proof system against leaching of waste and mixing to groundwater.

73. **Compacted Soil Liner** shall be placed at the bottom and on side slopes of the ponds. The material suitable to be used for compacted soil liner shall meet the following specifications:

- Vertical in-situ hydraulic conductivity in compacted state ≤ 1 x 10-7 cm/sec
- Fines (particles passing 0.075 mm sieve) ≥ 30 %
- Plasticity index = 8 – 30 %
- Gravels (particles passing 75 mm sieve and retaining 4.75 mm sieve) ≤ 20 %
- Maximum particle size ≤ 10 mm

74. Soft soil/fill material, if encountered during construction of the WWTP, will be be excavated and removed completely. The exposed surface will be compacted to at least 90% of the maximum modified Proctor dry density at ± 2 % of optimum moisture content.

75. The compacted soil liner shall be placed at the bottom and on side slopes of the ponds and shall have a minimum thickness of 600 mm (24 inches) and shall meet the material specifications mentioned above. The soil liner shall be placed in layers with maximum compacted layer thickness of 150 mm and compacted to at least 90

percent of the maximum modified Proctor dry density or 95 percent of the maximum standard Proctor dry density at 2 to 3 % wet of optimum moisture content.

76. **Geo-membrane (HDPE Liner):** High density polyethylene, HDPE Liner having minimum thickness of 60 mils (60/1000 inches) shall be placed over the compacted soil liner. HDPE liner must cover the entire area of earth material that would be in contact with the treated or stored effluent.

77. **Protective Soil Cover:** HDPE Liner is required to be covered immediately after placement. The HDPE Liner shall be covered by at least 300 mm (12 inches) thick cover of soil to prevent puncture by equipment and to protect it from degradation by ultraviolet light. The on-site / borrow area fine grained soils classified as ASTM class CL (Lean Clay), free of any objectionable material, will be used in the construction of the protective soil cover.

78. The protective soil cover shall be placed in layers with maximum compacted layer thickness of 150 mm (6 inches) and compacted to at least 90 percent of the maximum modified Proctor dry density at 2% of optimum moisture content. The protective soil cover will be placed within 24 hours after placement of the HDPE Liner to minimize the potential for damage from various sources, including precipitation, wind, and ultraviolet light exposure. Also, the Sides slope of pond embankments shall be constructed at 3H:1V slope for stability of sides.

3.3 Project Need

79. At present, Sahiwal city is urgently in need of a WWTP due to the following existing situation:

- Presently, no treatment plant is available for treatment of sewage in the project area of Sahiwal City.
- Raw sewage is being directly disposed of into the canals, seepage drain and in agricultural fields in outskirts of the city. This practice is environmentally unsafe and a violation of Punjab Environmental Protection Act;
- Disposal of untreated wastewater into water bodies/ agriculture fields is causing contamination of the water and food chain and several associated environmental and health issues;
- Many areas have no final disposal points. The disposal problem becomes more severe when the farmers do not need raw sewage for their crops(s) during raining season and certain period(s) of year when water is not required for crops.

80. Thus, the proposed scope of works need to be implemented on an urgent basis with the population projections over different time periods provided in the **Table 3.1** below.

Table 3.1: North Zone Projected Population[11]

System	2019	2029	2035	2044
Population	322,662	472,599	590,296	740,840

81. As can be observed, the Stage 1 of the proposed WWTP, upto year 2029, will benefit upto 472,599 people in Sahiwal city.

3.4 Project Design Parameters

82. The degree of treatment in proposed wastewater treatment plant would be such that the treated effluent can safely be reused in fields for agricultural purposes as per WHO Guidelines and discharged into inland waters i.e. Rivers etc. as per PEQS. When water would not be required for agricultural use, in case of rainy season or when water would not be needed by the crops, it will be safely discharged in to the seepage drain (Sukhrawa drain), which is ultimately linked to River Ravi in the down stream and thus would resolve the issue of ultimate disposal of wastewater of Sahiwal city. The expected projections of wastewater flows in year 2029 is provided as **Table 3.2** below.

Table 3.2: Projected Wastewater Flows (Year 2029)[12]

S/No.	Parameter	Value
i.	**Average Flow**	
a	MGD	24.6
b	Cusec	45.7
c	m^3/day	111,694
d	m^3/sec	1.29
ii.	**Peak Flow**	
a	MGD	38.5
b	Cusec	71.5

[11] PC-1 for Sahiwal WWTP
[12] PC-1 for Sahiwal WWTP

c	$m^{3/}$day	174,905
d	m^3/sec	2.02

83. Based on the comparison of the wastewater monitoring report of pollution parameters with previous data of similar projects and international literature, the design concentrations for WWTP are provided as **Table 3.3** below.

Table 3.3: Design Concentration for WWTP[13]

S/No.	Parameters	Unit	PEQS Value	Design Value
1	pH	-	6-9	7.0
2	Biological oxygen Demand (BOD_5)	mg/l	80	250
3	Total Suspended Solids (TSS)	mg/l	200	300
4	Fecal Coliform	MPN/100ml	-	$1X10^5$

84. WWTPs are intended for the removal of common pollutant presents in the wastewater. The principal target pollutants shall be BOD, SS and fecal coliform. The objective of the treatment system shall be to bring the values of wastewater BOD, TSS and fecal coliform within the limits given in the PEQS for Municipal and Liquid Industrial Effluents, as promulgated under Punjab Environmental Protection Act and WHO Guidelines.

85. The **Table 3.4** below presents the design influent characteristics for BOD, SS and Coliform, applicable PEQS values, expected effluent concentrations and respective expected treatment efficiencies.

Table 3.4: Design Influent Characteristics[14]

Parameter	PEQS Value	Design Concentrations		Treatment
		Influent	Effluent	Efficiency (%)

[13] PC-1 for Sahiwal WWTP
[14] PC-1 for Sahiwal WWTP

BOD (mg/l)	80	250	≤80 (filtered)	68
TSS (mg/l)	200	300	≤150	50
Fecal Coliform (MPN/100ml)	≤1000	$1X10^5$	≤1000	99.0

86. The design effluent concentrations for BOD and SS are in fact kept equal to those achievable, under normal operating conditions, in a typical well-designed aerobic treatment plant. These values are actually lower than the PEQS values. It is pertinent to mention that ideal operational conditions (i.e. growth of bacteria, algae, availability of nutrients and good process operation & control etc.) will be required to achieve the desired limits.

87. **Anaerobic ponds (APs)** have been designed on the basis of the volumetric loading rate. The design value of permissible volumetric BOD loadings and percentage BOD removal in the APs varies for different design temperatures as shown in **Table 3.5** below.

Table 3.5: Permissible Volumetric Loading Rates and & BOD Removal at Corresponding Temperatures[15]

Temperature (°C)	Volumetric Loading (g/m^3.day)	BOD Removal (%)	Adopted
<10	100	100	-
10-20	20T - 100	20T - 100	YES
20-25	10T + 100	10T + 100	-
>25	350	350	-

88. **Facultative ponds (FPs)** are designed for BOD removal on the basis of a relatively low surface loading (100 - 400 kg BOD/ha. d) to permit the development of a healthy algal population as the oxygen for BOD removal by the pond bacteria is mostly generated by algal photosynthesis. The design parameters along with the variation in the hydraulic retention time due to the temperature change is provided in **Table 3.6** below.

[15] PC-1 for Sahiwal WWTP

Table 3.6: Design Parameters for Facultative Ponds[16]

Parameter	Unit	Range	Adopted
Water Depth	m	1-2	2.5
Free Board	m	0.5-1	0.5
Length to Width Ratio	-	>1.5	7.0
Hydraulic Retention Time	Day		
a)For Temp <20°C	Day	>5	8
b)For Temp>20°C	Day	>4	-
BOD Removal Efficiency (filtered)	%	70-90	76.75
Side Slope	m	2-3	3.0

89. A comparison of area requirement and treated effluent BOD (filtered & unfiltered) at coldest month temperature (12.6ºC) and adopted temperature (20ºC) is presented in the **Table 3.7** below. As proposed for the project, wastewater flow is divided in to 10 parallel trains/modules. Each module will consist of one AP, one Facultative Pond (FP) and one Maturation Pond (MP) in series.

Table 3.7: Area Requirement and Treated Effluent BOD

Description	Temperature		Area Reduction (%)
	12.6°C	**20°C**	
No. of Modules	10	10	-
Ponds Area (acre)			
Anaerobic	2.0	1.4	30
Facultative	31.1	12.03	61.31
Maturation	5.64	2.22	60.6
Total Area (acre)	38.74	15.7	59.4

[16] PC-1 for Sahiwal WWTP

Effluent BOD – Unfiltered (mg/l)	59	30-88	-
Effluent BOD – Filtered (mg/l)	17.7	17.7-26.4	-

90. Adopted design temperature of 20°C shall result in significant reduction in area requirement (more than 50% less) as well as capital cost of proposed WWTP. At adopted design temperature of 20°C, treated effluent BOD (unfiltered) may slightly exceed PEQS limits in winter months (December & January). However, in other months, it will remain within PEQS limits.

91. It is pertinent to mention that filtered effluent BOD, as internationally adopted practice, will remain within PEQS limits throughout the year, if WSP is properly operated and managed. Technical committee constituted by P&D department; Punjab for Lahore also recommended to adopt design temperature of around 20°C for waste stabilization ponds in order to make the system economical and reduce the land requirement by around 50% approximately.

3.5 Project Components

92. The proposed WWTP will be designed and constructed in the northern part of Sahiwal city in the following two stages:

- Stage-1: Design of WWTP up to year 2029 (covered in this IEE report)
- Stage-2: Design of WWTP for year 2029 to 2044 (planned as a future investment, to be covered in a separate IEE report in the future)

93. The approximate area of land required till year 2029 (10 years design period) to meet irrigation standards for entire North zone will be 199 acres. In order to cater to the wastewater flow to be generated up to design year 2044, additional area of about 98 acres will be be required in the North zone. Thus, the total area requirement upto design year 2044 will be 290 acres.

94. The flow of the WWTP will be monitored during operation of Stage-1 as it will be required in estimating Stage-2 investment, depending upon actual flows and future requirements. However, to cater future flows up to design year 2044, financial capability/strength of MC/district government Sahiwal in year 2029 or future years will not be capable to bear Capital and O&M cost of other treatment technologies. In such a scenario, it is proposed that same WSP technology would be adopted for future flows and additional areas would be acquired for North zone.

95. It is recommended that at the first stage i.e. for design year 2029, WWTP will be constructed based on waste stabilization ponds (WSP) treatment technology. The proposed WWTP will serve population of approximately 472,599 people of Sahiwal city. The geometry of the proposed site for entire North zone is rectangular and this site is proposed on private agriculture land with the topography of the proposed WWTP site being generally plain.

96. Key treatment facilities of the proposed WWTP for planning horizon of 2029 shall consist of the following components.

- 01 No. Collection Chamber (CC)
- 01 No. Inlet Channel
- 10 Nos Anaerobic Ponds (APs) will be constructed with capacity to collect 2.46 MGD sewage flow from inlet channel.
- 10 Nos Facultative Ponds (FPs)
- 10 No. Maturation Ponds (MPs)
- 01 No. Outlet/Treated effluent Channel
- 01 No. Treated Effluent Pumping Station
- Treated Effluent Conveyance System for Irrigation Reuse

97. The design Consultant conducted 24 hour equal volume composite wastewater sampling and testing of various pollution parameters, through an EPD Punjab approved laboratory of major disposal stations in the North Zone of Sahiwal city. The wastewater samples were collected from the Collecting Tank and pump discharge points. The test results of disposal stations falling in the North Zone are provided as **Table 3.8** below.

Table 3.8: Wastewater Test Results of Project Area[17]

Parameters	Analysis Method	Unit	LOR	RESULT			PEQS
				Fareed Town	Small Industries	Kacha Pakka Noor	
CHEMICAL ANALYSIS							
Temperature	-	°C	-	20.0	21.0	19.0	-
pH	APHA-4500H+ B	pH unit	0.01	7.03	7.04	7.07	6-9
Total Dissolved Solid	APHA-2540 C	mg/l	1.0	1634.0	1708.0	1668.0	3500
Oil and Grease	USEPA-1664	mg/l	0.1	8.4	8.1	7.7	10
BOD (Raw)	APHA, 5210	mg/l	1.0	258.0	252.0	248.0	80
BOD (Filtered)	APHA, 5210	mg/l	1.0	71.0	52.0	41.0	80
BOD (Settable)	APHA, 5210	mg/l	1.0	75.0	56.0	49.0	80
COD (Raw)	APHA-5220-D	mg/l	1.0	799.0	806.0	764.0	150
COD (Filtered)	APHA-5220-D	mg/l	1.0	209.0	159.0	131.0	150
COD (Settable)	APHA-5220-D	mg/l	1.0	223.0	167.0	149.0	150
TSS (Raw)	APHA-2540-D	mg/l	1.0	291.0	348.0	197.0	200
TSS (Settled Sample)	APHA-2540-D	mg/l	1.0	232.0	119.0	121.0	200
Settable Solids	APHA-2540 F	mg/l		54.0	225.0	76.0	-
Chloride (Cl)	APHA-4500Cl- B	mg/l	0.24	359.88	329.89	299.90	1000
Cyanide (CN)	APHA-4500CN E	mg/l	0.01	<0.01	<0.01	<0.01	1.0
Anionic Detergents	APHA-5540 B	mg/l	-	1.0	1.2	1.4	20
Sulphate	APHA-4500-SO4C	mg/l	0.41	390.20	448.23	404.19	600
Sulphide	APHA-4500-S2-E	mg/l	0.2	1.6	1.6	3.2	1.0
Ammonia	APHA-4500-NH3-B	mg/l	0.002	2.8	2.6	3.0	40
Chromium	APHA-3500Cr B	mg/l	0.0054	0.48	0.56	0.52	1.0
Copper	APHA-3500Cu B	mg/l	0.0045	0.85	0.89	0.87	1.0
Lead	APHA-3500-Pb B	mg/l	0.013	0.16	0.22	0.12	0.5
Nitrite	APHA-4500NO2 B	mg/l	0.01	<0.01	<0.01	<0.01	-
Nitrate	APHA-4500NO3 B	mg/l	0.1	5.6	6.2	4.4	-
Phosphate	APH4500-P C	mg/l	0.002	0.12	0.14	0.073	-
Arsenic	APHA-3500As B	mg/l	0.01	0.28	0.39	0.22	1.0
Sodium Absorption Ratio	-	-	-	91.81	83.85	81.46	-
MICROBIOLOGICAL ANALYSIS							
Total Coliforms	APHA:9222 B	CFU/100ml		1600	$2.2x10^3$	1600	-
Faecal Coliforms	APHA:9222 D	CFU/100ml		900	1600	900	-

98. An overview of the WWTP components is provided in the **Table 3.9** below.

Table 3.9: Overview of WWTP Components

S/No.	Components	Numbers
1	**Sewage Conveyance Work**	
a	Collection Chamber	1
b	Inlet Channel	1
2	**Sewage Treatment Works**	
a	Anaerobic Ponds (AP)	10
b	Facultative Ponds (FP)	10

[17] PC-1 of Sahiwal WWTP

c	Maturation Ponds (MP)	10
3	**Treated Effluent Collection and Conveyance Works**	
a	Treated Effluent Channel	1
b	Treated Effluent Pumping Station for reuse in irrigation network	1
4	**Auxiliary Facilities**	
a	Access/Internal Roads	1
b	Substation Building	1
c	Staff/Operator Quarter	1
d	Laboratory and Admin Building	1
e	Main Gate and Guard Room	1
f	Buffer Zone (Thick Plantation) all around WWTP	1

99. The AP-FP-MP configuration has been selected based on the following rationale:

- APs work as primary treatment to remove settleable solids and associated BOD and COD. Domestic sewage usually has appreciable amount of settleable solid and associated BOD and COD. Same is the case for Sahiwal wastewater.
- FPs work as secondary ponds in order to remove colloidal and dissolved pollution loads.
- MP work as tertiary treatment requites to kill coliform to make treated effluent water fit for reuse for irrigation purpose. For compliance of PEQS, maturation ponds are not necessary, however, on Direction of MC Sahiwal, MPs are added in the scheme.

Considering above aspects, the AP-FP-MP scheme has been selected.

Description of all components is given below.

- **Collection Chamber**

100. One (01) collection chamber (CC) will be provided to receive influent sewage/wastewater from force mains and convey it to inlet channel as per capacity. The design summary of the CC is provided below as **Table 3.10** below.

Table 3.10: Design Specifications of Collectlon Chamber

S/No.	Parameter	Unit	Value
1	**Flows**		
	Design Peak Flow (year 2044)	m^3/sec	3.96
		Cusec	140
2	**Collection Chamber (CC)**		
	Number	No.	1
	Length	ft	25.0
	Width	ft	25.0
	Total Depth of Chamber	ft	8.4

- **Inlet Channel**

101. One (01) inlet channel has been proposed which shall carry sewage/ wastewater from distribution chambers to series of anaerobic ponds. The inlet channel is designed as the water retaining/distribution structure on the basis of hydraulic retention time. The purpose of the inlet channel is to uniformly distribute influent wastewater into the WSP modules. A summary of the design specifications of the inlet channel is provided in **Table 3.11** below.

Table 3.11: Design Specifications of Inlet Chamber

S/No.	Parameter	Unit	Value
1	**Flows**		
	Design Peak Flow (year 2044)	**m^3/sec**	**3.96**
		Cusec	**140**
2	**Inlet Channel**		
	No. of Channel	No.	1
	Length of Channel	ft	3,420
	Width of Channel	ft	8.0
	Hydraulic Depth of Channel	ft	3.0
	Total Depth of Channel	ft	3.5

- **Anaerobic Ponds (APs)**

102. Anaerobic ponds shall be provided for primary treatment. Total ten (10) numbers of APs shall be provided in parallel for primary treatment of wastewater. Each AP shall receive equal sewage flow of 2.46 MGD from inlet channel. These ponds will receive high strength wastewater and will reduce BOD of the sewage/wastewater through anaerobic processes. A summary of the design specifications of the APs is provided in **Table 3.12** below.

103. The retention time for the APs has been estimated on the basis of temperature dependent empirical relationship as given in design literature. As per empirical formula at design temperature of 20°C, retention time comes out to be 0.83 days. According to minimum retention time criteria, 1 day retention time has been adopted for this project.

104. Desludging of APs is normally carried out after 2-3 years. Drying of sludge is proposed to be carried out inside anaerobic pond on periodic basis. During desludging period, flow to respective anaerobic pond will be closed. At one time, one aerobic pond will be dewatered and settled sludge at bottom of pond, allowed drying under sunshine. Once sludge drying process will be completed, dried sludge will be removed from the pond and transported to the proposed landfill site for disposal, to be developed and commissioned by 2024-25. The land for this proposed landfill has already been acquired by the GoP.

105. The designing of the APs has been conducted to ensure extra volume is provided to accommodate sludge for two years in the APs. Therefore, an approximate time frame of two years will be available to develop the landfill site after commencement of operation of the WSPs.

Table 3.12: Summary of Anaerobic Ponds (APs) of WWTP

S/No.	Parameter	Unit	Value	
			AP-1	AP-02 to AP-10
1	Total No. of Anaerobic Ponds	No.	01	09
2	Retention Time	Days	1.0	1.0
3	Volumetric Loading Rate	g/m^3.d	300	300
4	Design	°C	20	20

	Temperature			
5	Influent BOD	mg/l	250	250
6	Effluent BOD	mg/l	90-100	90-100
7	BOD Removal Efficiency	%	60	60
8	Hydraulic depth of one pond	ft	16.4	16.4
9	Free Board	ft	1.64	1.64
10	Top length of one pond	ft	338	285
11	Top width of one pond	ft	180	205
12	Top area for one pond	Acres	1.4	1.38
13	Total area of 'n' No. of ponds	Acres	1.4	12.42

- **Facultative Ponds (FPs)**

106. Facultative ponds (FPs) shall be provided for secondary treatment. Total ten (10) FPs have been proposed in parallel for WWTP. Each FPs will receive a cumulative flow of 2.46 MGD wastewater flow one (01) APs. Treated effluent from the facultative ponds may be high in algal BOD because of presence of algae in the treated effluent. Algal BOD is usually different than non-algal BOD as algal produces more oxygen in natural water body than it consumes for respiration. A summary of the design specifications of the FPs is provided in **Table 3.13** below.

The removal rate of BOD in WSPs will depend upon the ambient temperature. In the summer months, the removal rate will be higher due to an increase in temperature, however, in winter months, the removal efficiency of the pond will be less. As per estimates, the unfiltered effluent BOD will remain in the range of 30-60 mg/l in the summer months (March to November), provided that the WSP will be properly operated and managed. However, in the winter months, it may slightly exceed from the PEQS limits and may range between 70-88 mg/l. However, it is estimated that

that the filtered effluent BOD will remain in the range of 17-27 mg/l throughout the year.

Table 3.13: Summary of Facultative Ponds (FPs) of WWTP

S/No.	Parameter	Unit	Value	
			AP-1	AP-02 to AP-10
1	Total No. of Facultative Ponds	No.	01	09
2	Retention Time	Days	8	8
3	Surface Loading Rate	kg/ha.d	253	253
4	Design Temperature	°C	20	20
5	Effluent BOD@ 20°C (unfiltered)	mg/l	≤80	≤80
6	Effluent BOD@ 20°C (filtered)	mg/l	≤50	≤50
7	BOD Removal Efficiency	%	60	60
8	Hydraulic depth of one pond	ft	6.56	6.56
9	Free Board	ft	1.64	1.64
10	Top length of one pond	ft	1572	1840
11	Top width of one pond	ft	338	285
12	Top area for one pond	Acres	12.22	12.22
13	Total area of ‘n’ No. of ponds	Acres	12.22	109.8

- **Maturation Ponds (MPs)**

107. For tertiary treatment, total ten (10) Maturation Ponds (MPs) have been proposed in parallel for WWTP. Each MP will receive a cumulative flow of 2.46 MGD wastewater flow from one (01) Facultative Ponds (FPs). A summary of the design specifications of the MPs is provided in **Table 3.14** below.

108. The removal rate of coliform in MPs will depend upon the ambient temperature. In the summer months, removal rate will be higher due to an increase in temperature, however, in the winter months, the removal efficiency of the pond will be less and the removal efficiency may be reduced.

Table 3.14: Summary of Maturation Ponds (MPs) of WWTP

S/No.	Parameter	Unit	Value
1	Total No. of Maturation Ponds	No.	10
2	Retention Time	Days	1
3	Design Temperature	°C	20
4	Hydraulic depth of one pond	ft	4.92
5	Free Board	ft	1.64
6	Top length of one pond	ft	340
7	Top width of one pond	ft	285
8	Top area for one pond	Acres	2.21
9	Total area of 10 ponds	Acres	22.14
10	Removal Efficiency in Summer months	%	99.0

- **Treated Effluent Channel**

109. One (01) Treated Effluent Channel shall be provided which shall carry treated effluent from series of MPs and transfer it to effluent pumping station which will convey it to irrigation water courses through force mains. In case, water is not required for irrigation purposes, treated effluent channel will discharge the treated effluent to Sukhrawa seepage drain and Sukhnaie Seepage drain under gravity by passing proposed effluent pumping station. A summary of the design specifications of the Outlet channel is provided as **Table 3.15** below.

Table 3.15: Summary of Outlet Channel of WWTP

S/No.	Parameter	Unit	Value
1	**Flows**		
	Design Peak Flow (year 2044)	m^3/sec	3.96
		Cusec	140
2	**Collection Chamber (CC)**		
	Number	No.	1
	Length of Channel	ft	8550
	Width of Channel	ft	9.0-20.0
	Hydraulic Depth of Channel	ft	3.0-5.0

- **Treated Effluent Pumping Station**

110. One treated effluent pumping station shall be provided for WWTP for North zone. The main function of treated effluent pumping station shall be to receive treated effluent from MPs through treated effluent channel and transport it to irrigation network courses for irrigation of field crops. Proposed treated effluent pumping station is designed on average daily flows of design year 2044. A summary of the technical specifications of the Treated Effluent Pumping Station is provided as **Table 3.16** below.

111. One screen chamber, two wet wells and two dry wells have been proposed with four pumps, non-clogging, horizontal, centrifugal type, in each dry well. All civil structures of the treated effluent pumping station have been designed on an average wastewater flow of 2.02 m^3/sec (71 cusec), estimated for year 2044. In the first stage, for design year 2029, pumping capacity of 60 cusecs will be provided with 33 percent standby pumping capacity. To cater treated effluent flow of year 2029, four pumps (3 operating, 1 standby) will be provided. Bypass engagement has also been proposed

to direct disposal of treated effluent into Sukhrawa Seepage drain without introducing it to the pumping station.

Table 3.16: Summary of Treated Effluent Pumping Station of WWTP

S/No.	Parameter	Unit	Value
1	**Design Average Flow (Year 2044)**	m^3/sec	2.02
		Cusec	71.5
2	**Wet Well**		
	No. of Wet Well	No.	2
	Detention Time	min	2
	Diameter of each Wet Well	ft	30.0
3	**Dry Well**		
i	No. of Dry Wells	No.	2
ii	No. of Pumps in each Dry Well (03 Working, 01 Standby)	No.	4
iii	No. of Pumps in Dry Well	No.	4
iv	Diameter of Dry Well	ft	30.0
4	**Pumps (Design Year 2034)**		
i	Total No. of Pumps	No.	4
ii	Working Pumps	No.	3
	a) No. of 20 cusec pumps	No.	2
	b) No. of 10 cusec pumps	No.	1
iii	Standby Pumps	No.	1
	a) Number of 10 cusec pumps	No.	1
5	**Force Mains**		
i	No. of Force Mains	No.	1
ii	Diameter of Force Mains	mm	1200

- **Treated Effluent Conveyance System for Irrigation Purposes**

112. As per requirement of MC Sahiwal, degree of treatment in proposed treatment plant would be such that the treated effluent can safely be reused in fields for agriculture purposes as per WHO and discharged into inland water i.e. Rivers as per PEQS. When water would not be required for agriculture use in case of rainy season or when water would not be needed by the crops, It can be safely discharged into the seepage drains available in the vicinity of WWTP sites. These seepage drains are ultimately linked to river Ravi and Sutlej in the down streams thus would also resolve the issue of ultimate disposal of wastewater of Sahiwal city.

3.6 Project Construction Schedule

113. The project construction phase is expected to last for a total of 2 years with the activity expected to commence in the second quarter of 2020 and completed by mid of 2023.

3.7 Construction Camps and Work Force

114. The construction activity has to span over approximately twenty-four months. There shall be a number of contracts for a variety of works. The selected Contractor shall have the option to select suitable site(s) located near the project sites to establish his labor camps. If private land is selected, the contractor shall enter into contract with the private owner.

115. Essential for the work bases is easy approach, availability of a suitable place for temporary storage of material and availability of water for construction in the vicinity. Presence of shade from trees close to the work bases can add to the comfort of the labor while taking rest during the hot season.

116. The location of storage materials and camps will be critical. Since the project contractor(s) will be responsible for identifying the suitable locations for storage and labor camps from the private sector, thus there will need to be clear guidelines for this process, which will need to be closely monitored by the implementing agency. As far as possible, the project design team shall be assigned the task to identify the suitable location(s) for storage of materials since inappropriate storage of materials may result disruption of the traffic movement.

3.8 Machinery Requirement

117. For storing materials, stocking equipment and parking machinery and vehicles, the Contractor shall require open and accessible sites close to the labor camps. The

Contractor, at his own expense, but keeping in view his contractual obligations to honor the applicable national and international guidelines regarding level of pollution, shall make the arrangements.

3.9 Climate Risks from Project

118. The biogas production in conventional APs is not collected and directly released into atmosphere due to the large pond area and this same practice has been adopted for the proposed WWTP project. In order to ensure collection and reuse of biogas, high rate anaerobic ponds are designed which have higher capital and operating expenses as compared to conventional APs. These systems are not considered for this proposed WWTP project.

119. It has been estimated that based on the WWTP's operational parameters, during the first stage, upto the Year 2029, approximately 16,600 tonnes/year CO_2e[18] will be emitted from the WWTP plant operation as a result of the wastewater treatment processes.

[18] https://www.researchgate.net/publication/7638191_A_Rational_Procedure_for_Estimation_of_Greenhouse-Gas_Emissions_from_Municipal_Wastewater_Treatment_Plants

Table 3.17: Sensitive Receptor Mapping

Distance of Sensitive Receptors from WWTP Site				
Sr. No	**Type of Sensitive Receptor**	**Name**	**Coordinates**	**Distance from WWTP Site**
1	Religious	Jamia Masjid Ghausia	30°43'7.02"N 73° 2'20.49"E	0.70 Km
2	Religious	Adda wali Masjid	30°42'1.07"N 73° 2'35.68"E	1.54 Km
3	Educational	Govt. High school Muhammad Pur	30 30°42'51.70"N 73° 1'0.05"E	0.61 Km
4	Health	Dispencry	30°42'34.40"N 73° 1'14.53"E	0.24 Km
5	Public Building	UC 43 Office	30°42'47.26"N 73° 1'1.08"E	0.588 Km
6	Grave Yard	N/A	30°42'23.00"N 73° 1'23.49"E	0.35 Km

Figure 3.1: Sensitive Receptor Map of WWTP

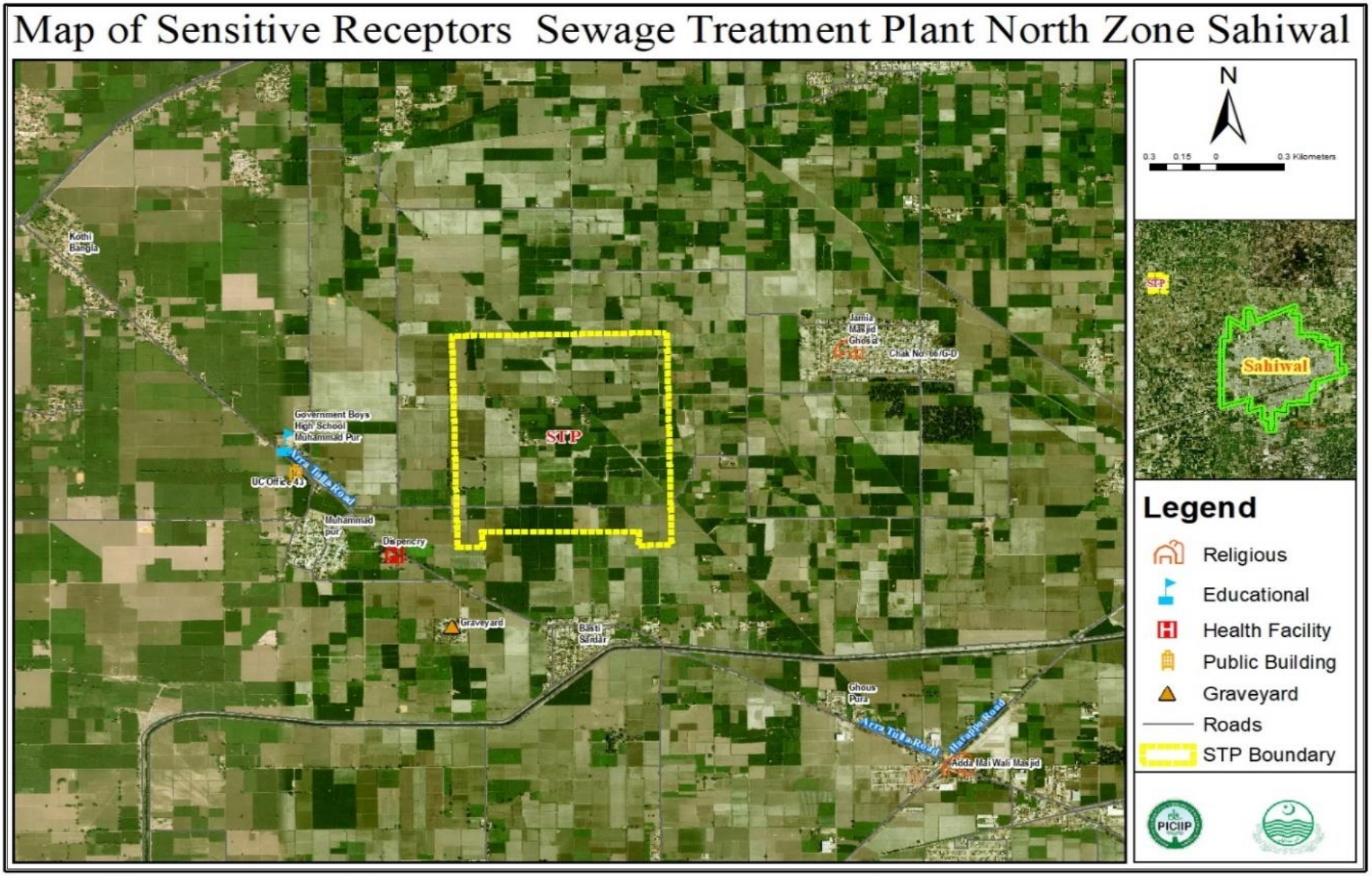


Figure 3.2: Proposed WWTP Site

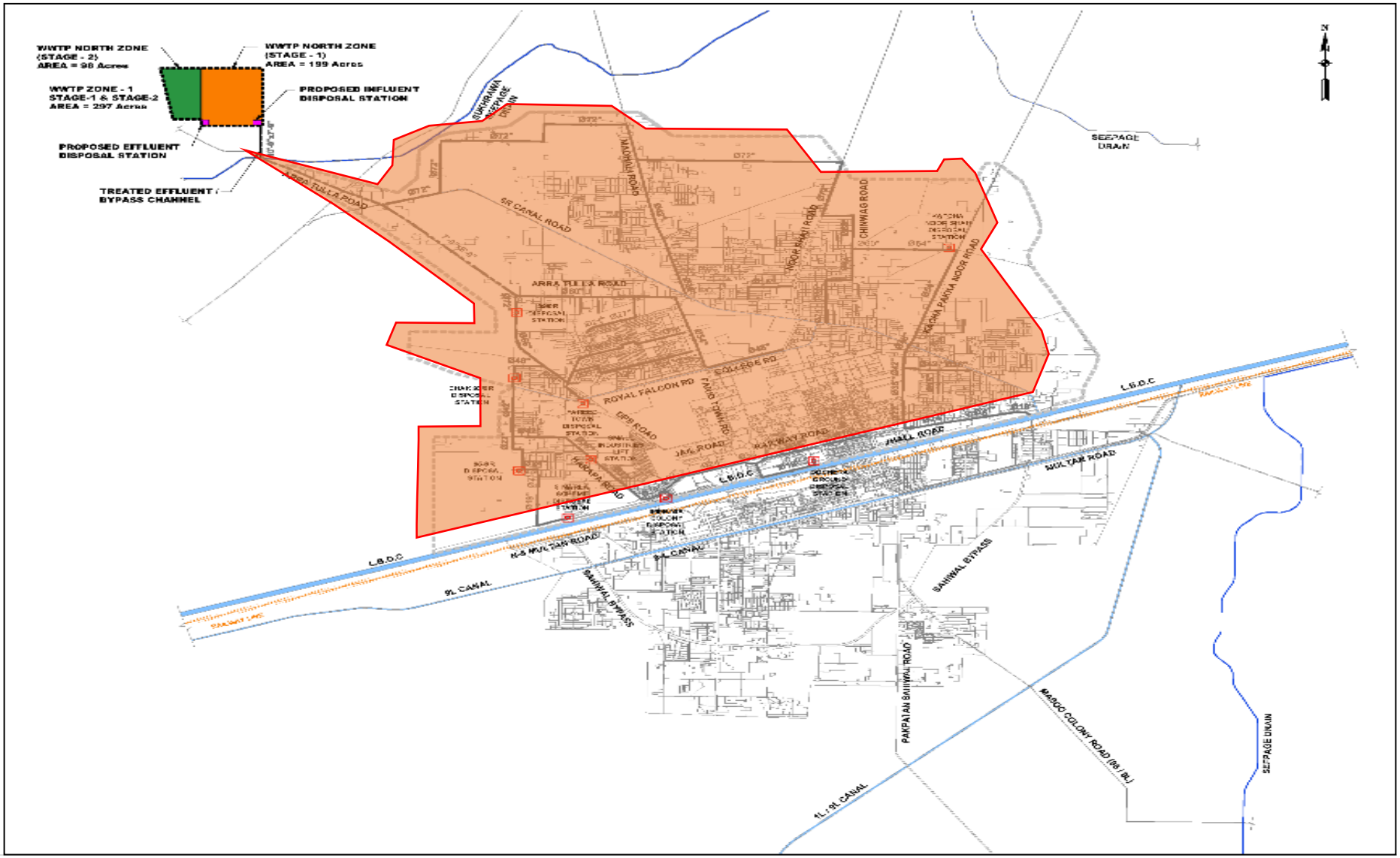


Figure 3.3: WWTP inlet, outlet, and bypass channel layout Plan

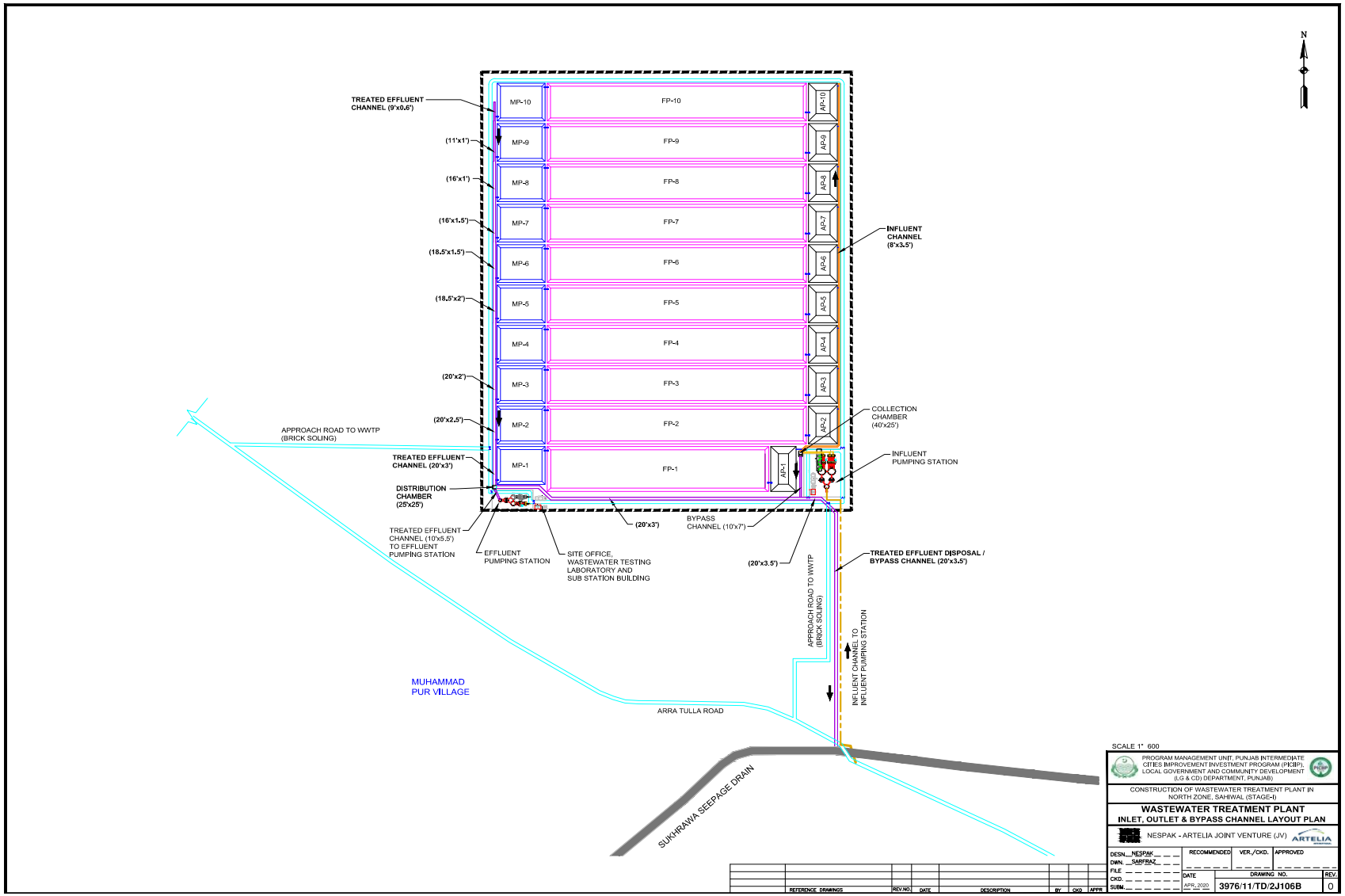


Figure 3.4: WWTP Process Flow Diagram

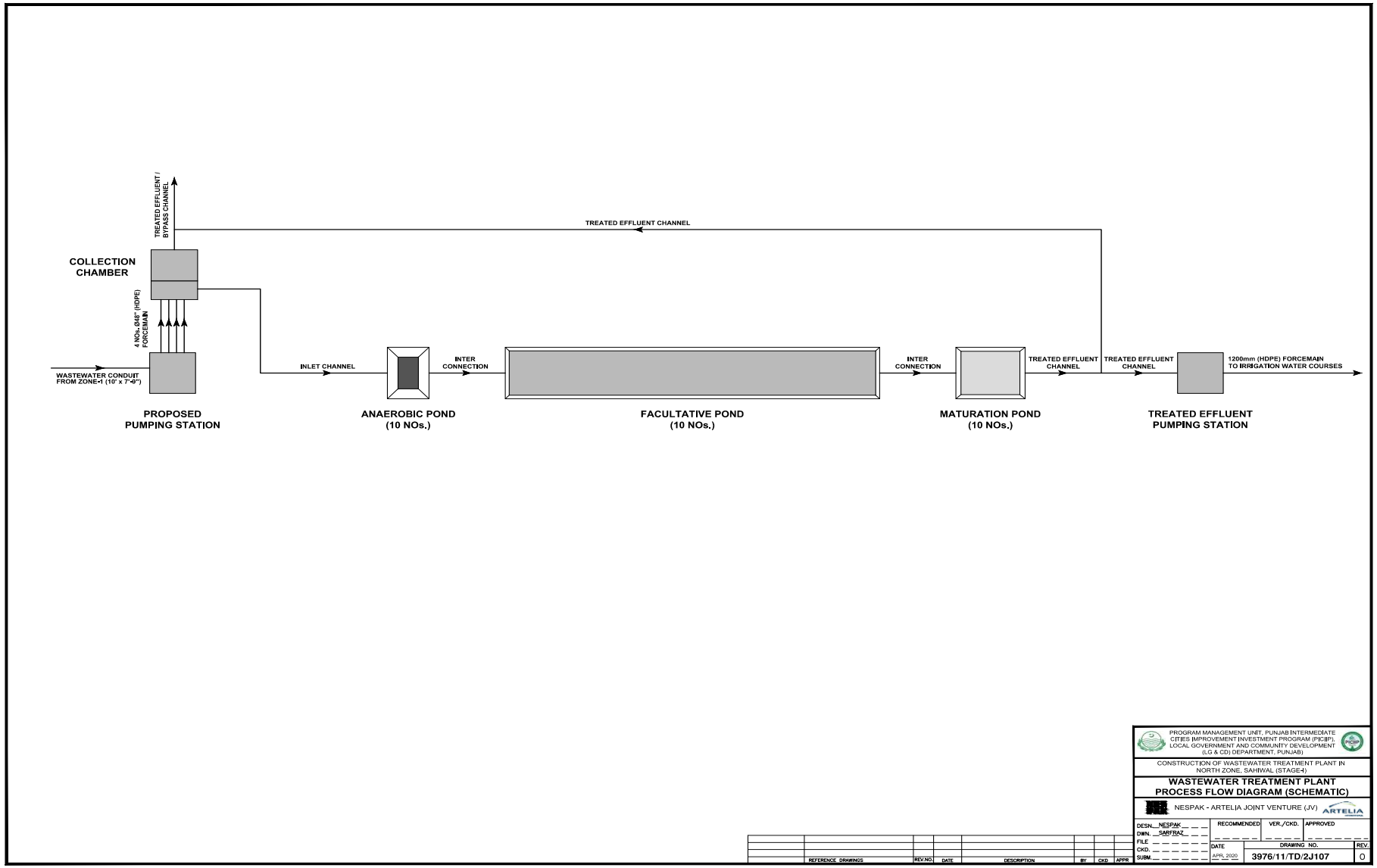


Figure 3.5: WWTP Hydraulic Profile

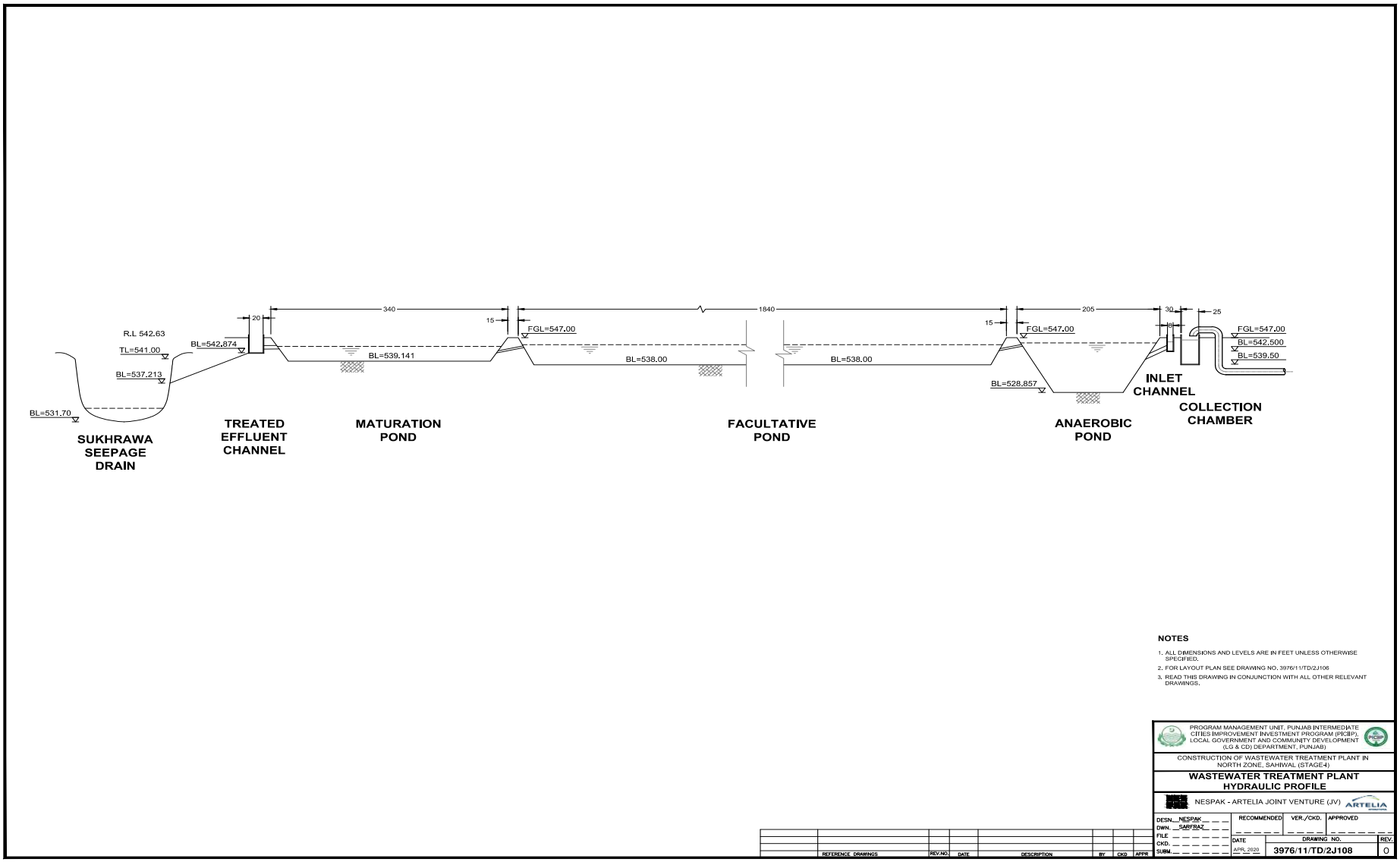


Figure 3.6: AP, FP & MP Plan and Section

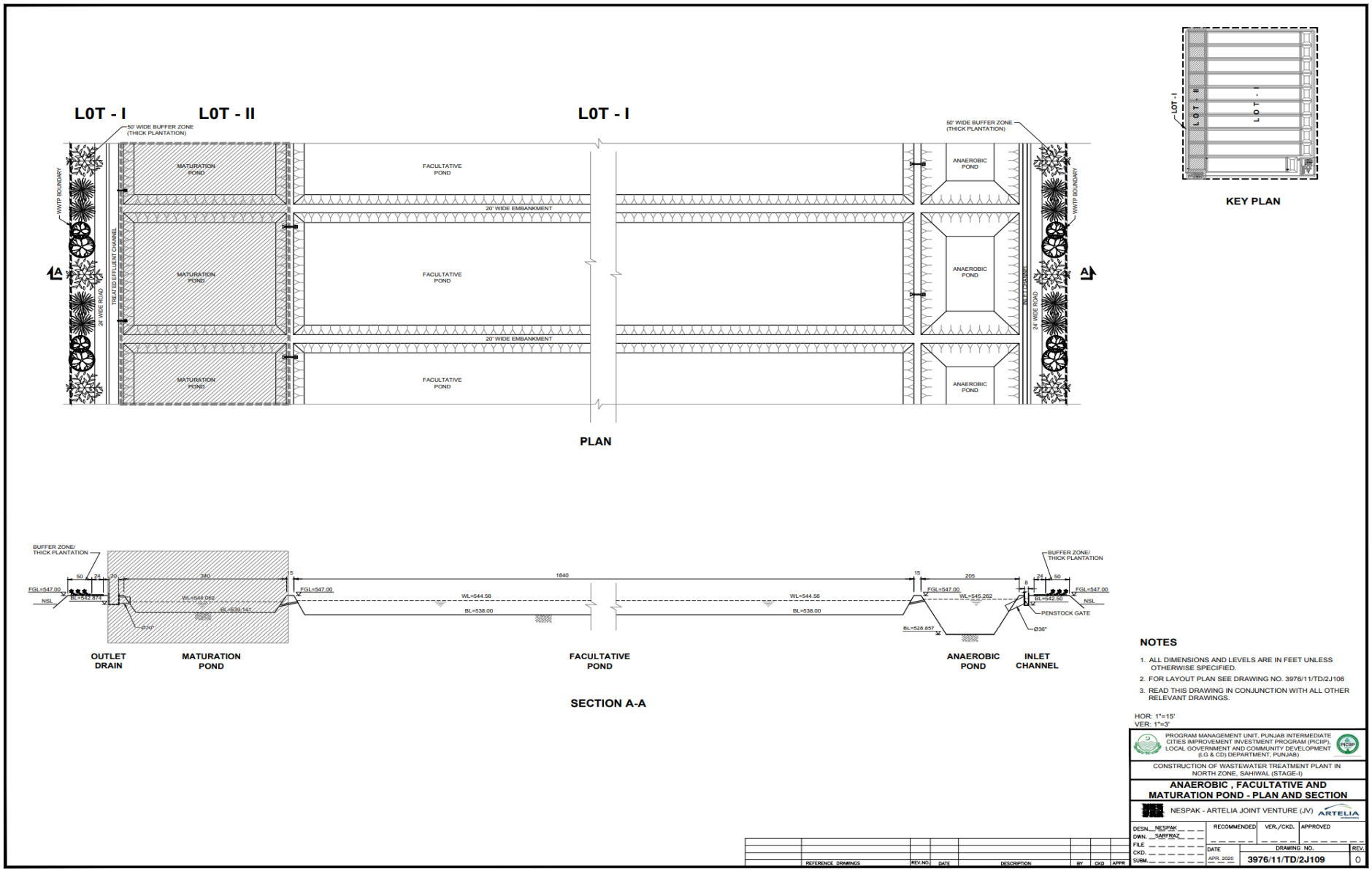


Figure 3.7: AP-01 & FP-01 Plan and Section

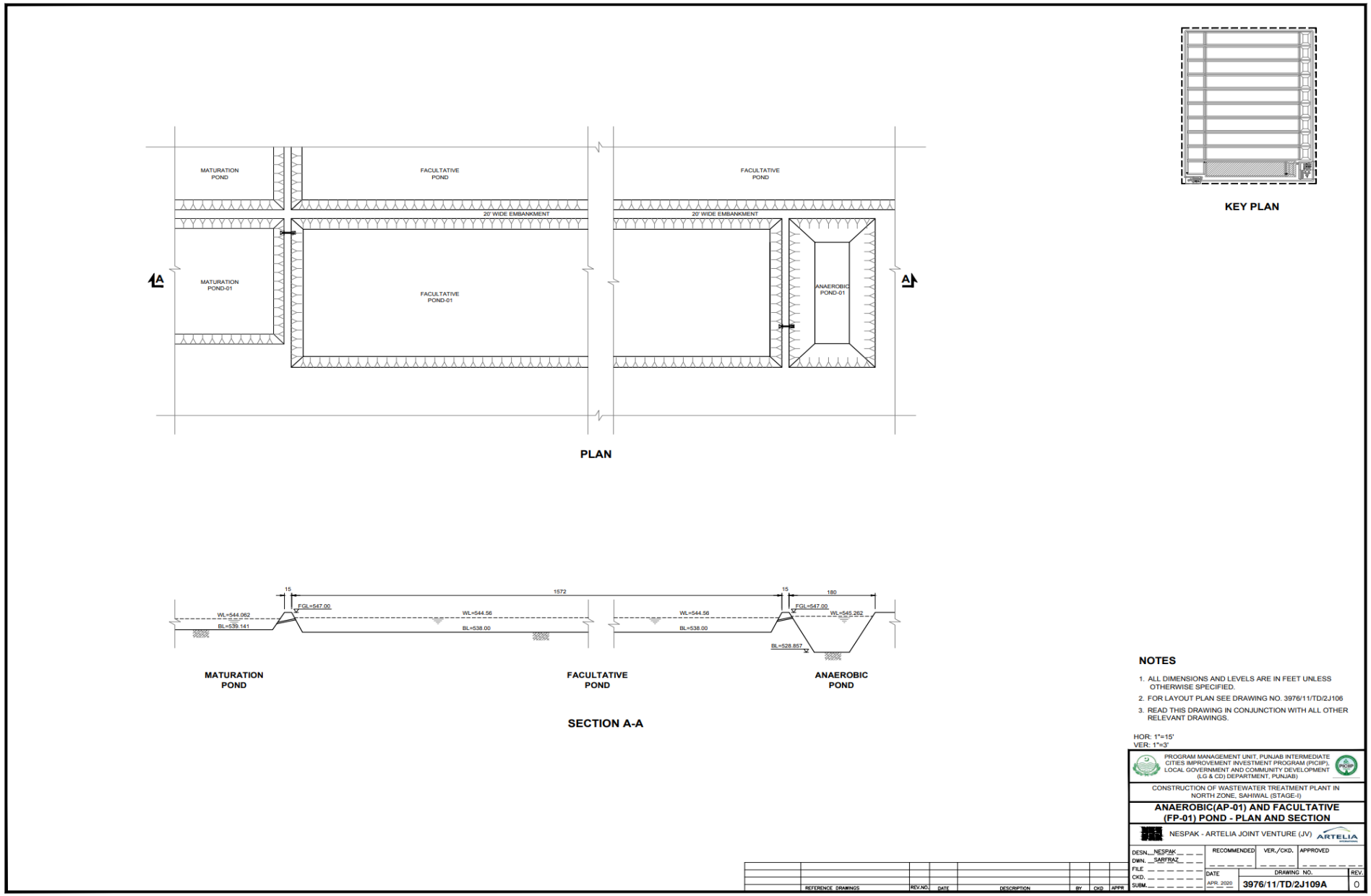


Figure 3.8: AP-02 to AP-10 Plan and Section

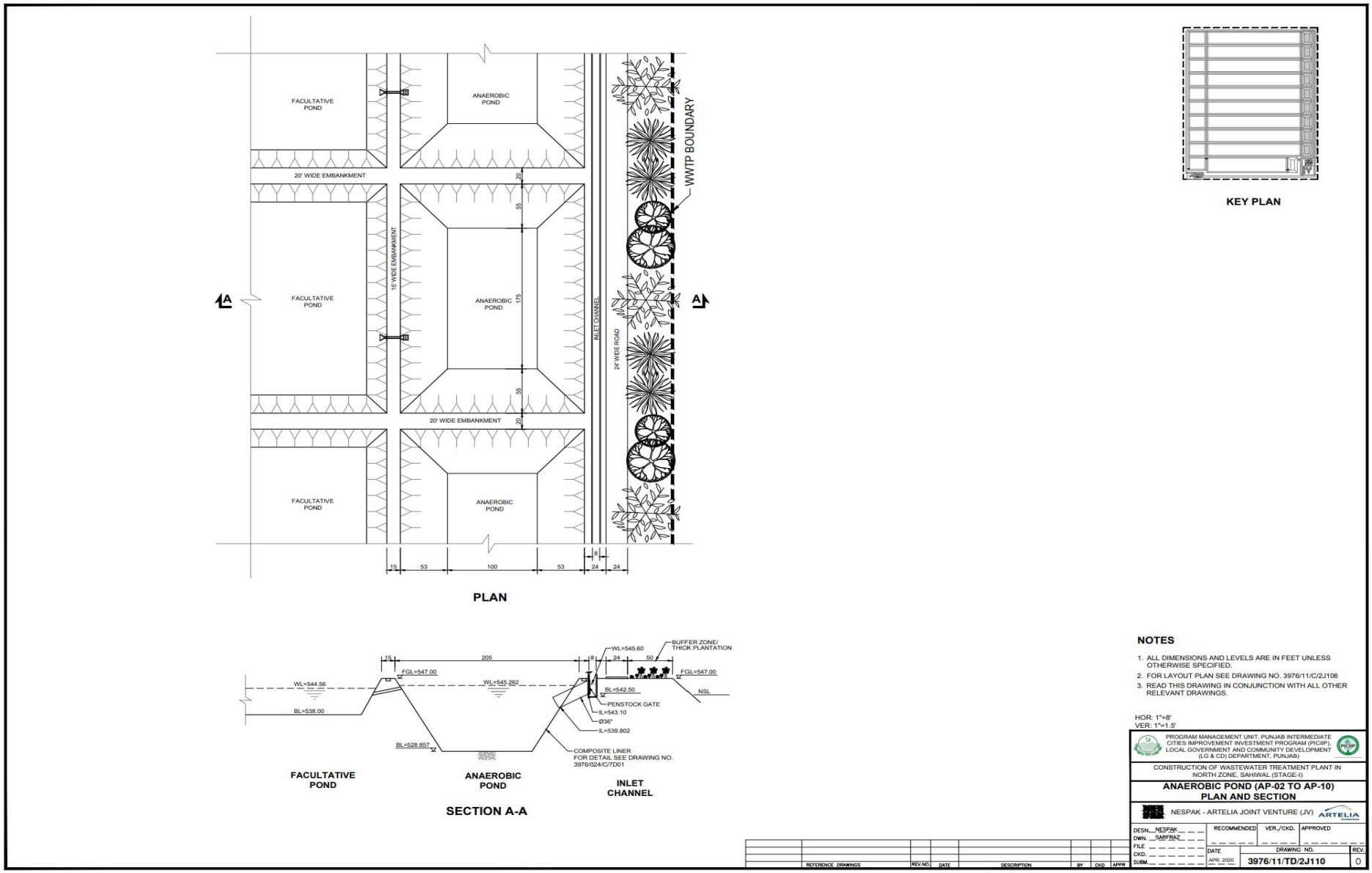


Figure 3.9: FP-02 to FP-10 Plan and Section

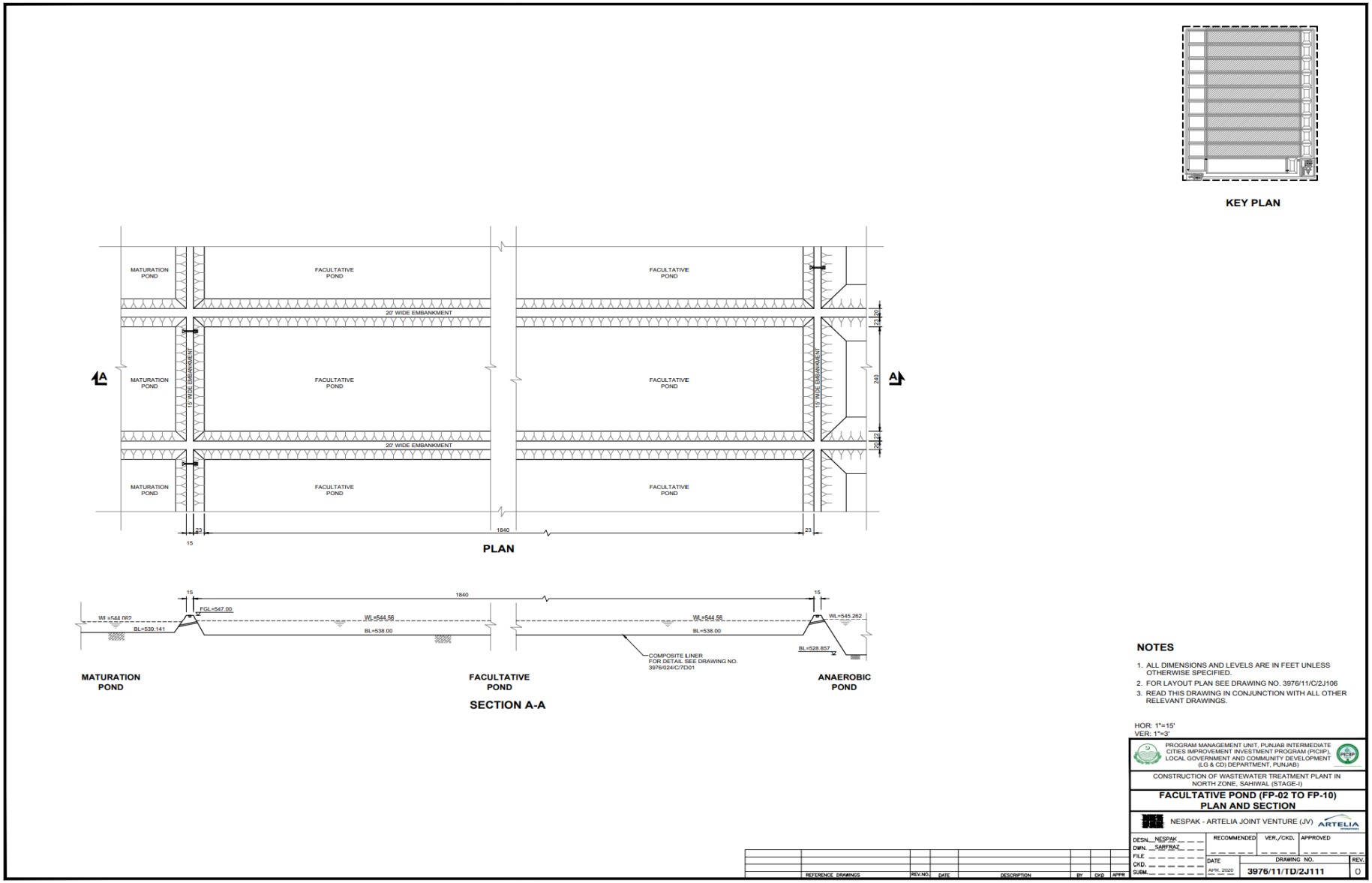


Figure 3.10: Collection Chamber Plan and Section

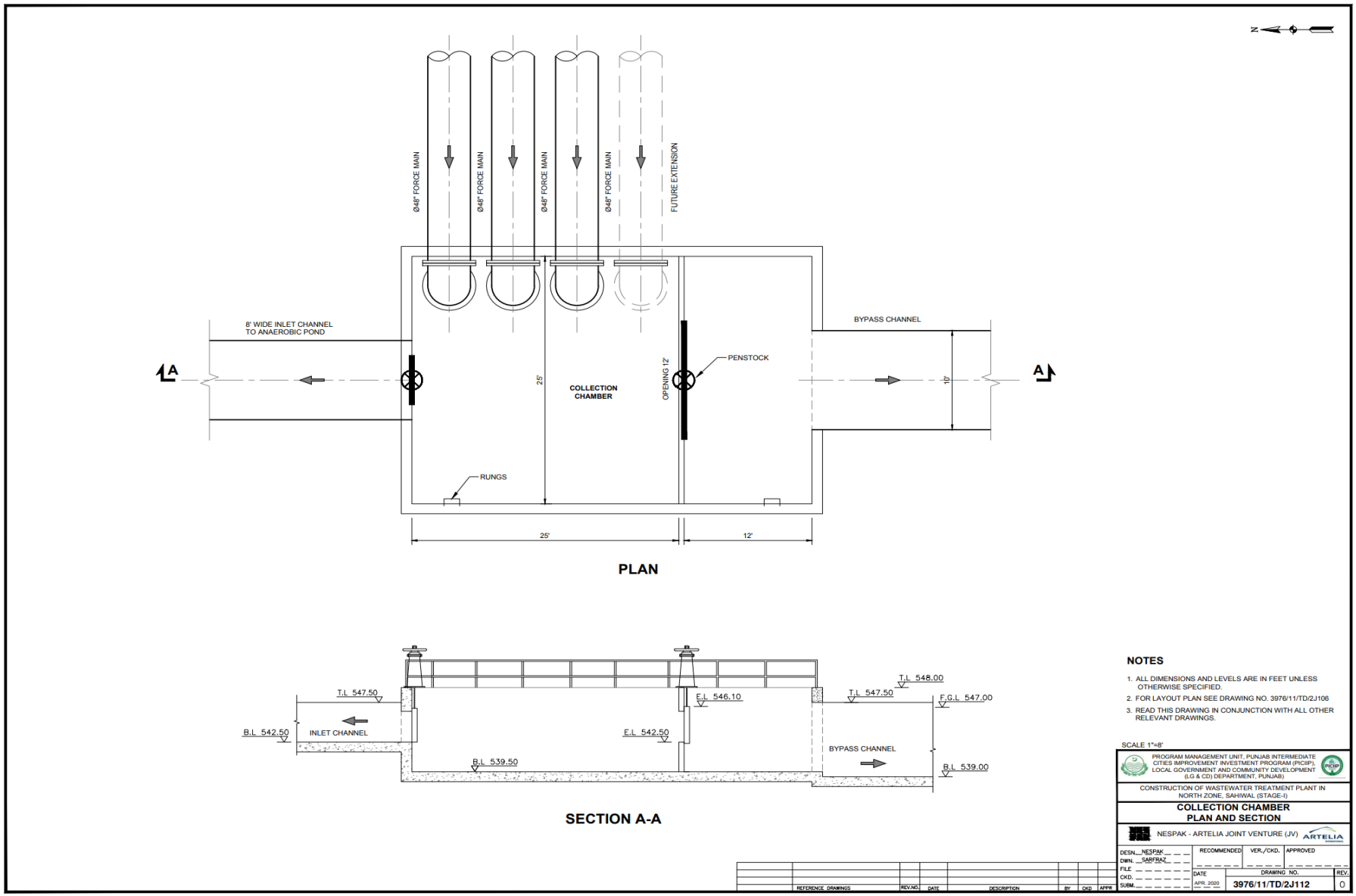


Figure 3.11: Inlet Channel and Outlet Channel - Section

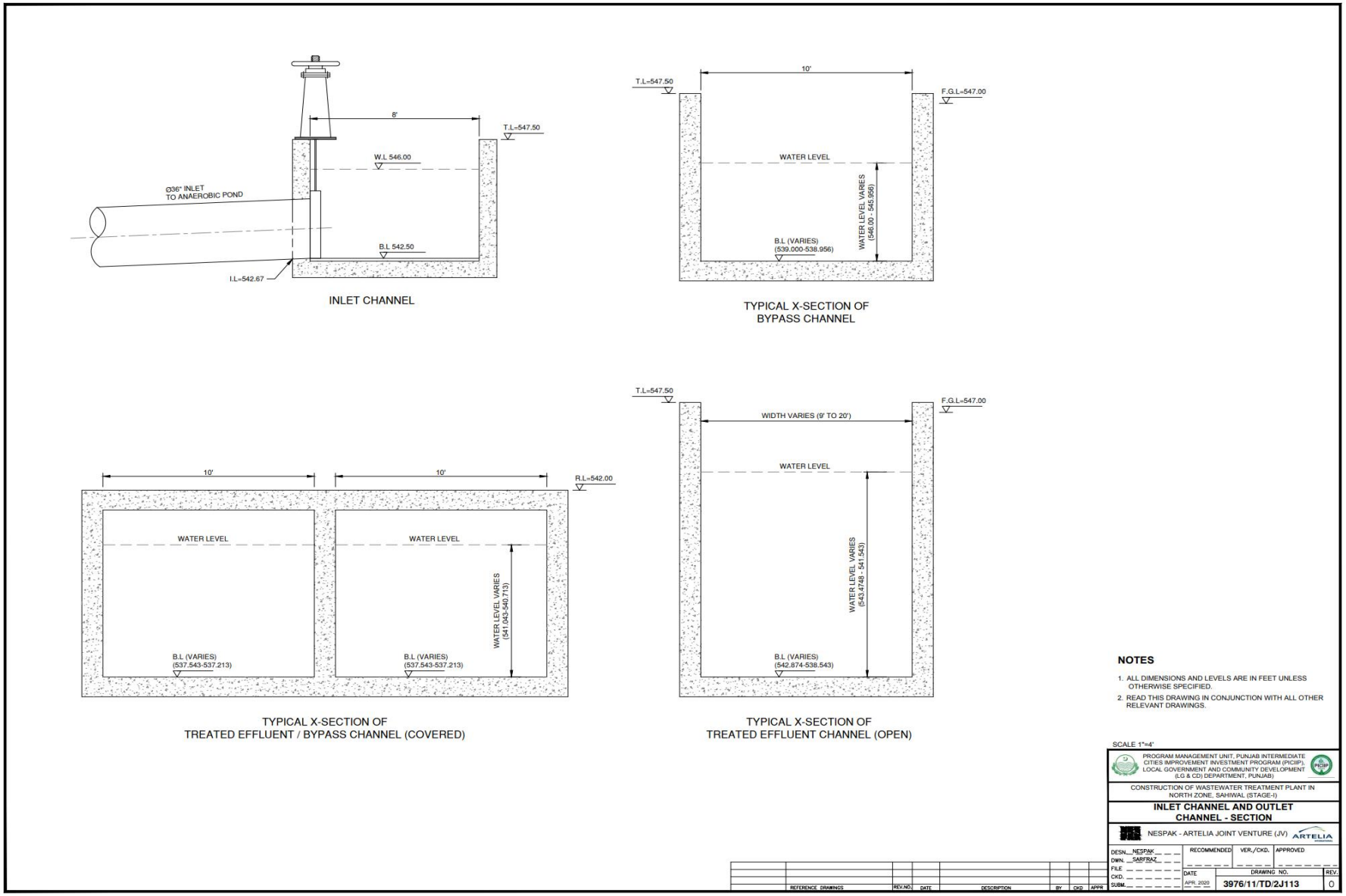


Figure 3.12: Interconnection detail between AP and FP

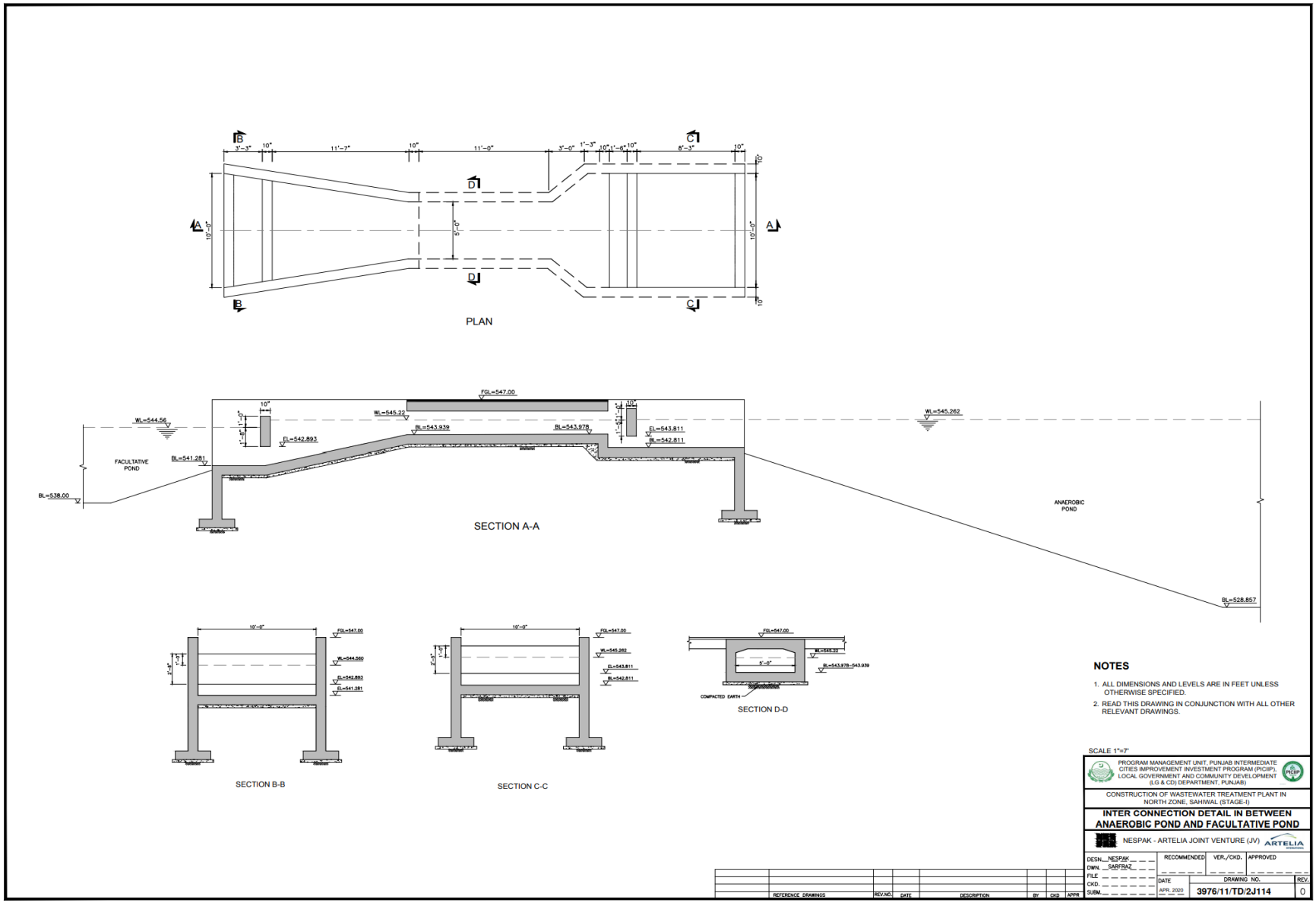
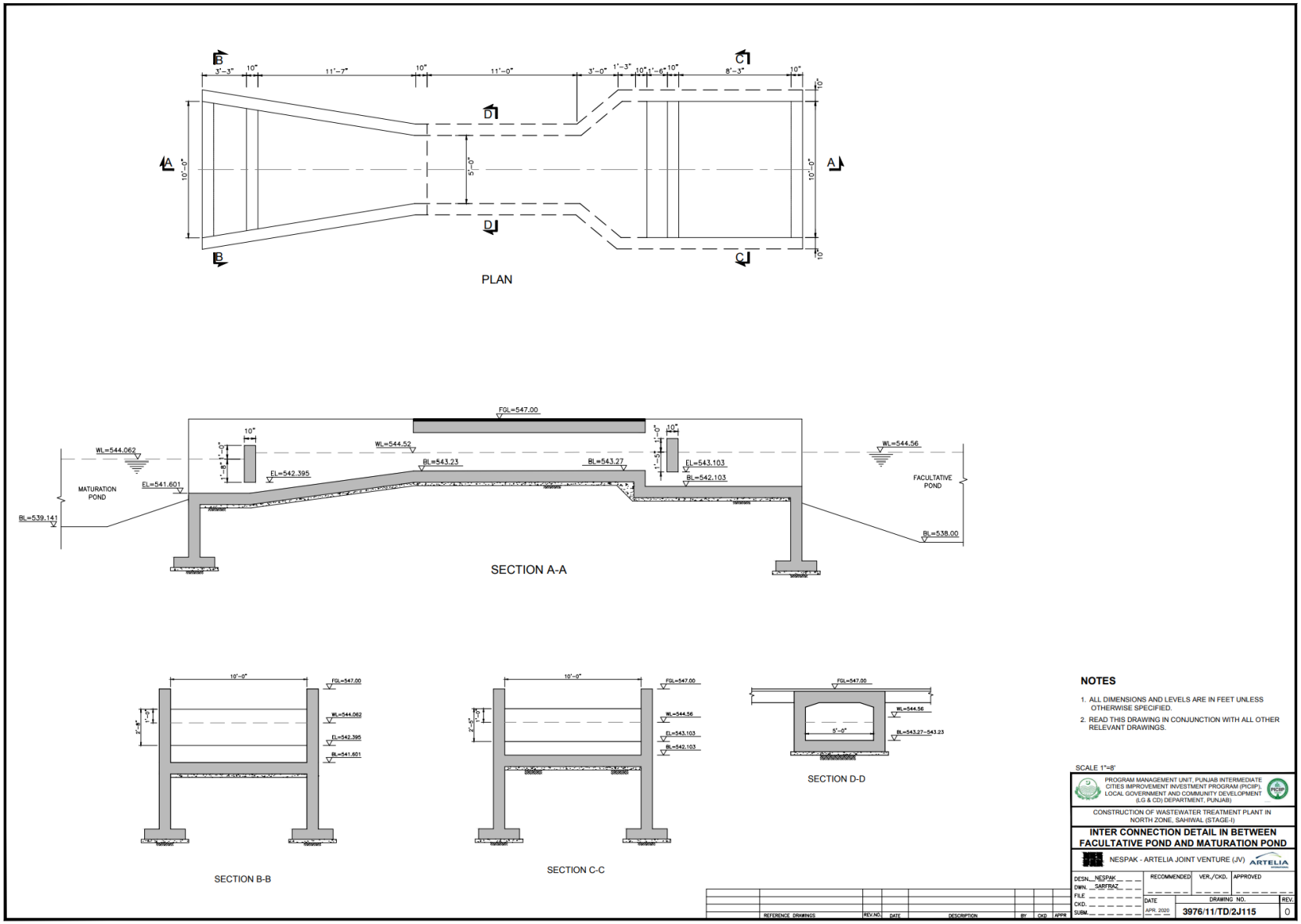


Figure 3.13: Interconnection detail between FP and MP



4 Description of Environment

120. This chapter describes the baseline environmental and social conditions of the project area for the proposed WWTP. The project area's environmental conditions will describe the various resources which could be affected by the economic development that takes place, i.e. physical resources (atmospheric conditions e.g. ambient air quality and climate, topography and soils, surface water and groundwater quality), ecological resources (fisheries, wildlife, forests, rare and endangered species, protected areas etc.) and social resources.

121. As mentioned in the previous Chapter of this report, the proposed WWTP site consists of agricultural fields spread over an area of 199 acres. The natural elevation of the WWTP site varies from 525 to 544 feet. Furthermore, generally, cohension-less soils are present below the pond base level with GWT depth at around 12 meters (39 feet) below NSL.

122. The hydraulic profile of the proposed WWTP site is also proposed as **Figure 3.5** which clearly shows the gradient/slope across the proposed site.

4.1 Physical Resources

4.1.1 Sahiwal City Geography

123. In 2014, the estimated population in Sahiwal district was 2.37 million. Of this 2.37 million, an estimated 1 million (42 percent) was urban while at an average provincial fertility rate of 1.93 percent, the district's projected population till 2035 is 3.5 million.

124. Sahiwal town is situated about 29 km from the left bank of the river Ravi, 187 km west of Lahore and 200 km east of Multan. The Grand Trunk Road and the main railway line pass through the town; they also connect Peshawar and Lahore with Karachi. The Lower Bari Doab Canal separates the town into two parts. Its approximate height is 152 m above sea level. Sahiwal lies at 30°39'52.16" N latitude and 73°6'30.54" E longitude.

125. Geologically, the area does not have any outstanding features. Saltpeter, which is made from saline earth called kallar, is found when the water table is high. In the east of the town, there can be found common salt mixed with a lesser quantity of sulfate of soda and a very small quantity of lime and magnesium salt.

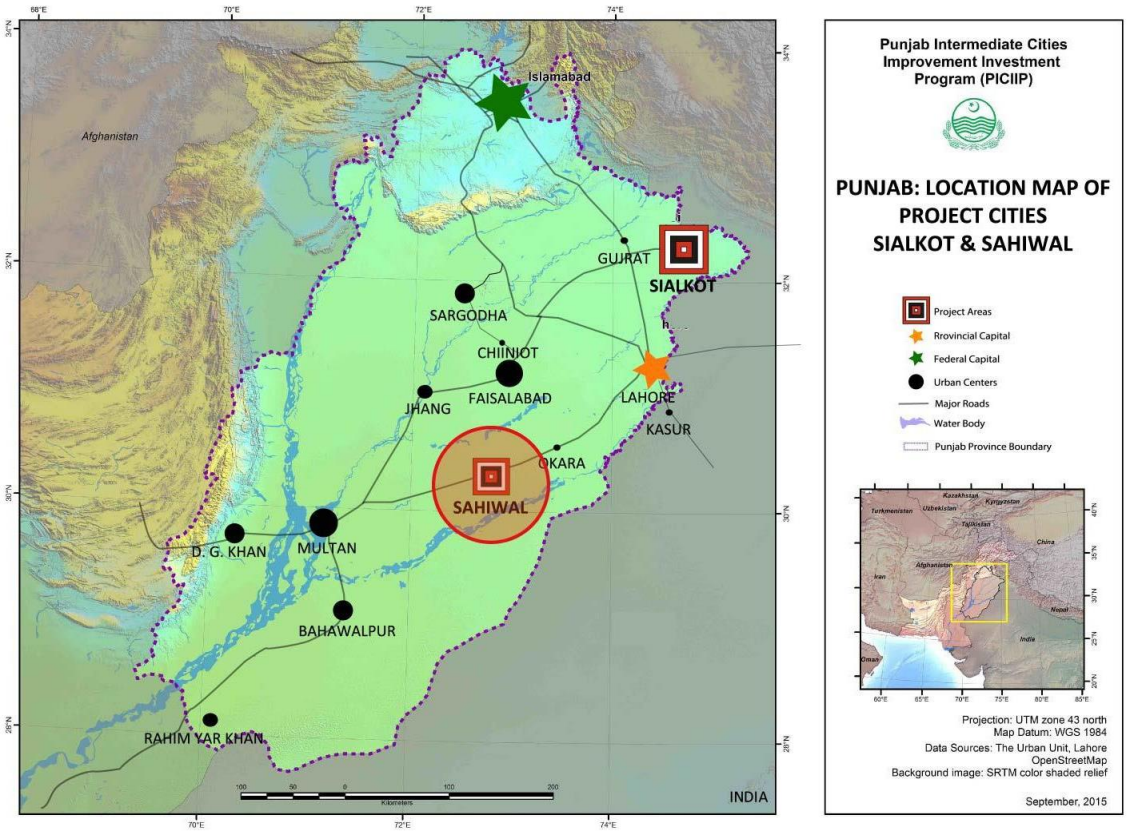
126. The topography of Sahiwal consists of a flat semi-arid plain that is fertilized using its extensive irrigation canal. The Lower Bari Doab is the main source of irrigation in the area and it is fed by a link from the Chenab river. From a topographical point of view, the semi-arid plain is remarkably homogeneous. The only noticeable relief is that of the flood plain bluffs and the belts of ravines and land that were formed by gully erosion along the Lower Bari Doab and its distributaries. Generally, the natural slope runs northeast to southwest. On the whole, the area is flat.

4.1.2 Natural and Climate Conditions of Sahiwal

127. In general, Sahiwal has the same basic natural and climatic conditions that prevail in Punjab. The climate in most of the area is arid to semi-arid, characterized by four district seasons in a year: winter from mid-November to February; spring from mid-March and April; summer from May to mid-September; and autumn from mid-September to mid-November.

128. Punjab's terrain is one of relatively low-lying plains, with several rivers that traverse the area from the northeast to the southwest and feed into the Indus river. The Ravi river is closest to Sahiwal, but it is still a distance of nearly 20 km. There is no history of the city being threatened by floods. The most challenging weather phenomenon in Sahiwal is the winds called 'Loo', which blow during the day in the predominately hot and dry summer.

Figure 4.1: Location Map of Sahiwal



129. The dust from the dry parched earth rises, the air becomes laden with it, and out-door work is difficult. Trees shed their leaves to avoid the loss of moisture and where there is no canal or well, the countryside presents a very dreary aspect. Occasionally, the hot weather is broken by thunderstorms and dust storms. The heavy rainfall, which the thunderstorms bring, and light rain, which follows the dust storm, produces a slight decrease in temperature. This temporary relief from the excessive heat is welcomed.

130. June is the hottest month with a mean daily maximum temperature of 42.4^{o}C. January is the coldest month with the mean daily minimum temperature of 4.4^{o}C. The **Table 4.1** shows the mean daily maximum and minimum temperatures of Sahiwal district.

Rainfall

131. Average annual rainfall ranges between 97 mm and 261 mm. The maximum rainfall (about 60 percent of the total annual rainfall) occurs during the monsoon season (July, August and September), while the period of minimum rainfall or drier period is October and November. The **Table 4.2** shows the mean monthly rainfall data for Sahiwal district.

Humidity

132. July, August and September are the most humid months in the area. May and June are the least humid. The **Table 4.1** shows the average monthly relative humidity in Sahiwal district.

Table 4.1: Mean Monthly Maximum and Minimum Temperature of Sahiwal district

Month	Mean Monthly Maximum (^{o}C)	Mean Monthly Minimum Temperature (^{o}C)
January	19.7	5.4
February	22.8	8.4
March	28.3	13.5
April	35.2	19.2
May	40.4	24.4
June	41.4	27.7
July	38.4	28.1

August	37.8	27.2
September	36.2	24.4
October	34.6	18.1
November	28.6	10.8
December	22.4	6.4
Annual	**32.2**	**17.8**

Table 4.2: Meteorological Data, Mean Monthly Precipitation of Sahiwal district

Month	Mean Monthly Precipitation (mm)
January	12.0
February	12.0
March	17.0
April	6.0
May	7.0
June	23.0
July	74.0
August	75.0
September	25.0
October	1.0
November	2.0
December	7.0
Annual	**261.0**

Wind Direction

133. Sahiwal is situated in southwest Punjab and is influenced by monsoon winds throughout the year. In winter, the wind blows from the north and heads east. In summer, the wind direction is southwest. However, these wind directions are usually disturbed by cyclones, which cause the temperature to drop and low-pressure systems to set in. This situation prevails in autumn. The Wind rose for Sahiwal is provided as **Figure 4.2** below.

4.1.3 Ambient Air Quality

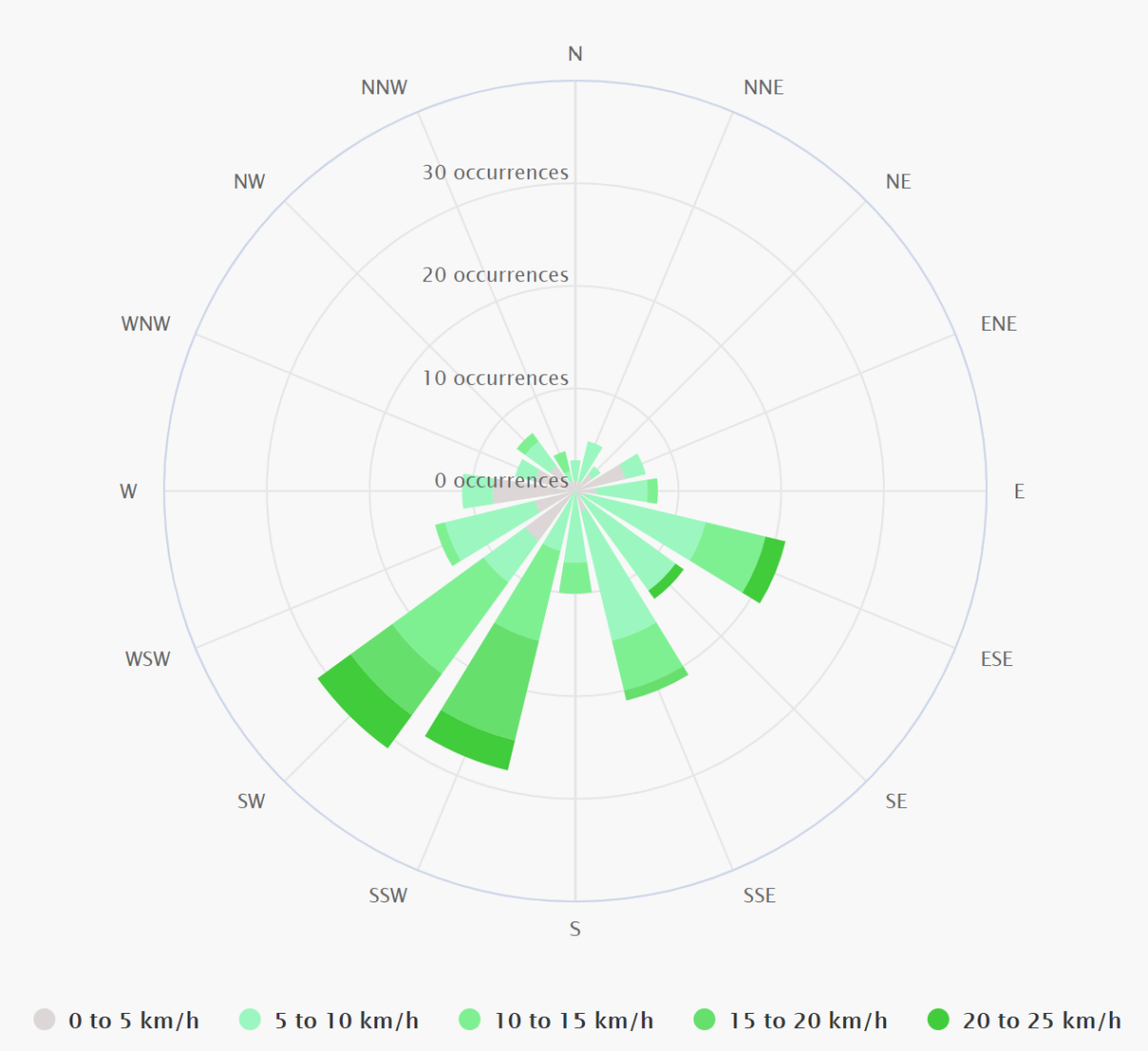
134. Ambient air quality was continuously monitored for 24 hours at the Chak Muhammad Pur in Sahiwal. The pollutant concentration parameters being exceeded are SO_2, PM2.5 and PM10.

135. The ambient air quality in the project areas is presented as **Annexure H.** All the results are within the permissble levels.

4.1.4 Noise Levels

136. The ambient noise levels were also monitored at the same locations as ambient air quality i.e. Chak Muhammad Pur in Sahiwal. The results of the noise monitoring are provided in **Table 4.5** below. As can be observed, the averaged noise levels for the location resulted in daytime noise levels of 53.4 dB, which is within the permissble level of 65 dB. Also, the nighttime noise limit is not being exceeded with average nighttime noise levels monitored to be 41.3 dB. The detailed noise level results are provided as **Annexure H.**

Figure 4.2: Wind Rose for Sahiwal[19]



[19] htt

Figure 4.3: Map of Monitoring Location

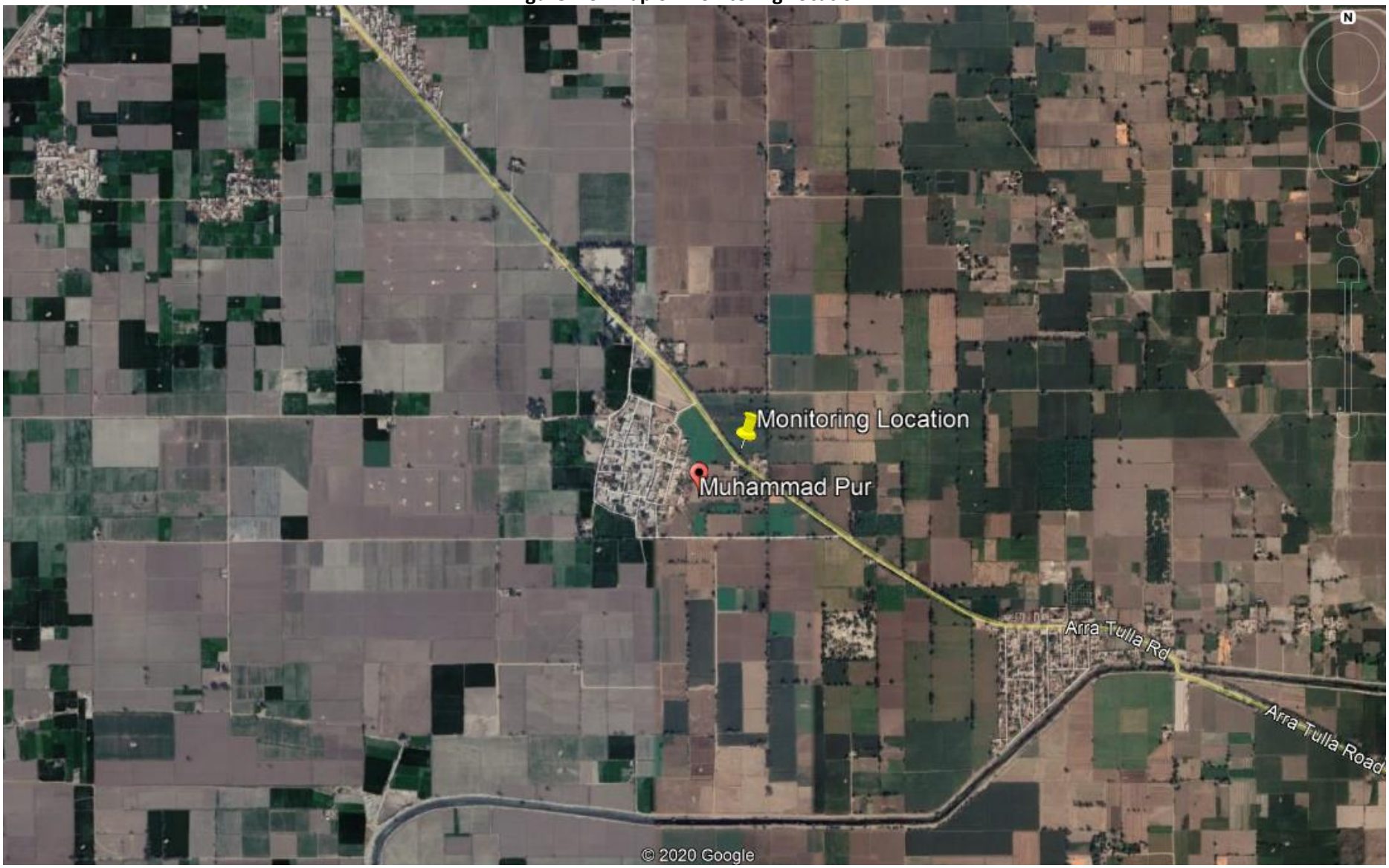


Table 4.3: Comparison of ambient air quality results versus applicable Air Quality standards

Monitoring Location	Parameter	NO (ug/m^3)	NO_2 (ug/m^3)	CO (ug/m^3)	SO_2 (ug/m^3)	NOx (ug/m^3)	$PM_{2.5}$ (ug/m^3)	PM_{10} (ug/m^3)	TSP (ug/m^3)
Applicable Guideline (ug/m^3) for 24 hrs		**-**	**80**	**-**	**20**	**-**	**25**	**50**	**500**
Average of Both Locations	**Average**	10.15	18.55	0.69	22.07	28.7	30.76	127.91	279.97

'Exceeding' applicable guidelines for acceptable pollutant levels **'Within' applicable guidelines for acceptable pollutant levels**

Table 4.4: Ambient Noise Monitoring Results (24 hrs) in Project Area

Monitoring Location	Parameter	Noise Reading Results	Noise Guideline (Commercial Area)	Compliance Status for Commercial Areas
Day Time Readings (0600 to 2200)			**Day time**	
Chak Muhammad Pur	dB(A) Leq	**53.4**	65	
Night Time Readings (2200 to 0600)			**Night time**	
Chak Muhammad Pur	dB(A) Leq	**41.3**	55	
Average Noise Levels (24 hour average)	dB(A) Leq	**47.3**		

Exceedance from applicable guidelines

'Within' applicable guidelines

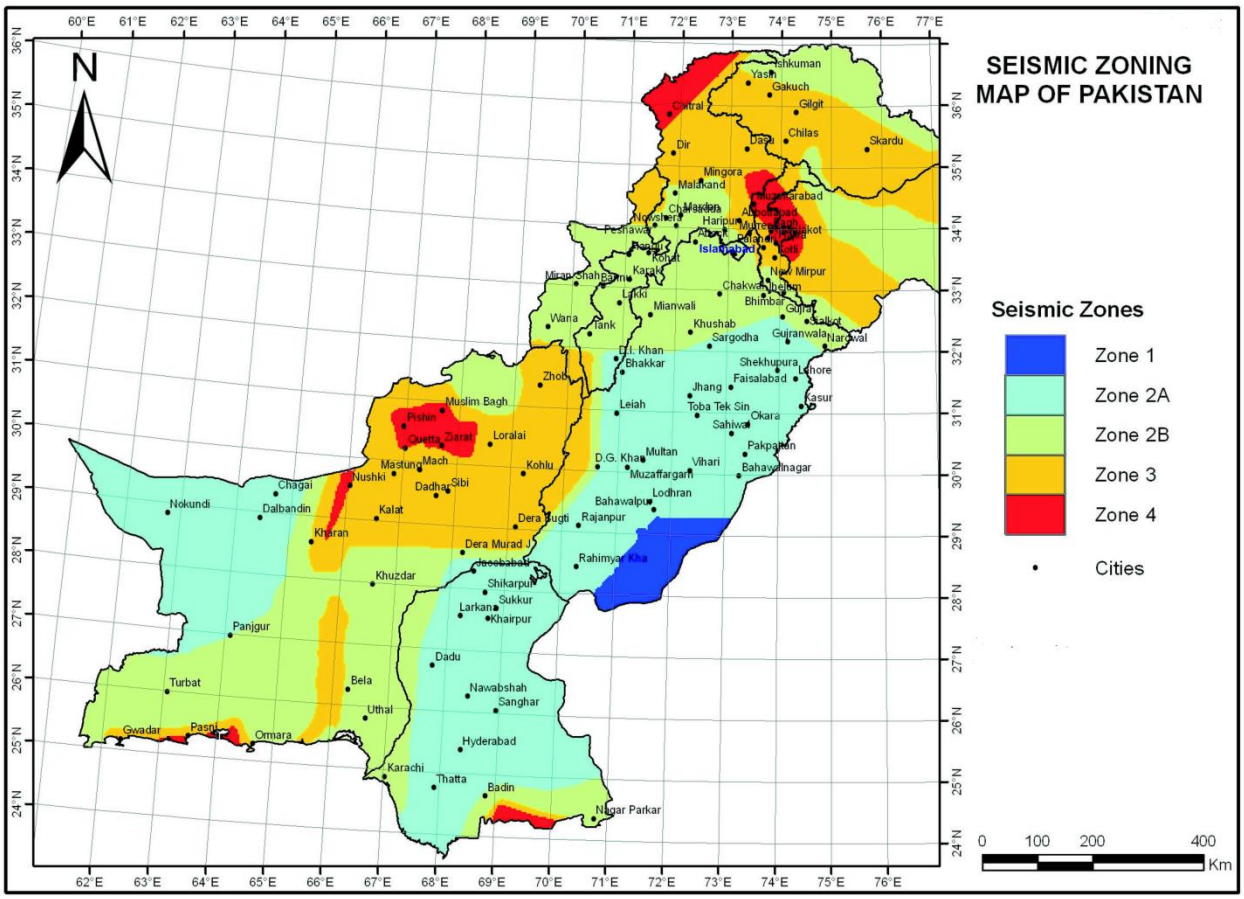
Table 4.5: Meteorological Data, Mean Monthly Relative Humidity

Month	Mean Monthly Relative Humidity (%)
January	62.3
February	56.3
March	51.6
April	40.0
May	33.2
June	39.9
July	56.0
August	59.7
September	56.3
October	51.6
November	61.4
December	66.6
Annual	**52.9**

4.1.5 Seismicity

137. Pakistan lies in a seismically active zone. Seismic observations indicate that hundreds of shocks occur in the region every year. According to the seismic zoning map of Pakistan, included in Pakistan Building Code Seismic Provisions (2007), the project area falls under seismic zone 2A, with a peak horizontal ground acceleration of from 0.08 to 0.16. The seismic zoning map of Pakistan is given as **Figure-4.3** below.

Figure 4.4: Seismic Zoning Map of Pakistan



4.1.6 Surface Water

138. The secondary data from water quality testing of the River Ravi is provided in the **Table 4.6** below. Since the treated wastewater from the WWTP will ultimately be discharged into the River Ravi, thus it is necessary that water quality testing of the water body of the River Ravi at the point of discharge of the treated effluent must be conducted prior to commencement of the WWTP operation, which will form the baseline as the pre-project scenario. Once the WWTP commences operation, monitoring of the effluent at the point of discharge into the River Ravi must be conducted on a quarterly basis to ensure that the PEQS standards for 'inland water' discharge are being met.

Table 4.6: Water Quality of River Ravi (Secondary Data)[20]

S/No.	Parameters	Units	Test Results	PEQS Standards for Drinking Water	WHO Standards
1	Color	pH	Muddy brown	≤15 TCU	≤15 TCU
2	Odor	-	Odorless	Non-objectionable/ Acceptable	Non-objectionable/ Acceptable
3	pH at 25°C	pH unit	7.51	6.5-8.5	6.5-8.5
4	Turbidity	NTU	2.32	<5	<5
5	TDS	mg/L	91.0	<1000	<1000
6	TSS	mg/L	1.07	-	-
7	Conductivity at 25°C	uS/cm	241.0	-	-
8	Volume Settleable Solids	ml/L/Hr	0.1	-	-
9	Organic Carbon, Total (TOC)	ppm	2.7	-	-
10	Hardness, Total as CaCO3	mg/L	78.0	<500	-
11	Calcium Hardness as CaCO3	mg/L	50.0	-	-
12	Magnesium Hardness	mg/L	28.0	-	-
13	Carbonates	mg/L	65.0	-	-
14	Bicarbonates	mg/L	79.3	-	-
15	Calcium	mg/L	20.0	-	-
16	Magnesium	mg/L	6.72	-	-
17	Potassium	mg/L	4.0	-	-

[20] ESIA of Ravi Syphon, 2020

18	Sodium	mg/L	10.0	-	-
19	Alkalinity, Total as CaCO3	mg/L	1.3	-	-
20	Nitrate, NO3	mg/L	0.72	≤50	50
21	Nitrite, NO2	mg/L	ND	≤3	3
22	Chloride	mg/L	15.38	<250	250
23	Sulphate	mg/L	20.56	-	-
24	Fluoride	mg/L	0.29	≤1.5	1.5
25	Dissolved Oxygen (DO)	mg/L	8.43	-	-
26	Arsenic	mg/L	ND	≤0.05	0.01
27	Iron	mg/L	ND	-	-
28	Aluminium	mg/L	ND	≤0.2	0.2
29	Nickel	mg/L	ND	≤0.02	0.02
30	Copper	mg/L	ND	2	2
31	Cadmium	mg/L	ND	0.01	0.003
32	Chromium	mg/L	ND	≤0.05	0.05
33	Total plate count	cfu/ml	3.8×10^3	-	-
34	Pseudomonas spp.	MPN/100ml	ND	-	-

ND: Not Detected

4.1.7 Groundwater

139. Groundwater is the sole source of potable water exploited in Sahiwal. The water table averages about 12 to 15 m below ground level and the upper levels produce limited quantities of mineralized water. At a depth of between 137 and 152 meters, greater quantities of good quality groundwater are available and this is where the city‘s supplies are abstracted from. In recent years, the water table has been dropping at a rate of 0.30 meter per year. This is because of pumping, and decreased rainfall and recharge. It is not clear whether the aquifer is being

overexploited but, in view of the wide dispersal of the tube wells, this is unlikely at the present level of abstraction.

140. The ground water was extracted and analysed to assess its suitability for drinking purposes. The detailed results of this monitoring are provided in **Annexure M**.

141. Samples of ground water were extracted from the following locations:

- **Peer Bukhari**
- **Grain Market**
- **Fareed town**
- **Shuhda Mosque**

142. Based on analysis of these water samples and their comparison with the applicable drinking water quality standards, the following observations were made:

- Water quality at Shuhda mosque had high levels of Total Dissolved Solids (TDS) and Arsenic while Total Coliforms and Fecal Coliform were also high and exceeding the permissible limits. All other parameters were observed to be within permissible limits.
- At Fareed Town, all parameters for drinking water quality were within the permissible limits apart from Total Coliforms and Fecal Coliform.
- At Peer Bukhari, all parameters are within permissible limits, except for Arsenic, Total Coliforms and Fecal Coliform.
- At Grain Market, all parameters are within permissible limits, except for Arsenic.

4.2 Ecological Resources

4.2.1 Flora of the Area

143. In Sahiwal district, the most important species of trees are Kikar (*Acacia Arabica*); Shisham or Tahli (*Delbergia sissoo*); Beri (*Zizyphus jujube*); Toot (*Morus alba*); Sharin (*Albizzia lebbek*); Dherek (*Melia azeharach*); Phulai (*Acacia modesta*); Pipal (*Ficus religiosa*); and Bohr (Ficus *bengalansis*), which are planted for shade. The trees in Rakhs mainly consist of three species: Jand (*Prosopis spicigera*); Karir (*Capparis aphylla*); and Wan (*Salvadora oleoides*). Occasionally, Rero (*Acacia ieucophhloea*) and Farash (*Tamarix articulata*) are also found. The Pilchhi (*Tamarix dioica*) is found on moist sandy soils along riverbanks and is used for wicker work, and basket making, etc. Mesquite bushes and some Eucalyptus trees grow wild in

the areas along the canals, roads and barren land, but natural forest cover has been significantly reduced.

144. Sahiwal is a green and fertile town with 11,522 forested acres. The area's main crops are wheat, cotton, sugarcane, maize, sorghum forage and rice. Main fruits grown are citrus, mangoes and guava.

145. Sahiwal district of Indus basin plain, falls under Tropical Thorn forest type and has a hot semi-arid climate intermediating between Desert climate and Humid climate in ecological characteristics with agricultural potential. The climate tends to have hot, sometimes extremely hot, summers and mild warm winters. The soil and climatic characteristics support short or scrubby vegetation which can be termed as open and pronouncedly of xerophytic nature in which thorny leguminous species predominate. However, commonly found vegetation (Trees, Shrubs, Grasses) of project as well as study area include species given in the **Tables 4.6** to **4.8** below.

Table 4.7: Name of Trees

S. No.	Common Name	Scientific Name	IUCN Status
1	Kikar	*Acacia nilotica*	NA
2	Shisham	*Dalbergia sisso*	NA
3	Simal	*Bombax ceiba,*	NA
4	Sufeda	*Eucalyptus species*	NA
5	Frash	*Tamarix articulate*	NA
6	Neem	*Azedarachta indica*	NA
7	Jaman	*Syzygium cumini*	NA
8	Bakain	*Melia azedarach*	NA
9	Ber	*Zyziphus mauritiana*	NA
10	Toot	*Morus alba*	NA
11	Lasura	*Cordia myxa*	NA
12.	Sukh Chaen	*Pongamia glabra*	LC
13.	Mesquite	*Prosopis juliflora*	NA
14.	Date Palm	*Phoenix dactylifera*	NA

NA= Not Assessed LC= Least Concern

Table 4.8: Name of Shrubs and Herbs

S. No.	Common Name	Scientific Name	IUCN Status
1	Akk	*Calotropis procera*	NA
2.	Phog	*Calligonum polygonoides*	NA
3	Jantar	*Sesbania aculeate*	NA
4	Bathu	*Chenopodium botrys*	NA
5	Lana	*Suaeda fruticosa*	NA
6	Arind	*Ricinus communis*	NA
7	Piazi	*Asphodelus tenuifolius*	NA

NA= Not Assessed

Table 4.9: Name of Grasses

S. No.	Common Name	Scientific Name	IUCN Status
1	Khabbal	*Cynodon dactylon*	NA
2	Dab	*Desmotachya bipinnata*	NA
3	Khawi	*Cymbopogan jwarancusa*	NA
4	Kana	*Saccharum munja*	NA
5	Gorkha	*Elionorus hirsutus*	NA
6	Kai	*Saccharum spontaneum*	LC

NA= Not Assessed, LC= Least Concern

146. **Existing Trees:** The project area is flat agricultural land which supports trees of various species on the boundary of agricultural fields as well as individually scattered growth. Trees (girth 61 cm and above) and pole crop (girth 20 to 58 cm) standing within the project area were enumerated along with their kind of species. The detail of trees present in the project area is given in **Table-4.9** below.

Table 4.10: Species Wise Tree Distribution

Sr. No.	Species	No. of Trees		
		Poles (girth 20 to 58 cm)	Trees (girth 61 cm and above)	Total
1	Kikar	5	12	17
2	Shisham	8	10	18
3	Toot	7	13	20
4	Miscellaneous	5	7	12
	Total	**25**	**42**	**67**

Miscellaneous includes Sukh Chaen, Lasura, Jaman, Neem, Date Palm

4.2.2 Fauna of the Area

147. Most of the Punjab is under intensive irrigated cultivation. Livestock rearing is also extensively practiced, and milk animals are common. The use of chemical fertilizers and pesticides is also very common. Several species of wildlife have adapted to the changed habitat. These include, the jackal; jungle cat; Bengal fox; small Indian mongoose; shrew; hog deer; ravine deer; black buck; blue bull; wild hare; and rodent pests, including porcupine; fruit bats; and wild boar. The avifauna that has survived the modified habitat include doves; black partridge; cuckoos; koel; woodpeckers; parakeets; bulbuls; babblers; black drongo; bee eaters; finches; owls; hawks; and house sparrow. The reptilian species of this modified habitat include krait; cobra; saw scaled viper; rat snake; and monitor lizard.

148. In these modified habitats, due to the extensive use of pesticides in these areas, the winter bird species from the Himalayas have been reduced, since these species feed on the insects. These birds play an important role in controlling insects, particularly in the forests.

149. Scavengers, such as, jackals are attracted to garbage dumps and human faeces for food. House sparrows breed in houses. Bank mynas and cattle egrets feed on grasshoppers that are present in the rangelands that also support cattle and buffalos. Banyan and peepal trees still grow in the villages. Green pigeons and barbets feed in these trees.

150. Some of the oldest trees still stand in the old British-era colonies. Some rare species of birds, such as hornbills, green pigeons, and barbets still live on these trees. Large populations of pigeons breed in urban houses. Kites, crows, mynas, house sparrows and alexandrine parakeets breed in urban areas. Shisham and acacia trees are usually planted along the roads and canals. Doves mainly breed on these types of trees.

151. The extent of fauna presence is related to the availability of vegetative cover in an area. Since the project area is basically agricultural supporting chunk of land without any dense forested area nearby, it lacks richness in natural fauna. No conspicuous wildlife was observed in the area during field visit However, mammals and birds reported in the project area, are given in **Tables 4.10** to **4.12** below.

Table 4.11: Names of Mammals

S. No.	Common Name	Scientific Name	IUCN Status
1	Jackal	*Canis aureus*	LC
2	Fox	*Vulpus bengalensis*	NA
3	Porcupine	*Hystrix indica*	LC
4	Squirrel with strips	*Funambulus pennanti*	NA
5	Mouse	*Mus musculus*	LC
6	Mongoose	*Herpestes auropunctatus*	NA
7	Indian Hare	*Lepus nigricollis*	LC

NA= Not Assessed, LC= Least Concern

Table 4.12: Names of Reptiles

S. No.	Common Name	Scientific Name	IUCN Status
1	Cobra	*Naja naja*	NA
2	Spiny tailed Lizard	*Uromastyx hardwickii*	NA

3	Fringed Toed Lizard	*Acanthodactylus cantoris*	LC
4	Indian Krait	*Bungarus caeruleus*	NA

Table 4.13: Names of Amphibians

S. No.	Common Name	Scientific Name	IUCN Status
1	Common Frog	*Rana tigrina*	LC
2	Common Toad	*Bufo bufo*	LC

152. The area is comparatively dry and does not support wide variety of birds. The common species found in the project area are enlisted in **Table-4.13**.

Table 4.14: Names of Birds

S. No.	Common Name	Scientific Name	IUCN Status
1	House Sparrow	*Passer domesticus*	LC
2	Mynah	*Acridotheres tristis*	LC
3	House Crow	*Corvus splendens*	LC
4	Pigeon	*Columba livia*	LC
5	Koel	*Eudynamys scolopacea*	LC
6	Red-Wattled Lapwing	*Vanellus indicus*	LC
7	Gray Partridge	*Francolinus Pondicerianus*	LC
8	Quail	*Coturnix coturnix*	LC
9	Red Vented Bulbul	*Pycnonotus cafer humayuni*	NA
10	Little Bittern	*Ixobrychus minutus*	LC
11	Hoopoe	*Upupa epops*	LC
12	Ring Necked Dove	*Streptopelia decaocto*	LC
13	Little Egret	*Egretta garzetta*	LC

153. On account of anthropogenic interventions mainly agriculture, no habitat is left to support much of wildlife in the project area. None of the existing species of plants or animals, therefore, are of endangered category.

4.2.3 Protected areas / National Sanctuaries

154. In Pakistan, there are several areas where land is devoted to the preservation of biodiversity, through the dedication of national parks and wildlife sanctuaries. There is no

protected area or national sanctuary near the area of where work will take place on the sub-project.

4.3 Socio-Economic Development

155. Before the introduction of the canal system, Sahiwal was an area of barren land. However, owing to irrigation, it has become very fertile. The real achievement occurred when the Lower Bari Doab canal was constructed in 1913. Later, the Deepalpur and Pakpattan canals brought almost the entire district under irrigation. Now, the district is one of the most fertile areas of the province and a leading grower of cotton.

156. In the early days, the town had been declared a congested area. Due to an influx of refugees from India and also to recent industrialization, it has attracted a considerable number of people. Consequently, two new sub-towns have cropped up beside the old part of the town.

157. There is a new Abadi on the eastern side of the old town and a modern satellite town, known as Farid Town, on the northwestern corner. At the time of its establishment, the area of the original town of Sahiwal was small. However, it grew with the passage of the time, and is now its total area is about 19 square kilometers. The city's major growth took place during the post-1947 period. However, the trend of this growth, even during this period, has largely been in a northerly direction. The city could not grow to the south, perhaps due to the obstruction of Railway line, and the Lower Bari Doab Canal and its distributaries. The city has also spread out toward the east in what appears to have been the result of forced development.

158. Due to this industrial development and the land's fertility, the city began to flourish and emerged as a place that attracted in-migration. In short, Sahiwal became a place where people wanted to reside. During the decades of 1911-1921, and 1921-1931, the city attracted the highest ever percentage of people. During these decades, the population growth rate was 79.7 percent and 79.3 percent, respectively.

159. The city also became important from a business point of view. It is situated at the point from where all types of communication are available to connect it and its people with the rest of the province and with the larger country as well. A great change has occurred in its economic structure, as it transitioned from an agricultural to an industrial economy. The town is now a commercial one, with a shopping center that caters to both the town people and also to those living in nearby localities.

4.3.1 Land Use and Settlements Pattern

160. Land use includes residential, commercial, industrial, recreational, and institutional activities, among others. A suitable arrangement of the physical elements of land use ensures that a town offers convenience, health and a better quality of life. The city comprises buildings, transportation channels, utilities, social services, and also vacant land, which may be used for agricultural purposes.

161. In August, 1972, the Punjab's Housing and Physical Planning Department began a land-use study of Sahiwal city, which it completed in September the same year. Out of the total area surveyed, the largest portion of the city consisted of undeveloped area that accounted for 41.70 percent of the total area surveyed. The scattered pockets of development exist within the built up areas and also in open strips of land that were situated between various built-up belts of development that ultimately abutted the agricultural land around the city. Since the undeveloped area made up a substantial percentage of the city's surveyed area, it was considered desirable to not take this percentage into account when calculating the percentage of area given to various land uses in the city. Consequently, the survey only included the built up area, revealing that 31.31 percent was for residential use. The transportation system was second largest user of land, occupying 18.58 percent of the total built up area. Other uses include, industry (occupying 3.85 percent); open spaces (8.54 percent); commerce (1.76 percent), and health (0.74 percent). Other important users of land are canals, distributaries, transport terminals, and Government buildings, which occupy 9.64%, 7.07% and 5.28% of the built-up area, respectively.

162. As for the land use pattern, originally the city was designed to be a planned colony town, covering an area of only about 307 acres (1,242,429 m^2). The city was designed with the oval as the main focal point. The road network radiated from its center toward a city space that consisted of a mixture of residential and commercial uses. Major bazaars and residences were established in the small streets that ran off the major arteries. Functions, such as administration, education, and transportation, were situated around the commercial and residential parts of the old town. After independence, the city further developed and emerged into a major administrative industrial and commercial town. Since no comprehensive plan was devised, land in the town was given to various uses, irrespective of its suitability. These uses were mostly based on expediency rather than the principals of the land development. Consequently, the present-day city is a mixture of various and, quite often, incompatible uses. Except for the new planned colony, there has been an intensive mixing of land use, particularly among small-scale cotton factories, etc.

However, for an overall pattern of land use, the city can be divided into following major zones:

Zone of Central Commercial Activities

163. This is limited to the old city and is surrounded by High Street, Railway Road, Hall Road, Masood Shaheed Road, the Deepalpur Bazar, and the few scattered roads that join this area. Development in this area of is of a ribbon type, along with its major bazaars, i.e., Pakpattan , Sadder , Deepalpur Sori Galli, and Sua Bazars, and is further extended up to Jinnah Chowk. The development of the commercial activities within this area is mainly due to historical reasons rather than to any planned effort.

164. A variety of commercial activities take place here, namely wholesale, and large specialized retail, etc., which cater to the needs of the entire city and the surrounding rural and urban areas that are concentrated in this zone. The shops usually have residential quarters, either attached to or above them, where the owner might be living. There is hardly any exception to this practice. The areas between the main streets form pockets that are filled with residential uses but, even here, it is common to see small shopping facilities scattered here and there. These bazars have developed, over the years, into their present form and will also retain this form in the future.

Zone of Mixed Land

165. The vegetable and fruit markets are also located in this area. They cause the usual nuisance to the residents and make it unattractive for living. The other uses are for restaurants, hotels, bus stands, and commercial offices. Among these, the bus stands, which cater to the needs of the city and the adjoining chaks (villages), create hindrances and chaos in the area.

Zone of Industrial Complexes

166. This zone as unlike those in the other cities of the Punjab, and is located on and across the Lahore Multan Quetta (LMQ) road. The majority of the large industrial units are found in this zone, however, a few small units are also scattered throughout the city. The reasons for setting up large-scale industry here, between the railway line and the LMQ road and across the LMQ Road, are neither deliberate nor due to any planning criteria. It is the result of the cheap rates for the land and the cheap communications that serve it. However, this development is also ribbon-like, similar to the development along the LMQ road, starting from chowk Pakpattan up to the Arifwala Chowk, and further up to new powerhouse and the grid station. The presence of a 9L water distributary has further helped this area develop for industrial purposes.

Zone of Administrative and Educational Buildings

167. This zone comprises the civil lines areas, the canal colony, the Government Boys College complex and the hospital. It further extends up to the Batala School and the Government Girls College. From its beginning, the civil-lines area is at the center of the administrative functions of the city, the district and the region. It extends up to the Boy's Degree College, and the canal colony, and covers a substantial part of the built up area of the entire city. In addition to being the center of administrative functions (almost all of the government offices are situated in this area), the city's main open spaces are situated in this zone, i.e., the stadium and the race course.

Zone of Planned Colonies

168. The zone of the planned colonies comprises the area of the satellite town known as "Farid Town." Its land-use character is very distinct and different from the old city. Comparatively, its residential density is very low. Both the planned colony and the canal colony were situated in their present locations due to the availability of government land.

169. To sum up, the land use of the city, as a whole, can be described as having developed out of sprawl and without any preconceived plan that could have coordinated the land of one area with that of another or with the transportation system. The result is the prevalence of chaos and unpleasant living conditions. The **Table 4.16** presents the areas and proportions of various land uses in Sahiwal:

Table 4.15: Land Use Distribution in Sahiwal

#	Land Use	Area		% of Total Area
		Acre	Sq. Km.	
1	Residential	1,143.14	4.63	36.1
2	Commercial	139.97	0.57	4.4
3	Agricultural	520.35	2.11	16.4
4	Public Buildings	357.86	1.45	11.3
5	Religious	23.32	0.09	0.7
6	Education	416.14	1.68	13.1
7	Health	18.72	0.08	0.6
8	Industry	55.97	0.23	1.8
9	Graveyard	53.34	0.22	1.7
10	Parks/Open Spaces	160.46	0.65	5.1
11	Vacant Area	175.70	0.71	5.6
12	Mixed Land use	99.97	0.40	3.2
Total Area		**3,164.94**	**12.81**	**100**

Source: Urban Unit data

4.3.2 Agriculture and Livestock

170. Agriculture is by far the main economic activity in the project area. The main crops, during Rabi, are wheat, gram, rapeseed, mustard, barley and oil seeds. During Kharif, crops include cotton, jawar, sugarcane, bajra, maize, and rice. In addition, there are subsidiary crops known as Zaid Rabi, such as Kharbooza, tobacco and potatoes, and also Zaid Kharif crops, such as potatoes and chilies. The main fruits grown are oranges, watermelon, muskmelon, guava, citrus, falsa, jaman, and pomegranate. When cultivation began, the inhabitants ate pilu and bair, the only wild fruits that grows, intermittently, in the region. With the introduction of canal irrigation, other fruits are now being grown on a commercial basis. However, wheat, cotton, sugarcane and rice remain the major crops.

171. Main Crops: Sugarcane, wheat, rice, maize and cotton are the main crops grown in the area. Besides guar seed, bajra, moong, mash, masoor, jawar, oil seeds are also grown in minor quantities in Sahiwal area. Average yield of important crops in the area of study is given below in **Table 4.15**.

Table 4.16: Average Yield of Agricultural Crops

Sr. No.	Crop Name	Average Yield/Acre (kg)
1	Cotton	1,000
2	Sugarcane	20,600
3	Maize (Spring)	3,400
4	Maize (Autumn)	2,800
5	Rice	800
6	Wheat	1,400
7	Potato	9,600

172. The vegetables are grown in abundance, as the water and soil are suitable for cultivation. Crops include potatoes, carrots, ladyfingers, chilies, onions and cauliflower. Bitter gourd, turmeric and garlic are also grown to meet public demand. Other vegetables include radish, tinda (apple gourd), and bringal.

173. Fruits: Citrus, guavas and mangoes are the main fruits grown in the district. Besides, pomegranate, litchi, falsa and banana are also raised on minor scale.

174. Livestock breeding is one of the main pursuits and means of livelihood among the rural and urban population in the project site. Common livestock are sheep, goats and cows, which serve as an important source of income.

175. Fisheries: Fishery sector is not rich in district Sahiwal on account of precious fertile land for agriculture production. Not much variety of fish is found in the LBDC and other

nearby water bodies, except Gulfam fish (*Cyprinus carpio*), which is basically cold-water species, but has adapted to harsh conditions. However, dependency of local people on fish as economic activity is very limited, because of the non-existence of large fish farms in the area.

4.3.3 Power

176. As with the rest of the country, Sahiwal does not have an adequate, reliable and uninterrupted 24/7 power supply. Interruptions are frequent, forcing industries, other businesses, and many of the residents who can afford it to rely on back-up diesel generators and uninterrupted power supply systems. These are costly, environmentally degrading and generally a poor second option. Power generation and primary distribution are generally beyond a single urban center's capacity, so it is necessary to rely on provincial and national government support. Any city with reliable power enjoys an immediate competitive advantage. Solar options for institutional and residential use are increasing in popularity, but the technology has not reached the stage where it can provide the major energy source for heavier industry.

4.3.4 Industrial Activity

177. There are three industrial sites in Sahiwal district, and more than 200 industries. There is also a small industrial estate, developed by the Punjab Small Industrial Corporation. It consists of 188 plots situated on about 52 acres land. Sahiwal is famous for its cotton ginning and pressing, its tannery, textiles, leather products, garments, pharmaceuticals, flourmills, and food industry. Sahiwal is also one of Pakistan's major multi-crop areas, and many pesticide companies do business here. Major industries include, Mitchell's Fruit Farms Limited; Engro Foods Limited; Beakers Land and Sweets Factory; Ittefaq Sugar Mills Limited; Baba Farid Sugar Mills Limited; Lackson Tobacco, Philip Morris Tobacco; Fauji Fertilizer Company; Habib Oil Mill; and Aziz Leather Craft, etc.

178. Most of the larger industries, such as Engro Food, Philips Morris Tobacco, dairy product plants, and other agro-based industries are situated along Multan Road, south of the canals, and along the ribbon developments outside the municipal limits.

179. The business community of Sahiwal district earnestly felt the need to establish a Chamber of Commerce & Industry, in Sahiwal. A group of traders and Industrialists succeeded in obtaining a license from the Government of Pakistan's Ministry of Commerce. After incorporation with Security Exchange Commission of Pakistan, under Companies Ordinance 1984, the Chamber became affiliated with the Federaton of Pakistan Chambers of Commerce & Industry.

180. The primary objective in establishing the Sahiwal Chamber of Commerce & Industry (SLCCI) was to provide businessmen in the area with an opportunity to strengthen the economic growth of Sahiwal, in particular, and the country, in general. Industry growth will certainly reduce unemployment in the area.

181. The prime objective of the SLCCI is to serve its members to their utmost satisfaction. The SLCCI acts as a bridge between the government and the business community. It plays an important role in policy formulation by maintaining a constant interaction with the relevant authorities.

4.3.5 Water Supply Service

182. The water supply is obtained from ground water and 46 tube wells. The water supply network covers 90 percent of the town and serves 90 percent of the total population. The distribution system consists of eight overhead reservoirs with a 450,000-gallon capacity. The distribution consists of a looped network made of different types of materials, including asbestos concrete, PVC, MS, and duct Iron pipes. Pipe sizes vary from 76 to 305 mm in diameter.

4.3.6 Sewerage System Service

183. The sewerage and drainage system covers 90 percent of the total area of Sahiwal through a 40 km sewerage network. Wastewater is disposed of in a nearby sewer system, which pollutes the surrounding environment and causes waterborne diseases. The residential areas are rapidly expanding to the north side of the town, and slower expansion is taking place toward the east, reducing the coverage of the facility to between approximately 20 and 30 percent.

184. Municipal wastewater is being used for irrigation purposes, according to farmers' demand, and the remaining wastewater is disposed of into rivers through drains and nullahs.

4.3.7 Solid Waste Management

185. The solid waste generation from Sahiwal city is overwhelmingly domestic and primarily organic in composition. Some industrial solid waste varies in different parts of the city. The main problems with refuse collection and disposal are old machinery, polythene bags, anti-social habits, lack of supervision, and the encroachment of open sewers.

186. Currently, there is no proper system of waste disposal in Sahiwal. Collected waste is dumped at designated dump sites, at Ratti Tibbi, without any environmental safeguards, such as segregating infectious hazardous waste produced by tanneries, slaughterhouses,

and hospitals. Presently, only 32 percent of solid waste is being collected and disposed of. However, with increasing economic activity in agriculture and manufacturing, the environmental and health situation will continue to worsen in the absence of proper disposal mechanisms.

187. The Sahiwal Municipal Corporation (SMC) manages Sahiwal's existing solid waste management system. The existing solid waste collection, in general, is divided into a primary and secondary system. Sahiwal city comprises of ten union councils, each of which has its peculiar characteristics in terms of land use the composition of waste generated. The amount of waste generated and the extent of pollution varies from union council to union council. The allocation of sanitary staff in the union councils does not commensurate with the workload, thereby resulting in huge heaps of waste piling up on the streets and in open places.

188. There is no available data on the composition of the waste generated in the city and there is no concept of the segregation of infectious/noninfectious and hazardous/nonhazardous wastes produced by industries, slaughterhouses and hospitals.

189. The SMC has prepared a PC-1 “Integrated Solid Waste Management System in Sahiwal, the estimated cost of which is Rs 135.68 million. The aim of this project is environmental improvement by enhancing institutional capacity and improving the collection, transportation, and disposal of the city’s solid waste, hospital waste, and slaughterhouse waste.

190. Presently, the SMC’s primary waste collection is carried out by the use of handcarts and is taken to open places of heaps on roadsides, followed by secondary collection through tractor trolley, and final dumping at the Ratti Tibbi dump side. Under the present scenario, only 32 percent of solid waste is being collected, transported and disposed of.

4.3.8 Transport

191. Sahiwal city has a total road length of 40 km, of which the regional road/highway is 10 km long. There are 12 km of major roads and 18 km of branch roads. In addition to that, there are numerous streets, which crisscross the city. Also there are about 11 important junctions in the network, out of which six are roundabouts and the remaining function as chowk.

192. Out of the total urban area of 1,652 hectares (16,515,870 m2), 55 percent offer good vehicular accessibility, 25 percent are fair, and 20 percent offer poor vehicular accessibility. Since the city is basically a planned town, numerous roads in the network are

fairly wide. About 9 percent of roads are 37 meter wide, 22 percent are 34 meter wide, 20 percent are 24 meter wide, and 49 percent are 18 meter wide or less.

193. The transport infrastructure in Sahiwal is generally adequate for its existing requirements; there are relatively few circumferential links. This results in extended journey times for many trips and the misuse of minor roads by through traffic. There is little provision for off-street car parking. There are no signals on any of the chowks and no available urban bus or van services. Mostly motorcycle rickshaws or auto rickshaws are being used as urban transport services on all roads.

Sahiwal in the Pak-China Economic Corridor

194. The Pakistan-China Economic Corridor (CPEC) is an ongoing mega project that aims to connect Gwadar Port in southwestern Pakistan to China's autonomous northwestern region of Xinjiang, via a network of highways, railways and pipelines that transport oil and gas. Other than the transport infrastructure, the economic corridor will provide Pakistan with telecommunications and energy infrastructure.

195. Sahiwal lies within this corridor and, thus, would be a direct beneficiary. In this corridor, two coal power plants are to be built in Qadirabad, which is located on Multan Road (N5), around 19 km from Sahiwal, in the direction of Lahore. Work on this project has already begun; it will generate 1,320 MW of electricity and be completed in 30 months, with China's assistance.

4.4 Social Resources

196. Sahiwal is a predominantly rural district, with only 16.9% (almost half of the provincial and national average) of the population living in an urban environment. Sahiwal City experienced rapid urban growth between 1951 and 1998, during which time the population increased from 50,185 to 208,778. The projected population in 2016 is 294,005. Migration from rural to urban areas has declined considerably in recent years. [21]

197. The majority of households (85%) own their own homes and the same percentage of houses are are made of baked bricks with reinforced cement concrete (RCC) rooves. The city has 29 regularized katchi abadis (squatter settlements) comprising 8,697 houses. The three marla low-cost government housing project is only half constructed. Many new housing colonies were planned nearly 10 years ago, but development and construction have not yet begun. Sahiwal City is comprised of 10 urban union councils. With the establishment of the municipal corporation in the near future, this will increase to 12.

[21] https://www.urbanunit.gov.pk/Upload/ProjectDocument/PASDP%20Sahiwal.pdf

198. Both public and private educational institutions exist in the city. The male literacy rate is 82% and the female rate is 71%. The primary school net enrolment ratio is 91 for boys and 82 for girls. Within the district, approximately 10.3% of children are not enrolled in school. Public and private sector health facilities are available in the city. According to one survey, 45% of household have a monthly income of PRs 30,000 or less. Unemployment is reportedly high, particularly for educated men. There are about 43 units in the small industries estate within municipal limits which provide employment to over 1500 workers.

199. Sahiwal district has witnessed poverty reduction in the past decade. Various studies report the percentage of the population below the poverty line as being in the range of 16% to 32% in urban areas of Sahiwal district. According to the Planning Commission of Pakistan, 30.8% of the population was facing multidimensional poverty in the district in 2015.

4.4.1 Employment and Unemployment

Unemployment

200. The unemployment rate is measured as the ratio of those laid off and seeking employment, and the total number of unpaid family helpers to the total number of those employed among the economically active population. This number is generally represented as a percentage. In 1998, the unemployment rate in the district was 20.6 percent, which was mainly due to unemployment among males, which represented 20.9 percent, while the female unemployment rate was only 2.8 percent, because of the small number of women active in the labor force. The unemployment rate was slightly low in rural areas, as compared to urban areas, representing 20.2 percent and 22.5 percent, respectively

Employment Status

201. The last formal, detailed employment statistics for Sahiwal date to the 1998. The population census is quoted in several publications, including the Sahiwal Urban Profile, 2010. A number of related and more current employment figures that are indicative of Sahiwal's urban situation include:

- **The labor force participation in Punjab of 55.4 percent, which is the highest of all four provinces.**
- **Industry engages 23.9 percent of the formally employed.**
- **In 2013, there were 220 reported factories in Sahiwal District, employing approximately 8,200 workers.**
- **Of these workers, 76.5 percent participated in the informal economy. Based on statistics of other employment sectors, this suggests that a proportion of those formally employed also engage in informal**

economic activity, a situation that is common in most emerging economies.

- **Approximately 26 percent were employed as service workers, in shops and as market sales workers.**
- **Another 27 percent were employed as in crafts and related trades.**
- **Approximately 14 percent were employed as unskilled workers.**
- **Just over 6 percent were employed as professionals.**
- **Another 6 percent were employed as plant machine operators.**

202. The main source of formal employment is 220 factories, of varying size, located in Sahiwal and its environs. These provide some 8,200 jobs. Agro-related industry is of particular importance as an employment generator.

4.4.2 Educational Services

203. Sahiwal has a number of higher post-secondary educational institutions, including:

- **Thirteen arts and science degree colleges have over 15,000 students enrolled, including the Sahiwal Medical College and the Government College of Technology**
- **Four vocational institutes have over 500 students enrolled.**
- **One technical/polytechnic institute has almost 3,000 students.**
- **Six commercial training Institutes have over 3,000 students enrolled.**

204. Additional institutes of higher education are always desired, particularly those directly targeting the employment needs of local industry. These also become important means of keeping youth from migrating to the major cities.

4.4.3 Health Facilities

205. Sahiwal district has nine hospitals, but with a total number of beds of slightly under 1,300. In addition, there are six regional health centers and 42 basic health units. As in most secondary urban centers, is retaining qualified staff, in both the health and education sectors, is one of the challenges. Staff often migrates to a major city to take advantage of the amenities it offers. The better the overall urban environment, quality of life, and social and economic amenities, the more likely they are to stay.

206. The prevalence of hepatitis B and C is reported at 5%. The 2011 Millennium Development Goals (MDG) Report for Punjab indicated a prevalence of Hepatitis B at 2.4% and C at 7.1% in the district. Participants of all FGD indicated that hepatitis prevalence is highest in Sahiwal City because of water supply contamination. In their opinion, roughly one quarter of the city population was suffering from hepatitis

because of contaminated water, highly inadequate waste water disposal and inappropriate solid waste removal.[22]

4.4.4 Harappa Archaeological Site as a Tourist Attraction

207. Harappa is one of the two main cities of the Indus culture, and is located about 20 km west of Sahiwal. It is a major tourist attraction and contains ruins of a fortified Bronze Age city. The city is believed to have had as many as 23,500 people living there as early as 2,500 BC, which can be considered a large population for that time.

208. The Harappa civilization was rediscovered in the 1920s. It was found to have had its own script, urban centers, and a diversified social and economic system. In 1857, the archaeological site at Harappa was partially damaged. Sadly, its current state is not satisfactory.

209. Harappa is generally characterized as having differentiated living quarters, flat-roofed brick houses, and fortified administrative or religious centers. Although copper and bronze were in use, iron was not yet employed. Cotton was woven and dyed for clothing; wheat, rice, and a variety of vegetables and fruits were cultivated; and a number of animals were domesticated, including the humped camel.

4.5 Socioeconomic Condition

210. This section covers the socio-economic conditions of the population that will be directly or indirectly affected by the project. The socio-economic profile focuses on the sources of livelihood, income levels, and accessibility to social services like health, education etc. The socioeconomic survey was divided into a settlement profile and a socio-economic household survey. Residents were interviewed with the help of semi structured questionnaire.

4.5.1 Settlements Profile

211. Social and Cultural Values: The existing community reflects rural culture with its characteristic norms and values. Women do all household work by themselves. Majority of the population follows Islamic tradition. Common food is wheat bread. Yogurt, Lassi and milk are also used. The common dress for males is Shalwar Qameez and for females Shalwar, Qameez and Dupatta/Chadar. Marriages are celebrated in traditional manners.

4.5.2 Conflict Resolution Mechanism

[22] https://www.urbanunit.gov.pk/Upload/ProjectDocument/PASDP%20Sahiwal.pdf

212. The people of the area were found to be loving, caring and hardworking. They reported that for petty conflicts resolution, they involve the influential people, Nazim or Naib Nazim or Councilor of the village, who after listening statements of both the parties, tries to reach to an unbiased decision which is acceptable to the aggrieved. Generally, the people accept the decisions of the influential.

4.5.3 Public Health

213. The major diseases that afflicted the residents of the village are seasonal. There are no adequate health care facilities in the surveyed settlements. Rural Health Centre and Basic Health Unit (BHU) are 4 to 5 km away from settlement. There is no qualified doctor in the surveyed settlement. The only medical services in the village are provided by Lady Health Workers (LHW).

4.5.4 Cultural and Religious Resources

214. Religious sites include shrine, mosques, graveyards and historical buildings. There are ten mosques, one shrine, five graveyard, four imam bargah and three church in the area. Mosque has been built in the recent past and has no historical or architectural significance. Shrine is regarded as a sacred place and receive devotion from the locals of nearby populations but is not well known outside the area.

4.5.5 Religion

215. The main religious groups in the area are Muslims and Christians. The population of the surveyed settlement is predominately Muslims i.e., 98% followed by Christians 2%.

4.5.6 Language Spoken

216. Punjabi is the most common language spoken by majority of population in the area. Urdu is spoken as secondary language.

4.5.7 Castes and Minority Groups

217. The project area is inhabited by the people of various castes including Bhutta, Bhatti, Mughal, Rajpoot, Araen, Rae, Sayyed, Malik, Dogar, Rajpoot, Rana, Jat, Rehmani and Chaudhry. Among all these, Araen is the dominant caste. Reportedly, lower castes associated with hereditary menial professions are also the part of the village population.

4.5.8 Educational Status

218. Educational facilities in any area predict the educational level and the interest of the people towards the education. Educational status of the respondents of surveyed village is shown in **Table-4.18**. This table shows that 149 children having age group of 1-3 have been excluded. Out of remaining, majority of the respondents had middle level education. It is also obvious from the table that the ratio of the masters is very low as compared to those having education up to primary, middle and matriculation.

Table 4.17: Educational Level of the Respondents

Education Level	Male	Female	Male (%)	Female (%)
Primary	115	103	21	25
Middle	130	127	24	31
Matriculation	118	24	22	6
Intermediate	51	22	9	5
Graduation	34	16	6	4
Masters	08	14	2	3
Deeni Taleem	04	08	1	2
Illiterate	78	99	15	24

Source: Socio economic Survey, February 2017

4.5.9 Economic Conditions of the Study Area

219. Occupations and Employment: Various income generating activities are practiced in the village. Apart from the categories of housework and students, which mainly pertains to the house wives and children, the major earning occupations are business and private servant. Residents of the village are also engaged with the small industries as skilled or unskilled labor.

220. Based on the sample-based socio-economic survey of the project area, **Table-4.19** presents distribution of the household members by occupation.

Table 4.18: Distribution of Household Members by Occupation

Occupation/ Source of Income	Number	%age
Agriculture	33	03
Housewives	248	23
Domestic Work	33	03
Students	302	27
Wage labor	67	06
Business	77	07
Private Servant	69	06
Government Servant	62	06
Retired Servant	11	01
Unemployed	18	02
Overseas	37	03
None	11	01
Babies	132	12

Total	**1,100**	**100**

Source: Socio economic Survey, February 2017

221. Income Levels: The **Table-4.20** shows the distribution of households with respect to their reported average monthly household income. It is evident from the table that the income level of most of the respondents is reasonable and economic conditions are well off.

Table 4.19: Distribution of Households by Average Monthly Household Income

Income Group	Number	%age
<10,000	11	08
10,001-20,000	52	35
20,001-30,000	30	20
30,000+	54	37
Total	**147**	**100**

Source: Socio economic Census Survey, February 2017

222. Housing Characteristics: Housing condition is an important indicator for determining the economic conditions of the population as it reflects the financial position and living standards of the inhabitants. Most of the houses in the study area are built with cement and bricks and permanent roofing structures. All the respondents (100%) are living in their own houses and none was found to live in the rented house. Nature of the housing conditions of the study area is shown in **Table-4.21**.

Table 4.20: Housing Type

Categories	Number	%age
Pucca (bricks, cement)	127	86
Katcha (bricks, mud)	-	-
Semi Pucca (bricks, cement, mud)	20	14
Total	**147**	**100**

Source: Socio economic Survey, February 2017

223. Livestock: In the surveyed settlement, livestock is normally raised for food and farming purposes. Livestock has market potential and is sold at the time of need. Major livestock of the area are cows, buffalos, goats, sheep, donkeys and poultry birds. Poultry birds are only kept for meeting the household's eggs and meat requirements.

5 Analysis of Alternatives

5.1 Overview

224. The scope of works for the proposed WWTP focused activities in North zone of Sahiwal city. consist of developing of a new WWTP. The installation of this infrastructure is based on detailed feasibility assessments focusing on assessing the city requirements with regards to wastewater and then determining the most suitable and effective alignment for laying the required infrastructure.

5.2 'No Project' Option

225. At present, Sahiwal city is urgently in need of a WWTP due to the following existing situation:

- Presently, no treatment plant is available for treatment of wastewater in the project area of Sahiwal City.
- Raw sewage is being directly disposed of into the canals, seepage drain and in agricultural fields in outskirts of the city. This practice is environmentally unsafe and a violation of Punjab Environmental Protection Act;
- Disposal of untreated wastewater into water bodies/ agriculture fields is causing contamination of the water and food chain and several associated environmental and health issues;
- Many areas have no final disposal points. The disposal problem becomes more severe when the farmers do not need raw sewage for their crops(s) during raining season and certain period(s) of year when water is not required for crops.

Thus, the proposed scope of works for development of the WWTP need to be implemented on an urgent basis and the 'No Project' option is not viable and cannot be considered further.

5.3 Selection of Wastewater Treatment System

226. The wastewater treatment facilities have been selected after taking due consideration of the pertinent technical, operational and economic factors, limitations and constraints. The key factors, which govern the choice of the treatment system, are listed and described below:

- **Nature and Strength of Wastewater**

227. The applicable physical, chemical and biological treatment processes are primarily governed by the nature of pollutants to be removed and their strengths in the wastewater. The treatment system selected shall ensure the required pollutant removal efficiencies.

- **Physical Constraints**

228. Physical constraints, principally being the area available and the topography of the plant site with reference to the system hydraulic requirement, govern the selection of the treatment technology.

- **Cost**

229. The system selected should be the least costeffective alternative, keeping in view both capital as well as operational costs, within the range of technically feasible options.

- **Operational Skills**

230. Skills required for the routine operation and maintenance of the treatment system should be available locally, with only a minimum of training. The proposed system shall have a relatively easy of operation and maintenance procedure.

- **Mechanical Equipment**

231. The selected system shall be such that minimum mechanical equipment needs to be provided. Unnecessary mechanical equipment should be avoided. The system should be designed such that maximum amount of mechanical equipment should be of local manufactured locally, where possible.

- **Nuisance**

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

233. A detailed technical and financial analysis was carried out for the proposed WWTP by considering the different wastewater treatment technologies. The technologies that were considered were as follows:

234. The qualitative analysis and cost comparison of alternative treatment technologies is presented as **Table 5.1** below.

235. **Activated Sludge Process (ASP):** Activated sludge process is the biological treatment, in which aerobic microorganisms present in wastewater, use the colloidal and dissolved organic matter of the wastewater, for their multiplication and growth, with the help of oxygen thus converting them into readily settleable biomass. Generally, the required oxygen supplies are maintained by forced supply of air to the wastewater in the aeration tank. The aerated effluent is then allowed to pass through a secondary settling tank to separate the biomass or the “activated sludge”. A part of the "activated sludge" is recycled to the aeration

tank to maintain optimum microorganism concentrations. The remaining secondary sludge is removed from the system periodically; dewatered and dried; and disposed of.

236. **Trickling Filter Process (TF):** In this process, the settled wastewater is allowed to trickle down over a circular deep bed of coarse aggregates filter. The microbial film, developed on the surface of aggregates over time, treats the wastewater. A part of this film, washed away by the hydraulic action of trickling wastewater, is separated in secondary clarifier, in form of humus sludge, disposed of after sludge treatment.

237. **Aerated Lagoons (AL):** Aerated lagoons are completely mixed basins, with detention periods, ranging from 2 to 6 days, in which wastewater is generally treated on flow through basis (without solids recycling), with forced aeration. The aerobic suspended biological flocs, responsible for the waste conversion, closely resemble to that of activated sludge process. Area requirements are in between those of the oxidation ponds and activated sludge process.

238. **Waste Stabilization Pond System (WSP):** Waste Stabilization ponds are large shallow basins, in which raw wastewater is treated entirely by natural processes, involving both algae and bacteria. They are the most important method of wastewater treatment in hot climates. However, since the rate of oxidation is slow so large areas are required for their construction. Their specific advantages are simple operation and no sludge management problem.

Table 5.1: Comparison of Alternative Treatment Technologies

S/No.	Parameter	ASP	TF	AL	WSP
1	**Qualitative Comparison incl. Environment related Parameters**				
a	Area requirement	Low	Moderate	Moderate	Large
b	Process Mechanical Equipment	Yes	Yes	Yes	No
c	Capital Construction Cost	High	High	High	Moderate
d	O&M Cost	High	Moderate	High	Low
e	Process Energy Requirement	High	Moderate	High	Nil
f	Operational Supervision & Control	High	High	High	Low
g	Quantities of Sludge produced	High	Moderate	High	Low
h	Daily Waste Sludge Disposal	Yes	Yes	Yes	No
2	**Cost Comparison**				
a	Capital Cost (incl. Land Cost) – Million PKR	11,550	10,164	9,240	2,400
b	Annual O&M Cost –	570	456	460	33

	Million PKR				
c	Area Requirement - Acres	70	91	100	199

Recommendation for Proposed Treatment Technology

239. In view of above technical and financial comparison of treatment technologies and availability of land in outskirts of Sahiwal City, Waste Stabilization Ponds (WSP) are recommended in Master Plan Report for the proposed WWTP.

240. WSPs are large earthen basins in which raw wastewater is treated entirely by natural process, involving both algae and bacteria. They are amongst the most important methods of wastewater treatment in hot climates. However, since the rate of oxidation is slow, large areas are required for their construction. Their specific advantages are simple operation and low operation & maintenance costs. Quantities of sludge produced are less, due to long stabilization periods and no daily waste sludge disposal is needed. The ponds need to be de-sludged after very long operational durations of the order of 2-3 years.

241. The proposed WSP system is recommended keeping in view the following key factors:

- It is established that local municipal bodies of Punjab, at present or in near future, would not be in a position to afford the high recurring operation & maintenance costs (mainly owing to high electric energy requirement), associated with the treatment systems other than waste stabilization ponds. Consequently, provision of any of the mechanized systems, would, ultimately lead to non-operation of these treatment plants and mere wastage of the capital investments made on this account.
- Mechanized treatment systems invariably need a higher level of operational skill, responsibility, supervision and control, for their proper functioning, which under the prevailing conditions is envisaged to be difficult to be maintained by the local municipal bodies. Under these circumstances, the treatment systems, which are relatively easy to monitor, operate and maintain need to be adopted. Oxidation ponds are almost self-operating and do not need much operational intervention, for their proper functioning. Ease of operation, maintenance, monitoring and control are their principal characteristic.
- Climatic conditions in the Punjab, in terms of high ambient temperatures and longer durations of intense solar radiation, which enhance microbial activity and photosynthetic production of algal oxygen, favour the selection of oxidation ponds.
- In contrast with mechanized treatment systems, waste stabilization pond systems do not have any permanent structure, except for wastewater screening and pumping station and plant building, if any. Consequently, they offer a much higher degree of flexibility in terms of system change in future. If in the future, the conditions governing the selection

are changed, the land used for ponds can easily be reclaimed and put to other urban uses and a mechanized treatment system with much less area requirements can be installed in its place.

5.4 Site Selection for Proposed WWTP

242. A detailed site selection report for the proposed WWTP was prepared by the EPCM Consultant on the basis of preliminary technical, social and environmental parameters. These parameters have been considered based on thorough literature review and subsequent evaluation of identified sites against each parameter is made on the basis of observations made during site reconnaissance surveys.

243. Two site options were considered with their respective locations shown in the maps provided as **Figures 5.1** and **5.2** below.

Figure 5.1: Layout of proposed WWTP Sites for Sub-Zone 1 (A) and Sub-Zone 1(B) in Option 1

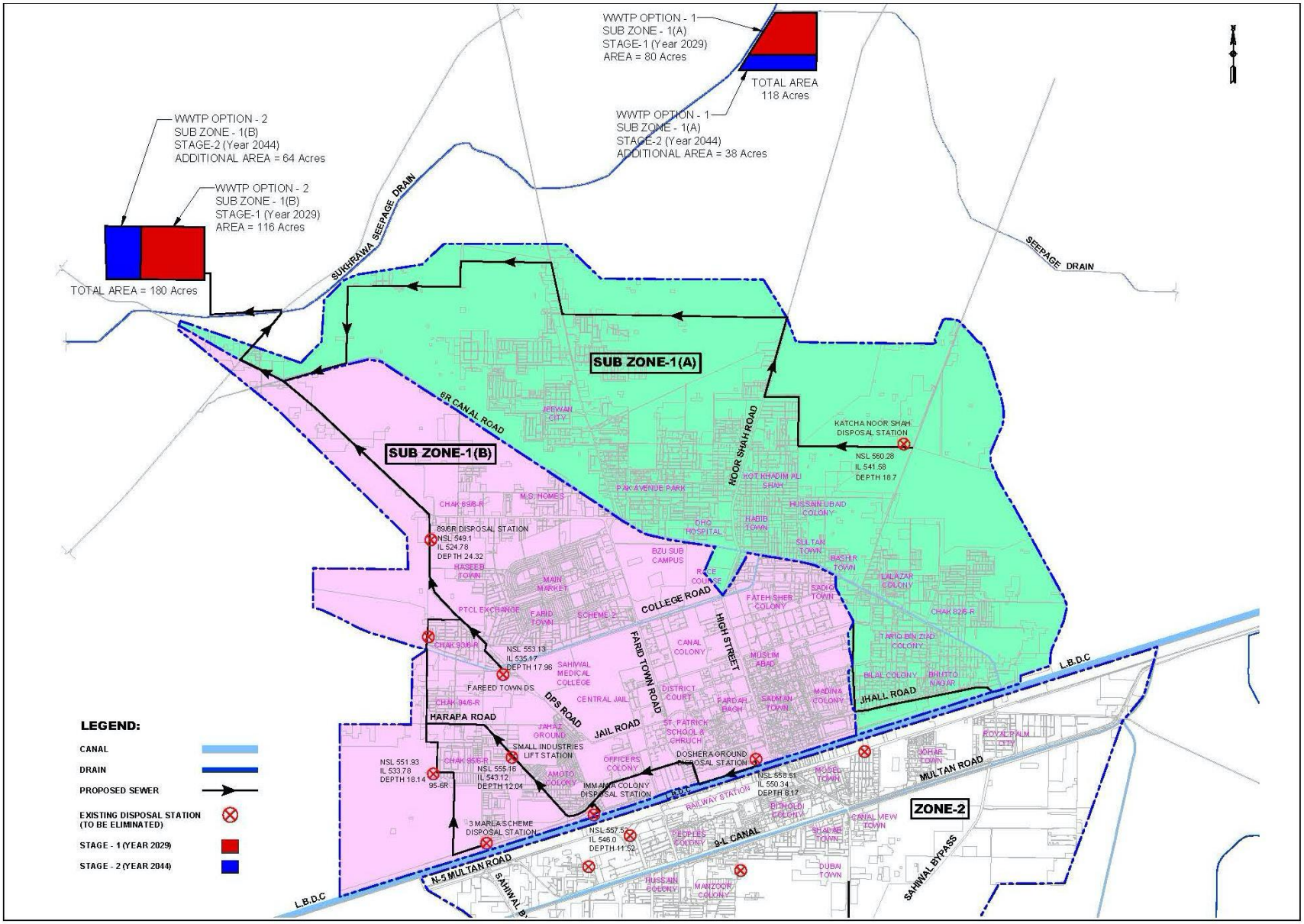
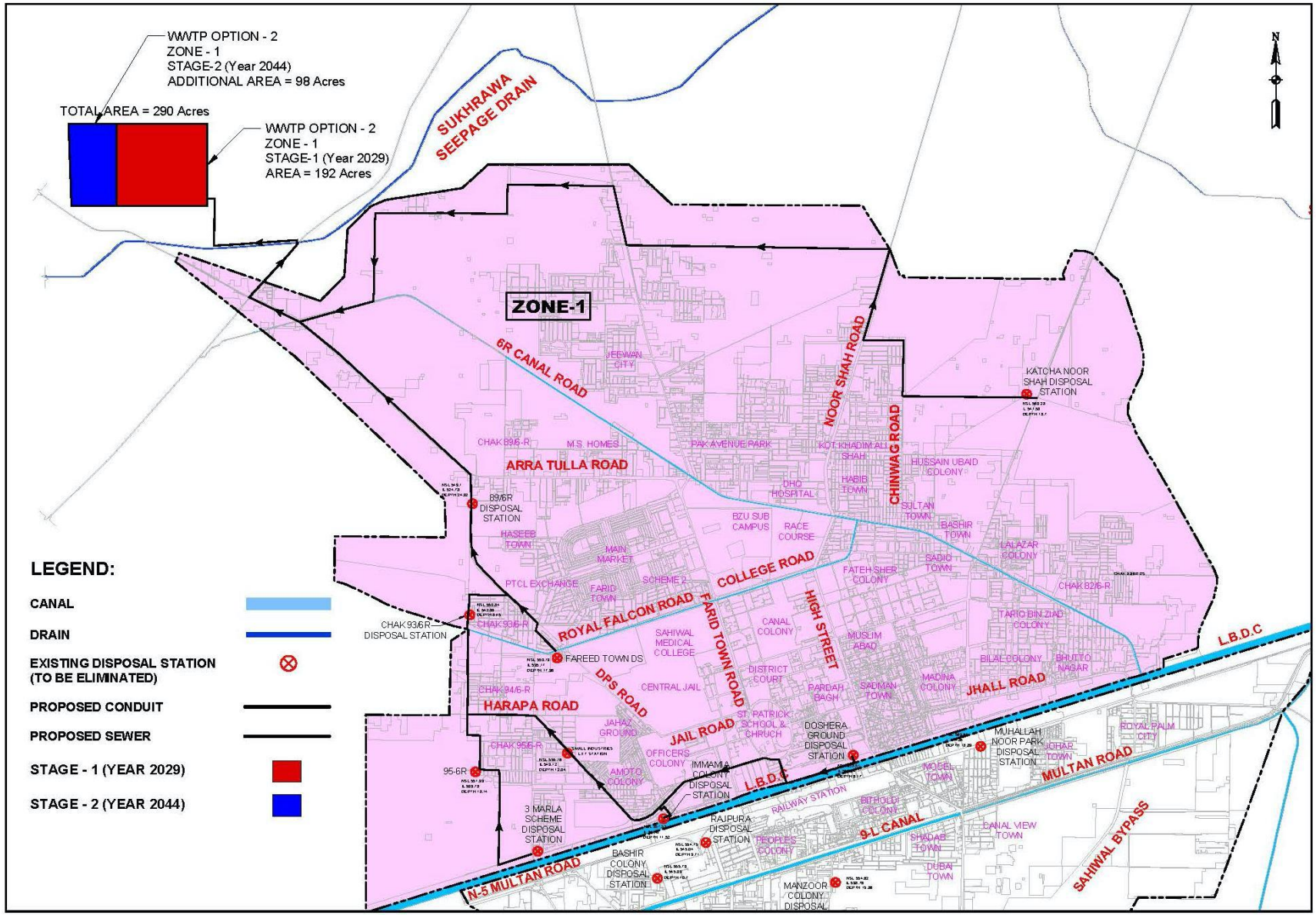


Figure 5.2: Layout of proposed WWTP Site for Zone-1 (Northern Part) in Option 2



Option -1

244. In option -1, North Zone was further sub-divided into two sub zones i.e. Sub North Zone (A) and Sub North Zone (B).

245. Sub North Zone (A) comprises north eastern part of North Zone and mainly consist of residential areas including Bilal Colony, Tariq bin Zad colony, Lalazar Colony, Sadiq Town, Habib Town, Hussain Abad, Kot Khadim Ali Shah and Chak 82/6-R etc. This sub zone will accommodate about 40% of total estimated population of North Zone. In Master plan of the city, it is proposed that existing disposal station "Kacha Pakka Noor Shah" will be eliminated and wastewater/sewage from this subzone, collected through sewerage network, will be carried to proposed inlet pumping station from where it will be transported to proposed wastewater treatment plant of Sub North Zone (A) for treatment. Catchment area of Sub North Zone (A) and its proposed treatment Plant site. The proposed treatment plant site is located at north of the city, on left side of crossing of seepage drain and Noor Shah road.

246. Sub North Zone (B) comprises north western part of North Zone and mainly consists of residential areas as well as small industries area. Main areas of the subzone include Madina Colony, Fateh Sher Colony, Shadman Town, Canal Colony, Officers Colony, Farid Town, Central Jail, Small Industries Area, BZU Sub Campus and Jeewan City etc. In the master plan, it is proposed that all the existing disposal stations (Imaamia Colony, Fareed Town, 3 Marla Scheme, Dosehra Ground, 95/6R, 93/ R, 89/6R disposal stations) within the sub zone will be eliminated and wastewater/sewage from the subzone, collected through sewerage network, will be carried to proposed inlet pumping station from where it will be transported to proposed wastewater treatment plant Sub North Zone (B). Catchment area of Sub North Zone (B) and its proposed treatment Plant site. The proposed site for Sub North Zone (B) is located at north eastern side of the city after crossing Sukhrawa seepage drain.

Option-2

247. In Option-2, one combined treatment plant is proposed for complete North Zone. Wastewater from entire North Zone will be collected through sewerage network under gravity and will be carried to proposed new disposal station near proposed wastewater treatment plant site. In the master plan, it is proposed that all the existing disposal stations will be eliminated and wastewater/sewage will be transported to new proposed disposal station by gravity. The location of the proposed treatment plant will be same as of Sub North Zone (B), however, larger area will be required due to sewage of entire North Zone. However, land for WWTP Stage-1 (199 acres) along with land for approach roads is being acquired. Acquisition of land for WWTP Stage-2 will be acquired subsequently after deliberations with the stakeholders.

Comparison of Option-1 and Option-2 for proposed WWTP

248. Selection of the site for proposed WWTP was based on evaluation of the site on certain preliminary technical, financial, environmental and social parameters. The parameters were selected as a result of thorough literature review and the evaluation of sites was based on the observations made during site visits and site reconnaissance surveys. Comparison of above-mentioned Option-1 and Option-2 is provided as **Table 5.2** below.

Table 5.2: Comparison of Option 1 & 2 Sites

Sr. No	Parameters	Option-1	Option-2
A	**Technical Parameters**		
1	Area Requirement	Approximate area requirement till year 2029 (10 years design period) to meet irrigation standards for Sub North Zone (A) and Sub North Zone (B) are **80** and **116** acres (Total area for both sub zones for year 2029 would be **196** acres). To cater to wastewater flow, to be generated up to design year 2044, additional areas of about 38 and 64 acres would be required for sub North Zone (A) and Sub North Zone (B) respectively. Total area requirement for design year 2044 would be to 118 and 180 Acres for sub North Zone (A) and Sub North Zone (B) respectively making total requirement of 298 Acres.	Approximate area requirement till year 2029 (10 years design period) to meet irrigation standards for entire North Zone will be **199** Acres. To cater wastewater flow, to be generated up to design year 2044, additional area of about 98 acres would be required North Zone. Total area requirement for design year 2044 would be to 297 Acres.
2	No. of Disposal Station	All existing disposal stations will be eliminated. Two (02) new disposal stations are proposed, one for each sub zone. Wastewater/sew age from each sub zone will be carried to proposed new disposal stations under gravity.	All existing disposal stations will be eliminated. One (01) new disposal station is proposed for entire North Zone. Wastewater/Sewag e from entire North Zone will be carried to proposed new disposal station under gravity.
3	Geometry of Land	Geometry of proposed WWTP Sites for both sub zones is almost rectangular.	Geometry of proposed WWTP Site for entire North Zone is rectangular.

		Sites are proposed on private agriculture land. In case of future extensions, further land may also be acquired.	Site is proposed on private agriculture land. In case of future extensions, further land may also be acquired.
4	Land Cost	Rs.1.50 – 2.0 Million per Acre according to verbal discussion with local population	Rs.1.50 – 2.0 Million per Acre according to verbal discussion with local population.
5	Topography	Topography of the proposed WWTP sites is generally plain.	Topography of the proposed WWTP site is generally plain.
6	Treated Wastewater Reclamation and Reuse	The proposed sites are located in agriculture area. Sewage after required treatment can be used for agriculture purposes. For agriculture use, outlet pumping station will be provided which will transport the treated effluent to required area through force main (s). Two outlet pumping stations, one for each WWTP, will be required to transport the treated effluent at required places for irrigation purposes. It will result in more capital and O&M cost. As proposed sites are located at two different places, agriculture area at north eastern and north western sites will be irrigated.	The proposed site is located in agriculture area. Wastewater after required treatment can be used for agriculture purposes. For agriculture use, outlet pumping station will be provided which will transport the treated effluent to required area through force main (s). Only one outlet pumping station is required to transport the treated effluent at required places for irrigation purposes. It will result in less capital and O&M cost as compared to option-1.
7	Receiving Body	The proposed sites are located near Sukhrawa seepage drain which ultimately discharge to River Ravi. Wastewater after treatment from WWTP can be discharged to Sukhrawa drain under gravity for final disposal.	The proposed site is located near Sukhrawa seepage drain which ultimately discharge to River Ravi. Wastewater after treatment from WWTP can be discharged to Sukhrawa drain under gravity for final disposal.
8	Transportation and Site Excess	The proposed sites are easily accessible through roads network. However, small length of approach roads may be required.	The proposed site is easily accessible through roads network. However, small length of approach road may be required.

9	Working Staff Requirement	In this option, two separate WWTPs proposed, therefore, separate teams of technical and support staff will be required for each WWTP thus will result in more staff requirement and increase in operation and maintenance expense.	In this option, working staff requirement is less as compared to Option-1.
B	**Environmental Parameters**		
1	Proximity to Ground water	Near proposed site of Sub North Zone (A), ground water exists at depth of 11.0 – 11.50m. Near proposed site of Sub North Zone (B), ground water occurs at depth of 14.0 – 15.0m. Ground water at both sites are at safer depths.	Groundwater depth at proposed site is about 14.0-15.0m.
2	Proximity to Populated Area	Nearest populated area to WWTP site of Sub- North Zone A) is Chak Adda Shabeel which is about 650-700 m away from WWTP site. Other Nearest populated areas to WWTP site of Sub- North Zone (A) is Chak. No.56/GD and Chak Rati Tabi which are about 1,000m and 1,500m from the site. Chak. No.66/GD is located near north eastern corner of the WWTP site of Sub- North Zone (B) at a distance of about 200-300m. To avoideffect of WWTP to the populated area, buffer zone of dense trees vegetation will be provided all around the WWTP Sites.	Two small populated areas are situated near the proposed WWTP site. Chak. No.66/GD is located near north eastern corner of the WWTP at a distance of about 100-200m. Muhammad Pur is located at southern side of the proposed site at distance of about 480-500m from the WWTP site. To avoid effect of WWTP to the populated buffer zone of dense trees vegetation will be provided all around the WWTP Sites.
3	Surface Water Contamination	At present, wastewater of entire North Zone is being discharged into canal and seepage drain without any treatment, causing surface water contaminations. After treatment from WWTP, treated water will be used for irrigation purposes. In case,	At present, wastewater of entire North Zone is being discharged into canal and seepage drain without any treatment, causing surface water contaminations. After treatment from WWTP, treated water will be used for

		water is not required irrigation, it will be discharged into seepage drain. Thus, it will result in removal of surface water contaminations.	irrigation purposes. In case, treated water is not required by irrigation, it will be discharged into seepage drain. Thus, it will result in removal of surface water contaminations.
4	Flora and Fauna	Proposed sites are located in agriculture area, there is no ecologically important vegetations and animals found in the area. However, existing flora and fauna in the proposed sites will be affected.	Proposed sites are located in agriculture area, there is no ecologically important vegetations and animals found in the area. However, existing flora and fauna in the proposed sites will be affected.
5	Sludge DIsposal	In proposed waste stabilization ponds, desludging is carried out after 2-3 years. Usually, sludge is disposed of into landfill site. However, it can be used as manure for irrigation after drying within the ponds module wise. However, presently, no landfill site is available in Sahiwal City. The site being prepared under PICIIP project will be used for disposal of sludge.	In proposed waste stabilization ponds, desludging is carried out after 2-3 years. Usually, sludge is disposed of into landfill site. However, it can be used as manure for irrigation after drying within the ponds module wise. However, presently, no landfill site is available in Sahiwal City. The site being prepared under PICIIP project will be used for disposal of sludge.
6	Historic and Archaeological Sites	No archaeological site exists within/near the proposed WWTP sites. Harappa archaeological site is located at a distance of 25-35 km from the sites.	No archaeological site exists within/near the proposed WWTP site. Harappa archaeological site is located at a distance of 25 km from the sites.
C	**Social Parameters**		
1	Compatibility with Existing Land Use	The selected areas of proposed sites are currently being used for agriculture purposes. The treated wastewater will be used for irrigation in the nearby area. Therefore, the WWTPs are expected to be compatible with the existing landuse.	The selected area of proposed site is currently being used for agriculture purposes. The treated wastewater will be used for irrigation in the nearby area. Therefore, the WWTPs are expected to be compatible with the existing landuse.
2	Issues Regarding Acquisition of the Land	The proposed sites are located on agriculture land. The proposed are selected at such locations where land costs are relatively lesser. There are no permanent settlements, therefore no	The proposed sites are located on agriculture land. The proposed sites are selected at such locations where land costs are relatively lesser.

		substantial relocation costs.	There are no permanent settlements, therefore no substantial relocation costs.
3	Traffic disruption	The proposed site for Sub North Zone (A) is located near Noor Shah Road. Construction of WWTP at the proposed site will result in increase of traffic on the Noor shah road. As Noor Shah Road is wide road, it is expected that it will cater the expected traffic for WWTP. For Sub North Zone (B), Arrat Ullah road leads towards the proposed Site. It is also a wide road and it is expected that it will also cater the traffic demand due to WWTP. In this option, WWTPs will affect traffic of Noor Shah road and Arrat Ullah Road.	For WWTP for entire North Zone site is located near Arrat Ullah Road. It is a wide road and it is expected that it will also cater the traffic demand due to WWTP.

249. Comparison of technical, environmental and social parameters is presented in above Table. Both the options have advantages and disadvantages. The Option -2 to construct combined WWTP in North Zone has been selected based on the comparison of the technical, environmental and social parameters in the Table above.

5.5 Options of Reuse of Treated Effluent for Agriculture

250. For reuse of treated effluent for agricultural purposes, following options were considered:

- **Reuse in nearby Agriculture fields under gravity:** Option of direct reuse of treated effluent for irrigational purposes in nearby agriculture area under gravity by using hydraulic head available in WWTP has been evaluated. In the surrounding area of WWTP site, levels of topography decrease from north eastern direction to south western direction i.e. from Gogera branch to Sukhrawa drain. For analysis, a channel was marked which will transfer the treated effluent to the agriculture fields towards Sukhrawa drain considering natural topography. Water level in the treated effluent channel will be about 541.0 ft within premises of WWTP, whereas, ground levels in the surrounding areas of WWTP vary from 543-544 ft which are already higher than available hydraulic head in the treated effluent channel.

251. Therefore, treated effluent cannot reach to agricultural fields for irrigation under gravity. In view of above, to carry the treated effluent to agriculture fields, lifting of treated effluent through pumping will be required. Therefore, option of treated effluent reuse under gravity was not considered for the project.

- **Disposal into Sukhrawa Drain:** In this option, treated effluent channel will be used to finally dispose of treated effluent in to Sukhrawa drain, which ultimately joins river Ravi. The proposal of discharging treated effluent and bypassing the flows to Sukhrawa drain has been designed accordingly.
- **Treated Effluent Conveyance system for irrigation purposes:** As per requirement of MC Sahiwal, degree of treatment in proposed wastewater treatment plant would be such that the treated effluent can safely be reused in fields for agricultural purposes as per WHO Guidelines and discharged into inland waters i.e. Rivers etc. as per PEQS.

252. When water would not be required for agricultural use in case of rainy season or when water would not be needed by the crops, it will be safely discharged in to Sukhrawa seepage drain which is ultimately linked to River Ravi thus would also resolve the issue of ultimate disposal of wastewater. Treated effluent from Maturation Ponds of WWTPs will be carried to proposed effluent pumping station, from where it will be transferred to respective irrigation water courses off taking from irrigation canal (Mohga) in the vicinity of proposed WWTP through proposed forcemains. Ground level at treated effluent pumping station is about 543-544 ft and ground levels on forcemains routes along Gogera Branch vary from 544 to 564ft.

5.6 Options for Biogas Management

253. The possible options considered with regards to management of the biogas to be produced during the wastewater treatment process, particularly from the APs, are as follows:

- **'Do Nothing Scenario':** In this scenario, the biogas to be produced from the WWTP, primarily from the APs, would not be utilized and would be permitted to escape, resulting in the operation of the WWTP contributing to global warming through the emission of CH4 emissions into the atmosphere as long as the plant will remain operational. In addition, the biogas produced would not be used for economic benefit by capturing it and utilizing it for some productive and economically viable use.
- **Biofuel production:** The biogas to be produced from the WWTP could be used for production of biofuel through purification of the biogas coming from the anaerobic

digestion of the sludge from the WWTP with the biofuel capable of being used later on in vehicles as fuel.

- **Combined Heat and Power (CHP) Utilization:** The biogas produced can be used to generate heat and power through installation of required infrastructure such as gas turbine to generate power which could be used for the auxiliary consumption at the WWTP with any excess power being sold to consumers.
- **Biogas Use for auxiliary and domestic consumption:** The biogas could be used for auxiliary consumption at the WWTP along with supplied to domestic consumers in the area for meeting their needs for natural gas with the added economic benefits resulting from sale of the produced biogas.

254. While the rationale to capture and use the biogas produced are indeed quite strong and worth considering, however, at present, due to the capital cost implications along with operating expenses associated with capturing the biogas produced and utilizing it for any of the options mentioned above, thus it has been agreed to proceed with the 'Do Nothing' Scenario and to permit the biogas to escape into the atmosphere.

5.7 Options for Sludge Use

255. The options that have been considered for utilization of the sludge to be produced as a by-product of the wastewater treatment process are provided below.

- **Agriculture**

256. Not only is sludge use on land the preferred option under the waste management hierarchy, but it is also usually the best practicable environmental option (i.e. objective balance of practicability, affordability, sustainability and acceptability).

- **Landfilling**

257. It is now widely accepted that landfill disposal of organic wastes, such as sludge, is not a sustainable option due to concern over gas and leachate emissions and the need to conserve landfill void for those wastes that cannot be reused or recovered. National measures vary but include limits on organic matter and the separation of municipal solid wastes. Ultimately, the only means of sludge disposal to landfill will be as ash resulting from its thermal destruction.

- **Incineration**

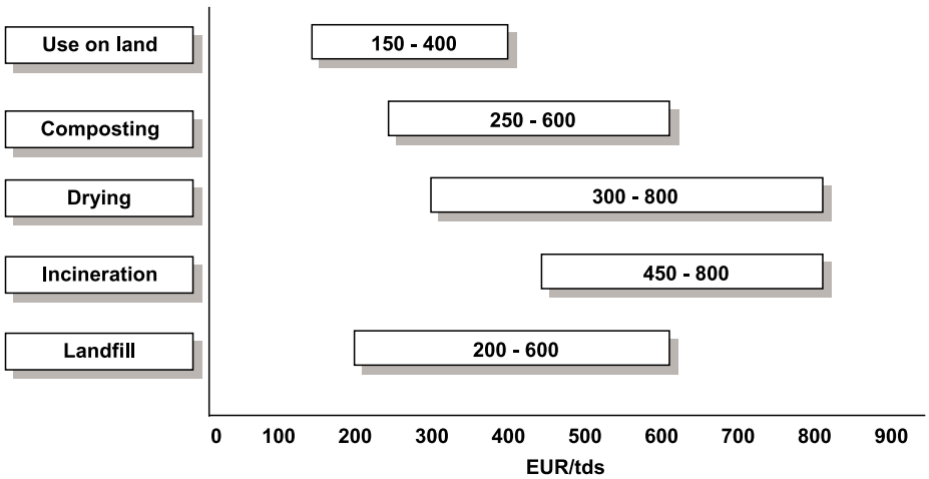
258. The main problem confronting the incineration process is how to reduce the high water content of the sewage sludge. Water reduction means energy demand. Raw as well as oxidises and digested sludges have a natural water content of between 92% and 99%, the sludge water being well combined with the solid particles. The separation process of the liquid and solid content can be facilitated by biological, chemical, physical and thermal means. Biological methods achieve the lowest and thermal methods the highest dewatering rates, though it should be borne in mind that the degree of dewatering depends on such factors as the type of energy (steam, electricity) used, processing pressure and reaction time.[23]

- **Composting**

259. The conversion of sludge to compost is a time and resource intensive activity which requires the dehydration of the sludge and the formation of the wind rows in order to enable the composting process to take place. The composting process itself requires a large acreage of available land for the wind rows. The logistical aspects are also cost intensive with the sludge required to be transported to the composting facility and once the compost is ready and has been packaged, it needs to be delivered to any interested customers. The composting process also leads to disease vector generation and thus required good housekeeping in order to minimize generation of any vectors.

260. The indicative costs associated with implementing any of these options are shown in **Figure 5.3** below. It can be observed that directly using the Sludge for agriculture i.e. 'Use on land' is the least cost option.

Figure 5.3: Sludge treatment and disposal costs



[23] https://ec.europa.eu/environment/archives/waste/sludge/pdf/workshoppart4.pdf

261. Based on the rationale provided above, till now it has been decided to use the sludge to be produced from the WWTP for landfilling since it is the least technically complicated and least resource intensive option, particularly from an economic standpoint.

6 Potential Environmental Impacts and Mitigation Measures

262. The analysis of potential environmental impacts in the umbrella IEE study[24] is generic and does not present any impacts specific to the proposed WWTP in north zone of Sahiwal city. Thus, this chapter presents a description of the environmental impacts and the proposed mitigation measures to minimize the negative impacts, if any.

263. Impact-screening matrices during each of the project phases i.e. project design, construction and operation are presented below.

6.1 Methodology for impact screening

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

265. Risk is assessed as the likelihood that the activity will have an effect on the environment as well as the consequence of the effect occurring. It is often described like this:

Risk = Likelihood × Consequence

Likelihood Scale

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

Consequence Scale

Consequence	Definition	Score
Catastrophic	The action will cause unprecedented damage or impacts on the environment or surrounding communities	5

[24] https://www.adb.org/sites/default/files/project-documents/46526/46526-007-iee-en_0.pdf

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

Risk Score Table

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

Risk: **Significant: 15-25**
Medium: 6-10
Low 1-5

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

6.2 Design/Pre-Construction Phase

Impact Screening Matrix

267. The 'activity wise' screening of potential impacts across the two Lots during the design/pre-construction phase is provided in **Table 6.1** below.

Table 6.1: 'Activity Wise' Screening of possible Impacts during Design/Pre-Construction phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Lack of integration of IEE/EMP requirements into	Likely	Moderate	Medium

	Construction bid documents			
2	Material Haul Routes	Likely	Moderate	Medium
3	Improper location of worker camps leading to improper disposal of solid waste and sewage and privacy issues for residents in project area.	Likely	Moderate	Medium
4	Contractor's Environmental Safeguards Capacity	Likely	Moderate	Medium

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

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

Impacts

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

Mitigation Measures

269. The proposed 'Safeguards unit' that should be developed at the PMU should be assigned the task to check that design and bid documents are responsive to key environmental, social and safety considerations, and that the proposed method of work reflects the boundaries defined in the EMP. The bid documents must include the EMP and its implementation cost must be reflected in the BoQ.

6.2.2 Material Haul Routes

Impacts

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

Mitigation Measures

271. The construction vehicles hauling materials along the Sahiwal city roads and anywhere where there are sensitive receptors such as hospitals, schools and/or roadside residences will be limited and the PMU in collaboration with the CIU will establish a route plan to minimize this disruption which shall be appended to the EMP.

6.2.3 Contractor's Environmental Safeguards Capacity

Impacts

272. The responsibility of the PMU in collaboration with the CIU is to review and finalize the documents relating to environmental issues. Contractors that do not possess the required capacity for safeguards management do not comply with workplace environmental, social and safety regulations.

Mitigation Measures

273. So far, local contractor firms in Pakistan working on large and medium scale environmentally sensitive projects have an unsatisfactory record for complying with workplace and environmental safety regulations. To address this, the contractor will be required to define an Occupational and Environmental Health and Safety procedure for all work, including work camp operation, management of cement dust, and use of Personal Safety Equipment. These procedures should be developed and approved by the PMU in collaboration with the CIU before the contractor commences any physical works on ground.

6.2.4 Identification of Locations for Labor Camps and ancillary facilities

Impacts

274. The duration of the construction activity for the WWTP development is expected to be 36 months and a considerable amount of work force will be engaged for development of the WWTP. As a result, worker camps will need to be developed and ancillary facilities will need to be provided such as electricity, washrooms for labor with suitable effluent and sewage disposal facilities as well as water for their everyday use for drinking and bathing etc.

Mitigation measures

275. In order to prevent a nuisance, specific locations shall be designated for development of the labor camps. All necessary facilities and amenities shall be provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc.

276. The use of proper planning while identifying locations for the labor camps will ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labor camps being set up roadside next to the construction sites.

6.2.5 Cultural Heritage & Religious Sites, Social Infrastructure

Impacts

277. No temples or religious sites are in proximity to the works to cause a nuisance.

278. The sensitive receptors already identified in the project areas are all separated from the sub-project and there will be sufficient buffer distance between the works and these facilities such that no major significant impact would be expected from the works. However, consideration should be made not to construct at night, from 7 pm onwards till 6 am in the morning, to avoid nuisances.

Mitigation Measures

No mitigation measures are required.

6.2.6 Land Acquisition and Resettlement Impacts

Impacts

279. The proposed works for the WWTP will be conducted on publicly owned land and no land acquisition or resettlement is expected.

Mitigation Measures

No mitigation measures required.

6.3 Construction Phase

Impact Screening Matrix

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

Table 6.2: Screening of Possible Impacts during Construction Phase

S/No.	Potential Impact	Likelihood (Certain, Likely,	Consequence (Catastrophic,	Risk Level (Significant,

		Unlikely, Rare)	Major, Moderate, Minor)	Medium, Low)
1	Degradation of air quality due to construction works	Certain	Major	Significant
2	Potential accidents and injuries to communities in project area during construction works	Likely	Major	Medium
3	Injuries to workers from lack of necessary training and/or not using PPEs etc.	Likely	Major	Medium
4	High noise levels from construction activities	Likely	Major	Medium
5	Improper handling and/or disposal of hazardous and non-hazardous waste	Likely	Moderate	Medium
6	Untreated disposal of effluent from worker camps and batching plant(s)	Likely	Moderate	Medium
7	Soil Erosion and Sedimentation	Likely	Moderate	Medium
8	Soil Contamination	Likely	Moderate	Medium
9	Employment Conflicts	Likely	Moderate	Medium
10	Communicable diseases	Likely	Moderate	Medium
11	Vegetation and Wildlife Loss	Unlikely	Moderate	Low
12	Historical/Archaeological Sites	Unlikely	Moderate	Low

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

6.3.1 Air Quality

Impacts

281. The proposed WWTP development will involve large scale earth works and transporting and dumping large quantities of dry material. This will likely lead to an increase in SPM (Suspended Particulate Matter) in and around the construction zones.

282. Potential sources of particulate matter emission during construction activities include earthworks (dirt or debris pushing and grading), exposed surfaces, exposed storage piles, truck dumping, hauling, vehicle movement on unpaved roads, combustion of liquid fuel in equipment and vehicles, land excavation, and concrete mixing and batching.

283. Vehicles carrying construction material are expected to result in increased SPM levels near the haul roads. This can be of potential importance if the vehicles pass through the areas with a high concentration of sensitive receptors, such as schools and hospitals in this particular case.

284. At the construction yard, the dust levels are also expected to increase due to unloading of construction materials. It shall be ensured that most of the excavated material will be used within the project, with minimal cut and fill material to come from outside the site.

285. The quantity of dust that will be generated on a particular day will depend on the magnitude and nature of activity and the atmospheric conditions prevailing on the day. Due to the uncertainty in values of these parameters, it is not possible to calculate the quantity from a 'bottom-up' approach, that is, from adding PM10 emissions from every activity on the construction site separately. Typical and worst-case PM10 emissions from construction sites have been estimated25 as 0.27 megagram per hectare per month of activity (Mg/ha-month) and 1.04 Mg/ha-month, respectively.

Fugitive Dust Control

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

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

Table 6.3: Control measures for Fugitive Dust emissions

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

Mitigation Measures

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

- At the WWTP site and the immediately adjoining areas, water will be sprinkled every three hours and at a higher frequency if felt necessary, at all construction sites to suppress dust emissions.
- All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations.
- Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions.
- Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions.

- Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin.
- Limitations to speeds of such vehicles as felt necessary. Transport through densely populated area should be avoided.
- Concrete plants to be controlled in line with statutory requirements and shall not be close to sensitive receptors.
- Stack height of generators will be at least 3 meters above the ground.
- Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed roads within project area.
- A minimum distance of 300 meters will be ensured between batching plant(s) and the nearest community.
- The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles should not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m^3) of crushed materials are necessary, they should be enclosed with side barriers and also covered when not in use.

Vehicular & Equipment Emissions

288. It shall be ensured that the following measures are taken to control emissions from vehicles being used in the construction activity:

- Periodically check and conduct maintenance of the construction machinery and haul vehicles.
- Regularly change the engine oil and use new engines/machinery/equipment having good efficiency and fuel burning characteristics.
- Use of catalytic converters and low Sulphur fuels.
- The stack height of generators will be at least 3 meters above the ground.
- Training of the technicians and operators of the construction machinery and drivers of the vehicles.
- Air quality monitoring at the project site during the construction phase.

6.3.2 Community Health and Safety

Impacts

289. The WWTP development will involve the use of considerable heavy machinery at the project site along with posing the risk of community members falling into trenches. In addition, the risk to commuters on the road during the construction works will be significant and thus a number of precautionary measures will be necessary to minimize the risk of possible accidents.

Mitigation Measures

290. The following mitigation measures will be implemented:

- Work areas outside the project site, especially where machinery is involved, will be barricaded and will be constantly monitored to ensure that local residents, particularly children stay away while excavated areas being prepared for laying of pipelines and WWTP related infrastructure will also be cordoned off. Also, no machinery will be left unattended, particularly in running condition.
- Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children.
- Speed limit of 20 km/hr will be maintained by all project related vehicles and nighttime driving of project vehicles will be limited where possible.
- Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.

6.3.3 Occupational Health and Safety

Impacts

291. There is invariably a safety risk when construction works for the WWTP are conducted, and precautions will be needed to ensure the safety of the workers.

292. The major safety hazards expected during the proposed activities are as follows:[26]

<u>Accident Hazards</u>

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

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

heavy loads;

Physical Hazards

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

Chemical Hazards

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

Biological Hazards

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

Ergonomic, psychosocial and organizational factors

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

Mitigation Measures

293. The Contractor will be required to take measures such as:

- Ensuring that all workers are provided with and use appropriate Personal Protective Equipment (helmet, hand gloves, boots, masks etc);
- Follow standard practices of safety checks as prescribed before use of equipment;
- Provide on-site Health and Safety Training for all site personnel;

294. The Contractor will be required to prepare and implement an effective Worker Health and Safety Plan that is supported by trained first aid personnel and emergency response facilities. Construction contracts will include standard Worker Health and Safety measures and contractors will be bound to implement these fully. This will include mandatory wearing of dust masks for any cement handling operations or at any area were cement dust is in the air.

295. Monitoring will be required to ensure that the health and safety plan based on contract specifications is followed. Cement feed hopper areas will be inspected daily to ensure compliance with the requirement of dust masks.

296. Based on the type of hazard applicable during the proposed works at site, the following mitigation measures as per IFC guidelines for Occupational Health and Safety (OH&S) must be implemented:[27]

Physical Hazards

Rotating and Moving Equipment

297. Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unobvious movement during operations. Recommended protective measures include:

- Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. Examples of proper design considerations include two-hand operated machines to prevent amputations or the availability of emergency stops dedicated to the machine and placed in strategic locations. Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment should be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards should be designed and installed in conformance with appropriate machine safety standards.

- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance.

- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms.

Noise

- No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C). ·

- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A). ·

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

- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.

- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.

- Periodic medical hearing checks should be performed on workers exposed to high noise levels.

Vibration

298. Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, should be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and action values. Exposure levels should be checked on the basis of daily exposure time and data provided by equipment manufacturers.

Electrical

299. Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or grounded metal objects brought into close proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:

- Marking all energized electrical devices and lines with warning signs; ·

- Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance;

- Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools; ·

- Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits; ·

- Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas; ·

- Appropriate labeling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited; ·

- Rubber tired construction or other vehicles that come into direct contact with, or arcing between, high voltage wires may need to be taken out of service for periods of 48 hours and have the tires replaced to prevent catastrophic tire and wheel assembly failure, potentially causing serious injury or death;

- Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work.

Eye Hazards

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

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

- Moving areas where the discharge of solid fragments, liquid, or gaseous emissions can reasonably be predicted (e.g. discharge of sparks from a metal cutting station, pressure relief valve discharge) away from places expected to be occupied or transited by workers or visitors. Where machine or work fragments could present a hazard to transient workers or passers-by, extra area guarding or proximity restricting systems should be implemented, or PPE required for transients and visitors.

- Provisions should be made for persons who have to wear prescription glasses either through the use overglasses or prescription hardened glasses.

Welding/Hot Work

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

- Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. ·

- Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels that have contained flammable materials.

Industrial Vehicle Driving and Site Traffic

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

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

Ergonomics, Repetitive Motion, Manual Handling

303. Injuries due to ergonomic factors, such as repetitive motion, overexertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems should be minimized or eliminated to maintain a productive workplace. Controls may include: ·

- Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind. ·
- Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds. ·
- Selecting and designing tools that reduce force requirements and holding times, and improve postures. ·
- Providing user adjustable work stations. ·

- Incorporating rest and stretch breaks into work processes, and conducting job rotation. ·
- Implementing quality control and maintenance programs that reduce unnecessary forces and exertions. ·
- Taking into consideration additional special conditions such as left-handed persons.

Working at Heights

304. Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters; into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface. Fall prevention / protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include:

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

<u>Physical Hazards</u>

Air Quality

305. Poor air quality due to the release of contaminants into the work place can result in possible respiratory irritation, discomfort, or illness to workers. Employers should take appropriate measures to maintain air quality in the work area. These include: ·

- Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects. ·
- Developing and implementing work practices to minimize release of contaminants into the work environment including:

- Direct piping of liquid and gaseous materials
- Minimized handling of dry powdered materials; o Enclosed operations
- Local exhaust ventilation at emission/release points
- Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
- Indoor secure storage, and sealed containers rather than loose storage

- Where ambient air contains several materials that have similar effects on the same body organs (additive effects).

Fire and Explosions

306. Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:

- Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:
  - Remote from entry and exit points into buildings
  - Away from facility ventilation intakes or vents
  - Have natural or passive floor and ceiling level ventilation and explosion venting
  - Use spark-proof fixtures
  - Be equipped with fire extinguishing devices and self closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time ·
- Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area. ·
- Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems.
- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment). ·
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression.

Corrosive, oxidizing, and reactive chemicals

307. Corrosive, oxidizing, and reactive chemicals present similar hazards and require similar control measures as flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases, and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant personal injury upon direct contact, regardless of any intermixing issues. The following controls should be observed in the work environment when handling such chemicals: ·

- Corrosive, oxidizing and reactive chemicals should be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills. ·

- Workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc). ·

- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid should be ensured at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water.

Biological Hazards

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

- If the nature of the activity permits, use of any harmful biological agents should be avoided and replaced with an agent that, under normal conditions of use, is not dangerous or less dangerous to workers. If use of harmful agents cannot be avoided, precautions should be taken to keep the risk of exposure as low as possible and maintained below internationally established and recognized exposure limits.

- Work processes, engineering, and administrative controls should be designed, maintained, and operated to avoid or minimize release of biological agents into the working environment. The number of employees exposed or likely to become exposed should be kept at a minimum. ·

- The employer should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs. ·

- Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented and maintained in

close co-operation with the local health authorities and according to recognized international standards.

6.3.4 Noise

Impacts

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

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

311. The assessment of the noise impacts on the sensitive receptors that have been identified at various locations in the project area depend upon:

- Characteristics of noise source (instantaneous, intermittent or continuous in nature)
- Time of day at which noise occurs, and
- Location of noise source

312. Each construction phase has its unique noise characteristics due to use of different equipment items. The potential sources of noise during the preparation, construction, and worksite closure phases for the WWTP works include equipment, machinery, and transportation used for the construction activities. The equipment used for construction will be the major source of noise.

313. The construction activities will include use of generators, excavators, concrete mixing trucks and back up alarms, which can generate significant noise.

314. Since various modern machines are acoustically designed to generate low noise levels, any high noise levels that might be generated will only be for a short duration during the construction phase.

315. Depending on the construction equipment used and its distance from the receptors, the community and the workers may typically be exposed to intermittent and variable noise levels. During the day, such noise results in general annoyance and can interfere with sleep during the night. In general, human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is

clearly noticeable, and a change of 10 dB is perceived as a doubling or halving of sound level.

316. Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the project site. The movement of heavy vehicles, loading, transportation and unloading of construction materials produces significant noise during the construction stage. However, these increased noise levels will prevail only for a short duration during the construction phase.

317. The **Table 6.4** below represents typical noise levels from various construction equipment items. It should be noted that the values indicated in the table may differ depending on the brand and age of machinery provided/used by construction company.

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

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

Sources: USEPA, 1971; http://www.waterrights.ca.gov/EIRD/text/Ch11-Noise.pdf; http://www.lacsd.org/LWRP%202020%20Facilities%20Plan%20DEIR/4_6_Noise.pdf; http://newyorkbiz.com/DSEIS/CH18Construction.pdf

Notes:

a. Where typical value is not cited in literature, mean of the peak noise range is assumed

b. Quieted equipment can be designed with enclosures, mufflers, or other noise-reducing features. Where data is not available, a 3 dB reduction is assumed

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

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

Mitigation Measures

320. The following mitigation measures will be implemented:

- Equipment noise will be reduced at source by proper design, maintenance and repair of construction machinery and equipment. Noise from vehicles and power generators will be minimized by use of proper silencers and mufflers.
- Excessive noise emitting equipment will not be allowed to operate and will be replaced.
- Blowing of horns will be prohibited on access roads to work sites.
- As a rule, the operation of heavy equipment shall be conducted in daylight hours.
- Construction equipment, which generates excessive noise, shall be enclosed or fitted with effective silencing apparatus to minimize noise.
- Well-maintained haulage trucks will be used with speed controls.

6.3.5 Hazardous and Non-Hazardous Waste Management

Impacts

321. In the absence of national or domestic regulations and a waste management system in the project areas, waste disposal of materials containing contents of both hazardous and non hazardous nature such as scrap wood, bricks, concrete, asphalt, plumping fixtures, piping, insultation (asbestos and non-asbestos), metal scraps, oil, electrical wiring and components, chemicals, paints, solvents etc. can potentially become a serious environmental issue, particularly with the local contractors. To avoid any potential issue, the CIU in collaboration with the PMU will need to impose adequate internal controls.

Mitigation measures

322. A waste management plan will be developed prior to the start of construction. This plan will cater to sorting of hazardous and non-hazardous materials prior to

disposal, placing of waste bins at the project sites for waste disposal and an onsite hazardous waste storage facility.

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

324. Training will be provided to personnel for identification, segregation and management of waste.

6.3.6 Camp & Batching Plant Effluent

Impacts

325. The staff and labor camps for the construction of the proposed WWTP will be a source of wastewater generated from the toilets, washrooms and the kitchen. The wastewater will not meet the national environmental standards and will therefore need treatment prior to disposal.

326. The project sites where construction is being conducted must not be treated by the project staff and/or labor as a public toilet or for disposal of camp effluent.

Mitigation measures

327. It will be ensured that no untreated effluent is released to the environment.

328. A closed sewage treatment system will treat the effluent, which will then be disposed of in a soak pit or will be used for plantation. The sewage treatment plants will be installed at each respective labor camp based on the number of laborers residing at the respective camp.

329. Water being released from any batching plant(s) must be treated as per requirements of PEQS prior to release to sewerage system/any other water body.

6.3.7 Soil Erosion and Sedimentation

Impacts

330. The majority of the works proposed for development of the WWTP may result in soil erosion and sedimentation.

Mitigation measures

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

6.3.8 Soil Contamination

Impacts

332. During the project construction, spills of fuel, lubricants and chemicals can take place while transferring from one container to another or during refueling. Also, during maintenance of equipment and vehicles, through leakages from equipment and containers and as a result of traffic accidents.

333. Depending on the nature of the material, location of spill and quantity of spill, the soil can get contaminated.

Mitigation measures

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

335. Regular inspections will be carried out to detect leakages in construction vehicles and equipment and all vehicles will be washed in external commercial facilities.

336. Fuels, lubricants and chemicals will be stored in covered bounded areas, underlain with impervious lining. Appropriate arrangements, including shovels, plastic bags and absorbent materials will be available near fuel and oil storage areas.

6.3.9 Employment Conflicts

Impacts

337. The proposed WWTP project is not likely to create any significant permanent job opportunities. Even unskilled and semi-skilled employment opportunities that are likely to be created will be for a short period, while the project is constructed. As persons with relevant skills may be available locally, people from the project area are likely to fill a significant number of the semi-skilled and skilled jobs.

338. This issue of provision of jobs can become particularly problematic if it is perceived by the local population that a significant number of construction-related jobs opportunities are not given to people from the local community. This can result in friction between local residents and construction workers from outside of the community.

Mitigation measures

339. The Construction Contractor will adopt a transparent hiring policy. Prior to the commencement of the construction activity, the local communities in the project area will be informed of the employment policy in place and number of people that can be employed for this project.

340. It will be ensured that maximum number of unskilled and semi-skilled jobs will be provided to the residents of the project area.

341. The PMU will ensure a balanced process of employment of the communities in the project area with preference given to those most directly affected by the project.

6.3.10 Communicable diseases

Impacts

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

Mitigation measures

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

6.3.11 Vegetation and Wildlife Loss

Impacts

344. The project consists of a semi-urban environment located in the outskirts of Sahiwal city with limited human settlements and activities and thus contains limited vegetation cover and limited wildlife of any significance as common in areas located close to urban centers.

345. No impact on vegetation and wildlife is expected since no trees are expected on the project site. There are only minor shrubs and bushes that will be cleared up, if felt necessary, during the site preparation stage of the project.

Mitigation measures

346. No hunting or killing of animals will be permitted.

347. No cutting down of vegetation or using vegetation or trees as firewood will be permitted.

6.3.12 Historical/Archaeological Sites

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

Mitigation measures

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

6.4 Impacts Associated with Operation of WWTP

350. The potential impacts from operation of the WWTP are provided as **Table 6.5** below.

Operation Phase

Table 6.5: Screening of Possible Impacts during Operation Phase

S/No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Level (Significant, Medium, Low)
1	Possible Emergencies and Plant Failure	Unlikely	Major	Medium
2	Odor generation	Likely	Major	Medium
3	Improper Disposal of Sludge	Unlikely	Major	Medium
4	Disease Vector Generation & Transmission	Likely	Major	Medium
5	Improvements in Public Health	Positive impacts expected		
6	Lower Loads on Ecosystem	Positive impacts expected		
7	Generation and use of byproducts i.e. Sludge for agriculture	Positive impacts expected		

Critical Risk Level

Significant Risk Level

Medium Risk Level

Low Risk Level

……..Positive Impacts

6.4.1 Possible emergencies and plant failure

Impacts

351. Operational difficulties may be experienced at plant start up or during periods when process equipment malfunctions, particularly the equipment providing aeration to certain process areas. Even under such scenarios, the effluent discharged would be of limited volume and would still be of better quality and an improvement over the existing condition where raw and untreated wastewater is being directly discharged into the different water bodies. Chlorination of the effluent could be increased under these conditions to kill pathogenic organisms if the need for chlorination is demonstrated.

352. The frequency of such incidents is likely to remain low as long as adequate training of operator personnel is maintained and supplies of spare parts are kept available and utilized as recommended to keep all units operational at close to design efficiency levels. The most likely impact scenario would be that large quantities of sludge would accumulate in the lagoons for an extended time period, leading to untreated wastewater needing to be discharged directly into the environment until the required technical issue has been resolved. This could lead to short term adverse impacts on the fish and other biota during the period of the release and for a period of time thereafter.

Mitigation measures

353. The steps laid out in the Emergency Response Plan, provided as **Annexure D** will be implemented.

354. Operator Personnel training on a pre-defined frequency, atleast once every quarter, shall be ensured to continue refreshing of the Standard Operating Procedures laid out in the Emergency Response Plan in case of possible emergencies and/or plant failure.

355. Preventive maintenance must be ensured on a pre-defined frequency with required spare parts available at the WWTP premises to ensure quick replacement of the faulty component(s) in order to resolve the technical issue and bring the plant back into operation at the earliest.

6.4.2 Improper disposal of Sludge

Impacts

356. The estimated amount of sludge to be produced would be about 15,000-19,000 m^3/annum during year 2022 to year 2029 respectively.This sludge to be produced as a by-product of the operations of the WWTP must be disposed off in accordance with international good practices to ensure there is no environmental degradation and other unexpected impacts such as disease vector generation etc. resulting from the improper disposal of the sludge.

Mitigation measures

357. A detailed strategy will be developed on management and disposal of the sludge to be produced as a by-product of the operations of the WWTP.

358. Licensed third party vendors will be contracted on long term arrangements to manage the disposal of the sludge in an environmentally beneficial manner in accordance with international good practices.

6.4.3 Odor generation

Impacts

359. It is possible that the operation of the WWTP and particularly the wastewater as it will be transported to the APs and onwards to the next lagoons for remaining stages of treatment may result in certain odor emissions.

360. Due to anaerobic digestion of solids settling at the bottom of the APs, odor is mainly caused by production of H_2S gas. Hydrogen sulfide, formed mainly by the anaerobic reduction of sulfate by sulfate-reducing bacteria. However, in aqueous solution, hydrogen sulfide is present as either dissolved hydrogen sulfide gas (H_2S) or the bisulfide ion (HS-), with the sulfide ion (S2–) only being formed in significant quantities at high pH. As the pH values normally found in well design anaerobic ponds is usually around 7.5, most of the sulfide is present as the odorless bisulfide ion.

361. Odor is not expected to be a problem if APs are designed on recommended loading rates and sulfate concentration in wastewater is less than 500 mg/l. In wastewater characterization for Sahiwal city, sulfate concentration in raw wastewater is in the range of 380- 448 mg/l.

362. As APs are designed on recommended loading rate and sulfate concentrations are also within limits, it is anticipated that if APs are properly maintained and not overloaded, there will be minimum chances of nuisance being cause due to odor.

The Wind Rose for Sahiwal City (provided as **Figure 4.2**) shows that the predominant wind direction is from the South West (SW) and South South West (SSW) directions. As a result, the potential impact on the households from any airborne related impacts, particularly during WWTP operations, such as odor, would be minimal as can be seen in the Corridor of Impact provided as Figure 6.1 below. The only receptor to be potentially impacted from any airborne related impact would be village No.66 (Chak No. 66), but even that impact is expected to be minimal since the nearest boundary of the village to the WWTP boundary is over 700 meters (0.7 km) away.

Mitigation measures

363. As part of the existing detailed design, in order to address any potential odor issue, a buffer zone of 50 feet wide all around the WWTP site consisting of thick plantation will be ensured to save the surrounding population from any adverse nuisance due to odor. This boundary of plantation can also be observed in the WWTP layouts.

364. Furthermore, all possible measures must be implemented to curb and control the odor generation from the WWTP operations by using odor controlling equipment at the WWTP and keeping all odor generating processes in a controlled environment.

6.4.4 Disease Vector Generation & Transmission

Impacts

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

366. Workers and staff at the proposed WWTP facility and fields where treated wastewater or sludge will be applied, as well as operators of sludge collection vehicles, can be exposed to the many pathogens contained in sewage. Processing of sewage can generate bioaerosols which are suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, molds, and fungi. These microorganisms can remain suspended in the air for long periods of

time, retaining viability or infectivity. Workers may also be exposed to endotoxins, which are produced within a microorganism and released upon destruction of the cell and which can be carried by airborne dust particles. Vectors for sewage pathogens include insects (e.g., flies), rodents (e.g., rats) and birds (e.g., gulls).[28]

Mitigation measures

367. The following measures must be implemented:

- Comprehensive plan must be developed and implemented to spray chemicals into the influent drains at different frequencies throughout the year based on the seasons;
- Minimize the sludge inventory present at the WWTP as far as possible to prevent breeding of disease vectors;
- Cover the sludge piles present at the WWTP as far as possible;
- Cover all influent drains leading to the APs and inject pesticides and/or chemicals as required to minimize/prevent breeding of disease vectors;
- Maintain good housekeeping in sewage processing and storage areas;
- Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors;
- Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods;
- Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes;
- Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure;
- Encourage workers at WWTP to wash hands frequently.

6.4.5 Improvements in Public Health

Impacts

368. The operation of the proposed WWTP will result in discharge of treated wastewater that will be meeting the PEQS standards and thus the different water quality parameters will be ensured to not exceed the pre-set threshold values.

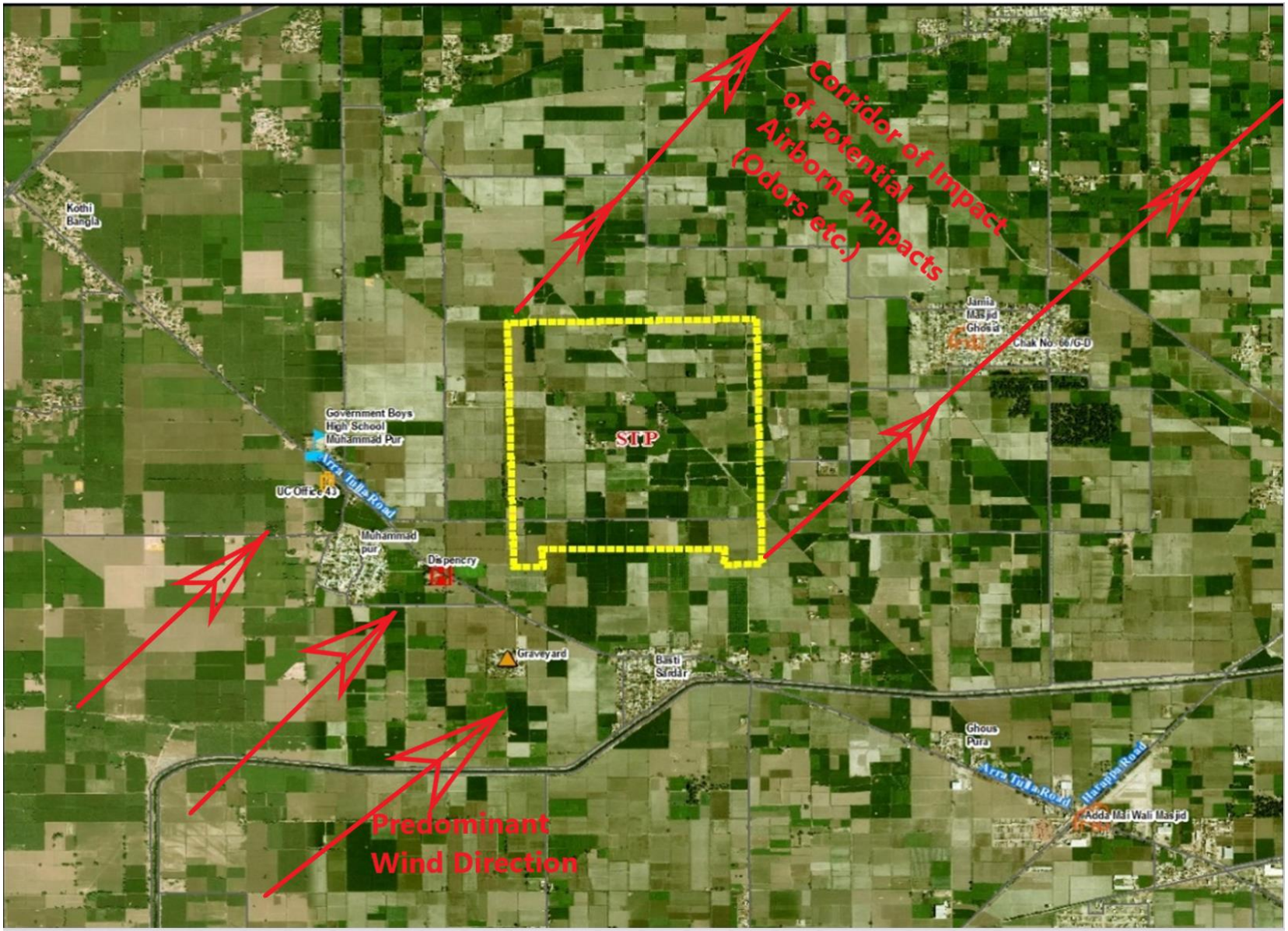
[28] 3 U.S. Environmental Protection Agency, Environmental Regulations and Policy Control of Pathogens and Vector Attraction in Sewage Sludge (Including Domestic Septage) Under 40 CRF Part 503, EPA/625/R-92/013, Revised July 2003. http://www.epa.gov/ord/NRMRL/Pubs/1992/625R92013.pdf

369. This in turn will ensure that a number of the key toxic and hazardous chemical concentrations in the wastewater will be controlled and will not be allowed to enter the discharge water body. This is expected to result in an overall positive impact on the public health by preventing issues such as waterborne diseases, disease vector generation, groundwater aquifer contamination etc.

Mitigation measures

No measures required.

Figure 6.1: Corridor of Impact of AirBorne Impacts from WWTP



6.4.6 Lower loads on Ecosystems

Impacts

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

371. The WWTP operation will result in treated water within the PEQS standards being discharged into the environment and thus is expected to reduce the load on the aquatic and terrestrial habitats present in proximity to the receiving water bodies in the project areas and play a major role in improving the overall ecosystems of the project areas. Significant reductions in the existing nutrient loads from the untreated wastewater are expected with majority of the nitrogen-ammonia being converted via nitrification to nitrates. This is expected to reduce ammonia concentrations to levels below those that have been reported to be toxic to different marine life and is expected to retard potential eutrophication occurring in the different water courses in which the treated wastewater will be discharged.

Mitigation measures

No measures required.

6.4.7 Generation and Use of by-products i.e. Sludge for Agriculture

Impacts

372. The sludge to be generated as a by-product of the WWTP process is expected to be used in agriculture with the WWTP management engaging into long term contracts with third parties to develop value chains for removal of the sludge from the WWTP premises and transport in an environmentally sustainable manner in accordance with international good practices to the pre-identified vendors for use in agriculture.

Mitigation measures

No measures required.

6.5 Cumulative Impacts

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

6.6 Indirect and Induced Impacts

374. The potential impact of development of the WWTP in the project area has been examined, which indicated that the existing and planned infrastructure such as water supply, wastewater collection and treatment, municipal solid waste collection and disposal would be adequate to accommodate any potential population intake as a result of the proposed WWTP development. Impacts on the environment from air emissions, traffic and community noise, and treated effluent discharge have also been assessed and have found to be acceptable and within the carrying capacities of the environmental media.

375. Thus, negative indirect and induced impacts from the proposed WWTP works are not expected.

7 Environmental Management Plan & Institutional Requirements

7.1 Introduction

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

377. The detailed EMP provided in this document as **Table 7.1** ensures that this sub-project has no detrimental effect on the surrounding environment. The Plan shall act as a guideline for incorporating environmental measures to be carried out by the contractors engaged for the proposed sub-project. It shall also be used for other parties concerned for mitigating possible impacts associated with each sub-project and will form part of the Contract documents to be considered alongside the specifications. This Plan shall act as the Environmental Management and Monitoring Plan during the construction phase of the sub-project and will allow for prompt implementation of effective corrective measures.

7.2 Environmental Management Plan (EMP)

378. The EMP attached with this report ensures the following:

- Delivery of the prescribed environmental outcomes during all phases of this sub-project;
- Formulating a system for compliance with applicable legislative requirements and obligations and commitments for this sub-project;
- Ensure that project design process incorporates best practice environmental design and sustainability principles to minimize potential impacts of construction on the environment and community.
- Ensure that the construction work procedures minimize potential impacts on the environment and community.
- Develop, implement and monitor measures that minimize pollution and optimize resource use.

7.3 Objectives of EMP

379. The EMP provides a delivery mechanism to address potential impacts of the project activities, to enhance project benefits and to outline standardized good practice to be adopted for all project works. The EMP has been prepared with the objectives of:

- Defining the roles and responsibilities of the project proponent for the implementation of EMP and identifying areas where these roles and responsibilities can be shared with other parties involved in the execution and

monitoring of the project;

- Outlining mitigation measures required for avoiding or minimizing potential negative impacts assessed by environmental study;
- Developing a monitoring mechanism and identifying requisite monitoring parameters to confirm effectiveness of the mitigation measures recommended in the study;
- Defining the requirements for communication, documentation, training, monitoring, management and implementation of the mitigation measures.

7.4 Environmental Management/Monitoring and Reporting

380. During the construction phase, the overall responsibility for the implementation and monitoring of the EMP rests with the City Manager – Sahiwal (CMS). The CMS, using the Project Management Consultant (PMC), will supervise the implementation of the proposed mitigation measures and monitor the implementation progress in the field.

381. The specific roles and responsibilities for environmental management and monitoring are provided in **Table 7.1** below. The expected costs for implementing any required mitigation measures are provided in **Table 7.7** below.

7.5 Institutional Arrangements

382. The environmental management plan will require involvement of the following organizations for its implementation:

i. Local Government and Community Development Department (LG&CDD)

383. The Local Government and Community Development Department (LG&CDD) of Punjab will be the executing agency (EA) of the project. Under the guidance of the Project Steering Committee, LG&CDD will be responsible for the overall execution of the project.

384. A Project Management Unit (PMU) has been established within LG&CDD to support LG&CDD.

ii. City Implementation Unit (CIU) - Sahiwal

385. The EA has established CIU in each of the two participating cities. The key role of the CIUs will be to support the cities in the implementation of the civil works components of the project.

7.5.1 Role of LG&CDD

386. The LG&CD Department, GoPb will:

- Act as the project executing agency (EA) for PICIIP;
- Establish a PMU, with adequate staff acceptable to ADB;
- Liaise with ADB to address any issues during design and implementation;
- Approve delegation of authorities to PMU and CIUs.

7.5.2 Role of PMU

387. The PMU will support LG&CD Department. The PMU will:

- Provide support to ADB missions;
- Coordinate activities with all stakeholders, review consultants, proposals, and provide overall guidance during various stages of project preparation;
- Act as a Secretariat to PSC headed by Chairman P&D Board;
- Manage and ensure safeguard due diligence and disclosure requirements including resettlement and environmental safeguards in accordance with ADB's Safeguard Policy Statement (2009) and government requirements;
- Manage and ensure effective implementation of the gender action plan;
- Ensure submission of all IEE requirements as per law by responsible entities; and
- Monitoring of activities in CIUs and the whole project.

7.5.3 Role of Municipal Corporation (MC)

388. The MC will:

- Facilitate land acquisition;
- Approve and implement all reforms related system, organizations, plans, and programs as required for the project including service delivery arrangements;
- Transfer assets and completed civil works to WSCs/USCs, as required for the projects and agreements; and
- Fill all vacancies in the MC, as per approved organogram and facilities required for CIU and Staff.

7.5.4 Role of City Implementation Unit (CIU)

389. The CIU will support the Municipal Corporations of Sahiwal in the following aspects:

- Conduct city level progress monitoring and reporting;
- Facilitate all monitoring requirements and reporting of GoPb and ADB;
- Ensure safeguard compliance and reporting in line with loan agreements;
- Monitor and ensure effective implementation of the gender action plan;
- Monitor city level activities for reporting and compliance.

7.5.5 Role of the ADB

390. The ADB will:

- Support the coordination and administration of the project;
- Provide guidance to LG&CD Department, PMU, MCs, and CIUs on implementation issues and project design;
- Disclose all safeguards documents, and monitor safeguards implementation;
- Monitor and report project performance;
- Conduct periodic review of the project;

7.5.6 Role of Project Contractor

391. The project contractor will be responsible for following items:

- Implementation of, or adherence to, all provisions of the IEE and EMP;
- Preparation of site specific EMPs (SSEMPs) as required.
- Contractor's environmental performance will rest with the person holding the highest management position within the contractor's organization. Reporting to their management, the contractor's site managers will be responsible for the effective implementation of the EMP.
- The Contractor will be required to have qualified Environmental Specialists in their team to ensure all mitigation measures are implemented during the different development phases of the project.

7.6 Monitoring Parameters

392. A monitoring plan for the construction phase of the project, indicating environmental parameters, frequency and applicable standards is provided below as **Table 7.3** below.

393. During the procurement/pre-construction period, the monitoring activities will focus on (i) checking the contractor's bidding documents, particularly to ensure that all necessary environmental requirements have been included; and (ii) checking that the contract documents' references to environmental mitigation measures requirements have been incorporated as part of contractor's assignment and making sure that any advance works are carried out in good time.

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

395. In general, the construction impacts will be manageable and no insurmountable impacts are predicted, provided that the EMP is implemented to its full extent as required in the Contract documents. However, experience suggests that some Contractors may not be familiar with this approach or may be reluctant to carry out some measures. For the proposed sub-project, in order that the Contractor is fully aware of the implications of the EMP and to ensure compliance, environmental

measures must be costed separately in the tender documentation and listed as BoQ items, and that payment milestones must be linked to environmental performance, vis a vis the carrying out of the EMP.

396. The effective implementation of the EMP will be audited as part of the loan conditions and the executing agency must be prepared for this. In this regard, the PMC will guide the design engineers and Contractors on the environmental aspects.

7.7 Environmental Training

7.7.1 Capacity Building and Training

397. Capacity building and training programs are necessary for the project staff in order to control the negative impacts resulting from the project construction and during its operation phase. They will also require trainings on monitoring and inspecting of such a project for environmental impacts and for implementation of mitigation measures.

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

Table 7.1: Environmental Management Plan

Project Activities	Section	Impact	Mitigation Measures Recommended	Responsibility		Timing
				Execution	Monitoring	
Design/Pre-Construction Phase	1.1	Lack of Integration of IEE/EMP requirements into bidding documents	The proposed 'Safeguards unit' that should be developed at the PMU should be assigned the task to check that design and bid documents are responsive to key environmental, social and safety considerations, and that the proposed method of work reflects the boundaries defined in the EMP. The bid documents must include the EMP and its implementation cost must be reflected in the BoQ.	CIU	PMU	BC: during detailed designing of the sub-project
	1.2	Material Haul routes	The construction vehicles hauling materials along the Sahiwal city roads and anywhere where there are sensitive receptors such as hospitals, schools and/or roadside residences will be limited and the PMU in collaboration with the CIU will establish a route plan to minimize this disruption which shall be appended to the EMP.	CIU	PMU	BC: during detailed designing of the sub-project
	1.3	Identification of Locations for Labor Camps and ancillary facilities	▪ In order to prevent a nuisance, specific locations shall be designated for development of the labor camps. All	CIU	PMU	BC: during detailed designing of the sub-project

			necessary facilities and amenities shall be provided in these camps such as electricity, sufficient supply of water, solid and liquid effluent waste disposal facilities etc. ▪ The use of proper planning while identifying locations for the labor camps will ensure there is minimal disturbance to all key receptors and the traffic is not disrupted by labor camps being set up roadside next to the construction sites.			
	1.4	Contractor's Environmental Safeguards Capacity	So far, local contractor firms in Pakistan working on large and medium scale environmentally sensitive projects have an unsatisfactory record for complying with workplace and environmental safety regulations. To address this, the contractor will be required to define an Occupational and Environmental Health and Safety procedure for all work, including work camp operation, management of cement dust, and use of Personal Safety Equipment. These procedures should be developed and approved by	CIU	PMU	BC: during detailed designing of the sub-project

			the PMU in collaboration with the CIU before the contractor commences any physical works on ground.			
Construction Phase	2.1	Air Quality	▪ At the WWTP site and the immediately adjoining areas, water will be sprinkled every three hours and at a higher frequency if felt necessary, at all construction sites to suppress dust emissions. ▪ All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations. ▪ Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions. ▪ Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions. ▪ Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin. ▪ Limitations to speeds of such vehicles as felt necessary. Transport through densely populated area should be	Contractor	PMC, CIU	DC

Construction Phase (Continued…)			avoided. ▪ Concrete plants to be controlled in line with statutory requirements and shall not be close to sensitive receptors. ▪ Stack height of generators will be at least 3 meters above the ground. ▪ Project traffic will maintain maximum speed limit of 20 km/hr on all unsealed roads within project area. ▪ A minimum distance of 300 meters will be ensured between batching plant(s) and the nearest community. ▪ The need for large stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles should not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m^3) of crushed materials are necessary, they should be enclosed with side barriers and also covered when not in use.			

			It shall be ensured that the following measures are taken to control emissions from vehicles being used in the construction activity: ▪ Periodically check and conduct maintenance of the construction machinery and haul vehicles. ▪ Regularly change the engine oil and use new engines/machinery/equipment having good efficiency and fuel burning characteristics. ▪ Use of catalytic converters and low Sulphur fuels. ▪ The stack height of generators will be at least 3 meters above the ground. ▪ Training of the technicians and operators of the construction machinery and drivers of the vehicles. ▪ Air quality monitoring at the project site during the construction phase.			
	2.2	Community Health and Safety	▪ Work areas outside the project site, especially where machinery is involved, will be barricaded and will be	Contractor	PMC, CIU	DC

			constantly monitored to ensure that local residents, particularly children stay away while excavated areas being prepared for laying of pipelines and WWTP related infrastructure will also be cordoned off. Also, no machinery will be left unattended, particularly in running condition. ▪ Local communities in the project area will be briefed on traffic safety, especially women who are the main care providers to children. ▪ Speed limit of 20 km/hr will be maintained by all project related vehicles and nighttime driving of project vehicles will be limited where possible. ▪ Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.			

	2.3	Occupational Health and Safety	▪ Ensuring that all workers are provided with and use appropriate Personal Protective Equipment (helmet, hand gloves, boots, masks etc); ▪ Follow standard practices of safety checks as prescribed before use of equipment; ▪ Provide on-site Health and Safety Training for all site personnel; ▪ The Contractor will be required to prepare and implement an effective Worker Health and Safety Plan that is supported by trained first aid personnel and emergency response facilities. Construction contracts will include standard Worker Health and Safety measures and contractors will be bound to implement these fully. This will include mandatory wearing of dust masks for any cement handling operations or at any area were cement dust is in the air.	Contractor	PMC, CIU	DC

			▪ Monitoring will be required to ensure that the health and safety plan based on contract specifications is followed. Cement feed hopper areas will be inspected daily to ensure compliance with the requirement of dust masks.			
	2.4	Noise	▪ Equipment noise will be reduced at source by proper design, maintenance and repair of construction machinery and equipment. Noise from vehicles and power generators will be minimized by use of proper silencers and mufflers. ▪ Excessive noise emitting equipment will not be allowed to operate and will be replaced. ▪ Blowing of horns will be prohibited on access roads to work sites. ▪ As a rule, the operation of heavy equipment shall be conducted in daylight hours.	Contractor	PMC, CIU	DC

			▪ Construction equipment, which generates excessive noise, shall be enclosed or fitted with effective silencing apparatus to minimize noise. ▪ Well-maintained haulage trucks will be used with speed controls.			
	2.4	Hazardous and Non-Hazardous Waste Management	▪ A waste management plan will be developed prior to the start of construction. This plan will cater to sorting of hazardous and non-hazardous materials prior to disposal, placing of waste bins at the project sites for waste disposal and an onsite hazardous waste storage facility. ▪ Licensed waste contractors will be engaged to dispose off all non-hazardous waste material that cannot be recycled or reused. ▪ Training will be provided to personnel for identification, segregation and management of waste.	Contractor	PMC, CIU	DC

	2.5	Untreated disposal of effluent from worker camps and batching plants	▪ It will be ensured that no untreated effluent is released to the environment. ▪ A closed sewage treatment system will treat the effluent, which will then be disposed of in a soak pit or will be used for plantation. The sewage treatment plants will be installed at each respective labor camp based on the number of laborers residing at the respective camp. ▪ Water being released from any batching plant(s) must be treated as per requirements of PEQS prior to release to sewerage system/any other water body.	Contractor	PMC, CIU	DC
	2.7	Soil erosion and sedimentation	Any drainage structures, culverts or pipes crossing the project site may need to be modified or protected and the detailed designs must make provisions to protect or re-provision all infrastructure that may be affected by the construction works.	Contractor	PMC, CIU	DC
	2.8	Soil Contamination	▪ It will be ensured that spill prevention	Contractor	PMC, CIU	DC

			trays are provided and used during refueling. Also, on-site maintenance of construction vehicles and equipment will be avoided as far as possible. In case on-site maintenance is unavoidable, tarpaulin or other impermeable material will be spread on the ground to prevent contamination of soil. ▪ Regular inspections will be carried out to detect leakages in construction vehicles and equipment and all vehicles will be washed in external commercial facilities. ▪ Fuels, lubricants and chemicals will be stored in covered bounded areas, underlain with impervious lining. Appropriate arrangements, including shovels, plastic bags and absorbent materials will be available near fuel and oil storage areas.			
	2.9	Employment Conflicts	▪ The Construction Contractor will adopt			

			a transparent hiring policy. Prior to the commencement of the construction activity, the local communities in the project areas of Sahiwal city will be informed of the employment policy in place and number of people that can be employed for this project. ▪ It will be ensured that maximum number of unskilled and semi-skilled jobs will be provided to the residents of Sahiwal city and adjoining areas. ▪ PMU will ensure a balanced process of employment of the communities in the project area with preference given to those most directly affected by the project.			
	2.10	Communicable diseases	A communicable diseases prevention program will be prepared for construction workers or residents near the construction sites.	Contractor	PMC, CIU	DC
	2.11	Vegetation and Wildlife Loss	▪ No hunting or killing of animals will be permitted.	Contractor	PMC, CIU	DC

			▪ No cutting down of vegetation or using vegetation or trees as firewood will be permitted.			
	2.12	Historical/Archaeological Sites	If evidence of any archaeological remains is found during the construction activities, the excavation work will be stopped immediately and necessary next steps taken to identify the archaeological discovery based on the 'Chance Find' procedures	Contractor	PMC, CIU	DC
Operation Phase	3.1	Possible emergencies and plant failure	▪ The steps laid out in the Emergency Response Plan, provided as **Annexure D** will be implemented. ▪ Operator Personnel training on a pre-defined frequency, atleast once every quarter, shall be ensured to continue refreshing of the Standard Operating Procedures laid out in the Emergency Response Plan in case of possible emergencies and/or plant failure. ▪ Preventive maintenance must be ensured on a pre-defined frequency with required spare parts available at the WWTP premises to ensure quick	O&M Contractor	Sahiwal Waste Utility	DO

			replacement of the faulty component(s) in order to resolve the technical issue and bring the plant back into operation at the earliest.			
	3.2	Improper disposal of Sludge	1. A detailed strategy will be developed on management and disposal of the sludge to be produced as a by-product of the operations of the WWTP. 2. Licensed third party vendors will be contracted on long term arrangements to manage the disposal of the compost in an environmentally beneficial manner in accordance with international good practices.	O&M Contractor	Sahiwal Waste Utility	DO
	3.3	Odor generation	▪ As part of the existing detailed design, in order to address any potential odor issue, a buffer zone of 50 feet wide all around the WWTP site consisting of thick plantation will be ensured to save the surrounding population from any adverse nuisance due to odor. This boundary of plantation can also be	O&M Contractor	Sahiwal Waste Utility	DO

			observed in the WWTP layouts. ▪ Furthermore, all possible measures must be implemented to curb and control the odor generation from the WWTP operations by using odor controlling equipment at the WWTP and keeping all odor generating processes in a controlled environment.			
	3.4	Disease Vector Generation & Transmission	▪ Comprehensive plan must be developed and implemented to spray chemicals into the influent drains at different frequencies throughout the year based on the seasons; ▪ Minimize the sludge inventory present at the WWTP as far as possible to prevent breeding of disease vectors; ▪ Cover the sludge piles present at the WWTP as far as possible; ▪ Cover all influent drains leading to the APs and inject pesticides and/or chemicals as required to minimize/prevent breeding of disease	O&M Contractor	Sahiwal Waste Utility	DO

			vectors; ▪ Maintain good housekeeping in sewage processing and storage areas; ▪ Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors; ▪ Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods; ▪ Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes; ▪ Provide areas for workers to shower			

			and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure; ▪ Encourage workers at WWTP to wash hands frequently.			

PMC : Project Management Consultant

BC : Before Construction

DC : During Construction

CIU : City Implementation Unit

DO During Operation

Table 7.2: 'Pre-Construction' Environmental Monitoring Plan for Baseline Development

Parameter to be measured	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Ambient Air Quality	To establish baseline air quality levels	CO,NO_x & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At three random receptor locations in the project area	Once	PMC

Ambient Noise	To establish baseline noise levels	Ambient noise level near receptors in project area	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour, and then averaged	At three random receptor locations in the project area	Once	PMC
Water Quality of River Ravi	To establish baseline for surface water quality at discharge point of treated effluent into River Ravi	Water quality at discharge point of treated effluent into River Ravi	Water sample for comparison against PEQS parameters	At discharge point of treated effluent into River Ravi	Once	PMC
Groundwater Quality in vicinity of WWTP site	To establish groundwater quality in project area	Groundwater quality in project area	Water samples for comparison against PEQS parameters	At two locations around the WWTP site in the project area	Once	PMC

Table 7.3: Construction Phase Monitoring Requirements

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Noise Disturbance due to noise from construction activity	To determine the effectiveness of noise abatement measures on sound pressure levels	Ambient noise level at different locations in project area	A-weighted noise levels – 24 hours, readings taken at 15 s intervals over 15 min. every hour at 15 m from receptors, and then averaged	At three random receptor locations in project area	Quarterly basis on a typical working day	Contractor's Environmental officer, PMC
Air Quality Dust emissions from construction vehicles and equipment	To determine the effectiveness of dust control program on dust at receptor level	CO,NO_x & PM_{10} (particulate matter smaller than 10 microns) concentration at receptor level	1-hr and 24-hr concentration levels	At three random receptor locations in project area	Quarterly basis on a typical working day	Contractor's Environmental officer, PMC

Project Activity and Potential Impact	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
		Visible dust	Visual observation of size of dust clouds, their dispersion and the direction of dispersion	Construction site	Once daily during peak construction period	Contractor's Environmental officer, PMC
Safety precautions by Safety workers	To prevent accidents for workers and general public	Number of near miss events and accidents taking place	Visual inspections	Construction site	Once Daily	Contractor's Environmental officer, PMC
Soil Contamination	To prevent contamination of soil from oil and toxic chemical spills and leakages	Incidents of oil and toxic chemical spills	Visual inspections	At construction site and at vehicle and machinery refuelling & maintenance areas	Once a month	Contractor's Environmental officer, PMC
Solid Waste & Effluent disposal Insufficient procedures for waste collection, storage, transportation and disposal	To check the availability of waste management system and implementation	Inspection of solid and liquid effluent generation, collection, segregation, storage, recycling and disposal will be undertaken at all work sites in project area	Visual inspections	At work sites in project area	Once daily.	Contractor's Environmental officer, PMC

Table 7.4: 'Operation Phase' Environmental Monitoring Plan

Parameter to be measured	Objective of Monitoring	Parameters to be Monitored	Measurements	Location	Frequency	Responsibility
Water Quality of River Ravi	To assess quality of treated wastewater being discharged into River Ravi	Water quality at discharge point of treated effluent into River Ravi	Water sample for comparison against PEQS parameters	At discharge point of treated effluent into River Ravi	Bi-annual	PMC
Groundwater Quality in vicinity of WWTP site	To assess whether WWTP operation is causing any seepage into the groundwater aquifers in project area and contaminating it.	Groundwater quality in project area	Water samples for comparison against PEQS parameters	At two locations around the WWTP site in the project area	Bi-annual	PMC

Table 7.5: Capacity Development and Training Programme

Provided by	Organized by	Contents	No. of training events	Duration	Cost (PKR)
Pre-construction Phase Monitoring Consultants/Organizations offering specialized services in environmental management and monitoring	CIU & PMU	Short seminars and courses on: Environmental Management Plan and Environmental Monitoring Plan	Two seminars for Contractor management staff and project staff	1 day	100,000
Construction Phase Monitoring Consultants/Organizations offering specialized	CIU & PMU	Short seminars on Environmental risks associated with construction phase.	Two seminars for Contractor management staff and project	1 day	100,000

services in social management and monitoring		Development of Environmental Performance Indicators Occupational Health and Safety (OHS) issues	staff dealing in environment and social issues		
Total			**200,000 (PKR 0.2 million)**		

7.8 Environmental Management Costs

399. The **Table 7.7** below provides cost estimates for 'Pre-Construction phase' monitoring while **Tables 7.7** and **7.8** provides cost estimates for 'Construction phase' and 'Operation phase' monitoring of key environmental parameters.

400. The costs associated with implementation of the EMP and the necessary mitigation measures are provided as **Table 7.9** below. The **Table 7.10** below provides the 'Capacity development and training programme' for project contractors for the proposed project.

Table 7.6: Annual Cost Estimates for 'Pre-Construction Phase' Environmental Monitoring[29]

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NOx, PM_{10}	3 (Once only at 3 locations)	90,000	3 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	3 (Once only at 3 locations)	90,000	3 readings @ PKR 30,000 per reading
Contingencies			9,000	5% of monitoring cost
Total (PKR)			**189,000**	

Table 7.7: Annual Cost Estimates for 'Construction Phase' Environmental Monitoring[30]

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Air Quality	CO, NOx, PM_{10}	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per sample
Noise Levels	dB(A)	12 (Quarterly basis at 3 locations)	360,000	12 readings @ PKR 30,000 per reading
Contingencies			36,000	5% of monitoring cost
Total (PKR)			**756,000**	

[29] For air quality monitoring: 'Passive samplers' such as test tubes can be used or 'Active samplers' with sorbent turbes can also be used.

For noise monitoring: sampling equipment with duration greater than 1 hour can be used.

Table 7.8: Annual Cost Estimates for 'Operation Phase' Environmental Monitoring[31]

Monitoring Component	Parameters	Quantity	Amount PKR	Details
Water Quality of River Ravi	PEQS	2 (bi-annual basis)	60,000	2 readings @ PKR 30,000 per sample
Groundwater Quality in vicinity of WWTP site	PEQS	4 (bi-annual basis @ 2 locations)	120,000	4 readings @ PKR 30,000 per reading
Contingencies			9,000	5% of monitoring cost
Total (PKR)			**189,000**	

Table 7.9: Estimated Costs for EMP Implementation

Item	Sub-Item	Estimated Total Cost (PKR)
Staff, audit and monitoring cost[1]	1 person for 24 months (@ 100,000 per month)	**2,400,000**
Monitoring Activities	Provided separately in Tables 7.7 and 7.8.	-
Mitigation Measures	As prescribed under EMP and IEE.	**40,00,000**
(i) Water sprinkling	To suppress dust emissions	800,000
(ii) Solid waste collection & disposal	From construction sites (based on initial estimates)	700,000
(iii) Plantation around project boundary to control odor levels	To plant vegetation all along the WWTP boundary to limit odor emissions	15,00,000
(iv) Chemicals/pesticides to prevent/minimize disease vector generation	Chemicals to be injected into the influent streams in order to minimize/prevent disease vector generation	10,00,000
Contingencies	5% of EMP implementation cost	320,000
Total Estimated Cost (PKR)		**6,720,000**

1: To cover staff cost and expenses of Environmental Specialist for Contractor

Table 7.10: Capacity Development and Training Programme for Project Contractor(s)

Provided by	Organized by	Contents	Target Audience	Venue	Duration
Pre-construction Phase PMC offering specialized services in environmental management and monitoring	CIU & PMC	Short seminars and courses on: Environmental Management Plan and Environmental Monitoring Plan	Contractor staff	CIU Office, Sahiwal	One day long training seminar
Construction Phase PMC offering specialized services in social management and monitoring	CIU & PMC	Short seminar on Environmental risks associated with construction phase. Development of Environmental Performance Indicators Occupational Health and Safety (OHS) issues	Contractor staff	CIU Office, Sahiwal	One day long training seminar

8 Public Consultation and Information Disclosure

401. Details on the public consultations conducted are provided below with the pictorial evidences and persons consulted provided as **Annexure B**.

8.1 Approach

402. The following approach was adopted for conducting due diligence to assess the potential impacts from the proposed works:

- Review of available information including SPS 2009, project design components;
- Field site visits along with the design team to identify and assess project impacts;
- Public consultations with the travellers, educational & health institutions in the proximity of project site to seek their views on the project and to discuss probable project impacts and mitigation measures.

403. Public consultations included meetings and interviews with the general public and other stakeholders. The consultation was carried out in accordance with the IR policy requirements of ADB's SPS 2009 and its outcome is discussed in the proceeding sections. Consultations were also held with the PMU, Local Government Board and the design consultants.

404. In this regard, eight (8) focus group discussions and ten (10) Interviews were conducted in nothern zones of Sahiwal;

405. There are two villages adjacent to WWTP area in the Northern Zone of Sahiwal listed below:

- Muhammad Pur and
- Chak#66GD

8.2 Information Disclosure and Consultation

8.2.1 Scope of Consultations

406. Discussions and consultations on social safeguard aspects of project were held with the educational, health institutions PMU team, CIU team, travelers, students, community in proximity of the project site, and design consultants during the month of May & June 2020. During the consultations, participants were requested to express their concerns with the proposed WWTP and suggestions or measures that can address potential consequences and enhance project benefits. During the consultation meetings, participants were informed about the WWTP, scope of the project and its various components. They were also informed about the stakeholder's involvement and their roles and responsibilities in this project. The

importance of Grievance Redress Mechanism (GRM) and the role of community in GRM was also the agenda of consultations.

8.2.2 General Response regarding construction of WWTP

407. The general response regarding WWTP can be summarized as follows:

- They considered this program of PICIIP as positive step for the development of the city as well as for uplifting the quality of life of the people.
- DPs of both villages were not agreed on the rates provided to them by the DPAC. They are ready to give their land if they get rates as per their desire.
- The Agricultural land is the only income source of DPs and where they will go in case of losing Land and also less compensate rate is provided to them.
- The project will cause pollution to the area.
- Compensation for Tube well and trees.
- DPs raised their concerns about the assessment of compensation for land and other assets and schedule for payment.
- They were keenly interested about the project and its interventions.

8.2.3 General Response regarding water Sanitation sector

408. The general responses regarding Sanitation sector can be summarized as follows:

- They considered this program of PICIIP as positive step for the development of the city as well as for uplifting the quality of life of the people.
- The sewerage system is very bad in city.
- Blockage of sewer lines is the routine matter in the city.
- Sewer water flows in the streets.
- Smell of stagnant sewer water is really very hazardous for the inhabitants of the city.
- In rainy season, the situation becomes worst when the rain water does not found any proper and timely drainage.
- The sewer water flows in streets and it results in disruption of traffic flow.
- This contaminated water gives rise to a number of harmful diseases.
- Silting of sewers/open drains is resulting in choking/blocking of the network in many places.
- Unplanned and haphazard sewers have been installed for the past many years resulting over flowing of the main sewers.
- Ponding problems in low lying areas during rainy season are evident.
- Non-operation/ non-function of existing disposal stations.

- Untreated sewage discharge into canals/drains and in open fields used for local and downstream irrigation may cause unhygienic conditions and potential health hazards.
- Non-availability of sewage treatment facilities.

8.2.4 Gender Responses/Issues

409. The issues discussed were as follows:

- Females also said that there should be a female in MC specifically to listen and register the complaints of females regarding the irregularity in any sewerage related issue. In this way they can easily go to MC to get the water services in a better way.
- Another opinion of females regarding the complaint registration system that it should be so smart that females can easily register their matters through online application by generating any software in this regard.
- It restricts the movements of the children outside as the parents don't let their children to play in streets spoiled with sewer water.
- Stagnant water is also causing bad and unhygienic breathing.
- They said that many infectious diseases are spreading due to the ponding of sewer water.
- They also agreed upon that people should not throw their garbage in sewer lines which ultimately resulted in blockage of sewer lines.
- Women consulted at the project site showed serious concerns about restricting their movement due to movement of labor force during construction.
- The construction contractor will make sure that the movement of the labor force is confined within the construction camp and walking/movement routes and passages of the passerby especially women/handicapped of the nearby localities are open and are not blocked.

8.2.5 Recommendations

410. The recommendations made by the stakeholders were as follows:

- Public safety should be on top priority during construction.
- The traffic should be managed properly during the execution of the Project.
- The pressure of the water should be adequate enough to accomplish all the household tasks with ease and simultaneously the sewer pipes should be capable enough to cater all the sewerage in an efficient manner.
- There should be arrangements for frequent tests to check the quality of water supply after the execution of the project so that reliability and validity of the water supply system will remain intact.
- There should be arrangements to properly segregate the water supply lines and the sewerage lines.
- As the existing water and sanitation is not in a good condition, so this sub-project should be executed on urgent basis with due diligence.
- The mechanism should be developed in such a way that the non availability of electricity should not affect the drainage system of sewerage.

- There should be awareness campaigns to guide public in a way that they may start discouraging the wastage of water and throwing the garbage in sewer lines.
- The contractor should comply with the mitigation measures proposed in the Environmental and Management and Monitoring Plan (EMMP) and HSE compliance policy.
- Contractor's activities should be confined to minimize any inconvenience to the public.
- Dust produced due to construction activities may create different health problems, therefore water sprinkling should be carried out regularly to suppress the dust emissions;
- During construction, labour force movement should be controlled so that activities of the community are not disturbed;
- The participants/representatives also stressed the need for timely completion of the project.
- The movement of the heavy machinery should be controlled to avoid harm to other associated properties/structures;
- Grievance redressal mechanism (GRM) at the PMU level should be formalized to address any complaints from the stakeholders at site.
- Awareness campaigns by using Print, Electronic and Social media are highly required to create civic sense among masses.

9 Grievance Redressal Mechanism

9.1 General

411. The ADB Policy (SPS 2009) requires establishment of a local grievance redress mechanism to receive and facilitate resolution of the Displaced/Affected Persons concerns and grievances regarding the project's social and environment performance. The measures have been identified to mitigate any potential environmental and social impacts to be caused due to implementation of the WWTP works.

412. However, in spite of best efforts, there is every chance that the individuals / households affected by the project or other stakeholders are dissatisfied with measures adopted to address adverse social impacts of the project. To address, such situation an effective Grievance Redress Mechanism (GRM) will be established to ensure timely and successful implementation of the project. It will also provide a public forum to the aggrieved to raise their objections and the GRM would address such issues adequately. It will receive, evaluate and facilitate the resolution of displaced persons' concerns, complaints and grievances about the social and environmental performance at the level of the project.

413. The GRM will aim to investigate charges of irregularities and complaints receive from any displaced persons and provide a time-bound early, transparent and fair resolution to voice and resolve social and environmental concerns link to the project.

414. The PIU shall make the public aware of the GRM through public awareness campaigns. The name of contact person(s) and his/her phone number, PMU contact numbers will serve as a hotline for complaints and shall be publicized through the media and placed on notice boards outside their offices, construction camps of contractors, and at accessible and visible locations in the project area. The project information brochure will include information on the GRM and shall be widely disseminated throughout the project area. Grievances can be filed in writing, via web-based provision or by phone with any member of the PIU.

415. **First tier of GRM.** The PIU is the first tier of GRM which offers the fastest and most accessible mechanism for resolution of grievances. The PIU staff for environment and social safeguards will be designated as the key officers for grievance redressal. Resolution of complaints will be completed within seven (7) working days. Investigation of grievances will involve site visits and consultations with relevant parties (e.g., affected persons, contractors, traffic police, etc.).

Grievances will be documented and personal details (name, address, date of complaint, etc.) will be included, unless anonymity is requested. A tracking number will be assigned for each grievance, including the following elements:

- Initial grievance sheet (including the description of the grievance), with an acknowledgement of receipt handed back to the complainant when the complaint is registered;
- Grievance monitoring sheet, mentioning actions taken (investigation, corrective measures);
- Closure sheet, one copy of which will be handed to the complainant after he/she has agreed to the resolution and signed-off.

416. The updated register of grievances and complaints will be available to the public at the PIU office, construction sites and other key public offices in the project area. Should the grievance remain unresolved, it will be escalated to the second tier.

417. **Second Tier of GRM.** The PIU will activate the second tier of GRM by referring the unresolved issue (with written documentation) to the Sahiwal Waste Management Company (SWMC) who will pass unresolved complaints upward to the Grievance Redress Committee (GRC). The GRC will be established by SWMC before start of site works. The GRC will consist of the following persons: (i) Project Director; (ii) representative District; (iii) representative of the affected person(s); (iv) representative of the local Deputy Commissioners office (land); and (v) representative of the PEPA (for environmental-related grievances). A hearing will be called with the GRC, if necessary, where the affected person can present his/her concerns/issues. The process will facilitate resolution through mediation. The local GRC will meet as necessary when there are grievances to be addressed. The local GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within fifteen (15) working days. The contractor will have observer status on the committee. If unsatisfied with the decision, the existence of the GRC will not impede the complainant's access to the Government's judicial or administrative remedies.

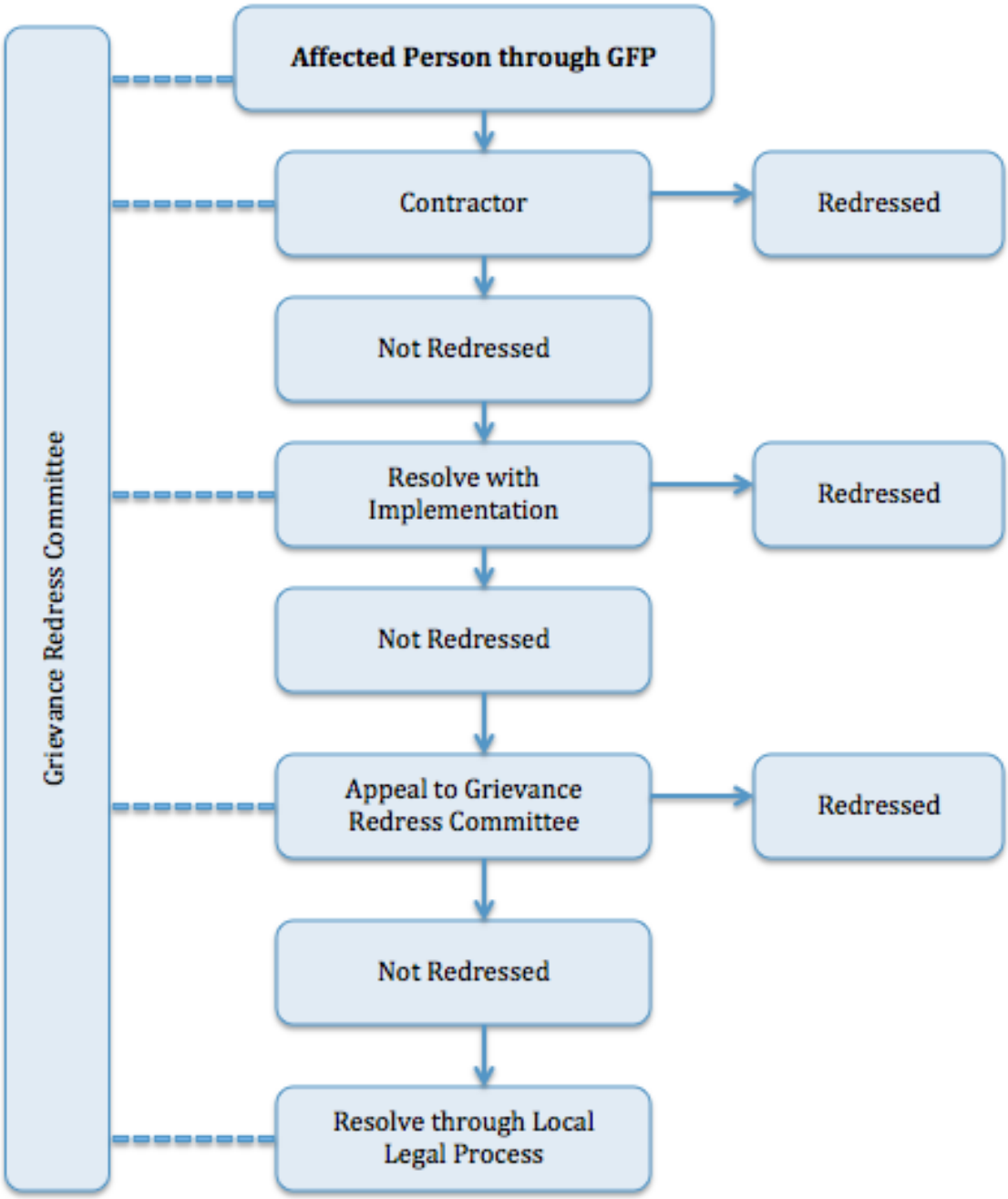
418. The functions of the local GRC are as follows: (i) resolve problems and provide support to affected persons arising from various environmental issues and including dust, noise, utilities, power and water supply, waste disposal, traffic interference and public **safety** as well as social issues and land acquisition (temporary or permanent); asset acquisition; and eligibility for entitlements, compensation and assistance; (ii) reconfirm grievances of displaced persons, categorize and prioritize them and aim to provide solutions within a month; and (iii) report to the aggrieved parties about developments regarding their grievances and decisions of the GRC.

419. The SWMC officers will be responsible for processing and placing all papers before the GRC, maintaining a database of complaints, recording decisions, issuing minutes of the meetings and monitoring to see that formal orders are issued and the decisions carried out.

420. **Third tier of GRM**. In the event that a grievance cannot be resolved directly by the PIU (first tier) or GRC (second tier), the affected person can seek alternative redressal through the district or sub-district committees as appropriate. The PIUs or GRC will be kept informed by the district, municipal or national authority. The grievance redress mechanism and procedure are depicted in the **Figure 8.1** below. The monitoring reports of the EMP and RP implementation will include the following aspects pertaining to progress on grievances: (i) Number of cases registered with the GRC, level of jurisdiction (first, second and third tiers), number of hearings held, decisions made, and the status of pending cases; and (ii) lists of cases in process and already decided upon may be prepared with details such as Name, ID with unique serial number, date of notice, date of application, date of hearing, decisions, remarks, actions taken to resolve issues, and status of grievance (i.e., open, closed, pending).

421. In order to provide greater clarity, the pictoral description of the GRM is provided in **Figure 8.1** below.

Figure 8.1: Grievance Redressal Mechanism



10 Conclusion and Recommendations

422. Due diligence visits were conducted to the project sites and to the project areas in general where the proposed WWTP works in North zones of Sahiwal city are to be conducted. Based on the findings of these visits, this IEE document in order to update the existing umbrella IEE report has been prepared.

423. Since the impact analysis presented earlier in the umbrella IEE report was quite generic and briefly covered all projects to be implemented in Sahiwal city, thus a comprehensive yet focused impact analysis and EMP specifically for the proposed WWTP works has been prepared as part of this IEE report.

424. The EMP contained within this IEE document is considered sufficient for issuance as part of the Contracts to the successful bidder(s) and for subsequent use during the project works for the two Lots. It should be mentioned that prior to the commencement of works, this EMP must be further updated by the Contractor for each of the two Lots into two site specific EMPs (SSEMPs) for review and approval of ADB. In these two SSEMPs, aspects such as a detailed traffic management plan, identification of locations for disposal of debris and spoil and any other details which shall become available later must be included for efficient implementation of all proposed mitigation measures and the subsequent monitoring of these measures.

425. This IEE document is considered sufficient to proceed with commencement of the required works.

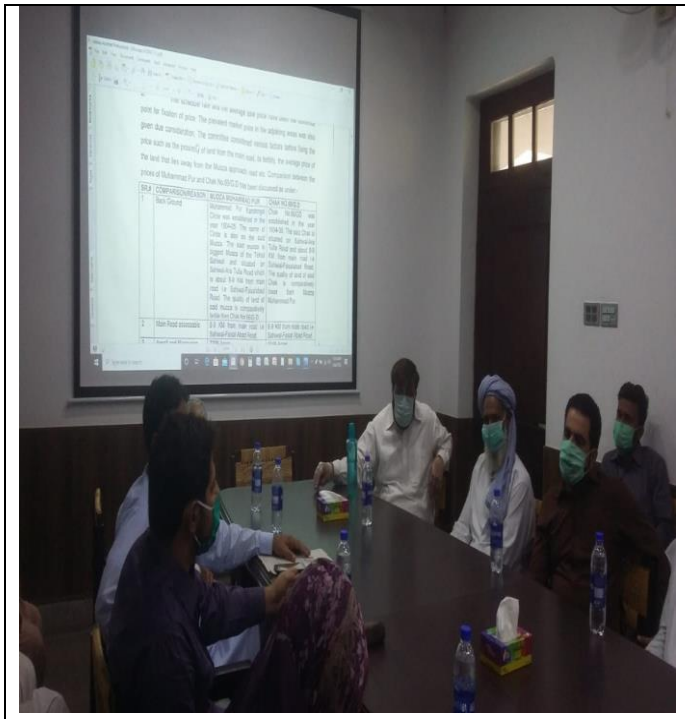
ANNEXURES

Annexure A

Photographs of public consultations

GRC Meeting held under the chairmanship of CO MC, Sahiwal Dated 06-06-2020	
	



PICIIP, CITY IMPLEMINTATION UNIT, SAHIWAL

ATTENDANCE SHEET

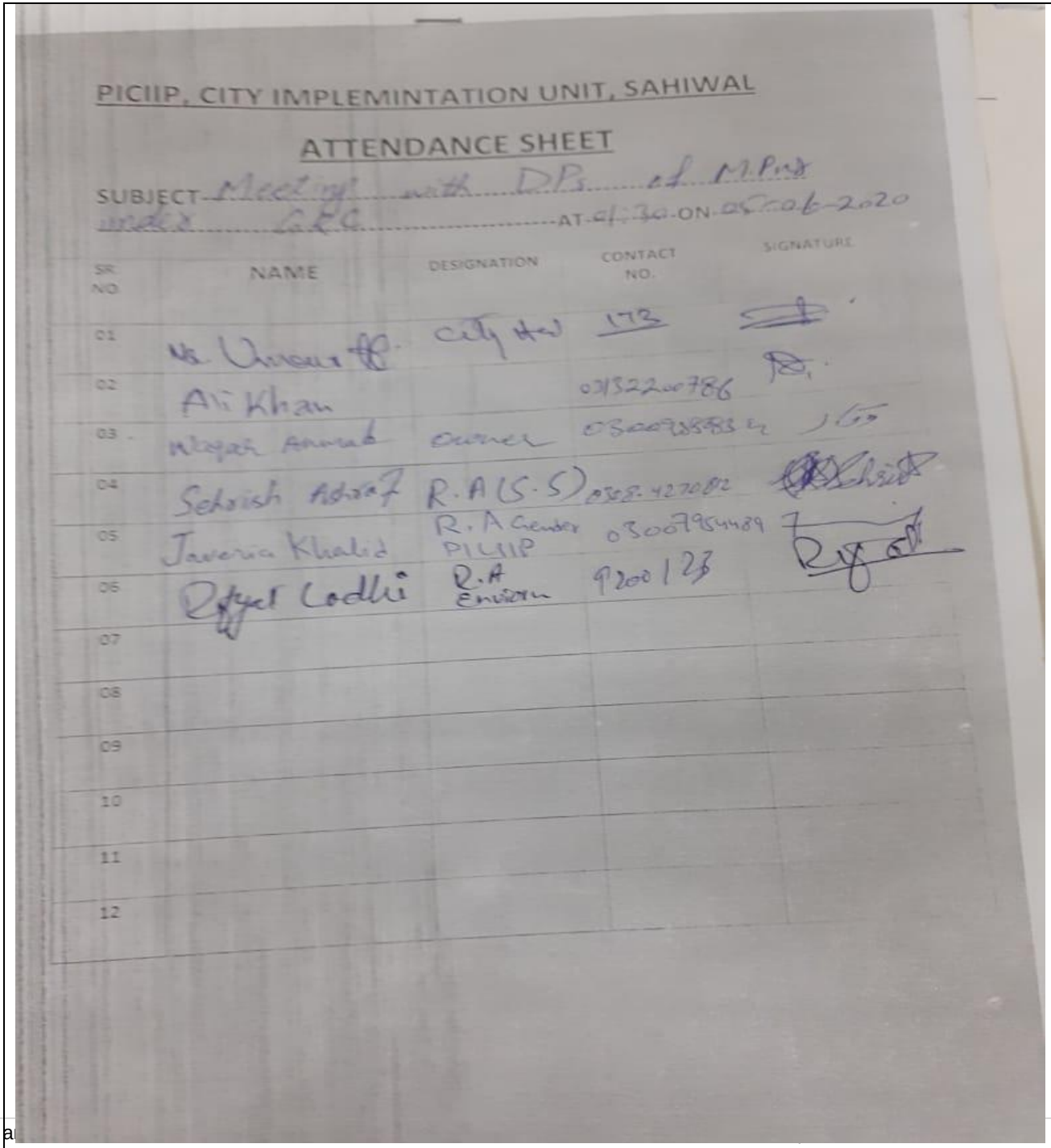
SUBJECT: GRC - for Chak 66 GD & Mohammad pur AT 11:30 ON 6/6/XX

SR NO	NAME	DESIGNATION	CONTACT NO.	SIGNATURE
01	Zubair Hussan	C.C.O M.C SWL	9200157	
02	Mr. M. Asad Khan Babar	M.O (I)	9200135	
03	M. Umair Ali	City Head	9200173	
04	M. Jahangir Khan Lambardar Muhammad Pur			M. Jahangir Khan
05	Muhammad. Ilyas patwari circle.			
06		Muhammad-pur. 66/G.D		
07	یعقوب احمد ولد دین محمد بذریعہ پیرحقیقی شاہد عمل			
08	محمد وحید ولد محمد دین 66/G.D			
09	محمد انور ولد امانت عمل نمبر 66/GD			
10				
11				
12	نعیم اشرف چوہدری 66.GD			

Sr. No	Name	Designation	Contact Number	Signature
12	66 (G.T.) بشیر احمد عمر دین محمد	زمیندار (ماکلائی)		بشیر احمد
13	ذیشان نذیر احمد ولد ندیم احمد	محمد پور (زمیندار)	03009613353	ذیشان
14	ذوالفقار علی (زمیندار)	Farmer	03016909721	[illegible]
15	دلدار احمد خان	محمد پور (زمیندار)	03009550834	دلدار
16	Javeria Khalid	RA Center PICIIP	0300-7954487	[illegible]
17	Sehris Ashraf	R.A Social Safeguard	0308-9270821	[illegible]
18	Zeeshan Muzaffar	Sub-Engineer CIU	0300-6561889	[illegible]
19				
20				
21				
22				

Photographic view of the Meeting held on 5th June 2020 at CIU Office Sahiwal	
	



PICIIP, CITY IMPLEMINTATION UNIT, SAHIWAL

ATTENDANCE SHEET

SUBJECT Meeting with DPs of M.Pur under C.E.C AT 01:30 ON 05-06-2020

SR NO	NAME	DESIGNATION	CONTACT NO.	SIGNATURE
01	Ms. Uroosa	City Hall	173	
02	Ali Khan		03132200786	
03	Waqar Ahmad	Owner	03007285334	
04	Sohaish Ashraf	R.A (S.S)	0308-4270002	
05	Javeria Khalid	R.A Gender PICIIP	03007954489	
06	Rafiyat Lodhi	R.A Environ	9200123	
07				
08				
09				
10				
11				
12				

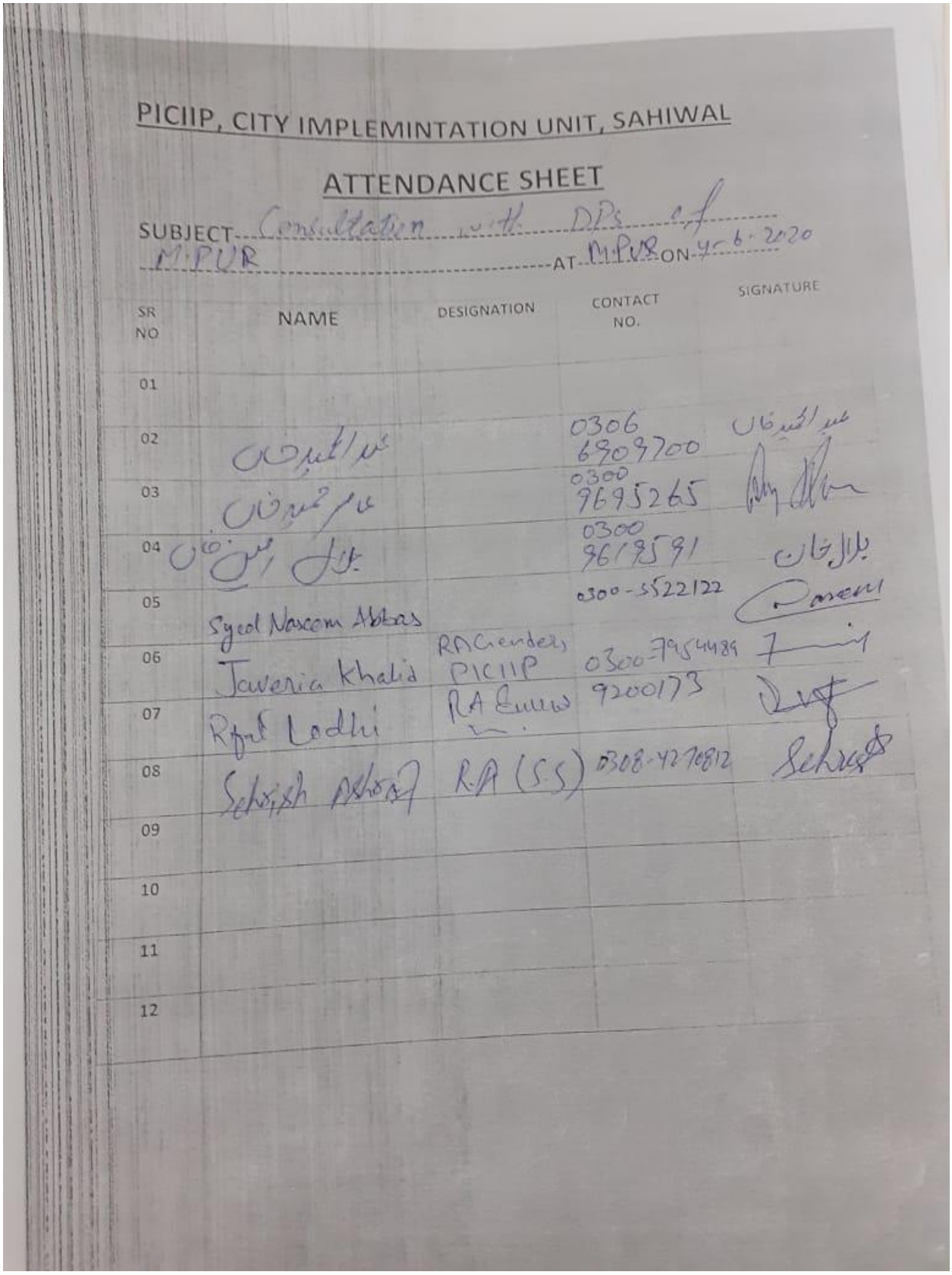
Photographic view of the consultation with DPs of WWTP(North Zone), Sahiwal held on 4th June 2020

PICIIP, CITY IMPLEMINTATION UNIT, SAHIWAL

ATTENDANCE SHEET

SUBJECT Consultation with DPs of MC Sahiwal related to STP AT MC Sahiwal ON 4-1-2020

SR NO	NAME	DESIGNATION	CONTACT NO	SIGNATURE
01	عبدالغفور نسیم	DP of MRs	0300 7690368	
02	محمد نواز	"	0301 6917323	
03	Syed Naseem Abbas	AAO	0300-5522122	
04	Javeria Khalid	RA Gender, PICIIP	0300-7954481	
05	Rafi Lodhi	R.A Environ	0300-9200173	
06	Sehrish Arshad	R.A (S.S)	0308-4270012	
07				
08				
09				
10				
11				
12				



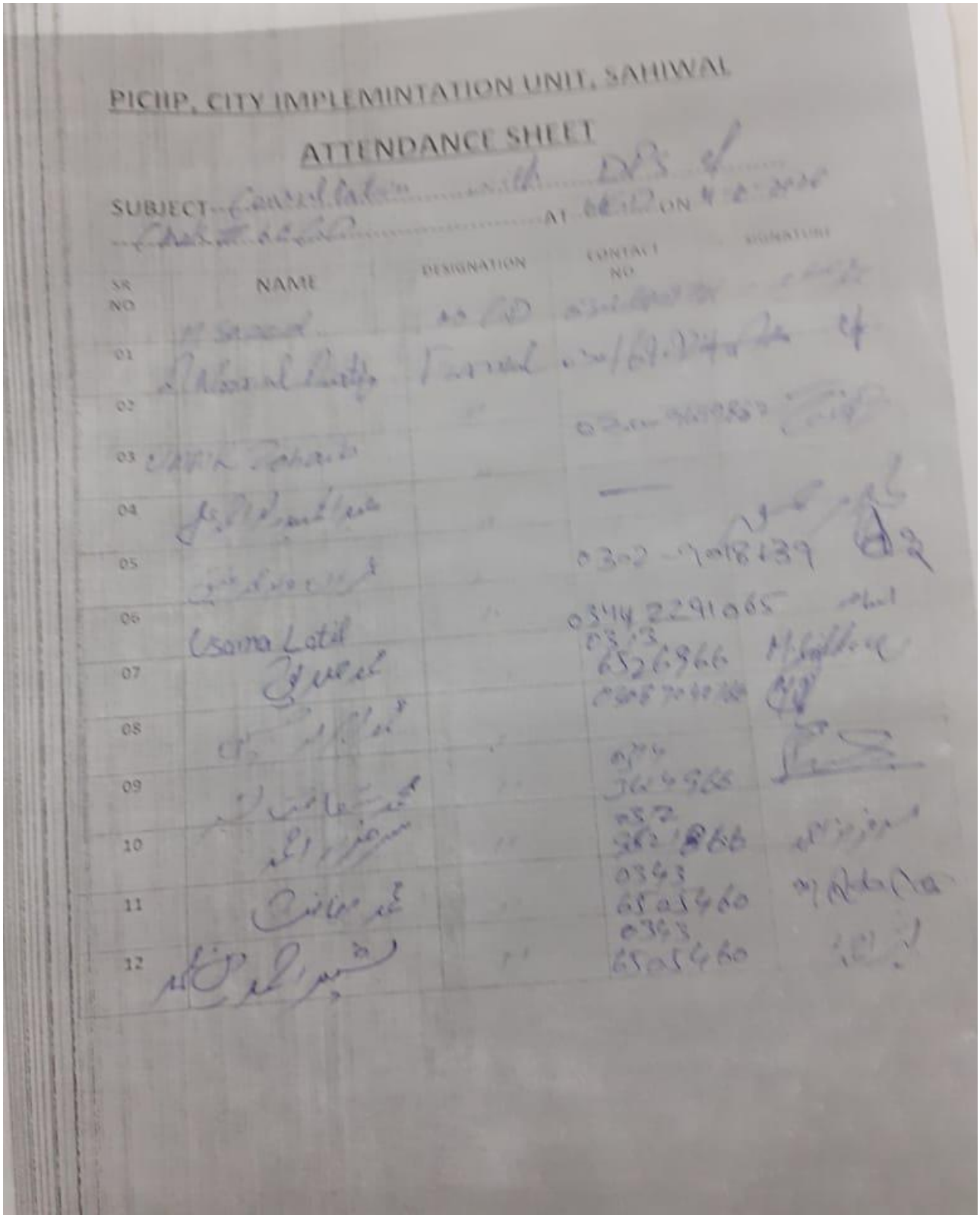
PICIIP, CITY IMPLEMINTATION UNIT, SAHIWAL

ATTENDANCE SHEET

SUBJECT Consultation with DPs of M.PUR AT M.PUR ON 4-6-2020

SR NO	NAME	DESIGNATION	CONTACT NO.	SIGNATURE
01				
02	عبدالحمید خان		0306 6909700	عبدالحمید خان
03	عمر حمید خان		0300 9695265	
04	بلال امین خان		0300 9619591	بلال خان
05	Syed Nascom Abbas		0300-5522122	
06	Javeria Khalid	RA Gender, PICIIP	0300-7954489	
07	Rafi Lodhi	RA Engg	9200173	
08	Sehrish Ashraf	RA (SS)	0308-4270812	
09				
10				
11				
12				



PICIIP, CITY IMPLEMINTATION UNIT, SAHIWAL

ATTENDANCE SHEET

SUBJECT ..... AT ..... ON .....

SR NO	NAME	DESIGNATION	CONTACT NO	SIGNATURE
01				
02				
03				
04				
05			0302-7018139	
06			0344 2291065	
07	Usama Latif		0343 6526966	
08				
09			0344 3649966	
10			0343 3621866	
11			0343 6503460	
12			0343 6503460	

4-6-2020

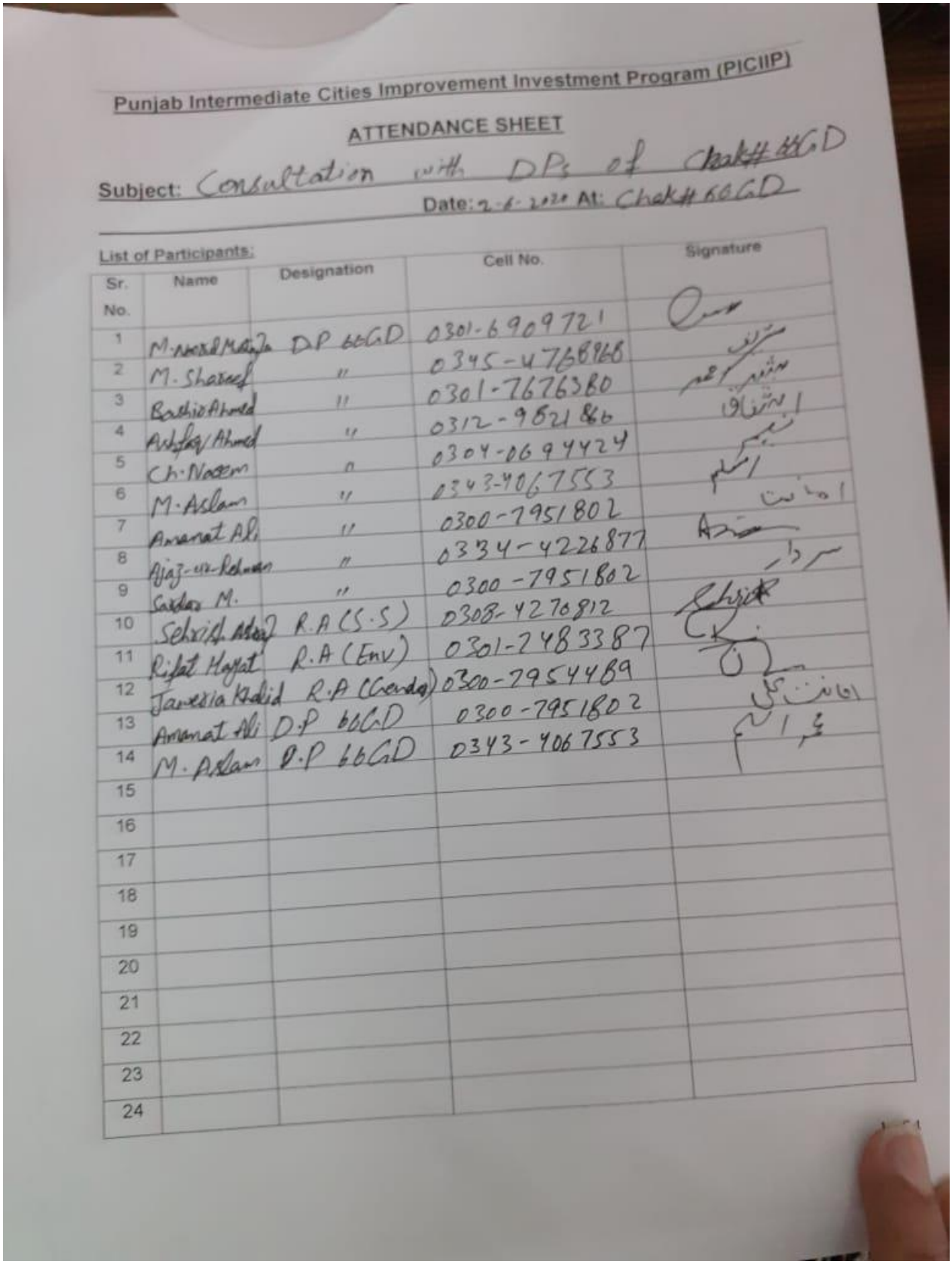
Name	Designation	Contact Number	Signature
محمد شریف	GIS	0343 7811226	
Javeria Khalid	RA Gender	0300-795-4489	
Sehrish Ashraf	R.A (S.S)	0308-4270812	

DPs of Chak#66 G.D Dated 3-6-2020

نام	عہدہ	شناختی کارڈ نمبر	موبائل نمبر	دستخط / انگوٹھے کا نشان
اللہ دتہ ملہی	DP WGD		0312 6166796	
محمد اقبال	"		0300 2274214	
محمد [illegible]	"		0300 4991251	M Akram
لواء المصطفیٰ	"		0303 6955064	
اکرم علی	"		0300 6930929	Akram Ali
محمد خالد	"		0302 4998062	M Khalid
محمد منظور	"		0307 5327551	
منشاء	"		0300 4193190	
مزمل حسین	"		2465466 0300	
محمد شہید	"			
فرید احمد	"		0307 5327551	Farid
دریا خان	"		0300 4193190	
سلطان احمد	"		0301 5293932	
Jawaria Khalid	RA Member, PCIIP		0300-7154489	
Rifat Lodhi	RA Envir.		9200177	
Sehrish	R.A (S.S)		2308.427082	

4. شرکاء کی فہرست D.Ps of M.Pus Dated 13-6-2020

سیریل نمبر	نام	عہدہ	شناختی کارڈ نمبر	موبائل نمبر	دستخط/انگوٹھے کا نشان
1	Ali Murad	D.P M.Pus		0300 6920761	Ali
2	نور الامین مستوئی	D.P M.Pus		0301-6909724	
3	غضنفر علی	DP M.Pus		0321-6902854	
4	عمیر بن کریان	"		03066 6924733	
5	وقار احمد خان	"		0300-9550834	waqar
6	فیض احمد خان	"		03016906645	
7	محمد ساجد خان	"		03009695995	
8	ذیشان نصیر خان	"		0300 6900274	ذیشان
9	محمد علی خان	"		03132200786	
10	Javeria Khalid	RA Gender, PICIP		0300-7954489	
11	Rifyat Lodi	RA Environ. PICIP		9200173	
12	Sehrish Ashraf	R.A Social Safeguard		0308-4270812	Sehrish



Punjab Intermediate Cities Improvement Investment Program (PICIIP)

ATTENDANCE SHEET

Subject: Consultation with DPs of Chak# 66GD

Date: 2-6-2020 At: Chak# 66GD

List of Participants:

Sr. No.	Name	Designation	Cell No.	Signature
1	M. Waqar Mirza	DP 66GD	0301-6909721	
2	M. Sharif	"	0345-4768966	
3	Badar Ahmed	"	0301-7676380	
4	Arif Iqbal Ahmed	"	0312-9821866	
5	Ch. Naeem	"	0304-0694424	
6	M. Aslam	"	0343-4067553	
7	Amanat Ali	"	0300-7951802	
8	Ajaz-ur-Rehman	"	0334-4226877	
9	Sardar M.	"	0300-7951802	
10	Sehrish Aziz	R.A (S.S)	0308-4270812	
11	Rifat Hayat	R.A (Env)	0301-2483387	
12	Javeria Khalid	R.A (Gender)	0300-7954489	
13	Amanat Ali	D.P 66GD	0300-7951802	
14	M. Aslam	D.P 66GD	0343-4067553	
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				


ASSISTANT COMMISSIONER
SAHIWAL

PICIIP, CITY IMPLEMENTATION UNIT, SAHIWAL

ATTENDANCE SHEET

SUBJECT: Public Consultation with DPs in AC office Regarding WWTP South Zone AT 12:30 PM 1:30 PM ON THURSDAY

SR NO.	NAME	DESIGNATION	CONTACT NO.	SIGNATURE
01	SUFYAN DILAWAR	LAC/AC		
02	M. UMAIR ALI	City Head CIU-SWL	040-9200173	
03	مہر انور	66/G.D	0300-7951802	
04	بشیر احمد	66/G.D	03017676380	Bashir Ahmad
05	ناصر نفیر	66/G.D	03457435255	
06	نور مصطفیٰ	66/G.D	03036955065	
07	سرفراز احمد	66/G.D	03129821866	سرفراز احمد
08	مہر بشیر احمد	66/G.D	03009609257	
09	منظور احمد	چیف آپریٹر	0307-5327551	منظور احمد
10	Noor-ul-Mustafa	66/GD	03016907221	
11	Ali Murad Khan	M.Pur	03006920761	Ali Murad
12	M.Ali Khan	M. Pur	03132200786	

Annexure B

Environment Screening & Categorization Forms (ESCF)

- **Punjab Intermediate City Improvement Investment Project (PICIIP)**

- **Environment Screening & Categorization Form (ESCF**

Instructions

(i) The CIU staff may complete this form to support the environmental categorization of a project and submit to the ADB for verification and approval.

(ii) This checklist focuses on environmental issues and concerns. To ensure that the Social dimensions are adequately considered, refer also to the Checklists on involuntary resettlement and Indigenous Peoples.

(iii) This form is to be completed assuming the "without mitigation" case. The purpose is to identify potential impacts.

2. **Project Name: Construction of North Zone Waste Water Treatment Plant (WWTP) Sahiwal**

2. Project Scope of Work (list the major interventions): The north zone WWTP is proposed for north side of Sahiwal city. It is proposed that WWTP will be designed to cater for the sewerage generation up to 2044. There are two major components of WWTP. One is influent pumping station/ disposal station which will be constructed on 2.43 acres land from the territory of Muhammad Pura village of District Sahiwal while other component is construction of sewage treatment plant. Waste Stabilization Ponds (WSP) technology will be use in this sewage treatment plant to treat the sewerage water of north side of Sahiwal city. The degree of proposed treatment plant would be such that treated effluents can safely be reused for agriculture purpose as per WHO guidelines and discharge into inland water as per Punjab Environmental Quality Standards (PEQS). The total capacity of proposed WWTP is 24.6MGD.

3. **Project Location:** Chak No.66/ G.D and Chak Muhammad Pura, District Sahiwal

4. **Total Project Cost (million PKR):** 3128.27Million

5. Project GPS Co-ordinates2 30.717813"N 73.025188"E

6. The proposed project activity is NOT listed in the Prohibited Investment Activities List (PIAL) (please refer to Annexure I below).

YES **No** ☑ ☐

Based on mapping of GPS Co-ordinates onto Google Earth (Annexure II), please respond to the following:

7. Is the project site(s) located adjacent to or within any environmentally sensitive areas (National Park, Protected Area, Buffer zone of Protected Area, Wetland, Mangrove?) If so, provide details and explain the potential risks to the sensitive areas from the proposed project activities:

S.No	Issues	Yes	NO
1.	Is the sub-project area adjacent to or within the cultural heritage site?		√
2.	Is the sub-project area adjacent to or within environmentally protected area?		√
3.	Is the sub-project area adjacent to or within Wetland?		√
4.	Is the sub-project area adjacent to or within the Forest?		√
5.	Is the sub-project area adjacent to or within Biodiversity hotspot?		√
6.	Is the sub-project area adjacent to or within Buffer zone of		√

[1] Required to assess categorization under Pak EPA guidelines

[2] In case of cluster of projects, please provide GPS Co-ordinates for each project location

Is project(s) located in a densely populated area ? NO

8. Use the satellite imagery to identify the numbers and types (as far as possible) of sensitive receptors (SR) below:

SR Type 1: School **Approx. Number of SR1:** 0

SR Type 2: Mosque **Approx. Number of SR2:** 0

SR Type 3: Hospital/Clinic **Approx. Number of SR3:**0

SR Type 4: Public building **Approx. Number of SR4:** 0

SR Type 5: Grave yard **Approx. Number of SR5:** 0

9. Will the proposed project activity require dislocation of people? If so, please mention the estimated number of people to be displaced.

Yes

Total one hundred and forty seven (147) people will dislocate economically due to project activity. Agriculture is the source of income. The numbers of affected persons from Chak Muhammad Pura are one hundred and fourteen (114) while from Chak 66/GD is thirty three (33) in numbers.

10. Will any land acquisition be required for the proposed project activity? If so, please provide details.

Yes

The north zone WWTP has been proposed on a private piece of land. The project is proposed at Chak 66 /GD and Chak Muhammad Pura of Sahiwal district. Total 201 Acres, 03 Kanals and 12 Marlas land will acquire for proposed WWTP. The land is under the possession of private ownership of local community and was being used for agriculture purposes.

11. Please provide details of any significant expected impacts (''without mitigation'' case) due to the proposed project activities on the identified sensitive receptors:

Sr. No	Type of expected impact	Details on Severity of expected impacts
1	Generation of high dust levels in sensitive areas during construction.	Medium
2	High noise levels in sensitive areas due to blasting and civil works.	Minimal
3	Occupational and community health and safety risks.	Medium
4	Impact on water bodies due to disposal of Chemicals/oils/lubricants and other hazardous/semi-hazardous substances.	Minimal

5	Risks to community health and safety caused by (any or all of the below) (i) Management and disposal of waste and/or (ii) Civil or electrical works and/or (iii) Accidental and natural hazards, particularly where structural elements or components of project are accessible to members of affected community and/or (iv) Fire, electric shock or failure of civil structures during operation.	Medium
6	Generation of disease vectors due to project activities.	Minimal
7	Depletion and/or Contamination of ground water reservoirs due to leaching of chemicals, oil, lubricants and other hazardous/semi- hazardous substances.	Medium
8	Improper sanitation and liquid waste disposal system.	Minimal
9	Degradation of land and ecosystem (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests).	NO
10	Road blocking and temporary flooding due to land excavation during rainy season.	Medium
11	Dislocation or involuntary resettlement of people.	Yes
12	Impacts on vulnerable groups such as the poor, women and children and indigenous peoples.	NO
13	Degradation of cultural property and loss of cultural heritage and tourism reserves.	NO
14	Impact on Flora and Fauna, particularly on any endangered species located in project area(s).	Endangered species are not present in project area.
15	Social conflicts	High
16	Interference with other utilities and blocking of access to building	Minimal

Project Category Recommendation

12. It is recommended that based on the available project information and subsequent analysis, the project should be placed in (please tick one):

☐ Category 'A' ☑ Category 'B' ☐ Category 'C'

13. Please provide an explanation to justify the Categorization above:

There are no sensitive receptors at project site and severity of expected impacts as evident from above table are less adverse and few site specific impacts are irreversible and As per ADB Safeguard Policy, a proposed project is classified as category "B" if it is likely to have few site specific adverse environmental impacts. So Initial Environmental Examination (IEE) would be require.

Screening & Categorization Conducted by: **Endorsed by:**

_____ _____

Environment Officer, CIU **Head of PMU**

Approved by: **Endorsed by:**

_____ _____

ADB Environment Safeguards Focal Point Project Officer, ADB

Annexure C

Occupational Health and Safety Plan

Occupational Health and Safety covers all personnel working under the project and will be in line with the World Bank EHS guidelines on health and safety.

The Occupational Health and Safety program will aim to ensure that the workplace is safe and healthy by: addressing the hazards and risks at the workplace; outlining the procedures and responsibilities for preventing, eliminating and minimizing the effects of those hazards and risks; identifying the emergency management plans for the workplace or workplaces; and, specifying how consultation, training and information are to be provided to employees at various workplaces.

Some of the risks/hazards associated with workplaces are due to working close to or at sites associated with the various project construction activities. Other risks associated with the project construction phase include risk of increase of vector borne and other different diseases.

The following sections will be implemented during the construction phase to address and ensure workers' health and safety.

a. Screening and regular unannounced checking of workers.

As per the procedure for hiring workers, all contractors and labor agencies are required to make all prospective workers undergo medical tests to screen for diseases and sicknesses, prior to selection and employment of any worker. The contractor is also responsible for ensuring that no worker who has a criminal record is employed at the project site. It will be ensured that all workers undergo medical tests to screen diseases at source and at sites in consultation with the designated Health Officer.

In addition to this, the Project Management will also undertake sudden, unannounced checks on workers to look for diseases such as HIV, STDs, and hepatitis and take necessary steps as mandated by the Contractual agreement between the Contractor and the Worker(s).

b. Minimizing hazards and risks at the workplace.

To ensure safety at all work sites, the following will be carried out:

i. Installation of signboards and symbols in risky and hazardous areas, to inform workers to be careful.

ii. Construction of barricades around construction sites and deep excavated pits, to cordon off and deter entry of unauthorized personnel and workers into these areas.

iii. Providing a safe storage site/area for large equipment such as power tools and chains, to prevent misuse and loss.

iv. Proper Housekeeping: Ensuring that materials are all stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse. Brick stacks will not be more than 7 feet in height and for concrete blocks they will not be more than 6 feet high.

v. Removing all scrap timber, waste material and rubbish from the immediate work area as the work progresses.

vi. Where scaffolds are required, ensuring that each scaffold or its components shall be capable of supporting its own weight and at least 4 times the maximum intended load applied or transmitted to it. The platform/scaffold plank shall be at least 15 inches wide and 1.5 inches thick. The rope should be capable of supporting at least 6 times the maximum intended load applied or transmitted to that rope. Pole scaffolds over 60 feet in height shall be designed by a registered professional engineer and shall be constructed and loaded in accordance with that design. Where scaffolds are not provided, safety belts/safety nets shall be provided;

vii. Ensure that all ramps or walkways are at least 6 feet wide, having slip resistance threads and not inclined at more than a slope of 1 vertical and 3 horizontal.

viii. Stacking away all excavated earth at least 2 feet from the pit to avoid material such as loose rocks from falling back into the excavated area and injuring those working inside excavated sites.

ix. Constructing support systems, such as bracing to adjoining structures that may be endangered by excavation works nearby.

x. Only a trained electrician to construct, install and repair all electrical equipment to prevent risks of electrical shocks and electrocution.

xi. Install fire extinguishers and/or other fire-fighting equipment at every work site to prepare for any accidental fire hazards.

c. Provision of Personal Protective Equipment

Risks to the health and safety of workers can be prevented by provision of Personal Protective Equipment (PPEs) to all workers. This will be included in the construction cost for each Contractor. Depending on the nature of work and the risks involved, contractors must provide

without any cost to the workers, the following protective equipment:

i. High visibility clothing for all personnel during road works must be mandatory.

ii. Helmet shall be provided to all workers, or visitors visiting the site, for protection of the head against impact or penetration of falling or flying objects.

iii. Safety belt shall be provided to workers working at heights (more than 20 ft) such as roofing, painting, and plastering.

iv. Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on feet.

v. Ear protecting devices shall be provided to all workers and will be used during the occurrence of extensive noise.

vi. Eye and face protection equipment shall be provided to all welders to protect against sparks.

vii. Respiratory protection devices shall be provided to all workers during occurrence of fumes, dusts, or toxic gas/vapor.

viii. Safety nets shall be provided when workplaces are more than 25 feet (7.5 m) above the ground or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors or safety belts is impractical.

The specific PPE requirements for each type of work are summarized below.

Table C.1 PPE Requirement List

Type of Work	PPE
Elevated work	Safety helmet, safety belt (height greater than 20 ft), footwear for elevated work.
Handling work safety	Helmet, leather safety shoes, work gloves.
Welding and cutting work	Eye protectors, shield and helmet, protective gloves.
Grinding work	Dust respirator, earplugs, eye protectors.
Work involving handling of chemical substances	Dust respirator, gas mask, chemical-proof gloves. Chemical proof clothing, air-lined mask, eye protectors.

Wood working	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Blasting	Hard hat, eye and hearing protection.
Concrete and masonry work	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Excavation, heavy equipment, motor graders, and bulldozer operation	Hard hat, safety boots, gloves, hearing protection.
Quarries	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.

d. Procedures to Deal with Emergencies such as Accidents, Sudden Illness and Death of Workers

First aid kits will be made available at all times throughout the entire construction period by the respective contractors. This is very important, because most work sites will be at some distance from the nearest hospital. In addition to the first aid kits, the following measures should be in place:

i. Provision of dispensaries by the individual EPC contractor.

ii. A vehicle shall be on standby from the Project Office so that emergency transportation can be arranged to take severely injured/sick workers to the nearest hospital for immediate medical attention.

iii. A designated Health Officer/worker for the Project will be identified as a focal person to attend to all health and safety related issues. This employee's contact number will be posted at all work sites for speedy delivery of emergency services. The focal person shall be well versed with the medical system and facilities available at the hospital.

iv. Communication arrangements, such a provision of radios or mobile communication for all work sites, for efficient handling of emergencies, will be made.

e. Record Maintenance and Remedial action

The Project Management will maintain a record of all accidents and injuries that occur at the work site. This work will be delegated by the contractor to the site supervisor and regularly reviewed every quarter by project management. Reports prepared by the contractor shall include information on the place, date and time of the incident, name of persons involved,

cause of incident, witnesses present and their statements. Based on such reports, the management can jointly identify any unsafe conditions, acts or procedures and recommend for the contractor to undertake certain mitigative actions to change any unsafe or harmful conditions.

f. Compensation for Injuries and Death

Any casualty or injury resulting from occupational activities should be compensated as per the local labor laws of Kyrgyz Republic. Where compensation is sought by the injured party, proper procedures for documentation of the case will be followed, including a detailed report on the accident, written reports from witnesses, report of the examining doctor and his/her recommendation for treatment. Each individual contractor will be responsible for ensuring compensation for the respective workers.

g. Awareness Programs

The Project management will undertake awareness programs through posters, talks, and meetings with the contractors to undertake the following activities:

i. Dissemination sessions will clarify the rights and responsibilities of the workers regarding interactions with local people (including communicable disease risks, such as HIV/AIDS), work site health and safety, waste management (waste separation, recycling, and composting), and the illegality of poaching.

ii. Make workers aware of procedures to be followed in case of emergencies such as informing the focal health person who in turn will arrange the necessary emergency transportation or treatment.

h. Nomination of a Health and Safety Focal Person

Within each site (especially if different sites are being implemented by different contractors), a Health and Safety Focal Person will be appointed. The Terms of Reference for the focal person will mainly be as follows:

i. Function as the focal person/representative for all health and safety matters at the workplace;

ii. Responsible for maintaining records of all accidents and all health and safety issues at each site, the number of accidents and its cause, actions taken and remedial measures undertaken in case of safety issues;

iii. Be the link between the contractor and all workers and submit grievances of the workers to the contractor and instructions/directives on proper health care and safety from the contractors back to the workers;

iv. Ensure that all workers are adequately informed on the requirement to use Personal Protective Equipment and its correct use;

v. Also responsible for the first aid kit and making sure that the basic immediate medicines are readily available.

Annexure D

Emergency Response Plan

D.1 PURPOSE

The purpose of this Emergency Response Procedure is to provide measures and guidance for the establishment and implementation of emergency preparedness plans for the BNBR project. The aim of the Emergency Response Procedure is to:

(i) Ensure all personnel and visitors to the office/job sites are given the maximum protection from unforeseen events.

(ii) Ensure all personnel are aware of the importance of this procedure to protection of life and property.

D.2 EMERGENCY PREPARATION AND RESPONSE MEASURE SCOPE

The emergency management program is applied to all Project elements and intended for use throughout the Project life cycle. The following are some emergencies that may require coordinated response.

(i) Construction Accident

(ii) Road & Traffic Accident

(iii) Hazardous material spills

(iv) Structure collapse or failure

(v) Trauma or serious illness

(vi) Sabotage

(vii) Fire

(viii) Environmental Pollution

(ix) Loss of person

(x) Community Accident

D.3 RESPONSIBILITIES

The detailed roles and responsibilities of certain key members of the Emergency Response team available to assist in emergency are provided in **Table D.1** below.

Table D.1 Emergency Response Team

Action Group	Responsibility
Emergency Coordinator	▪ Overall control of personnel and resources. ▪ The Emergency Coordinator will support and advise the Site Safety Supervision as necessary. ▪ Serves as public relations spokes persons, or delegates to some staff member the responsibility for working with news media regarding any disaster or emergency. Also assure proper coordination of news release with appropriate corporate staff or other designated people.
Site Safety Supervision (Emergency Commander)	▪ Overall responsibility for activating emergency plan and for terminating emergency actions. ▪ Be alternative of emergency response chairpersons. ▪ Disseminates warnings and information as required to ensure all people in the immediate area have been warned and evacuated either by alarms or by word of mouth. ▪ Supervise the actions of the Emergency Response Team to ensure all persons are safe from the danger. ▪ Notify outside authorities if assistance is required. ▪ Carries the responsibility for coordinating actions including other organizations in accordance with the needs of the situation. ▪ Ensure maximum co-operation and assistance is provided to any outside groups called to respond to an emergency. ▪ Establish and appoint all emergency organization structure and team. ▪ Assures adequate delegation of responsibilities for all key positions of assistants on the Project to assist with any foreseeable emergency. ▪ Ensure resources available to purchase needed emergency response equipment and supplies. ▪ Assures that all persons on the Emergency Response Team aware and fully understand their individual responsibilities for implementing and supporting the emergency plan. ▪ Establish the emergency drill schedule of all identified emergency scenarios, track the status and evaluate the emergency. ▪ The Emergency Commander shall ensure that senior management personnel have been reported of the emergency as soon as practical after the event.
	▪ Ensure that the exit route is regularly tested and maintained in good working order. ▪ Maintain station at the security gate or most suitable location to secure the area during any emergency such that only authorized

Security Team	personnel and equipment may enter, prevent access to the site of unauthorized personnel. ▪ Assist with strong/activation of services during an emergency. ▪ Ensure vehicles and obstructions are moved to give incoming emergency vehicles access to the scene, if ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct any incoming emergency service to the site of emergency.
Rescue & Medical Team	▪ Protect the injured from further danger and weather. ▪ Provide treatment to the victim(s) to the best of their ability by first aid and then transfer to hospital. ▪ Remain familiar with the rescue activities and rescue apparatus. ▪ Assist outside medical services personnel when they arrive
General Administration Team	Response to support any requested general facilities for assisting Emergency Response Team in their work.
Government Relation Team	▪ Coordinate with local government on a matter of concerned in the emergency response plan to liaise with local officers in their affair for support Emergency Response Team. ▪ Coordinate emergency plan with the government authorities, local community.
Environment Team	In case of emergency related to the environmental pollution such as the chemical spill, oil spill into the ambient, the environment team will support the technical advice to control and mitigate the pollution until return to the normal situation.
Department Heads	▪ Call up of personnel into the safe location for protective life and property. ▪ Take immediate and appropriate action while Emergency Response Team is being mobilized. ▪ Keep in touch with the Emergency Commander ▪ Control and supervise operators and contractors on the implementation of this procedure, with consultation with Safety Team as necessary. ▪ Provide and maintain emergency equipment of their responsible areas.
Other Staff and Employees	▪ All other staff and employees will remain at their workstations or assembly point unless directed otherwise from Emergency Response Team. ▪ Each supervisor will ensure that all members of his work group are accounted for and keep in touch with each of their Department Head.

D.4 PROCEDURE

Emergency situation and injuries to person can occur at any time or place either on Project site or elsewhere. The most two common types of emergencies on site are fire and serious

accident.

Figure D.1 Emergency Procedure for Fire

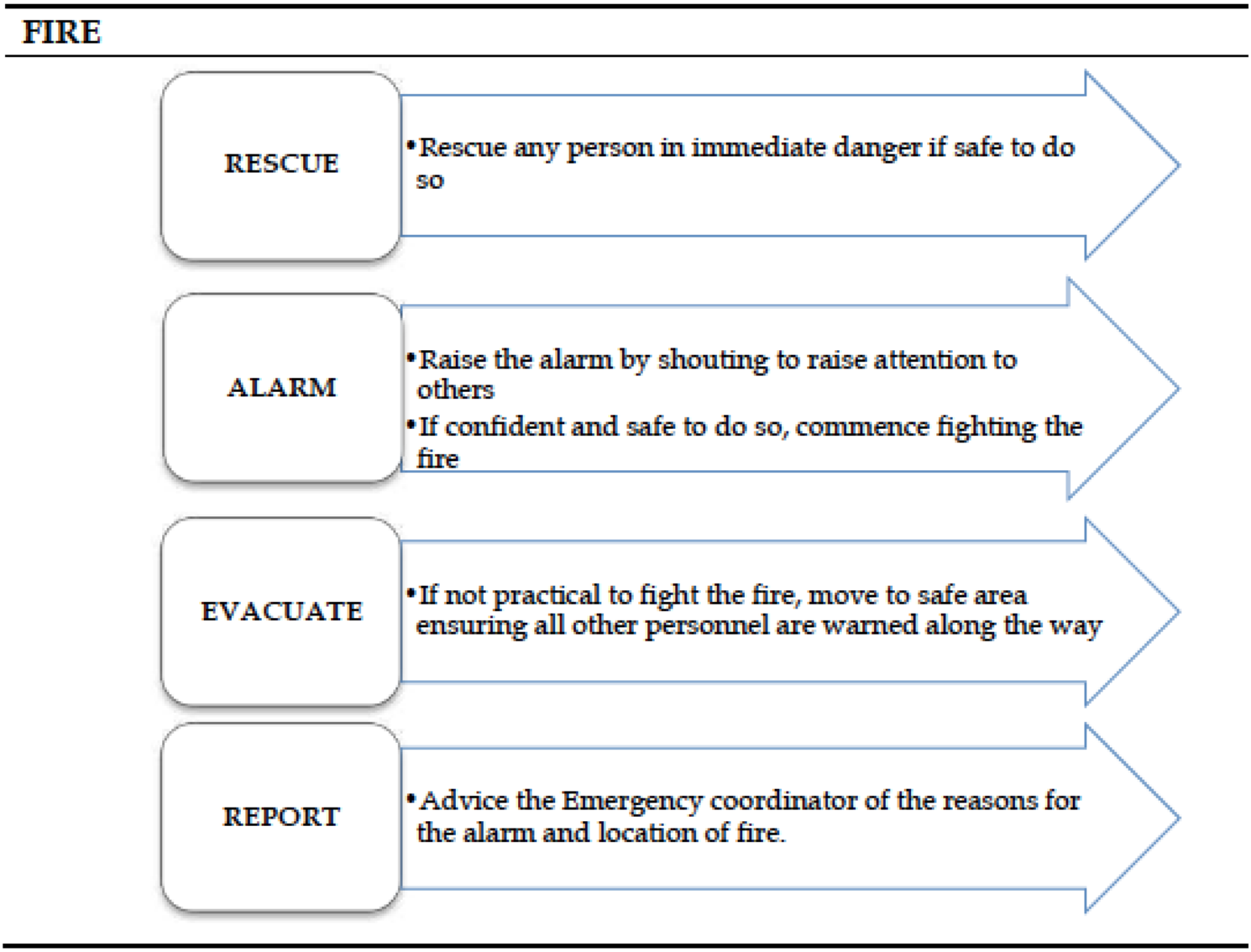


Figure D.2 Emergency Procedure for Serious Accident

ACCIDENT

In the event of injuries of persons, the first person on the scene should take the following action:

If a hazard exists consider your own safety then if possible remove the hazard or the injured person.

Assess the patient by checking for Airway, Breathing, Pulse and obvious

Report directly to First Aid or Security Centers, when raising the alarm you must clearly give the following in formation;

- Your name and the detail of accident
- The location of the injured person(s)
- The number of persons injured
- The extent of the injuries, if known
- What known hazards are in the area

Make the injured person as comfortable as possible

Treat the obvious injuries

Reassure the injured person

D.5 COMMUNICATION WITH AUTHORITIES / PRESS AT SITE

In the event of an accident or incident, only senior staff is permitted to give factual information to the authorities for resource of liability exposure. The press must be avoiding politely, at all costs, with the terse comment that “the matter is under investigation and relevant information when available will be provided by our Head Office” Do not ever give your opinion or story.

First Aid Persons

Upon advice of medical emergency, make immediate assessment to response required and if necessary, advise security to summon ambulance or medical assistance, the qualified first aid

attendant should also,

- Provide treatment to the victim(s) to the best of his/her ability.
- Ensure the safety of victims by ceasing any work activity in the area.
- Protect the injured from further danger and weather.
- Assist medical services personnel when they arrive.

General Administration Team

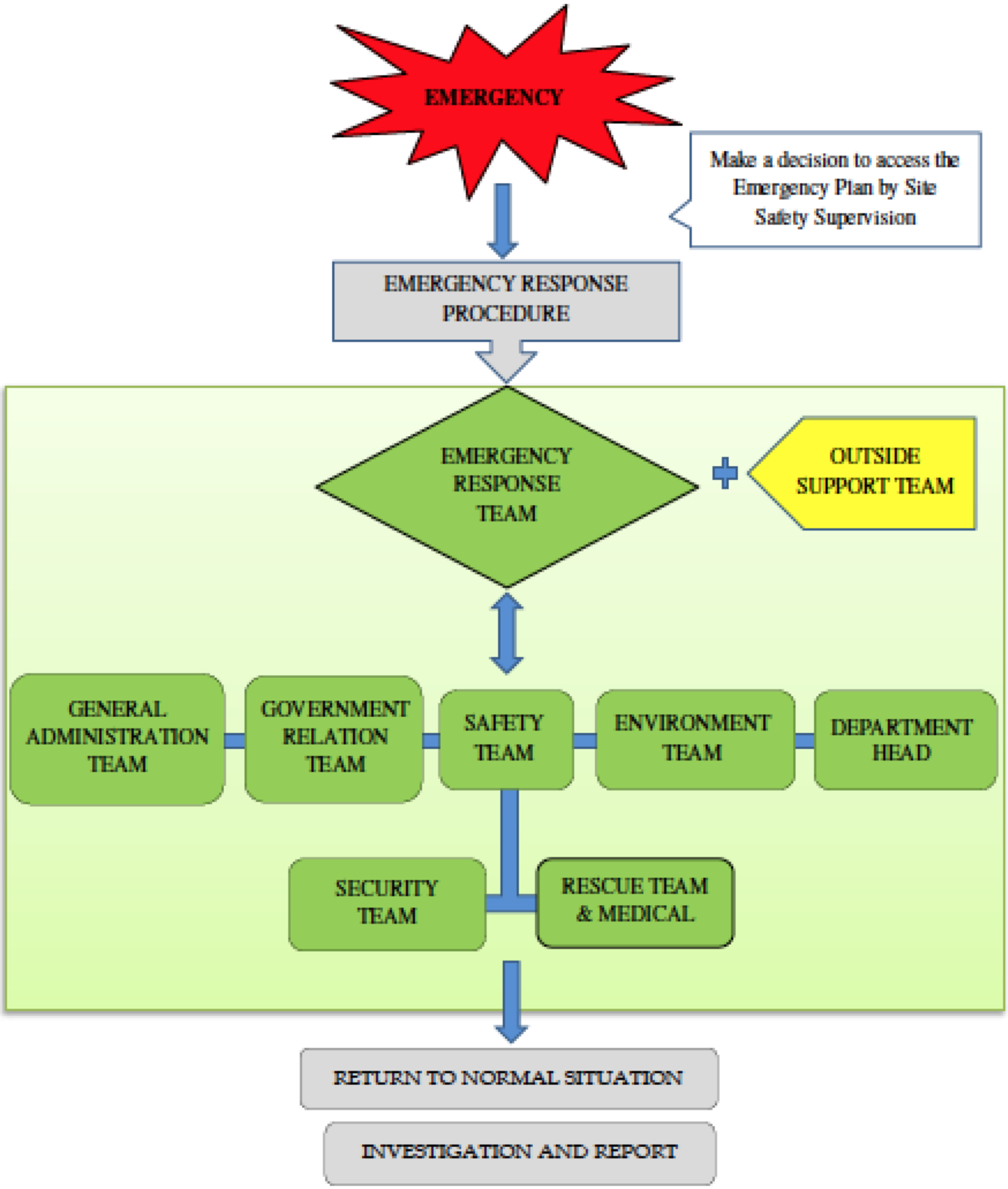
Upon advice of medical emergency, maintain contact with first aid personnel and summon ambulance if required.

Security Team

- If ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct vehicle closest to the scene.
- Prevent access to the site of unauthorized personnel (press, etc.).

Emergency Coordinator

- The Emergency Coordinator shall assist emergency personnel at the scene as required through allocation of company resources.
- The Emergency Coordinator shall ensure next-of-kin are properly notified as soon as possible and give whatever company support and assistance is necessary to assist them bundle the situation
- The Emergency Coordinator shall ensure that senior management personnel are advised of the emergency as soon as practical after the event.



Note: Name of contact person and call number from Owner/Contractor to be determined.

Section A: Identification Data

Report No:	Date of Reported:	Reporter:	Sign:
Job Title:		Company Name:	

Section B: Violence Rate

Accident Violence: ☐ 01-Death ☐ 02-Serious Injury ☐ 03-Lost Time Injury ☐ 04-First Aid ☐ 05- Not Injury ☐ 06-Near Miss

Property Damage Cost: ☐ 1-2,000 USD ☐ 2,001-10,000 USD ☐ 10,001-50,000 ☐ > 50,001

Section C: Environmental Impact

Affected area	☐ Construction area	☐ Public area	
Receptor	☐ None	☐ Workers	☐ Community
Type of pollution	☐ Physical	☐ Chemical	☐ Biological
Toxicity	☐ Non-toxic	☐ Low - toxic	☐ High - toxic
Return to Normal	☐ 1 day	☐ 1 day to 1 week	☐ ≥ 1 week
Cumulative impact	☐ Non-cumulative	☐ Cumulative	

Section D: Injured/Illness Employee

1.Name:	Sex: ☐ Male ☐ Female	Date of Birth: Month / Day / Year	Age:	Regular Job Title:	Experience: In this job title Years Weeks / In this Project Years Weeks

Site:	Company:	Reference:	Phone No:	Social Security Number

Part of Body Injured or Affected:

☐ Head	☐ Hands	☐ Face	☐ Nose
☐ Eyes	☐ Legs	☐ Teeth	☐ Neck
☐ Trunk	☐ Toes	☐ Elbow	☐ Shoulder
☐ Back	☐ Ankle	☐ Wrist	☐ Foot
☐ Arms	☐ Thump	☐ Fingers	☐ Internal

Remark: .....

Nature of Injury or Illness:

☐ Laceration	☐ Amputation	☐ Puncture	☐ Fracture
☐ Strain & Sprain	☐ Burns	☐ Contusion	☐ Dry Heat Friction
☐ Hernia	☐ Foreign Body	☐ Chemical	☐ Contamination
☐ Skin (Occupationnel)	☐ Rash	☐ Irritation	

Remark: .....

2.Name:	Sex: ☐ Male ☐ Female	Date of Birth: Month / Day / Year	Age:	Regular Job Title:	Experience: In this job title Years Weeks / In this Project Years Weeks

Site:	Company:	Reference:	Phone No:	Social Security Number

Part of Body Injured or Affected:

☐ Head	☐ Hands	☐ Face	☐ Nose
☐ Eyes	☐ Legs	☐ Teeth	☐ Neck
☐ Trunk	☐ Toes	☐ Elbow	☐ Shoulder
☐ Back	☐ Ankle	☐ Wrist	☐ Foot
☐ Arms	☐ Thump	☐ Fingers	☐ Internal

Remark: .....

Nature of Injury or Illness:

☐ Laceration	☐ Amputation	☐ Puncture	☐ Fracture
☐ Strain & Sprain	☐ Burns	☐ Contusion	☐ Dry Heat Friction
☐ Hernia	☐ Foreign Body	☐ Contamination	☐ Chemical
☐ Skin (Occupationnel)	☐ Rash	☐ Irritation	

Remark: .....

Section E: Accidents/incident Details

Date Accident/Incident Occurred:	Time Accident/Incident Occurred:	Exact Location of the Accident / Incident:

Details of the actual Job Being done at the time:

Details of Accident / Incident / What actually happened?

Section F: Accident Cause (Basic cause mark X / Contributing cause, if any mark O)

UNSAFE CONDITIONS		UNSAFE ACTS	
1	☐ Inadequately Guarded	1	☐ Operating Without Authority / Training
2	☐ Unguarded	2	☐ Operating at Unsafe Speed
3	☐ Defective Tools, Equipment, or Substance	3	☐ Marking SHE Device Inoperative
4	☐ Unsafe Design or Construction	4	☐ Using Unsafe Equipment or Equipment Unsafely
5	☐ Hazardous Arrangement	5	☐ Unsafe Loading, Placing, Mixing
6	☐ Unsafe Illumination	6	☐ Taking Unsafe Position
7	☐ Unsafe Ventilation	7	☐ Working on Moving or Dangerous Equipment
8	☐ Unsafe Clothing	8	☐ Distraction, Teasing, Horse Play
9	☐ Insufficient Instruction	9	☐ Failure to use Personal Protective Devices
10	☐ Lack of system of work	10	☐ Lack of effective instruction or supervision

Why was the unsafe act committed? _____ Why did the unsafe condition exist? _____

Section G: Guide to Corrective Action (Base on the cause checked above, I am taking the following corrective action)

UNSAFE ACT	UNSAFE CONDITION	If Supervisor can't handle, then recommend to
☐ Stop the Behaviour	☐ Remove	☐ Site Engineer, or
☐ Study the job	☐ Guard	☐ Site Manager, or
☐ Instruct (tell-show-try-check)	☐ Warn	☐ Project Manager, or
☐ Follow Up	☐ Supervisory Training	☐ Safety Committee
☐ Enforce		

Detail below any immediate remedial actions that have been taken:

Detail below any corrective and preventative actions that could be taken to prevent future re-occurrence:	Responsible	Completion Date

Section H: Witness Statement	
Witness Name	**Interviewer Name**

Section I: Reviewed & Recommend by			
Recommendation:			
Reviewed By:	Position:	Signature:	Date:

Remarks : If Accident or Incident happened with lost time injury and affected to the publicity must further report to Safety Department;

: First Aid Cases will not applicable to this form;

: The accident report shall submit to Safety Department within 3 days

: Attached the photograph or sketch the location of accident / incident;

Annexure E

Archaeological ‘Chance Find’ procedure

Background

The purpose of this document is to address the possibility of archaeological deposits becoming exposed during ground altering activities within the project area and to provide protocols to follow in the case of a chance archaeological find to ensure that archaeological sites are documented and protected as required.

Archaeological sites are an important resource that is protected for their historical, cultural, scientific and educational value to the general public and local communities. Impacts to archaeological sites must be avoided or managed by development proponents. The objectives of this 'Archaeological Chance Find Procedure' are to promote preservation of archaeological data while minimizing disruption of construction scheduling It is recommended that due to the moderate to high archaeological potential of some areas within the project area, all on site personnel and contractors be informed of the Archaeological Chance Find Procedure and have access to a copy while on site.

Potential Impacts to Archaeological Sites

Developments that involve excavation, movement, or disturbance of soils have the potential to impact archaeological materials, if present. Activities such as road construction, land clearing, and excavation are all examples of activities that may adversely affect archaeological deposits.

Archaeological 'Chance Find' Procedure

If you believe that you may have encountered any archaeological materials, stop work in the area and follow the procedure below:

The following 'chance-find' principles will be implemented by the contractor throughout the construction works to account for any undiscovered items identified during construction works:

(i) Workers will be trained in the location of heritage zones within the construction area and in the identification of potential items of heritage significance.

(ii) Should any potential items be located, the site supervisor will be immediately contacted and work will be temporarily stopped in that area.

(iii) If the site supervisor determines that the item is of potential significance, an officer from the department of Archaeology (DoA) will be invited to inspect the site and work will be stopped until DoA has responded to this invitation.

(iv) Work will not re-commence in this location until agreement has been reached between DoA and IPIG as to any required mitigation measures, which may include excavation and recovery of the item.

(v) A precautionary approach will be adopted in the application of these procedures.

Detailed Procedural Steps

- If the Director, department of Archaeology receives any information or otherwise has the knowledge of the discovery or existence of an antiquity of which there is no owner, he shall, after satisfying himself as to the correctness of the information or knowledge, take such steps with the approval of the Government, as he may consider necessary for the custody, preservation and protection of the antiquity.
- Whoever discovers, or finds accidentally, any movable antiquity shall inform forth with the Directorate within seven days of its being discovered or found.
- If, within seven days of his being informed, the Director decides to take over the antiquity for purposes of custody, preservation and protection, the person discovering or finding it shall hand it over to the Director or a person authorized by him in writing.
- Where the Director decides to take over an antiquity, he may pay to the person by whom it is handed over to him such cash reward as may be decided in consultation with the Advisory Committee.
- The Director or any officer authorized by him with police assistance may, after giving reasonable notice, enter into, inspect and examine any premises, place or area which or the sub-soil of which he may have reason to believe to be, or to contain an antiquity and may cause any site, building, object or any antiquity or the remains of any antiquity in such premises, place or area to be photographed, copied or reproduced by any process suitable for the purpose.
- The owner or occupier of the premises, place or area shall afford all reasonable opportunity and assistance to the Director.
- No photograph, copy of reproduction taken or made shall be sold or offered for sale except by or with the consent of the owner of the object of which the photograph, copy or the reproduction has been taken or made.
- Where substantial damage is caused to any property as a result of the inspection, the Director shall pay to the owner thereof reasonable compensation for the damage in consultation with the Advisory Committee.
- If the Director after conducting an inquiry, has reasonable grounds to believe that any land contains any antiquity, he may approach the Government to direct the Revenue Department

to acquire such land or any part thereof and the Revenue Department shall thereupon acquire such land or part as for a public purpose.

Annexure F

Dust Management Plan

The purpose of this plan is to describe the measures that the project shall take to ensure that the risk of emissions from dust generated by site operations during construction are minimized and that best practice measures are implemented.

Dust emissions from construction can cause ill health effects to Contractor staff along with nuisance and annoyance to members of the local community. Dust will be controlled through:

- Elimination
- Reduction/Minimisation
- Control

This dust management plan shall be implemented based on the measures already provided in the Environmental Management Plan (EMP) relating to controlling dust emissions.

Methodology

The following methodology will be undertaken for each project section:

Step 1 – Identify the dust generating activities

Construction activities that are likely to produce dust will be identified. The activities that will be taken into account are:

Haulage Routes, Vehicles and Asphalt/Concrete Batching Plant

- Roads, surfaces and public highways
- Static and mobile combustion plant emissions
- Tarmac laying, bitumen surfacing and coating

Materials Handling, Storage, Spillage and Disposal

- Storage of material
- Stockpiles
- Spillages
- Storage of Waste

Site Preparation and Restoration after Completion

- Earthworks, excavation and digging
- Storage of spoil and topsoil

Demolition

Construction and Fabrication Processes

Step 2 – Identify Sensitive Receptors

Sensitive receptors have already been identified. The nature and location of the sensitive receptors will be taken into account when implementing control measures.

Step 3 – Implement Best Practice Measures to Control

Based on the nature of the activity producing the dust, the likelihood of dust being produced and the possible consequence of dust based on the sensitive receptors, the most effective control measure will be identified and implemented.

Step 4 – Monitor effectiveness of control

Construction Supervision Staff (CSC) will have the responsibility to ensure that dust control measures are being implemented and are effective.

Step 5 – Record and report result of monitoring

All inspections, audits and results of monitoring will be recorded and kept as part of the site filing system.

Method Statements and Risk Assessments

The Contractor's Risk Assessments and Method Statements will be required to be approved by the CSC prior to commencing work and will be required to contain environmental aspects of the task, including dust control measures where required.

Where dust has been identified within the risk assessment as a significant issue, the method statement will be required to cover the following:

- Methods and materials that will be used to ensure that dust generation is minimized.
- The use of pre-fabricated materials where possible.
- Optimum site layout:
  - Dust generating activities to be conducted away from sensitive receptors
  - Supply of water for damping down.
- Good housekeeping and management

All employees will be briefed on the Risk Assessment and Method Statement before starting work.

Training

All Contractor staff will be required to attend training seminars as already mentioned in the EMP document. A site-specific induction will also be required before being allowed to work on site. These will include site-specific sensitive receptors and details regarding dust control measures to be taken. Toolbox talks on air pollution and minimizing dust emissions will be provided on a regular basis to Contractor staff.

Identification of Dust Generating Sources and Control Methods

Haulage Routes, Vehicles and Asphalt/Concrete Batching Plant	
Dust Source	**Dust Control Methods**
Major haul roads and traffic routes	Haul roads will be dampened down via a mobile bowser, as required.
Public Roads	Road sweeper will be used to clean public roads as required.
Site traffic management	▪ Site traffic will be restricted to constructed access roads as far as possible. ▪ Site speed limit will be set at 10 mph as this will minimize the production of dust.
Road Cleaning	A mechanical road sweeper will be readily available and used.
Handling, Storage, Stockpiling and Spillage of Dusty materials	
Material handling operations	The number of times a material will have to be handled will be kept to a minimum to prevent double handling and ensure dusty materials are not handled unnecessarily.
Transport of fine dusty materials and aggregates.	Closed tankers will be used or sheeted vehicles.
Vehicle loading/unloading materials on to vehicles and conveyors.	▪ Dusty materials will be dampened down ▪ Drop heights will be kept to a minimum and enclosed where possible.
Storage of Materials	
Bulk cement, bentonite etc.	This will be delivered in tankers and stored in dedicated enclosed areas.
Fine dry materials	These will be protected from the weather and by storing in appropriate containers and indoors, where necessary.
Storage location	Material will be stored in dedicated lay-down areas.
Storage of Stockpiles	
Stockpile location	Stockpiles will be placed so as to minimize double handling and facilitate the site restoration.

Building stockpiles	Stockpiles, tips and mounds will not be stored at an angle greater than an angle of repose of the material.
Small and temporary stockpiles	▪ Where possible, stockpiles will be placed under sheeting. ▪ Dusty material will be damped down. ▪ Wind barriers (protective fences) of a similar height to the stockpile will be erected, if required.
Large and long term stockpiles	▪ Long-term stockpiles will be vegetated and stabilized as soon as possible. ▪ Stock plies will be dampened down until stabilized, where necessary. ▪ Wind barriers (protective fences) of a similar height to the stockpile will be erected, if required.
Waste Material from Construction	
Disposal method	A dedicated lay-down area will be available for waste. Waste will not be allowed to build up and will be disposed off at the designated locations as per EMP.
Site Preparation and Restoration	
Earthworks, excavation and digging	These activity areas will be kept damp where required and if possible, will be avoided during dry and windy periods.
Completed earthworks	Surfaces will be stabilized by re-vegetation as soon as possible, where applicable.
Construction and Fabrication Process	
Crushing of material for reuse, transportation and disposal	▪ Authorization will be obtained from IPIG and ADB before using any mobile plant on site for activities such as crushing and screening. ▪ Any crushing or screening activities will be located away from sensitive receptors.
Cutting, grinding, drilling, sawing, trimming, planning, sanding	▪ These activities will be avoided wherever possible. ▪ Equipment and techniques that minimize dust will be implemented. ▪ Water will be used to minimize dust.
Cutting roadways, pavements, blocks	Water sprinkling to be used.
Angle grinders and disk cutters	Best practice measures will be used such as dust extraction.

Monitoring Arrangements

Monitoring will be conducted at sensitive receptor locations in the project area as provided in the EMP. Furthermore, at locations where PM levels are exceeding applicable guidelines, additional

stringent measures will be implemented at the respective location(s) in the project area to ensure dust levels are controlled as far as possible.

ANNEXURE G

Site Specific EMP (SSEMP) Guide & Template for Guidance to Contractor

Guide for Development of SSEMP

Step 1: Define Boundaries

Step 2: Identify Sensitive Receptors

Step 3: Specify construction activities

Step 4: Conduct Risk Assessment

Step 5: Assign Environment Management measures

Step 6: Prepare Site Plans

Step 7: Prepare Environment Work Plans (if required)

Step 8: Monitoring

Step 1: The project area needs to be clearly defined.

Step 2: The mapping of sensitive receptors has already been conducted and needs to be presented clearly in a map.

Step 3: The tentative construction activities to be conducted are as follows:

- **Site Surveying and Vegetation (Trees and plants) Clearance**
- **Establishment of Work Camp, Batching and Asphalt plant and access roads**
- **Dismantling of Asphalt and existing structures including Utilities**
- **Preparation of ground for Asphalting**
- **Asphalting**
- **Landscaping**

Step 4: The Risk Assessment matrix template is provided in the table below.

Risk is assessed as the likelihood that the activity will have an effect on the environment as well as the consequence of the effect occurring. It is often described like this:

Risk = Likelihood × Consequence

Likelihood Scale

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

Consequence Scale

Consequence	Definition	Score
Catastrophic	The action will cause unprecedented damage or impacts on the environment or surrounding communities e.g. extreme loss of soil and water resources and quality from stormwater runoff extreme pollution of soil and water resources including major contamination from hazardous materials widespread effects on ecosystems with deaths of fauna/flora widespread community impacts resulting in illness, injury or inconvenience loss or destruction of archaeological or historical sites Occurrence will almost certainly result in the work being halted and a significant fine.	5

Major	The action will cause major adverse damage on the environment or surrounding communities e.g. major loss of soil and water resources and quality from stormwater runoff major pollution of soil and water resources including contamination from hazardous materials significant effects on ecosystems with isolated deaths of non-vulnerable flora and fauna significant annoyance or nuisance to communities major damage to or movement required to archaeological or historical sites Occurrence may result in work being halted and a fine	3
Moderate	No or minimal adverse environmental or social impacts e.g. no measurable or noticeable changes in stormwater quality. Water quality remains within tolerable limits little noticeable effect on ecosystems no or isolated community complaints no or unlikely damage to archaeological or historical sites no likelihood of being fined	2
Minor	No or minimal adverse environmental or social impacts e.g. no measurable or noticeable changes in stormwater quality. Water quality remains within tolerable limits little noticeable effect on ecosystems no or isolated community complaints no or unlikely damage to archaeological or historical sites no likelihood of being fined	1

Risk Score Table

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

Risk: **Significant: 15-25**
Medium: 6-10
Low 1-5

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

The higher the risk the more intensive the required mitigation measure will need to be; e.g. where site sedimentation is deemed to be low risk, then silt fences may be needed but as the risk increases, then sediment traps may be required. The selection of the appropriate mitigation measure will require judgement based on the level of risk and the specific site parameters.

Step 5: The Environmental Management measures are to be extracted from the IEE study for this project and should be added in the last column of the table below.

No.	Construction Activity	Hazards to Consider	Likelihood that the site or sensitive receptors will be affected?	Consequence of the site or sensitive receptors being affected?	Risk Score (consequence x likelihood)	Environmental Management Measures
i	**Site Surveying & vegetation clearance**	Damage to vegetation beyond project footprint				These can be taken from the EMP provided in the IEE report (If Risk Score is 6 or more)
		Erosion of exposed areas and sediment				
		Loss of topsoil				
		Dust generation				
		Noise				
ii	**Establishment of Work Camp, Batching plant etc.**	Soil deposited onto roads from tires				
		Stockpile erosion				
		Noise & Vibration				
		Traffic congestion				

		Fuel spills				
iii	**Dismantling of Asphalt and existing structures including Utilities**	Noise and vibration				
		Dust generation				
		Community safety				
		Worker safety				
		Traffic Congestion				
iv	**Preparation of Sub-Base**	Noise and vibration				
		Dust generation				
		Traffic Congestion				
v	**Asphalting**	Noise and vibration				
		Dust generation				
		Traffic Congestion				
		Community safety				

		Labor safety (PPEs)				
vi	**Landscaping**	Dust generation				
		Sediment runoff				
		Failure of vegetation to take root				

Step 6: The Site plans are a critical part of the SSEMP and will need to be prepared, otherwise the ADB will consider the document as incomplete.

The site plan will need to provide the following:

- **Indication of North and scale**
- **Existing and planned supporting infrastructure (e.g. access roads, water supplies and electricity supplies)**
- **Location of planned work**
- **Contours**
- **Drainage systems**
- **Locations of sensitive receptors**

Step 7 (if required)[32]: The completed SSEMP provides details of all the environmental management requirements for all stages of the construction process. For individual work teams who are responsible for only a small part of the overall construction works it can be confusing as to what is required for their particular work component. For example, the work team responsible for stripping soil for the construction areas are not going to be interested in the requirements for pouring concrete for footings and foundations. However, it is essential that the soil stripping team knows exactly what to clear and what to leave and where to put stockpiles of soil for later use.

In situations where different work activities are required at different times or at different locations, environmental work plans can be prepared. These are similar to the work method statements that are often produced for major construction projects.

Step 8: A detailed monitoring plan will be provided along with frequency and responsibilities to ensure all key environmental parameters are monitored to ensure compliance with both national and ADB requirements.

Template for SSEMP

1. **Introduction**

   1.1 Project Overview

[32] ADB, Safeguards Unit for Central & West Asia Department, *Environmental Management for Construction Handbook.*

1.2 Scope of SSEMP

1.3 Objectives of SSEMP

2. Map of Sensitive Receptors

3. Construction Activities

3.1 Activities

4. Risk Assessment

4.1 Risk Assessment Matrix & Mitigation Measures

5. Site Plan(s)

6. Environmental Monitoring Plan

6.1 Instrumental Monitoring of Environmental Parameters by Contractor as per EMP

6.2 In-house monitoring

6.3 Third Party environmental monitoring

6.4 Visual monitoring of Environmental Parameters by Contractor as per EMP

7. Responsibilities

7.1 Organizational Responsibilities and Communication

7.2 Responsibility of EA

7.3 Responsibility of Construction Supervision Consultant (CSC)

7.4 Responsibility of Contractor

7.5 Responsibility of EPA

ANNEXURE H

Ambient Laboratory Monitoring

Air Quality

ASIAN ENVIRONMENTAL SERVICES PVT. (LTD)
www.asianenvirolab.com

Monitoring Location

Chak Muhammad Pur

Page 1 of 6

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com

ASIAN ENVIRONMENTAL SERVICES PVT. (LTD)
www.asianenvirolab.com

GROUND WATER ANALYSIS REPORT

Sample Detail

Reference No.	AES-070-LG/2020	**Reporting Date**	08-06-2020
Nature of Sample	Ground Water	**Grab/Composite**	Grab
Date of Sample Collection	02-06-2020	**Date of Sample Receipt**	04-06-2020
Sample Collected by/Sent By	AES	**Temperature & Humidity**	25˚C & 54%
Sample ID	AES-GW-25/2020	**Sampling Location**	Tap Water (Chak Muhammad Pur)
Project Name	Baseline Environmental Study Of Sewage Treatment Plant, Sahiwal		
Client Detail	Punjab Intermediate Cities Improvement Investment Program, Local Government and Community Development Department Govt Of Punjab		

Nitrate (NO_3^-)	APHA 4500 NO_3^- B	≤ 50 mg/l	0.0	Optimal
Nitrite (NO_2^-)	APHA 4500 NO_2^- B	≤ 3.0 mg/l	0.0	Optimal
Selenium (Se)	APHA 3114 B	0.01 mg/l	<0.01	Optimal
Residual Chlorine	APHA 4500 Cl^- B	0.5 mg/l	0.0	Optimal
Phenolic Compounds (as Phenols)	APHA 5530 D	NGVS	0.044	Optimal
Zinc (Zn)	APHA 3113 B	5.0 mg/l	0.036	Optimal
Microbiological Analysis				
Total Coliforms	APHA 9222 B	0/ 100 mL CFU	0	Optimal
Fecal Coliforms	APHA 9222 D	0/ 100 mL CFU	0	Optimal

Abbreviations:

PEQS = Punjab Environment Quality Standards
TCU = True Color Unit
NTU = Nephlometric Turbidity Unit
APHA = American Public Health Association
NGVS = No Guideline Value Set
BDL = Below Detection Limit
CFU = Colony forming Unit

Report Disclaimer

The remaining portion of the sample (s) will be disposed off after 15 days after the issuance date of report from the laboratory unless otherwise instructed (Condition Apply).
This report shall not be reproduced in part/parties.

Analyzed By — Asian Environmental Services (Pvt) Ltd LAHORE

Reviewed By (TM)

Approved By (QM)

----------End of Report----------

Page 2 of 2

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com

ASIAN ENVIRONMENTAL SERVICES PVT. (LTD)
www.asianenvirolab.com

GROUND WATER ANALYSIS REPORT

Sample Detail

Reference No.	AES-070-LG/2020	**Reporting Date**	08-06-2020
Nature of Sample	Ground Water	**Grab/Composite**	Grab
Date of Sample Collection	02-06-2020	**Date of Sample Receipt**	04-06-2020
Sample Collected by/Sent By	AES	**Temperature & Humidity**	25˚C & 54%
Sample ID	AES-GW-25/2020	**Sampling Location**	Tap Water (Chak Muhammad Pur)
Project Name	Baseline Environmental Study Of Sewage Treatment Plant, Sahiwal		
Client Detail	Punjab Intermediate Cities Improvement Investment Program, Local Government and Community Development Department Govt Of Punjab		

Ground Water Analysis Results

Parameter	Analysis Method	PEQS	Result	Remarks
Field Analysis				
Temperature	APHA 2550 B	NGVS	23	Optimal
pH	APHA 4500 H^+ B	6.5- 8.5	7	Optimal
Lab Analysis				
Color	APHA 2120 C	≤ 15 TCU	0.0	Optimal
Taste	APHA 2160 C	Non- Objectionable	Non- Objectionable	Optimal
Odor	APHA 2150 B	Non- Objectionable	Non- Objectionable	Optimal
Turbidity	APHA 2130 B	< 5 NTU	2.45	Optimal
Total Hardness (as $CaCO_3$)	APHA 2340 C	< 500 mg/l	443	Optimal
Total Dissolved Solids (TDS)	APHA 2540 C	< 1000 mg/l	580	Optimal
pH	APHA 4500 H^+ B	6.5- 8.5	7.14	Optimal
Aluminum (Al)	APHA 3111 B	≤ 0.2 mg/l	0.007	Optimal
Antimony (Sb)	APHA 3114 B	≤ 0.005 mg/l	<0.005	Optimal
Arsenic (As)	APHA 3114 B	≤ 0.05 mg/l	0.007	Optimal
Barium (Ba)	APHA 3113 B	0.7 mg/l	<0.005	Optimal
Boron (B)	APHA 3113 B	0.3 mg/l	0.02	Optimal
Cadmium (Cd)	APHA 3113 B	0.01 mg/l	<0.006	Optimal
Chloride (Cl)	APHA 4500 Cl^- B	< 250 mg/l	45.5	Optimal
Chromium (Cr)	APHA 3113 B	≤ 0.05 mg/l	<0.003	Optimal
Copper (Cu)	APHA 3111 B	2.0 mg/l	0.164	Optimal
Cyanide (CN^-)	APHA 4500 CN^- F	≤ 0.05 mg/l	0.0	Optimal
Fluoride (F^-)	APHA 4500 F^- C	≤ 1.5 mg/l	0.0	Optimal
Lead (Pb)	APHA 3114 B	≤ 0.05 mg/l	0.05	Optimal
Manganese (Mn)	APHA 3113 B	≤ 0.5 mg/l	0.016	Optimal
Mercury (Hg)	APHA 3114 B	≤ 0.001 mg/l	<0.001	Optimal
Nickel (Ni)	APHA 3113 B	≤0.02 mg/l	0.012	Optimal

Page 1 of 2

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com

ASIAN ENVIRONMENTAL SERVICES PVT. (LTD)
www.asianenvirolab.com

Ambient Air Monitoring Report

Monitoring Details			
Reference Number	AES-070-LG/2020	**Reporting Date**	08-06-2020
Monitoring Coordinates	30°42'41.5"N 73°01'46.8"E	**Date of Monitoring**	01 & 02 Jun, 2020
Project name	Baseline Environmental Study Of Sewage Treatment Plant, Sahiwal		

Parameters	Units	Monitoring Duration	LDL	Average Obtained Concentration	PEQS
Nitrogen Dioxide (NO_2)	$\mu g/m^3$	24Hours	1.00	18.55	80.0
Nitrogen Oxide (NO)	$\mu g/m^3$	24Hours	1.00	10.15	40.0
NO_x	$\mu g/m^3$	24Hours	1.00	28.70	120.0
Sulpher Dioxide (SO_2)	$\mu g/m^3$	24Hours	1.00	22.07	120.0
Carbon Monoxide (CO)	mg/m^3	24Hours	0.01	0.69	05.0
Particulate Matter (PM_{10})	$\mu g/m^3$	24Hours	1.00	127.91	150
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	24Hours	1.00	30.76	35
Suspended Particulate Matters(SPM)	$\mu g/m^3$	24Hours	1.00	279.97	500

Page 3 of 6

Abbreviation:
LDL= Lower Detection Limit **PEQS**= Punjab Environmental Quality Standard **$\mu g/m^3$** = Micro Gram per Meter Cube
mg/m^3 = Mili Gram per Meter Cube

Asian Environmental Services LAHORE

Lead Field Operations

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com

√

Sahiwal WWTP

Noise Levels

ASIAN ENVIRONMENTAL SERVICES PVT. (LTD)
www.asianenvirolab.com

Noise Level Monitoring Report

Monitoring Details			
Reference Number	AES-070-LG/2020	**Reporting Date**	08-06-2020
Monitoring Coordinates	30°42'41.5"N 73°01'46.8"E	**Date of Monitoring**	01 & 02 Jun, 2020
Project name	Baseline Environmental Study Of Sewage Treatment Plant, Sahiwal		

Sr. No.	Time	Noise dB(A)		PEQS
1	09:00	53.4		
2	10:00	52.5		
3	11:00	53.9		
4	12:00	51.1		
5	13:00	50.3		
6	14:00	52.2		
7	15:00	53.5	Day Time	65
8	16:00	51.7		
9	17:00	49.1		
10	18:00	51.8		
11	19:00	48.9		
12	20:00	44.2		
13	21:00	43.1		
14	22:00	41.2		
15	23:00	42.2		
16	00:00	41.4		
17	01:00	39.5		
18	02:00	38.2	Night Time	55
19	03:00	42.1		
20	04:00	43.7		
21	05:00	41.3		
22	06:00	43.9		
23	07:00	42.1	Day Time	65
24	08:00	45.2		

Asian Environmental Services (Pvt) Ltd LAHORE

Lead Field Operations

Page 5 of 6

Head Office:
Basement, C-3, Jhelum Block, Green Forts-II, Lahore - Pakistan
Phones: +92 42 35450914-15,
Fax: +92 42 35450916,
Email: info@asianenvirolab.com