

ENVIRONMENTAL AND SOCIAL IMPACT **ASSESSMENT (ESIA) REPORT**

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Version-16

PAKISTAN

**Extension of Project of Biotech Energy (Pvt.) Ltd. By
SAFCO Venture Holdings**



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LIST OF ABBREVIATION

AA	Ambient Air
AC	Assistant Commissioner
ADB	Asian Development Bank
AOC	Area of Concern
Aol	Area of Interest
AOI	Area of Influence
ARU	Ammonia Recovery Unit
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
BTE	Biotech Energy Private Limited
CD	Conservation Dependent
CE	Critically Endangered
C-ESMP	Contractor's Environmental & Social Management Plan
CI	Carbon Intensity
CSR	Corporate Social Responsibility
DD	Data Deficient
DPO	District Police Officer
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EN	Endangered
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Management Monitoring Program
ESMMP	Environmental and Social Management and Monitoring Plan
ESMS	Environmental and Social Management System
ESSU	Environmental And Social Safeguard Unit
EPCM	Engineering Procurement Construction Management (called as contractor in the

	entire report).
FGDs	Focus Group Discussions
GHG	Greenhouse Gases
GRM	Grievance Redress Mechanism
GW	Ground Water
HEFA	Hydrotreated Esters and Fatty Acids
HVO	Hydrotreated vegetable oil
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILO	International Labor Organization
ISCC	International Sustainability and Carbon Certification
ISS	Inter-Stage Stripping
JHA	Job Hazard Analysis
LESCO	Lahore Electric Supply Company
LMP	Labor Management Plan
LR	Lower Risk
MBBR	Moving Bed Bioreactor
MPAs	Members of Provincial Assembly
MT	Metric Tons
NDMA	National Disaster Management Authority
NE	Not Evaluated
NEQS	National Environmental Quality Standards
NGOs	Nongovernmental Organization
NHA	National Highway Authority
NPO	No Project Option
NT	Near Threatened
PCD	Public Complaints Desk

PEPA	Punjab Environmental Protection Act
PEQS	Punjab Environmental Quality Standards
PFACO	Poultry Feather Acid Oil
PM	Particulate matter
PPEs	Personal Protective Equipment's
PS	Performance Standard
QC	Quality Assurance
SAF	Sustainable Aviation Fuel
SC	Supervisory Consultant
SDGS	Sustainable Development Goals
SEP	Stakeholder Engagement Plan
SPS	Safeguard Policy Statement
SPSS	Statistical Package for Social Sciences
SSAO	Soap Stock Acid Oil
SW	Surface Water
TMA	Tehsil Municipal Administrations
TMP	Traffic Management Plan
UCO	Used Cooking oil
USEPA	United States Environmental Protection Agency
Vu	Vulnerable
WHO	World Health Organization
WMP	Waste Management Plan

Unit Conversion

Length

1 inch = 2.54 centimeters (cm)

1 meter = 3.28 feet (ft)

1 mile = 1.61 Kilo-meter (km)

1 foot = 0.30 meters (m)

1 yard = 0.91 meters (m)

1 km = 0.62 mi

Weight

1 ounce = 28.3 grams (g)

1 pound = 0.45 kilo-gram (kg)

Area

1 inch = 6.45-centimeter square cm²

1 meter square = 1.196-yard square (yd²)

1 hectare = 2.47 acres

Volume

1 inch cube = 16.39 milli-liter (mL)

1 litre = 1.06 quart (qt)

1 gallon = 3.79 litres (L)

1 meter cube = 35.31-foot cube (ft³)

1 quart = 0.95 liters (L)

Currency (As of 15 March 2024)

1 (USD) = 279 (PKR)

1 (British Pond) = 355.40 (PKR)

1 Euro = 303.53 (PKR)

NON-TECHNICAL EXECUTIVE SUMMARY

ES-1. Background Introduction

1. Company Overview: Biotech Energy Pvt Ltd (BTE) is a company under the SAFCO Venture Holdings (SAFCO) which is Pakistan's sole large-scale biodiesel producer, operating a second-generation biodiesel unit in Sheikhpura and holding a leading regional position in the biodiesel industry.
2. Certifications: BTE is certified by ISCC, the EU Renewable Energy Directive (II), ISO 9001:2015, ISO 14001:2015, and ISO 45001:2018. Additional certifications include CabRUE (France), the Union Database for Biofuels (EU), NABISY (Germany), Dutch Decree, and DEKRA. These demonstrate BTE's commitment to sustainability, quality, environmental responsibility, and safety.
3. SAF Project: BTE proposes developing a Sustainable Aviation Fuel (SAF) facility adjacent to its biodiesel plant, utilizing shared infrastructure and HEFA (Hydroprocessed Esters and Fatty Acids) technology supplied by Axens. The facility will have a production capacity of 200,000 MT/year, using the same feedstock as the biodiesel unit. Upon full capacity, the project will avoid an estimated 704,500 tonnes of CO₂ emissions annually—equivalent to planting 41 million trees per year.
4. Regulatory Alignment: To secure funding from the International Finance Corporation (IFC) and the Asian Development Bank (ADB), the Environmental and Social Impact Assessment (ESIA) for the SAF project complies with Pakistani regulations and IFC/ADB standards, ensuring alignment with international environmental and social requirements.

ES-1.1 Project Location

5. The project site location is situated along Sharaqpur Road in the Sheikhpura District. The site can be accessed via the main Lahore-Sheikhpura Road and Motorway M3. It is located in a designated industrial zone and is surrounded by a mix of agricultural, industrial, and residential areas. The nearest sensitive receptors within 01 km radius are village of Chah Shadulwala (1048 m) on eastern side, Nagina Kids campus (non-functional 477 m) on northern side, Mohammad Educational Complex (831 m) on southern side and Aghosh Al-Khidmat Orphanage (305m) on eastern side of the project site. The other adjacent facilities within 01 km include Prosperity Weaving Mills which is 325m away on western side, while Levon Pharmaceuticals is 312 m on northern side, Labaik Filling Station is situated 785 m away on northern side, Jhanda Poultry Farm is 620 m away on north-eastern side, and Ittefaq Construction Associates is located 831 m on southern side, Wahdat Industrial Services Pvt. Ltd. is 412 m away on southern side, while the non-functional poultry farm and Chadhar Agricultural Model Farm are both 425 m on western side from project site.

ES-2. Environment and Social Consideration

ES-2.1 Environment Screening

6. The project is a Category B according to both the IFC Environmental and Social Categorization and the ADB's Safeguard Policy Statement from 2009, because it has limited adverse environmental or social risks that are generally site-specific and reversible, and manageable through mitigation measures. It is also classified as Category C for ADB's Involuntary Resettlement Safeguards and Indigenous Peoples Safeguards, with no foreseen impacts in these areas.

ES-3. Applicable Standards

ES-3.1 Environmental and Social Performance Standards of the International Finance Corporation

Table 0-1: IFC's Environmental and Social Performance Standards

IFC Performance Standard		Project Relevancy
PS1	Assessment and Management of Environmental and Social Risks and Impacts	<i>Triggered</i>
PS 2	Labor and Working Conditions	<i>Triggered</i>
PS 3	Resource Efficiency & Pollution Prevention	<i>Triggered</i>
PS 4	Community Health, Safety and Security	<i>Triggered</i>
PS 5	Land Acquisition and Involuntary Resettlement	<i>Not Triggered</i>
PS 6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	<i>Not Triggered</i>
PS 7	Indigenous Peoples	<i>Not Triggered</i>
PS 8	Cultural Heritage	<i>Not Triggered</i>

ES-3.2 ADB Safeguard Policy Statement, 2009

Table 0-2: ADB Safeguard Policies 2009 Relevant to Project

Sr. No.	Safeguard Policies	Project Relevancy
1.	Environment	<i>Triggered</i>
2.	Involuntary Resettlement (IR)	<i>Not Triggered</i>
3.	Indigenous Peoples	<i>Not Triggered</i>

ES-3.3 World Bank Group's EHS Guidelines and applicable sector guidelines

7. In addition to the IFC Performance Standards, the World Bank Group EHS Guidelines are also applicable to the project. The project falls within the chemical industry sector, thus subject to industry-specific guidelines for Oleochemicals Manufacturing (2007), WBG EHS Guidelines for Petroleum

Refining (2016).

8. The ESIA report also addresses all the risks and the issues identified in the ESDD report.

ES-4. Project Description

9. The Proposed SAF facility has the following two main components:

ES-4.1 Component 1 - Enhancement + Improvement of the existing feedstock collection activity of BTE, across Pakistan, in Urban Areas.

10. The feedstock for the production of SAF or renewable diesel consists of raw materials such as vegetable oils, animal fats, and recycled cooking oils. These materials contain fatty acids that can be converted into renewable diesel through the SAF production process. Biotech, operating in Pakistan, collects waste feedstock including used cooking oil, poultry feather acid oil, soap stock acid Oil, and waste from edible oil refineries from various sources such as restaurants and chicken shops across 16 cities. Transportation of feedstock to the manufacturing facility in Sheikhpura is conducted by third-party transportation companies using open trucks and tankers from following BTE standard operating procedures and on-site testing for safety.

ES-4.2 Component 2: SAF (Sustainable Aviation fuel) using AXENS Vegan Technology.

11. The project will employ AXEN's Vegan technology for sustainable aviation fuel (SAF) production, comprising two main sections:
 - Hydrotreatment (HDT): Oxygen removal from renewable lipids using hydrogen, yielding linear paraffin.
 - Hydro isomerization (HDI): Upgrading linear paraffin into real drop-in middle distillate biofuels. HDI can be adjusted to produce various grades of renewable diesel or renewable jet fuel by altering the process.

ES-4.3 Associated and Shared Facilities

- **Associated facilities:** No associated facilities are identified for SAF project, as per the definition in the IFC Performance Standards.
- **Shared Facilities,** the utilities such as boilers (04 and 02 ton), generators (625 KVA and 525 KVA) and turbines will be shared with the existing BTE biodiesel project.

ES-4.4 Construction Activities and Duration of Project

12. The total project duration for construction is approximately 02 years, expected to be initiated by February 2025. The duration of the construction work is given as under:-
 - Phase 1: Contractual Obligations (0 days)
 - Phase 2: Design Phase (68 days)
 - Phase 3: Project Tender Document (7 days)

- Phase 4: Construction Supervision and Management (272 days)
- Phase 5: Construction of Tanks (272 days)
- Phase 6: Closure and Demobilization (15 days)

ES-4.5 Study Area Evaluation

13. **Area of Interest (Aoi):** The primary focus of the SAF project is centred on the location where the industry's infrastructure is being developed but the project also involves the collection of feedstocks from key urban centres across Pakistan via major roadways. As a result, the Area of Interest (Aoi) encompasses the perimeters of these significant cities involved in feedstock collection, with a 1-kilometer buffer around each city boundary. Additionally, it includes the primary highway routes utilized by vehicles collecting feedstock, incorporating a 50-meter buffer on both sides of the highway for comprehensive coverage.
14. The Aoi includes a 05-kilometer radius around the SAF facility's footprint, a 1-kilometer buffer around city boundaries, and a 50-meter buffer along primary highways. The 1-kilometer buffer addresses urban impacts such as traffic, air pollution, and noise, while the 50-meter highway buffer manages risks like road safety, emissions, and spillage. Mitigation measures focus on a robust Supply Chain Management System, emphasizing route optimization, safety protocols, emergency response, and monitoring to ensure compliance with safety and IFC standards.
15. **Area of Influence (AOI) and Area of Concern (AOC):** The Area of Influence (AOI) has been marked within the Area of Interest (Aoi). For assessment and initial data gathering, the Area of Influence (AOI) and Area of Concern (AOC) has been defined within the area of interest (Aoi), spanning a 5 KM radius from the site's actual footprint. Here the AOI and AOC are interchangeable terms and both terms can be used simultaneously.
16. **Core Zone Area:** The core zone, encompassing the project footprint area and its immediate surroundings within a 500-meter radius, is defined as the primary focus area for assessing impacts during the mobilization, construction, and operation phases of the project. Impact evaluations related to soil, land, and noise are primarily concentrated within this core zone.

ES-5. Analysis of Alternatives

Analysis of Alternatives:

17. **No Project Option:** Opting out of the SAF installation (No Project Option) would perpetuate waste accumulation in waste streams, negatively impacting the environment, economy, and climate change mitigation. Implementing waste-to-energy technologies could address these concerns.

Location Alternatives: Two locations were evaluated:

18. **Option I:** Sunder Industrial Estate, Lahore – Offers modern infrastructure and firefighting services but requires acquisition and incurs higher transportation costs.

19. **Option II:** BTE Site, Sheikhpura-Sharaqpur Road – Already owned by the company, with existing facilities and better road connectivity, reducing costs but relying on district firefighting services. Option II was selected for its logistical and cost advantages.
20. **Wastewater Treatment:** Advanced technologies, compliant with WBG EHS Guidelines for Petroleum Refining, were selected, including Dissolved Air Flotation (DAF), Activated Sludge Process (ASP), Sand Carbon Filtration, and Reverse Osmosis (RO). These ensure efficient removal of oil, grease, BOD, COD, salts, and heavy metals, achieving economic, environmental, and operational balance.
21. **Air Pollution Control:** Wet scrubbers are prioritized for their versatility, efficiency in removing gases and particulates, and adaptability to variable contaminant levels, aligning with the project's environmental goals.
22. **Transportation Alternatives:** Road transport was chosen for its flexibility, accessibility, and suitability for small volumes and shorter distances, despite environmental concerns, making it ideal for the project's logistical needs.

ES-6. Baseline Conditions

23. **Topography:** The proposed Sustainable Aviation Fuel (SAF) project site is located on flat, alluvial plain terrain with deep calcareous soil. The region experiences extreme climate conditions, with temperatures ranging from 3–48°C.
24. **Flood assessment:** A flood assessment concluded negligible flooding risk, while climate change trends indicate rising temperatures and decreasing precipitation.
25. **Surface Water:** Sampling at six points revealed all parameters within compliance.
26. **Groundwater:** Sampling at five points showed all parameters compliant except for turbidity at GW02 (southeast) and GW04 (north), due to shallow aquifer depth.
27. **Air Quality:** Sampling at five sites over 24 hours showed compliance for most parameters, except PM2.5 and PM10, which were elevated due to industrial emissions, vehicular pollution, and agricultural burning. No H2S gas was detected near the facility.
28. **Noise Levels:** Monitoring within a 500-meter core zone showed noise levels ranging from 50.7 dB(A) to 93.3 dB(A) inside the BTE plant, with peaks at air compressors and diesel generators. Outside the facility, noise ranged from 52 dB(A) to 86.4 dB(A), with the highest levels near the main road.
29. An **ecological study** was conducted near the proposed project site to identify floral and faunal species, their habitats, and potential endangered or endemic species. The AOI does not contain any natural or critical habitats. The flora species were observed belonging to 16 families and reported 55 plant species from the project site and adjacent areas. Among them, 16 tree

species, 09 shrubs, 20 herbs and 10 grass species were found. The fauna species were observed and recorded at and around the project site. A total of sixteen bird species, ten mammal species, five reptiles, two amphibians, three fishes and three grazing mammal species were observed whereas no endangered, critically endangered and vulnerable species were reported within the AOC/AOI

30. A **socio-economic study** was conducted around the project area. Quantitative and qualitative data collection techniques were used, including primary data for the baseline study and secondary data for latest statistics. Population statistics were derived using GIS (Geographic Information System) calculations. According to the GIS-derived estimates, the population of the AOC is approximately 29,000 individuals. A sample size of 69 individuals was chosen using an Online Standard Statistical Calculator, with a 90% confidence level and a 10% margin of error, through Simple Random Sampling. Additionally, 42 Focus group discussions and 18 specific interviews were conducted with local community members including existing staff of biotech.
31. The AOC covers a 5-kilometer radius around the proposed plant site and, all of the respondents included in the survey were individuals living within this specified AOC. Initial reconnaissance and subsequent comprehensive field surveys were conducted. Data was collected through surveys, interviews, consultations, Focus Group Discussions (FGDs), and direct observations. The survey covered demographic characteristics, occupation and income, housing conditions, health, infrastructure, migration patterns, mode of transportation, women participation and decision making, educational services, sources of drinking water, home appliances, social amenities, and other indicators.
32. **The findings of the socio-economic study** indicates that there are no issues related to acquiring land or resettlement. The proposed project is expected to generate employment opportunities in the area therefore improve the overall social economic conditions of area. However, the community might fear the exclusion of marginalized groups, such as women or casual workers, from meaningful opportunities despite promises. Additionally, concerns may arise about the transparency of job opportunities and welfare programs provided by the project, as well as its long-term sustainability and equitable benefit distribution.

ES-7. Potential Impacts and Their Mitigation Measures

ES-7.1 Impacts And Their Mitigation Measures During Construction Phase

33. In the construction phase, several environmental and social impacts are anticipated. Soil erosion, contamination, and dust emissions will likely result from excavation and the operation of construction machinery, while wastewater and solid waste generation are anticipated to pose risks to soil and water quality. Mitigation measures will include setting up containment for hazardous materials, installing drainage systems to prevent water

accumulation and contamination and establishing waste management protocols. Air quality may degrade due to emissions from machinery; therefore, regular vehicle maintenance and dust control measures, such as covering material loads and watering roads, will be implemented. Noise from construction machinery, which could affect nearby communities, will be mitigated by limiting high-noise activities to daylight hours and using noise-dampening equipment. Additionally, occupational health and safety measures will ensure worker protection through mandatory PPE, training, and scheduled medical check-ups. Invasive species can be introduced through imported machinery and equipment, as seeds, insects, or other organisms hitch a ride on containers or packaging that poses environmental, economic, and health risks to new ecosystems and communities. Mitigation measures for invasive plants and animals include disinfecting machinery, ecological inspections, and setting up designated washing/cleaning areas to control introduction and spread.

34. Socio-economic measures will address potential issues related to labor practices and community impacts. Strict policies will be enforced to prevent child labor and to promote gender equity in hiring and employment practices. By prioritizing the recruitment of local workers, providing them with specialized training, and maintaining transparency in the hiring process, the potential influx of external workers can be minimized. However, this approach may not completely eliminate the possibility of some external workers joining the workforce. Security personnel will be trained in human rights to prevent conflicts with local residents, and grievance mechanisms will be set up to allow community members to express their concerns.
35. These mitigation measures are designed to minimize environmental impact and enhance construction site safety.

Cumulative Impacts during Construction of SAF and Existing BTE Operation

36. The total water usage for BTE operations and SAF construction is 58 m³/day, accounting for less than 0.32% of the overall water consumption (4,840 m³/day) of industries within the Area of Influence (AoI). Optimized water-saving strategies, such as dust suppression and curing techniques, have been implemented to minimize environmental impact, thereby obviating the need for additional mitigation measures. The combined wastewater generation from both BTE operations and SAF construction totals 30 m³/day, representing just 0.14% of the total wastewater produced (3,872 m³/day) from various activities within the AoI. Wastewater from BTE operations is processed through a dedicated treatment plant, while SAF construction wastewater will be managed through septic tanks and licensed disposal contractors, in full compliance with PEQS and World Bank EHS Guidelines.
37. Cumulative noise levels at the BTE boundary average 52 dB(A) for SAF construction and BTE operations, remaining within acceptable limits and causing negligible impact on the nearest receptor—an orphanage mosque located 180 meters from the BTE boundary wall. Mitigation measures include

limiting noisy activities to daytime hours, conducting regular equipment maintenance, and constructing a partition wall between BTE and SAF construction sites. Air emissions from BTE boilers and gensets, together with SAF construction activities, are in compliance with World Bank EHS Guidelines. The ESIA-recommended mitigation measures effectively reduce potential impacts from moderate to minor levels.

38. The additional traffic generated by BTE and SAF activities (37 trucks/vehicles per day) constitutes less than 1% of the baseline traffic (4,097 vehicles/day). Traffic management measures, such as transportation management plan, off-peak operations, speed controls, regular vehicle maintenance, and community awareness initiatives, ensure that any impacts remain negligible. Through the implementation of comprehensive management and mitigation strategies, the cumulative environmental and social impacts are minimized, ensuring full compliance with international best practices and standards.

ES-7.2 Impacts and Their Mitigation Measures During Operational Phase

39. In the operational phase, the potential impacts will involve spills, soil pollution, and health hazards from the activities such as collection, transportation, storage of feedstock and final SAF. Implementing spill prevention and control protocols, using proper storage containers, and regularly inspecting transportation equipment to prevent pollution. Health hazards will be minimized by providing personal protective equipment (PPE), training of workers, and maintaining hygiene standards throughout operations. Additionally, a Supply Chain Management System (SCMS) will be developed, including a Responsible Collection Policy (RCP) for 100% traceability, a Supplier Code of Conduct prohibiting child or forced labor, and ensuring life and fire safety (L&FS) controls per IFC standards. Compliance will be monitored through audits, KPIs, and a Remediation Plan for non-compliance.
40. The proposed SAF facility will generate noise from machinery, with the highest levels in the Gantry Room exceeding 70 dB(A), and moderate levels observed in the Pump Room and Air Compressor areas. Noise impacts are considered reversible, and of minor significance. Mitigation measures include regular equipment maintenance, isolating generators, monthly noise monitoring, providing hearing protection, and installing quieter equipment to reduce noise and ensure compliance with standards. These efforts aim to minimize the impact on workers and the surrounding environment.
41. The SAF production process requires approximately 104 m³ of water per day. According to the hydrological analysis, the groundwater extraction for SAF production does not significantly affect the groundwater table depth. Mitigation measures include installing engineered containment structures to prevent groundwater contamination, implementing water-saving devices in washrooms, and setting up a wastewater treatment along with the recycling system to recycle 61% of treated water. These measures aim to reduce freshwater usage by 40% and will be monitored monthly. All systems will be installed before the operational phase to ensure sustainability and protect local water resources.

42. The nearest surface water body to the SAF plant is the Metalwala Feeder Canal, located 2.4 km southwest of the BTE facility. Wastewater from the BTE facility is currently discharged into the Ghazi drain, a seasonal drain with an average flow rate of 8-16 cusecs, with the BTE's contribution being minimal (0.01 cusecs). The SAF plant's wastewater will comply with PEQs and WB Guidelines, ensuring no adverse impact on surface water. The SAF plant will generate 4 m³/hr of wastewater, with 61% recycled via reverse osmosis, and the remaining 2.4 m³/hr will be discharged. The impact can be mitigated by installing a wastewater treatment plant (WWTP) to meet WB Guidelines and PEQS standards, with monthly compliance checks. Additionally, treated water will be diverted from the BTE facility to the SAF treatment plant to ensure it meets Pakistan Environmental Quality Standards (PEQS) and WB Guidelines, confirming compliance through monthly testing.
43. During operations, the SAF plant will generate various wastes, including oil-contaminated clothes, chemical waste, plastics, paper, general waste, sludge, and spent catalysts. To mitigate environmental impact, a waste collection system will be established for source segregation, with monthly audits and a dedicated waste management team. Properly labelled containers will be placed throughout the facility, and a catalyst recycling process will ensure 100% recycling. Staff will be trained in proper disposal, and the waste management system will be regularly reviewed for continuous improvement.
44. The SAF plant presents fire and explosion risks due to chemical reactions in the production process, the use of flammable liquids like methanol and hydrogen gas, and potential equipment malfunctions, such as overheating or leaks from boilers and storage tanks. Additionally, human errors during chemical handling or equipment operation, coupled with inadequate training, can further increase the likelihood of accidents. Proper safety measures are essential to mitigate these risks. The impact of fire and explosion risks can be mitigated by designing and constructing the facility to meet NFPA fire and safety standards, verified before operations. Quarterly inspections of fire systems, along with employee fire safety training and emergency response drills, will ensure compliance and preparedness. Additionally, biannual maintenance of fire safety equipment will be scheduled to guarantee operational readiness and safety.
45. Although no child labor is reported at the existing facility. The preliminary supply chain survey found out that the child labor exists in the supply chain specially in the restaurants sector. To mitigate this impact, a Standard Operation Procedure and BTE Child Labor Policy will be implemented to prevent and address child labor, supported by quarterly compliance checks. Training for staff and management, bi-annual supplier audits, and partnerships with local communities and NGOs for awareness campaigns will ensure the elimination of child labor from the supply chain.
46. Workers handling feedstock face health and safety risks, including exposure to hazards, physical hazards, and poor sanitation. Inadequate safety measures and training, as well as insufficient PPE, exacerbate these risks

and affect mental health. Mitigating these risks involves comprehensive safety and PPE training, weekly sanitation checks, and monthly safety inspections to maintain health standards. Counselling and Employee Assistance Programs (EAP) will support mental well-being, with quarterly audits ensuring compliance and swift response to any issues.

47. During the operational phase of the proposed project, potential health and safety impacts include fire, fuel spillage, gas leaks, explosions, injuries from machinery, falls, strikes, environmental emergencies (e.g., extreme weather), hazardous chemical spills, internal emergencies like power loss or structural collapse, and bomb threats. To mitigate health and safety risks, a dedicated HSE team will conduct monthly safety audits and maintain emergency equipment. First aid boxes will be installed and regularly stocked, while staff, especially supervisors, will undergo first aid and safety training, aiming for 100% compliance. An emergency response plan will be created and tested with biannual drills, and access control measures will be implemented to ensure only authorized personnel are allowed entry.
48. Exposure to chemicals like H₂ and other chemicals like methanol during SAF production can pose significant health risks to workers, particularly through prolonged or direct exposure in the process area. To mitigate the impact of chemical hazards, PPE such as helmets, gloves, safety boots, and masks will be distributed to all workers, with daily checks and monthly audits to ensure compliance. Corrosion-resistant and leak-proof containers will be used for chemical storage, with quarterly inspections to verify proper storage practices. Fire safety procedures will be enforced, ensuring 100% compliance through audits and training, while effective ventilation systems will be installed in chemical storage areas and monitored for air quality. Clear protocols for chemical storage will be developed and reviewed regularly, with a designated safety officer overseeing these measures.
49. The storage of feedstock at a biofuel facility in Punjab risks contamination from pest infestations, which could affect biofuel quality, production efficiency, and compliance. To manage these risks, monthly inspections, sanitation practices, and prompt pest control measures will be implemented. To mitigate these impacts, the facility plans to plant 500 native trees within the first year, involve the community in annual planting events, and establish a monitoring system to support biodiversity.
50. The proposed project is expected to have minimal effects on the traditional lifestyles and occupations of local communities, with benefits from job opportunities prioritized for locals. By prioritizing local recruitment, offering specialized training, and ensuring transparency in hiring can minimize, though not entirely eliminate, the influx of external workers. Additionally, the project aims to enhance community well-being by converting unhygienic waste into sustainable products. While minor social and health-related issues may arise during operations, these can be effectively mitigated through the implementation of best management practices by prioritizing employing local workers, providing training, and ensuring all new hires have valid CNICs and police clearances. First aid kits and biannual medical check-ups will promote

health, while safety training and PPE usage will be prioritized. Quarterly cultural sensitivity training will foster better community relations.

Cumulative Impacts of SAF and BTE Operations

51. The increased collection of feedstocks with both BTE and SAF will have a positive overall impact, as more waste will be utilized as feedstock, reducing waste and the illegal use of used cooking oil and other feedstocks. There are no other planned projects in the area that require consideration, relevant to the cumulative impacts assessment. While there are existing facilities (industries) within the Area of Influence (Aoi) that do have environmental and social impacts, these are not significant enough to necessitate consideration in the context of cumulative impacts related to the SAF project.
52. However, the transportation of this additional feedstock will lead to a significant increase in the number of vehicles, from 80 to 380 per month, as well as a rise in product transport vehicles, from 03 to 0 per month. This will result in higher levels of pollutants, greenhouse gas emissions, and an elevated risk of spills and leaks. The feedstock storage capacity will expand from 1,000 metric tons to 8,000 metric tons, and the product storage capacity will increase from 1,000 metric tons to 4,000 metric tons, which raises concerns about the potential risks of leaks, air quality deterioration, worker health and safety. The expansion of operations and the supply chain network will entail the same risk of child labor, gender-based violence, and health and safety issues for workers within the supply chain, the overall mitigation measures will apply in the same basis, but for a larger supply chain. No additional new risks in the supply chain, apart from volume of the supply chain are envisaged. However, this increase in activity may also lead to a reduction in waste, providing environmental benefits, as well as some tangible benefits for the informal sector.
53. The noise modelling shows that the cumulative impact of noise from both BTE and SAF operations exceeds the PEQS nighttime standards at receiver 1 on southern side. . To mitigate this, a noise barrier wall will be constructed by extending the existing boundary wall by 2 feet using brick masonry along the entire perimeter.
54. The hydrological analysis revealed that a net groundwater declines of approximately 0.06-0.068 m/year over a 17-year period. Although nearby agricultural and industrial activities contribute to groundwater depletion, the hydrological study concludes that the projected water usage for BTE and SAF facilities—149.3 m³/day—is minimal compared to local demands within the AOI and poses a negligible impact on groundwater levels.
55. With the operation of SAF, the wastewater production is expected to increase from approximately 1 m³/hr to 5 m³/hr. However, 61% of this water will be recycled, and the final discharge will be around 3.4 m³/hr. This final discharge volume complies with PEQS and WBG Guidelines and will be released into a nearby seasonal drain, the Ghazi drain, which has an average flow rate ranging between 8 to 16 cusecs. Therefore, the cumulative impact of wastewater discharge from both SAF and BTE operations is negligible.

56. The BTE plant meets its energy demands through electricity from the national grid and on-site utilities, including 02 HFO and 02 diesel-fired generators, 02 steam boilers, and 01 thermal oil heater, which emit pollutants such as NO_x, SO₂, PM, and CO that may degrade local air quality if not mitigated.
57. AERMOD modelling was conducted to assess air pollution emissions under four scenarios: Scenario A, modelling 100% operation of one BTE plant boiler; Scenario B, modelling 100% operation of one SAF plant boiler; Scenario C, considering emissions from both BTE and SAF boilers operating at 100% capacity along with the thermal oil heater; and Scenario D, including emissions from both boilers, the thermal oil heater, and backup power generators (CAT generator 15, CAT generator 18, HFO-1, and HFO-2) operating under normal conditions. These scenarios evaluate cumulative air quality impacts under different operational conditions.
58. Under Scenario D, combined emissions from all stacks and standby generators lead to CO concentrations exceeding Pakistan Environmental Quality Standards (PEQS) for 1-hour and 8-hour periods at nearby sensitive receptors, with particulate matter (PM_{2.5} and PM₁₀) also exceeding IFC standards. Despite this, the surrounding air quality is already degraded, and the cumulative contribution of emissions to ambient levels is minimal (<1%). In Scenario C, which excludes standby generators and includes emissions only from SAF, BTE, and thermal oil heater stacks, all parameters comply with PEQS and IFC standards at sensitive receptor locations. As standby generators operate only 3% of the year, Scenario C is considered the more practical and compliant scenario.
59. The existing BTE facility produces approximately 100 kg of solid waste per month, including plastics, chemicals, paints, sewage sludge, paper, and cardboard. The upcoming SAF operations are expected to generate an additional 150 kg of solid waste per month. Overall, the operation of both the BTE and SAF facilities will result in a total increase of about 250 kg of solid waste per month.
60. Both BTE and SAF plants are not expected to pose significant fire or process safety risks. Both facilities have been designed and built in accordance with applicable NFPA standards, ensuring compliance and even exceeding required safety measures for inter-tank and inter-building distances.
61. The addition of SAF operations with the existing BTE operations is anticipated to have a positive socioeconomic impact. The expansion is likely to create more direct and indirect employment opportunities, leading to increased incomes and improved living standards for the surrounding community. The creation of new skilled and unskilled jobs, as well as the indirect economic activities supported by the expanded operations, will contribute to the overall economic development and prosperity of the local area.

ES-8. Environmental & Social Management Plan & Grievance Redress Mechanism

62. The **Environmental Social Management Monitoring Program (ESMMP)** for the proposed SAF Project includes key components such as Institutional Requirements, Environmental Mitigation and Management Matrix, Environmental Monitoring Plan, Planning for EMP Implementation, Training and Capacity Building, Communication & Documentation, Management Plans, and ESMMP Cost. Draft version of the contractor management plans (HSE Plan, Emergency Response Plan, Construction Plan) has been considered in the ESIA however, these plans will be finalized in line with the findings of the ESIA and applicable requirements. Tentative ESMMP annual based costs for the construction and operational phases is PKR 39.49 million and PKR 90.893 million respectively, to effectively implement the mitigation measures. The contractor ESMMP will be adjusted within this cost. The ESMMP will be part of the contract bid documents.
63. The key players involved during the construction phase of the proposed Project are Biotech Energy Pvt Ltd. as employer/proponent, ESSU, Lenders, Govt Departments, the Supervisory Consultant (SC) and the Contractor.
64. The key players involved during the operational phase of the proposed Project are the BTE, ESSU, Lenders and Govt. Departments. The ESSU have Environmental Social Governance (ESG) Specialist, Community Liaison Officer (CLO), HSE manager and HSE officers, Environmental Engineer, GHG Compliance Officers and Supply Chain Compliance Officer.
65. To address the concerns and grievances of Affected People (AP), a two-tier **Grievance Redress Mechanism (GRM)** both for labours/Employees and community members is established for both the construction and operational phases. According to the GRM the Complaints will be received at Public Complaints Desk through Community Liaison Officer (CLO) which will serve as the first tier, the CLO is responsible to receive, scrutinized, record and send complaints to social expert. The social expert will attempt to resolve the complaint at tier 1 however, if it is unresolved, then the complaint will be forwarded to the Grievance Redress Committee (GRC) that act as tier 2 and includes representatives from contractors, HR-BTE, Admin-BTE, ESSU, Community Members or any co-opted members as needed. The BTE management will be responsible for notifying the GRC, including the committee chair, committee secretary, and other committee members.

ES-9. Information Disclosure

66. A non-technical summary in both English and Urdu will be disseminated to stakeholders. Moreover, the ESIA report and other pertinent project documents will be accessible on the websites of ADB, BTE, and IFC. Copies of the ESIA report can also be obtained from BTE's head office in DHA Lahore and at the project site in Sheikhpura. Additionally, information brochures will be distributed at local shops within the Area of Concern to ensure residents are informed about the project.

67. The stakeholder engagement process employed diverse methods to ensure inclusivity, including formal meetings with regulatory bodies, public consultations, focus group discussions, one-on-one meetings, and field visits.
68. The primary data collection methods included surveys, focus group discussions, and interviews. A survey was conducted with 69 participants from the general population of the Area of Interest (AOI). Focus group discussions included one session with 8 Biotech Energy workers and laborers, as well as two sessions with women—one with 14 participants and the other with 20 participants. In-depth interviews were conducted with 6 senior officials and 4 junior managers at the Biotech Energy Unit, totalling 18 participants, and with 8 farmers. Additionally, 8 interviews were conducted with local community members and project employees. These methods provided a comprehensive understanding of the perspectives and concerns of various stakeholder groups, ensuring a diverse range of insights from both primary and secondary stakeholders.

ES-10. Conclusion

69. The ESIA finds that the project is expected to yield environmental advantages, particularly in terms of improving waste oil management and converting it into renewable resources. Additionally, substantial reductions in greenhouse gas emissions are anticipated as a result of the project. Furthermore, the initiative is projected to bring about health benefits and address the issue of waste oil disposal, which if left unmanaged could negatively impact both aquatic and human life through its eventual entry into sewerage systems. The environmental impacts related to the construction of the project will be concentrated within the core zone (500 m) of the proposed project site. These impacts are short-term, site-specific, reversible and manageable. The operational impacts are relative long term however The Environmental and Social Management Monitoring Plan (ESMMP) has been provided to mitigate both construction and operational phase impacts and bring these impacts to an acceptable level.

CHAPTER - 1: INTRODUCTION

1.1 Background

70. Biotech Energy Pvt Ltd (BTE) is a company under SAFCO Venture Holdings (SAFCO) currently operates a second-generation biodiesel unit in Sheikhpura, with 100% of its output sold in EU markets. BTE, as a leading Bio Diesel supplier in the region, is the first and only large-scale Bio Diesel producer in Pakistan. BTE suppliers are based locally and worldwide.
71. Commercially sensitive information has been redacted.
72. With the increasing demand for biofuels across Europe, BTE plans to expand its current operations in Sheikhpura by setting up an independent Sustainable Aviation Fuel (SAF) facility. This SAF processing facility will use the same feedstock as those needed for biodiesel production. It is anticipated that the production capacity of SAF will reach 200,000 MT/year.
73. The SAF initiative is set to occupy a brownfield site, positioned next to BTE's current setup and make use of crucial shared infrastructure like utilities and feedstock storage. For the production of SAF, BTE intends to employ HEFA technology, choosing Axens as their provider for this technology.
74. The BTE facility spans a total of 5.84 acres, with the biodiesel production facility occupying 2.66 acres and the area designated for the SAF plant extending over 3.18 acres.
75. At full capacity, the project will lead to significant Green House Gas Savings, a project 704,500,766kg/co₂ is saved per year through the expansion (equivalent of planting approximately 41 million trees per year)
76. The project company is certified by ISCC, and fully compliant with EU Renewable Energy Directive (II), ISO 9001: 2015, ISO 14001:2015, and ISO45001:2018. As well as certification from the Ministry of Ecology (France) under CabRUE, registered under the Union Database for Biofuels (EU), NABISY (Germany) and compliant with Dutch Decree and Ministerial order for transport certified by DEKRA.
77. To secure funding from the International Financing Corporation and the Asian

Development Bank, a bankable Environmental and Social Impact Assessment Report regarding the SAF (“the Project”) adhering to the IFC/World Bank Group's standards and ADB’ s Safeguard Policy Statement must be submitted to these financial bodies for review and approval.

1.2 Location and Accessibility of the Project

78. The project site location is situated 14 kilometres along Sharaqpur Road in the Sheikhpura District. The site on Sharaqpur Road can be accessed via the main Lahore-Sheikhpura Road and Motorway M3. The current site is located in a designated industrial zone and is surrounded by a mix of agricultural and residential areas. The nearest settlement is the village Chah Shadulwala and is located around 1 KM from the project site. The location map of the site is given as under:

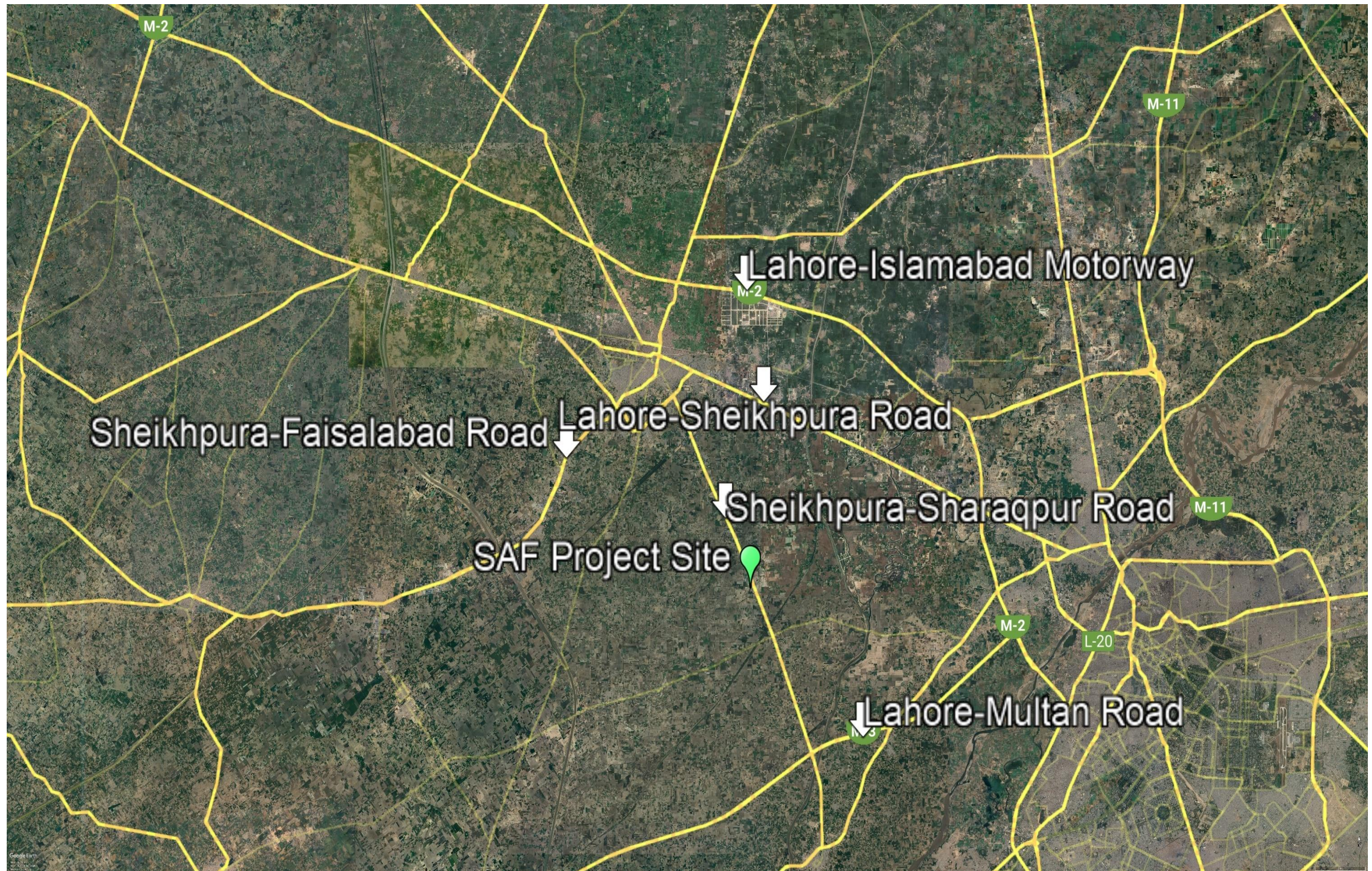


Figure 1-1: Location Map of Proposed Project Site

1.3 Land use

79. The proposed project is situated on land already owned by the client, eliminating the need for any land acquisition, including for the facilities such as drainage and access roads. The site is located within the industrial zone of Sheikhupura District, with coordinates at 31°35'49.29"N, 74°3'21.47"E.

80. The land use distribution of Area of Concern (AOC) is given below:

Land Use Classes	Area (sq. km)	Percentage (%)
Agricultural	75.62	96
Area under Water	0.02	1.1
Arterial and Circulations	0.03	1.5
Commercial	-	-
Cultural heritage	-	-
Education	0.08	0.1
Graveyard	0.09	0.1
Health Services	0.01	0.01
Industrial	0.62	0.78
Public Building	-	-
Religious Building	0.005	0.006

81. The land use map of AOC is given as under:-

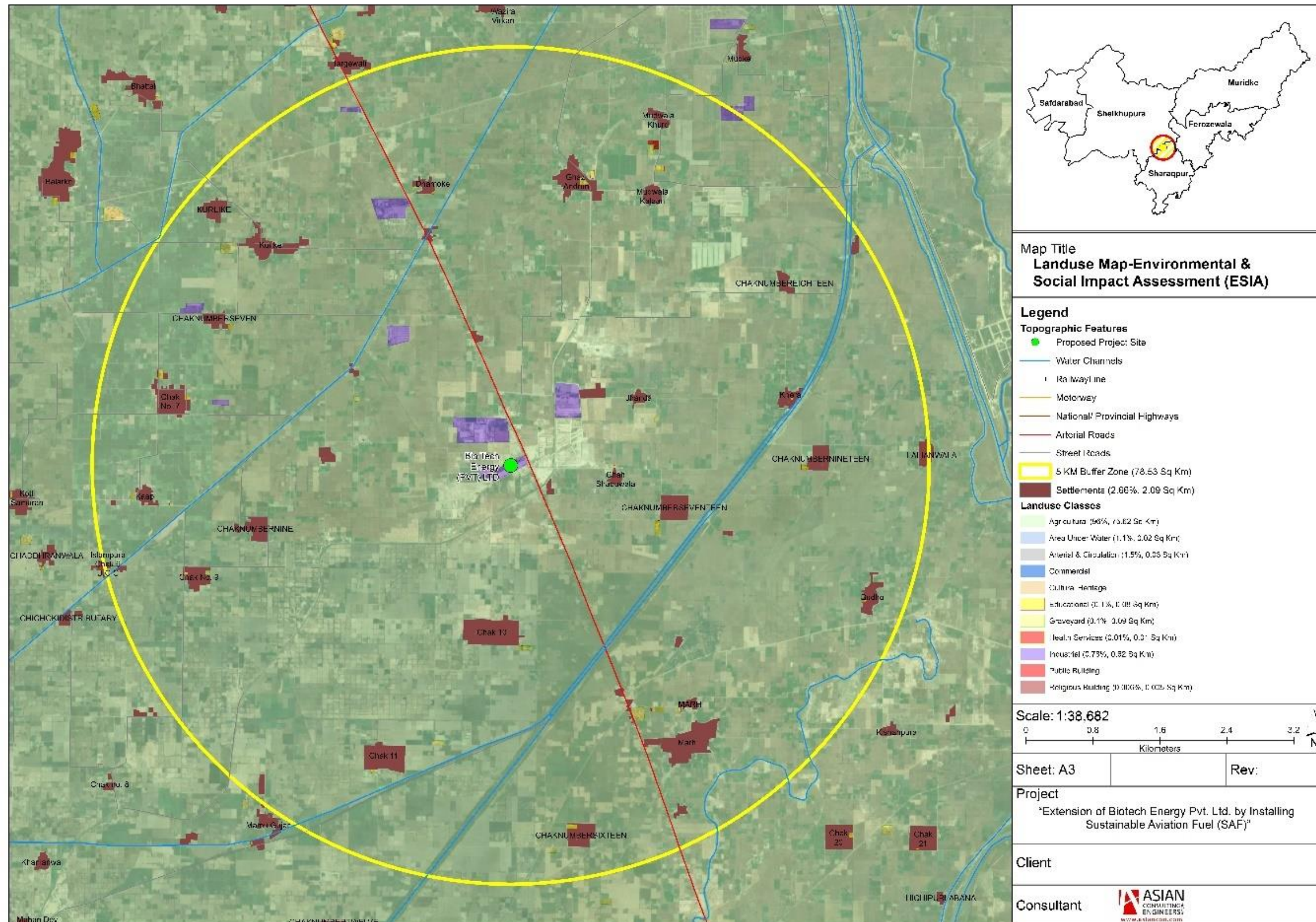


Figure 1-2: Land use Map of AOC

1.4 Silent Features of the Project

82. The salient features of the project are summarized in **Table 1-1**.

Table 1-1: Project Salient Features

Salient Features	Extension of Biodiesel Production Plant by installing Sustainable Aviation Fuel (SAF)
Project Owner	Biotech Energy Pvt. Ltd
Project Capacity	200,000 MT/year
Location of Site	14-Km, Sharaqpur road, District Sheikhpura
District	Sheikhpura
State	Pakistan
Project Coordinates	31° 35'49.29"N 74° 3'21.47"E
Nearest Settlement	Nearest Village is Chah Shadulwala and is located around 1 KM from the Project site
Nearest Airport	Allama Iqbal International Airport
Total Land Area	Total Area: 5.84 acres Covered Area for Existing Facility: 2.66 acres Covered Area for SAF Plant (Proposed Project): 3.18 acres
Type of Land	Owned by BTE
Status of Land and land use	Industrial Zone
Present Status of Proposed Project	Planning Phase
Expected year of Operation	2027
End life of the project	The plant design philosophy is on a 50-year operational life.

1.5 Key Permits and Approvals for SAF

Permits and Approval	Status
Environmental Approval – Construction and Operational Stage	Construction Phase Approval is obtained through submission of an IEE Report as per Punjab EPA regulations 2022 Operation phase NOC will be applied before start of operations
Building Permits	4 Weeks' time after the Completion of the Construction
ISCC Certification	Before Operation of the Site
Civil Defense	4 Weeks' time After completion of Construction

1.6 Purpose of ESIA Study

83. The main purpose of the ESIA study is to identify, evaluate and manage environmental and social impacts that may arise due to implementation and operation of the project. The document has been made to comply with the requirements of IFC's Performance Standards, ADB Safeguard Policy 2009, World Bank Group's EHS Guidelines and applicable sector guidelines, as

well as applicable local and national regulations. The objectives of the ESIA study are:

- To identify and establish the baseline environmental and socioeconomic conditions, to analyze the environmental and social risks and impacts of the project and its associated components.
- Socio-economic survey involving consultation with local community, and stakeholders to identify the needs and problems of the community with respect to the project activities.
- To suggest appropriate safeguards for the associated environmental and social risk, which may not lead to project investment and activities at risk.

1.7 Approach and Methodology of the ESIA Study

84. The approach and methodology applied for undertaking the environmental and social impact assessment study are as provided.

- Desktop review of project-related documents
- Reconnaissance survey to understand site-specific issues
- Discussion with the local community in the project influenced villages and stakeholders to understand their perception of the project and identification of key issues.
- Baseline noise level, air, water, soil, ecology, and biodiversity data collection of the site through primary surveys and secondary data source surveys.
- Identification of environmental and social risks associated with the project (including associated facilities) during the construction and operation..
- Identification of cumulative impacts for SAF project during both the construction and operational phases.
- Preparation of an environmental and social management action plan (with timelines & responsibilities) & Environmental monitoring plan to manage these risks and impact.

1.8 ESIA Team

85. ASIAN Consulting Engineers Private Limited (AsCE) is providing its services to conduct environmental and social assessments for the project. ASIAN Consulting Engineers Private Limited is an independent consulting company working in the field of environment. Asian provides consulting services and sustainable solutions for infrastructure projects, industrial projects and social development projects.

86. The contact details for the company are given as under:-

Asian Consulting Engineers Private Limited

Tel: +92 42 35450914-5 | **Fax:** +92 42 35450916 |

Mobile: +92 321 4260133

E-mail: arslan.hanif@asiancon.com, aleem.butt@asiancon.com

Address: C-3, Jhelum Block, Green Forts-II, Lahore, Pakistan.

The qualified and experienced ESIA team of experts is given as under:-

Table 1-2: ESIA Consultant

Sr. No.	Team Member	Position Held	Qualifications & Experience	Responsibilities on Project Study
1.	Aleem Butt	Chief Environmentalist Team Leader- ESIA	Qualification M.Phil. Environmental Sciences, Government College University (GCU) Lahore M.Sc. Environmental Sciences, Punjab University (PU), Lahore NEBOSH, Lead Auditor Stakeholder Engagement Specialist Experience 15+ years' experience in Environmental impact Assessments	- Responsible for overseeing the planning, execution, and delivery of the report. - Coordinates the work of the multidisciplinary team of experts. - Assurance of quality and consistency of data and analysis. - Communicating the findings and recommendations to the client. - Consultation with the stakeholder regarding project. - Ensure that the project is finished within the specified timeframes. - Lead stakeholders & public consultation for both construction and operational phases. - Assess the risk of supply chain and industry specific fuels.
2.	Rameez Ahmed	Fuel Technology and Supply Chain Expert	Qualification BS Mechanical Engineering, University of Engineering & Technology (UET) Lahore Experience 20+ years' experience in Fuel processing, pyrolysis and Supply Chain	- Assessing the feasibility of different fuel processing technologies for the project, including their efficiency and suitability. - Evaluating the design of the SAF processing plant to ensure optimal performance and adherence to industry standards. Managing the supply chain for raw materials by overseeing sourcing, logistics, and processing, using fuel supply chain experience to reduce risks and ensure reliability. - Analyzing the supply chain for raw materials, including sourcing, logistics, and processing methods.

Sr. No.	Team Member	Position Held	Qualifications & Experience	Responsibilities on Project Study
				Reviewing SAF production processes to identify areas for improvement in efficiency and cost-effectiveness. Contributing to the development of operational protocols and best practices for SAF production.
3.	Sameen Khokhar	Environmental Specialist	Qualification M.Phil. Environmental Sciences, Government College University (GCU)Lahore M.Sc. Environmental Sciences, Punjab University (PU), Lahore Experience 15+ years' experience in Environmental impact Assessments and Compliance	- Responsible for conducting a comprehensive analysis of the potential environmental and social risks and impacts of the project. - Identifying the relevant legal and regulatory frameworks, and proposing appropriate mitigation and monitoring measures. - Preparation of detailed environmental and social management plan that outlines the roles and responsibilities of the project stakeholders and implementation of the mitigation and monitoring actions.
4.	Noman Ashraf	Environmental Specialist	Qualification M.Phil. Environmental Sciences, Government College University (GCU), Lahore PHD, Environmental Law, University of the Punjab, Lahore Experience 10 years' experience as Environmental Specialist on Mega Development Projects as per World Bank, ADB, IFC guidelines etc.	- Responsible for the assessment of the current environmental conditions in and around the project area including data collection on key environmental parameters - Also defined areas directly influenced by the project activities (areas of influence) and identified areas that could potentially experience negative impacts as a result of these activities (areas of concern).
5.	Muhammad Ibrar	Ecologist	Qualification M.Phil. Botany, Government College University (GCU) Lahore Experience	Responsible for conducting ecological assessments of project site, which involves evaluating biodiversity, habitats, and ecosystem dynamics.

Sr. No.	Team Member	Position Held	Qualifications & Experience	Responsibilities on Project Study
			08 years' experience in ecological studies	Conduct field surveys and data analysis, to identify potential impacts and develop solutions.
6.	Sajad Hussain	Sector Risk Assessment Expert	Qualification M.Phil. Chemistry Government College University (GCU), Lahore Experience 08 years' experience as Sector Risk Assessment Expert	Responsible for identifying and analyzing potential risks of project, assessing their impact, and recommending mitigation strategies. This role involves continuous monitoring of industry trends, collaboration with stakeholders, and the preparation of comprehensive risk assessment reports to guide decision-making.
7.	Asma Butt	Sociologist	Qualification MPhil Sociology University of Punjab Experience 06 years' experience of Social and Cultural Studies	- Responsible for conducting field visits, interviews, surveys, and public consultation meetings to gather relevant information on the social and economic conditions of nearby communities of the project site. - Evaluating policies related to child labor and examining vendor and supplier practices to ensure alignment with project requirements. Assessing all aspects of the supply chain to confirm compliance with social responsibility and ethical standards.
8.	Engr. Maryam	Environmental Engineer	Qualification B.Sc. Environmental Engineering, University of Engineering & Technology (UET) Lahore Experience 03 years' experience in Environmental impact Assessments	Responsible for project coordination and worked across various sections oversees communication, and task coordination to ensure project goals to meet efficiently.
9.	Ayesha Rasheed	Environmentalist	Qualification M.Phil. Environmental Sciences, Government College University (GCU)Lahore BS Hons Environmental Sciences, Government College	

Sr. No.	Team Member	Position Held	Qualifications & Experience	Responsibilities on Project Study
			University (GCU) Lahore Experience 02 years' experience in Environmental impact Assessments	
10.	Engr. Umair Tallat	Environmental Monitoring expert	Qualification M.S. Environmental Engineering, NUST Islamabad Experience 05 years' experience in Environmental Monitoring and Field Analyst	- Responsible for conducting surveys and collecting primary and secondary data relevant to project. - Responsible for environmental monitoring and evaluation.
11.	Muhammad Abbas	Field Officer	Qualification M.S. Environmental Sciences, University of the Punjab Experience 02 years' experience of Environmental Monitoring and Field Analyst & Environmental impact Assessments	

1.9 Screening

87. The first stage in any impact assessment is screening. The primary objective of screening is to identify the requirements apply to the Project. The Applicable Standards are presented in Chapter 2.

1.10 Scoping

88. Scoping is undertaken to identify the potential Area of Interest and Area of Influence for the Project (and thus the appropriate Study Area), to identify potential interactions between the Project and resources/receptors in the Area of Influence and the impacts that could result from these interactions, enabling these potential impacts to be evaluated in terms of their likely significance.

89. In order to have an informed and Project specific impact assessment, it is important to select resources/receptors based on the understanding and evaluation of environmental, social and health conditions specific to the Project and proposed activities, with consideration of the potential Area of Influence. This stage is intended to ensure that it identifies and focuses on those issues that are most important for design, decision-making and stakeholder interest. The findings of the scoping exercise are reported in Chapter 2.

1.11 Analysis of Alternatives

90. A comparative analysis of alternatives for the project is provided in terms of no project option, location alternatives, technology alternatives, transportation and wastewater treatment plant are described in Chapter 4 of this ESIA report.

1.12 Project Description

91. In order to set out the scope of the Project features and activities, with particular reference to the aspects which can impact the environment, a Project Description is prepared. Details of the Project includes the location of SAF at the project site, the waste collection as a feedstock, transportation of feedstocks, storage and handling of feedstock, SAF production process and transportation of final product oil, are provided in Chapter 5.

1.13 Baseline Conditions

92. The baseline conditions provide an overview of the information on the physical environment, collected from primary as well as secondary sources. The major parameters covered include Physical, biological, ecological and socioeconomic features of the project, given in Chapter 06.

1.14 Impact Assessment

93. This section presents the overall impacts (either beneficial or adverse) of the pre-construction/design, construction and operation phases of the proposed Project on the physical, ecological and socio-economic environment of the project site. In addition, it also covers the mitigation measures of the potential

adverse environmental and social impacts.

94. Impacts of the proposed project were identified on the basis of a detailed review and analysis of secondary data available for all environmental parameters in the Project Area, site surveys and expert opinion on prevailing site conditions and sensitive receptors, given in Chapter 07 of this ESIA.

1.15 Environmental and Social Management Monitoring Program (ESMMP)

95. This Section provides an overall approach for managing and monitoring environmental issues and describes the institutional framework and reporting mechanism to implement the Environmental Management Plan (EMP) for the proposed project given in Chapter 8 of this ESIA.

1.16 Stakeholder Engagement

96. The Project recognizes that achieving effective stakeholder engagement involves building and maintaining constructive relationships over time. Therefore, the Project has committed to an ongoing consultation and engagement process. The process focuses on a broad range of activities, including information sharing, consultation negotiation and partnership building.
97. A Stakeholder Engagement Plan (SEP) is designed with the aim of providing a platform for consultation and disclosure with Project stakeholders throughout all phases of the development. The SEP sets out the approach that the Project will adopt in order to implement an effective engagement program with stakeholders over the life of the Project. Good relations between the Project and its surrounding communities and relevant stakeholders will be an essential condition for the Project to maintain a social license to operate, providing an important mechanism for receiving community feedback on project-related concerns and also disseminating project-related information back to the community. A SEP has been prepared for the Project and presented in Chapter 9 of this report.

1.17 ESIA Structure

1. Introduction
2. Screening and Scoping
3. Applicable Regulations, Guidelines, Legislations and Standards
4. Analysis of Alternatives
5. Description of the Project
6. Description of Environmental & Social Baseline Conditions
7. Potential Environmental Impacts & Mitigation Measures
8. Environmental & Social Management and Monitoring Program
9. Stakeholder Engagement Plan
10. Conclusion and Recommendation

CHAPTER - 2: SCREENING AND SCOPING

2.1 Screening and Categorization of Project

98. Under the applicable ADB safeguard policy 2012 and IFC Sustainability 2012 standards proposed project is screened according to type, location, scale, and sensitivity and the magnitude of their potential environmental impacts, including direct, indirect, induced, and cumulative impacts. Projects are classified into categories in terms of the potential significance of impacts, taking into account such factors as: the sector and scale of the project, the substance, degree and uncertainty of potential environmental and social impacts considering the environmental and social context of the proposed project site and surrounding areas.
99. A detailed screening of potential environmental impact on different components i.e. physical, biological & social of the proposed project is carried out for SAF project and presented in **Section 7.3 Table 7-1 of the ESIA**. Most of the construction impacts are temporary, largely site specific and easily mitigatable. However, the key impacts of the project during operational phase includes supply chain risk, workers related HSE issues, community H&S risk, air emissions, noise emissions and surface water pollution. The operational phase required the mitigation measures to remain minimum and ensuring no residual impacts. The SAF Project is located on an existing brownfield site within BTE-owned land, eliminating the need for land acquisition and resettlement. All construction activities are limited to site-specific. There is no cultural heritage site, nationally or internationally designated site, wetland, or any other area of special significance, located in the vicinity of project site that may be significantly affected. Also, the project is the renewable energy project which falls under category B project defined by ADB sample project categorization according to Environment Assessment Guidelines 2003. According to the national environmental guidelines the project falls under Schedule I as Category B Clause 5 Waste to Energy Generation Project, thus requiring an Initial Environmental Examination and falling into the category of low-risk projects. The anticipated environmental and social impacts of the proposed project are generally site-specific, largely reversible and could be readily addressed through mitigation measures.
100. Therefore, According to IFC Environmental and Social Categorization, the project is categorized as B, Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.
101. According to ADB's Safeguard Policy Statement from 2009, the project is classified as Category B due to its relatively low potential for adverse environmental impacts. These impacts are mostly site-specific and can generally be minimized through mitigation measures.
102. As per ADB Involuntary Resettlement Safeguards, the project is categorized as a category C project, where no involuntary resettlement

impacts are foreseen.

103. As per ADB Indigenous Peoples Safeguards, the project is categorized as a category C project where No IP impacts are foreseen.

2.2 Scoping

2.2.1 Area of Interest (Aoi) and Area of Influence (AOI)

104. Scoping was undertaken to identify potential interactions between the Project activities and resources/receptors in the Area of Influence (AOI). The AOI was defined for the Project SAF; and was utilized in this ESIA exercise. As per IFC- PS 1 the AOI should be:

- I. The **project, the client's activities, and facilities** that are directly owned, operated, or managed (including by contractors) and that are a component of the project.
- II. Impacts from **unplanned but predictable** developments caused by the project that may occur later or at a different location.
- III. **Indirect project impacts on biodiversity or on ecosystem services** upon which Affected Communities' livelihoods are dependent. There are no affected communities from this project.
- IV. **Associated facilities**, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable. No associated facilities are identified for SAF project.
- V. **Shared Facilities**, the utilities such as boilers (04 and 02 ton), Generators (625 KVA and 525 KVA) and turbines are shared facilities with existing BTE for proposed SAF project.
- VI. **Cumulative impacts**, that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.
- VII. In the event of **risks and impacts in the project's area of influence** resulting from a **third party's actions**, the **client will address those risks and impacts** in a manner commensurate with the client's control and influence over the third parties, and with due regard to conflict of interest.
- VIII. Where the client can reasonably exercise control, the risks and impacts identification process will also consider those **risks and impacts associated with primary supply chains, as defined in Performance Standard 2** (paragraphs 27–29) and Performance Standard 6 (paragraph 30).
- IX. Where the project involves specifically identified physical elements, aspects, and facilities that are likely to generate environmental and social impacts, the identification of risks and impacts will take into account the findings and conclusions of related and applicable plans, studies, or assessments prepared by **relevant government authorities or other parties** that are directly related to the project and its area of influence. These **include master economic development plans, country or regional plans, feasibility studies, alternatives analyses, and cumulative, regional, sectoral, or**

strategic environmental assessments where relevant. The **risks and impacts identification** will take account of the outcome of the **engagement process with Affected Communities** as appropriate.

105. The key stakeholders identified during the scoping exercise includes:

Stakeholder Groups	Identified Stakeholders
Internal Stakeholders	• Lenders: IFC & ADB • Employees of BioTech • Security Personnel • Suppliers and Trasport Vendors • Collectors and Sub-collectors • Contractors and Sub-contractors • O and M Operations SAF Plant
Raw Material Management Stakeholders	• UCO/Feedstock Collectors • Brokers • Port Qasim Authority (PQA Karachi Port Trust (KPT)
Final Product Management Stakeholders	• Buyers • Transporters • Waste Management Companies • Third-Party Monitoring Labs
Utility Departments	• Lahore Electric Supply Company (LESCO) • Tehsil Municipal Administration (TMA)
Regulatory Institutions	• Environment Protection Department (EPD) Lahore • Punjab Food Authority, Sheikhupura • Punjab Irrigation Department
Government Institutions	• Resue 1122 Sheikhupura • District Heath Authority, Office CEO, Health Sheikhupura • Assistant Commissioner (AC), Local Government of Sheikhupura District • Sheikhupura Chamber of Commerce & Industry • National Highway Authority (NHA) • DSP, Police Station, Sharaqpur Sheikhupura • Traffic Department Sheikhupura
Institutional Stakeholders	• Nagina Kids Campus Sheikhupura (Neighbor) (Non-Functional) • MFTC Research Farm, Sheikhupura (in AOC) • Muhammadan Educational Complex, Sheikhupura (Nearby Educational Institute)
Community	• Local Community (Residents, Farm Houses, Farmers, and Businesses) • Local Laborers
Nearby Industries	• Ittefaq Group (Neighbor) • Prosperity Weaving Mills (Neighbor) • Etihad solvent plant pvt Ltd, Sheikhupura (nearby industry) • Polity Form • Kaboota machinery engineering company
Non-Government Organizations (NGOs) and other Groups	• Aghosh Al-Khidmat Sheikhupura (Neighbor) • Nearby Local Shops, Sheikhupura

106. The consultations were carried out during the scoping exercise with key

stakeholders along with their outcomes are given below:

Key Stakeholder	Scoping Outcomes/Concerns	Responses
Collectors and Sub-collectors	The ESIA should address the health and safety of supply chain workers.	The comment is addressed through mitigation measures detailed in Chapters 07 and 08 of the ESIA.
Contractors and Sub-contractors	The ESIA should address the health and safety of supply chain workers.	The comment is addressed through mitigation measures detailed in Chapters 07 and 08 of the ESIA.
Environment Protection Department (EPD), Lahore	Suggestion for the preparation of an IEE to comply with local regulations and submission to the EPA for NOC.	The relevant NOC will be obtained from the EPA.
Punjab Food Authority, Sheikhpura	The project requires NOC from the Food Department.	The necessary NOC will be acquired.
Punjab Irrigation Department	The project requires NOC from the Irrigation Department.	The necessary NOC will be acquired.
Rescue 1122 Sheikhpura	Emphasized the need for emergency response training.	Emergency response training and protocols will be provided, as detailed in Chapters 07 and 08.
Nearby Local Community	Interest in local job opportunities and specialized training, emphasizing local hiring.	Job opportunities for locals will be prioritized, as outlined in Chapters 05 and 07 of the ESIA.
Prosperity Weaving Mills (Neighbor)	Suggested implementation of mitigation measures for noise and dust during construction activities.	Mitigation measures for noise and dust will be implemented, as described in Chapters 07 and 08.
Aghosh Al-Khidmat Sheikhpura (Neighbor)	Suggested implementation of mitigation measures for noise and dust during construction activities.	Mitigation measures for noise and dust will be implemented, as described in Chapters 07 and 08.

- x. Where the project involves specifically identified physical elements, aspects, and facilities that are likely to generate impacts, and as part of the process of identifying risks and impacts, the **client will identify individuals and groups that may be directly and differentially or**

disproportionately affected by the project because of their disadvantaged or vulnerable status. Where individuals or groups are identified as disadvantaged or vulnerable, **the client will propose and implement differentiated measures so that adverse impacts do not fall disproportionately** on them and they are not disadvantaged in sharing development benefits and opportunities.

107. As per SAF's activities, the primary focus will be on the location where the industry's actual footprint is being developed. The project entails gathering feedstock from key urban centres via major roadways in Pakistan. Therefore, the Area of Interest (Aoi) has been first marked that covers the perimeters of these significant cities involved in feedstock collection, with a 1 KM buffer around each city boundary. It also encompasses the primary highway routes used by vehicles collecting feedstock, including a 50-meter buffer on both sides of the highway.

108. The rationale and reference for setting for setting a buffer (1 km and 50 m) in the Aoi is given below: Furthermore, it includes a 05-kilometer radius from the center of SAF facility's actual footprint within its Aoi.

Rationale for the 1-Kilometer Buffer Around City Boundaries:

109. The buffer of 1 KM around cities ensures that potential environmental and social impacts from feedstock collection activities, such as traffic congestion, air pollution, and noise, can be identified and assessed.

Rationale for the 50-Meter Buffer Along Primary Highways:

110. The rationale for 50-meter buffer along Primary Highways provides a manageable zone to identify potential impacts of vehicle operations, such as road safety risks, air emissions, noise, and accidental spillage during feedstock transportation. The buffer balances effective monitoring with practicality, avoiding overly extensive areas that may dilute the focus of mitigation measures.

111. Identifying receptors in the Aoi along highways and within major cities of Pakistan is impractical due to the extensive geographic coverage, the dynamic nature of urban environments, and the operational challenges of monitoring such a wide scope. Instead, risks of supply chain will be mitigated through a robust Supply Chain Management System (SCMS). This will include route optimization to avoid sensitive areas, strict safety protocols for vehicles and drivers, emergency response plans for incidents, and regular monitoring to ensure compliance with safety and IFC standards. This approach ensures practical, effective risk mitigation while maintaining operational feasibility.

112. The map of Aoi of the project site is given as under:-

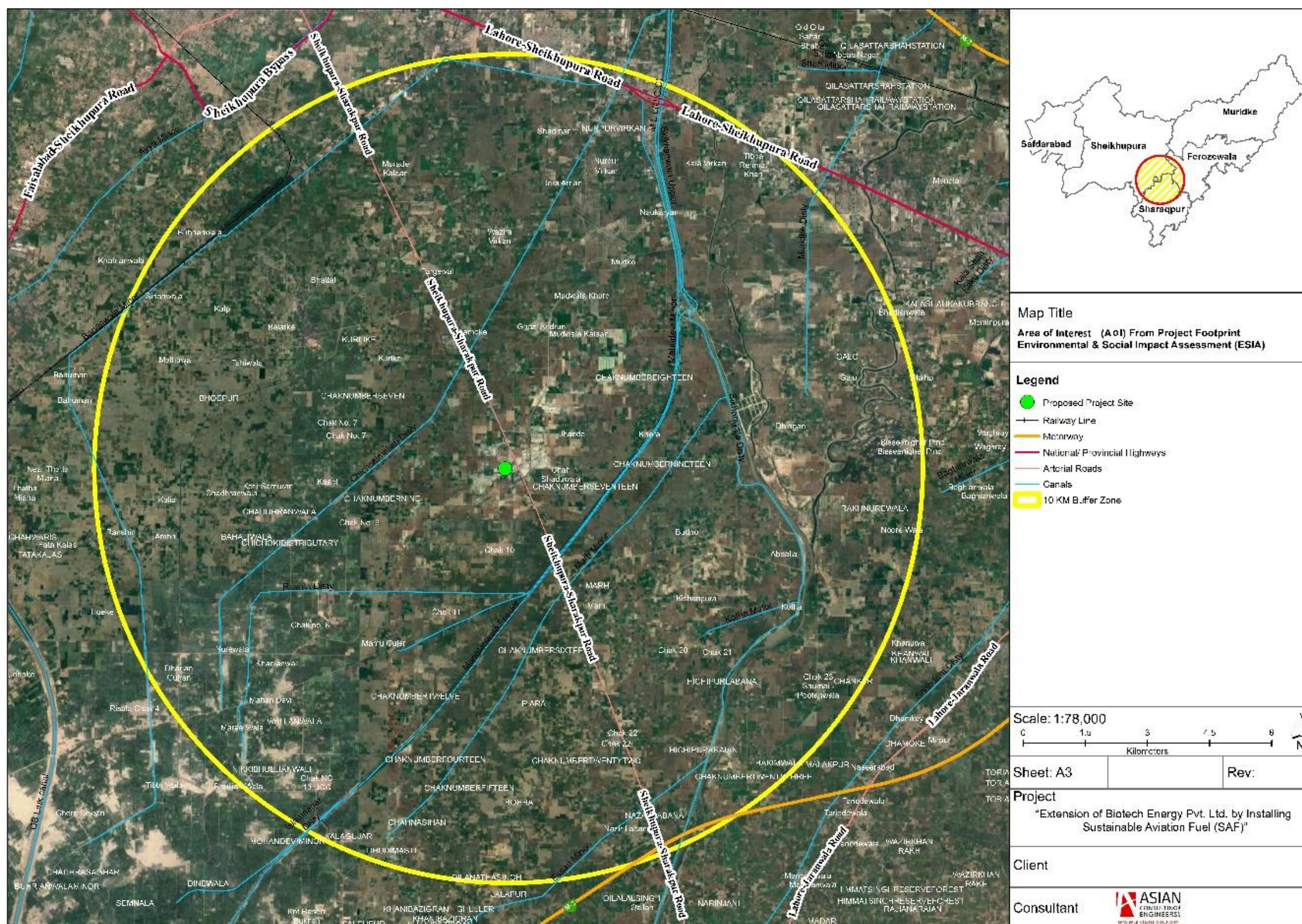


Figure 2-1: Area of interest (AoI) Map 10 KM Radius from Center of Proposed Site

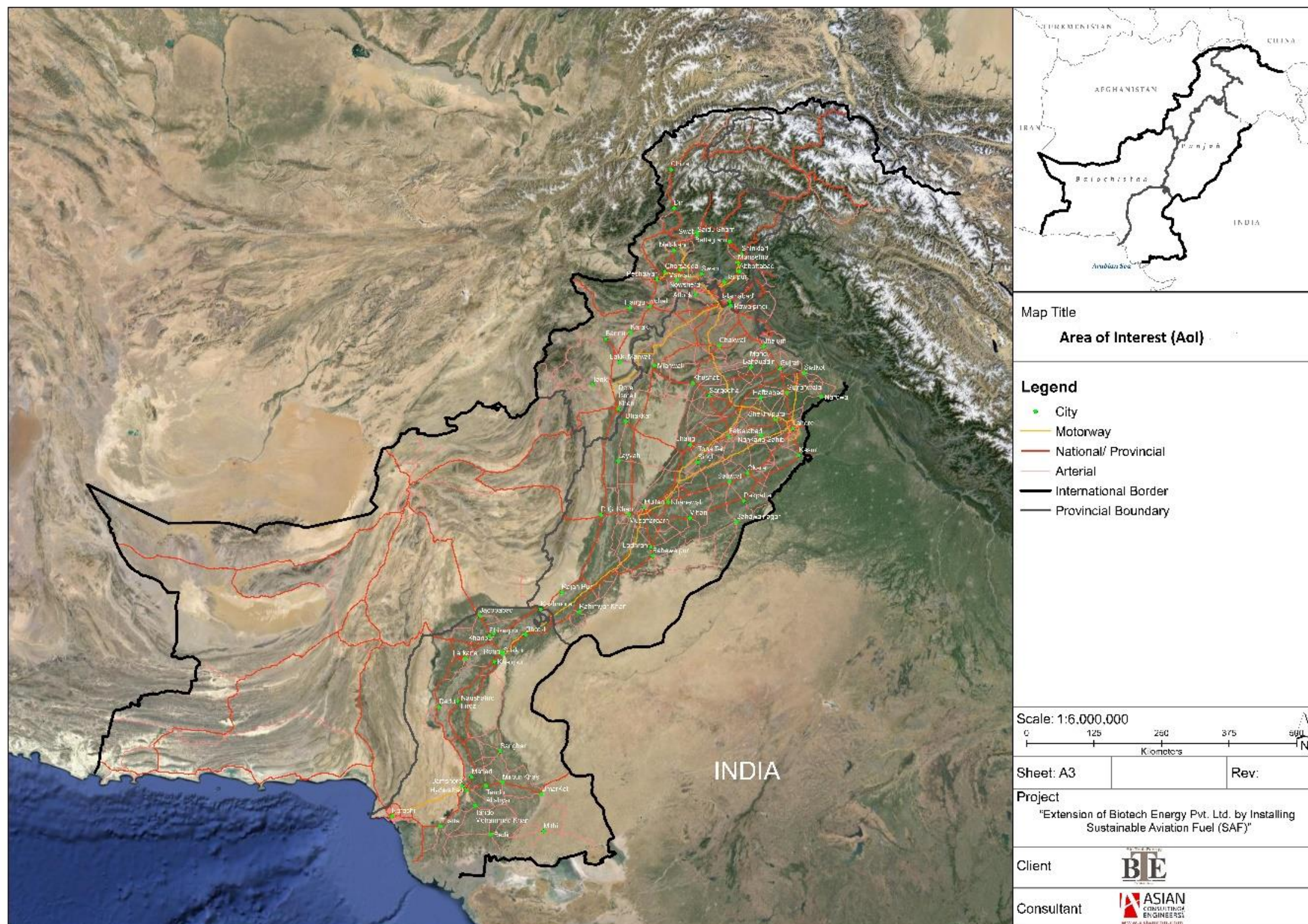


Figure 2-2: Area of Interest (Aoi) Map Primary Highway Routes and Citie

2.2.2 Area of Influence (AOI) and Area of Concern (AOC)

113. The Area of Influence (AOI) has been marked with in the Area of Interest (Aoi). For assessment and initial data gathering, the Area of Influence (AOI) and Area of Concern (AOC) has been defined within the area of interest (Aoi), spanning a 5 KM radius from the site's actual footprint. Here the AOI and AOC are interchangeable terms and both terms can be used simultaneously. The 5 KM AOI/AOC for the proposed Project is determined based on environmental and social resource considerations given as under-

Table 2-1: Environmental & Social Issues

Sr. No.	Environmental Social Issues	Area of Concern	Justification
1	Air Quality	5 KM	Dust emissions, fugitive dust, etc. are typically observed within 100-200m from the construction site. Air dispersion modeling has been performed for emission sources of SAF which shows that the pollutants (CO, NOx, SO ₂ and PM) has been completely dispersed by 5 km area (reference to Annexure 7B of the ESIA). Therefore, the 5 km AOC has been taken for baseline and impact assessments.
2	Water Quality	5KM	A 5 km AOC is selected based on the distance of surface water bodies from the actual footprint of the site and the impact from the source point downstream.
3	Social Economic Conditions	5 KM	A 5 km radius area of concern is selected for the social and economic baseline aimed at understanding the perceived effects of the project, such as job opportunities and the environmental social risk resulting from project activities including public road for the transport using vehicles.
4	Ecology	5 KM	An area of 5 kilometers in radius is chosen for the ecological study. This radius provides adequate coverage to assess various habitats and the impact of project activities on ecological resources.

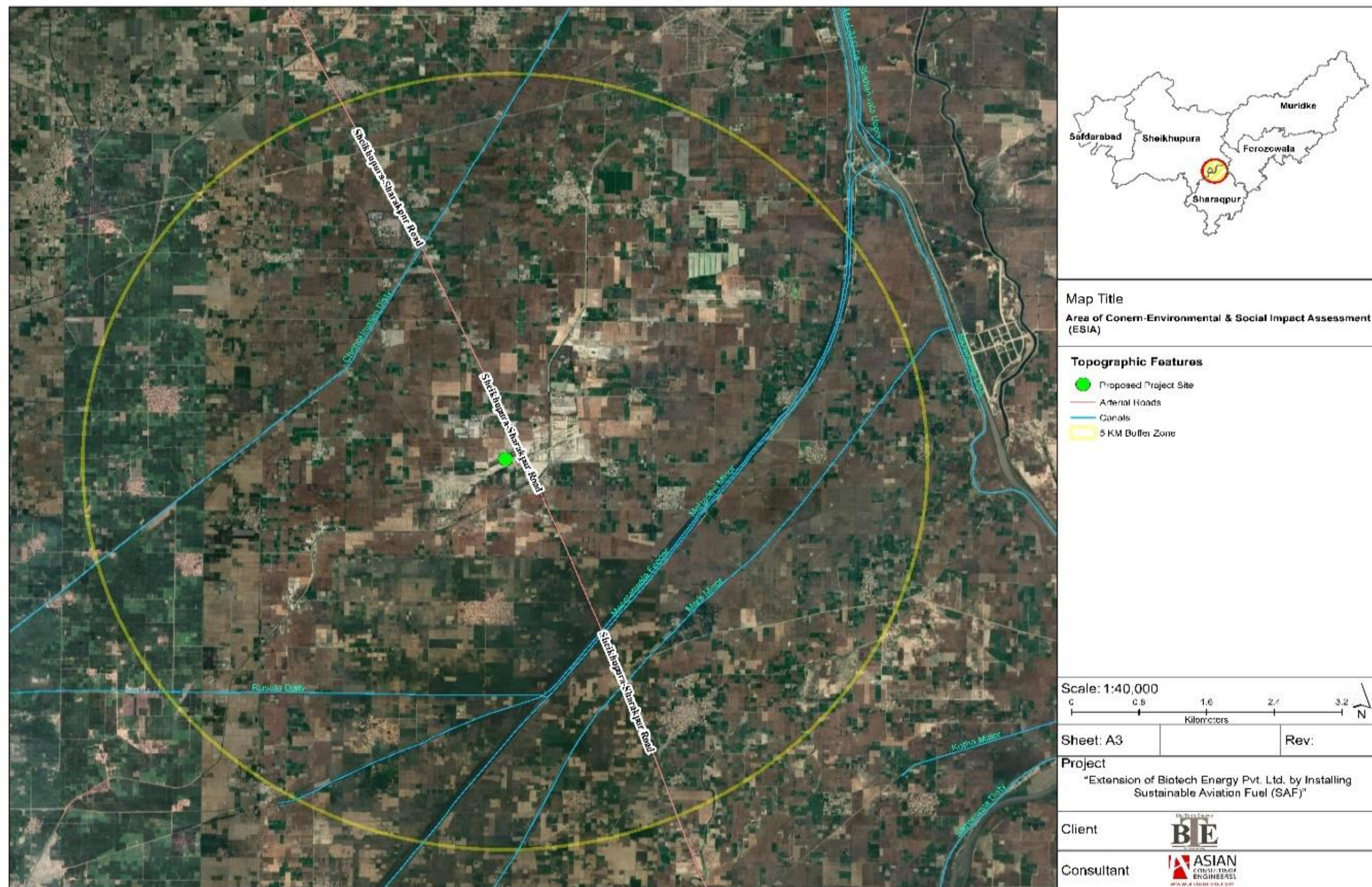


Figure 2-3: Area of Influence Map

2.2.3 Core Zone Area

114. The core zone is defined with in AOI/AOC as the radius extending from the Project footprint area which would have the majority of the impacts (during mobilization, construction and operation phase of the project). The core zone area for the study is the project footprint area and adjacent area within a 500 m radius. The impact on soil, land, and noise is limited to this zone.

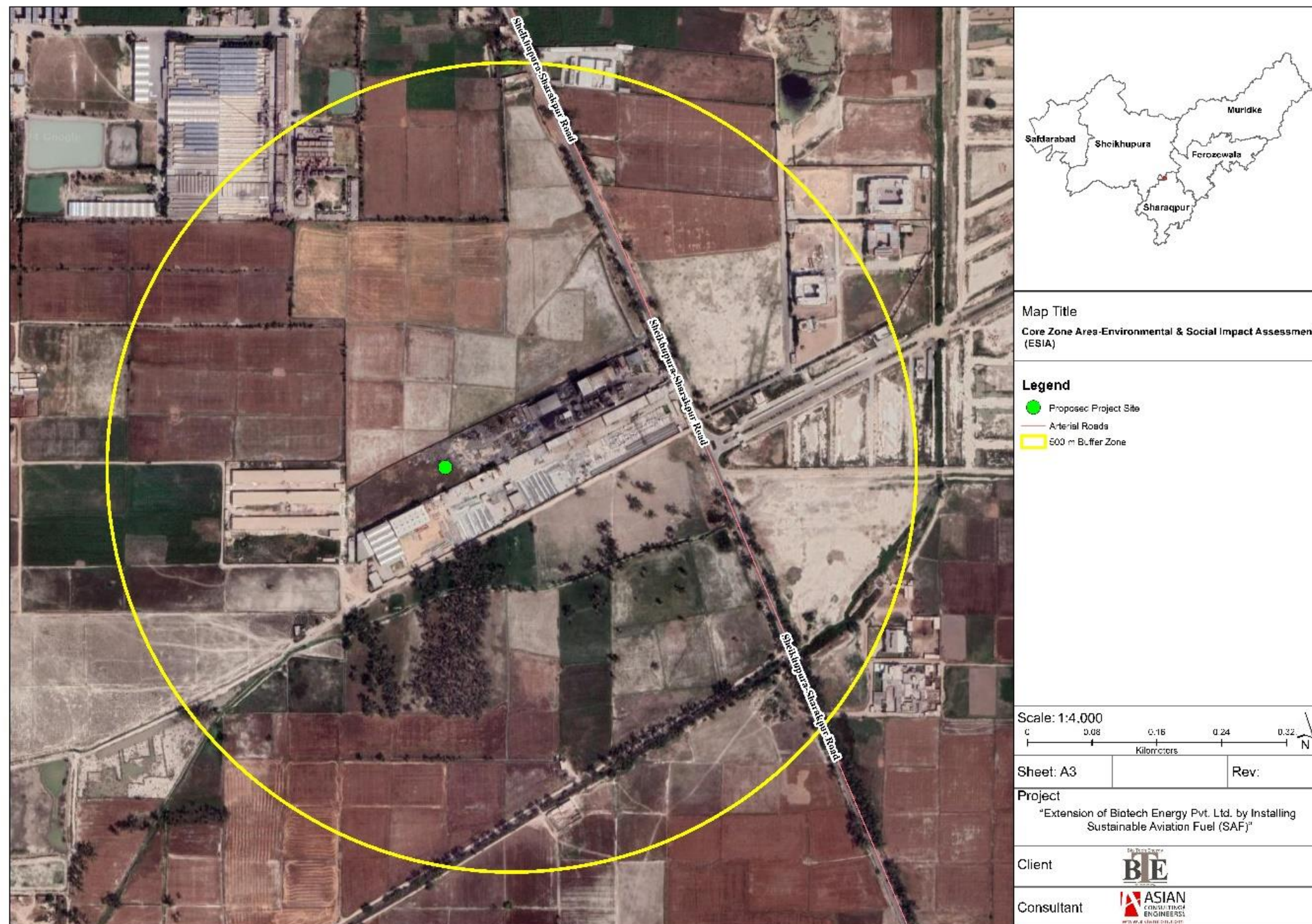


Figure 2-4: Core Zone Area

2.3 Scope of Consideration of Supply Chain in ESIA

115. According to Performance Standard I, Clause 10, where the client can reasonably exercise control, the risk and impact identification process will include risks and impacts related to primary supply chains, as outlined in Performance Standard 2 (paragraphs 27–29) and Performance Standard 6 (paragraph 30). BTE will identify all risks and impacts associated with the primary supply chain and propose appropriate mitigation measures to address them.

2.4 Screening of Cumulative Impacts

116. The screening of cumulative impacts for the proposed Sustainable Aviation Fuel (SAF) project was carried out based on consultations with relevant stakeholders and secondary data analysis. No upcoming or planned projects within the Area of Influence (AOI) of the proposed project were identified. In line with IFC guidelines, cumulative impacts should not only be assessed in isolation but also by considering the combined effects of the proposed project and the operations of surrounding facilities. Therefore, the screening of cumulative impact has been conducted specifically in conjunction with the existing facilities operating within the AOI.

Table 2-2: Screening of Potential Sources of Cumulative Impacts

Construction Phase

Sr. No	Aspects	Cumulative impacts from BTE operation	Cumulative impacts from SAF Construction	Cumulative impacts from Existing Facilities (AOI)	Remarks
1	Ground Water Resource	✓	✓	✓	Detailed impacts analysis and mitigations are given in Chapter 07 Section-7.3.3.2 of the ESIA.
2	Wastewater	✓	✓	✓	Detailed impacts analysis and mitigations are given in Chapter 07 Section-7.3.3.3. of the ESIA.
3	Noise	✓	✓	✓	Detailed impacts analysis and mitigations are given in Chapter 07 Section 7.3.3.4 of the ESIA.
4	Vibration	✗	✗	✗	The machinery used during the construction phase is not typically employed for heavy infrastructure development and is unlikely to generate significant vibrations. As a result, there will be no adverse impact on surrounding

					community facilities, workers, or existing BTE operations.
5	Air Emissions	✓	✓	✓	Detailed impacts analysis and mitigations are given in Chapter 07 Section-7.3.3.3 of the ESIA.
6	Community H&S risks associated with the transport	✓	✓	✓	Detailed impacts analysis and mitigations are given in Chapter 07 Section-7.5.2 of the ESIA.

Operational Phase

Sr. No	Aspects	Project Impacts	Cumulative impacts from BTE	Cumulative impacts from Existing Facilities (AOI)	Transboundary Impacts	Remarks
Physical Environment						
1	Collection of Feedstock	✓	✓	✗	✗	- There will be negligible cumulative impact from BTE. - There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
2	Transportation of Feedstock	✓	✓	✓	✗	There will be cumulative impacts from existing facilities. Appropriate Mitigations have been proposed
3	Storage of Feedstock	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
4	Supply Chain Risks	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
5	Gender-based violence (GBV) risks associated with feedstock (UCO)	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts

6	Child labour	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
7	Health and Hygiene of the Workers	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
8	Storage of Final Product (Renewable diesel and SAF)	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
9	Transportation of Final Product	✓	✓	✓	✓	There will be cumulative impacts from existing facilities. Appropriate Mitigations have been proposed
10	Ground Water Resource	✓	✓	✓	✗	A hydrological study has been conducted which shows that the negligible impact on the ground water resource. The report is attached as Annexure-7C.
11	Surface Water Resource	✓	✓	✓	✗	There will be cumulative impacts from existing facilities. Appropriate Mitigations have been proposed
12	Wastewater	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
13	Noise	✓	✓	✗	✗	- There will be no cumulative impacts from BTE - There will be no transboundary impacts. Appropriate mitigations proposed. Further Detail analysis in Noise modeling report
14	Vibration	✗	✗	✗	✗	The machinery and equipment used for SAF operations, such

						as pumps and compressors, are not vibration-producing. Therefore, there will be no adverse impact on surrounding community facilities, workers, or existing BTE operations.
15	Air Emissions	✓	✓	✓	✗	There will be cumulative impacts from existing facilities. Appropriate Mitigations have been proposed. Further detail analysis in Air Modeling Report
16	Occupational Health and Safety	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
17	Biofuel Transport: Community H&S Risks	✓	✓	✓	✗	There will be cumulative impacts from existing facilities. Appropriate Mitigations have been proposed
18	Solid Waste	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
19	Fire Explosion and Process Safety	✓	✗	✗	✗	- There will be no cumulative impact from BTE - There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
20	Chemical Hazard	✓	✓	✗	✗	- There will be no cumulative impacts from existing facilities - There will be no transboundary impacts
Ecological Environment						
21	Impact on Flora & Fauna	✓	✗	✗	✗	- There will be no cumulative impact from BTE - There will be no cumulative

						impacts from existing facilities • There will be no transboundary impacts
Socio-Economic Environment						
22	Impact on Socio Economy	✓	✓	✓	✗	• There will be positive impacts on socio-economy cumulatively • There will be no transboundary impacts
23	Community H&S risks associated with the use of security personnel	✓	✓	✓	✗	• There will be positive impacts on socio-economy cumulatively • There will be no transboundary impacts
24	Impacts related to the risk of breeding of pests/rodents	✓	✓	✗	✗	• There will be positive socio-economic from BTE • There will be no cumulative impacts from existing facilities • There will be no transboundary impacts

CHAPTER - 3: APPLICABLE REGULATIONS, GUIDELINES AND STANDARDS

117. This section provides a comprehensive overview of the relevant national, provincial and international legislations and guidelines applicable to the proposed project. By analyzing the legal and institutional framework, as well as pertinent laws, the objective is to pinpoint policy directives and essential procedures for evaluating the Project's social responsibility, environmental accountability, and financial stability.
118. The Project's environmental and social performance, as well as the ESIA (Environmental and Social Impact Assessment) procedure, will be governed by a set of instruments. These include the Government of Pakistan's policies, regulations from the Governments of Punjab, IFC's Performance Standards for Social and Environmental Sustainability, ADB Guidelines and international environmental treaties endorsed by Pakistan. These instruments, along with their corresponding directives, are identified and evaluated for their applicability to the Project in this section.

3.1 National Environmental Policy, Legislation and Guidelines

119. The enactment of comprehensive legislation on the environment, covering multiple areas of concern, is a relatively new and ongoing phenomenon in Pakistan. Whereas a basic policy and legislative framework for the protection of the environment and overall biodiversity in the country is now in place, detailed rules, regulations and guidelines required for the implementation of the policies and enforcement of legislation are still in various stages of formulation and discussion. A brief overview of the existing national policies, legislation and guidelines is briefly described below:

Table 3-1: Existing National Policies, Legislation and Guidelines Related to Environment and Relevance to the Project

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
1.	Pakistan Penal Code, 1860	The Code deals with offenses where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions and disposal of effluents.	The provisions of the Penal Code, 1860 are applicable to the project in terms of penalties for affecting human lives and public property. It also addresses the control of noise, air emissions and effluent disposal.
2.	Land Acquisition Act (LAA), 1894 Including Later Amendments	The Land Acquisition Act, 1894, is a "law for the acquisition of land needed for public purposes and for companies and for determining the amount of compensation to be paid on account of such acquisition". The exercise of the power of acquisition has been limited to public purposes. The principles laid down for the determination of compensation, as clarified by judicial pronouncements made from time to time, reflect the anxiety of the law-giver to compensate those who have been deprived of property, adequately. The land needed for the construction of development projects will be acquired under normal conditions based on prevailing market prices or negotiated prices between the client and the owners of land. Section 17(4) of the LAA will not be used in the absence of an emergency. Instead, the land will be purchased under a willing-seller willing-buyer deal at agreed-upon market rates and the seller will have the option not to sell the land, in case an acceptable deal for both parties is not reached.	This Act will not be applicable as the proposed project site for SAF is already owned by the project proponent. There is no land acquisition involved.
3.	National Conservation Strategy, 1992	Pakistan National Conservation Strategy (PNCS), which was approved by the federal cabinet in March 1992, is the principal policy document on environmental issues in the Country. The NCS	The key focus areas for the proposed project include minimizing environmental impact during both construction and operation i.e., using waste as raw material and converting in to renewable

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		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.	bio-diesel. BTE will emphasize resource efficiency and plans to use wet scrubbers for pollution prevention.
4.	National Clean Air Act, 2000	The Act aims to control vehicular emissions, pollution from industry, and indoor air pollution in rural and urban areas.	This Act will be applicable and the machinery and vehicles, and equipment used in construction and operational activities must release air pollutants within its allowable limits.
5.	National Forest Policy, 2001	The goal of this policy is to foster the sustainable development of Renewable Natural Resources (RNR) in Pakistan, through the maintenance and rehabilitation of these essential resources and the enhancement of sustainable livelihoods of rural masses, particularly women, children and other deserving groups. The various components of the policy include: a) Reducing poverty, powerlessness and unemployment; b) Population planning in critical ecosystems; c) Reducing the impact of socio-economic factors; d) Providing substitutes for firewood in the mountain woods; e) Reducing political interferences in Forestry and Wildlife Departments; f) Renovating and invigorating the institutions of RNR; g) Supporting Local Governments in the sustainable	Not applicable as there are no forests or reserved forests within the vicinity.

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		development of their RNR; h) Policies for fragile ecosystems; i) Riverside forests; j) Irrigated plantations; k) Preservation of sensitive and unique forests; l) Wildlife conservation; m) Rangelands and desert ecosystems; and o) Planting trees and fodder on farmlands.	
6.	The Boilers and Pressure Vessels Ordinance, 2002	The Boilers and Pressure Vessels Ordinance, of 2002, regulates the use, construction, installation, and repair of boilers and pressure vessels in Punjab, Pakistan. It prohibits unregistered or uncertified use and allows owners to apply for renewals under the Inspector's supervision.	The proposed project will have boilers (as refer in Chapter 5 Machinery and Equipment's Details) in relevant facilities and regulate them as per regulations.
7.	The Oil & Gas Regulatory Authority (OGRA) Ordinance, 2002	It is a legislative framework in Pakistan that establishes the Oil & Gas Regulatory Authority as a regulatory body for overseeing and regulating the oil and gas sector in the country. The rules of this framework include key provisions like the granting of licenses and permits for oil and gas activities, setting and monitoring industry standards, determining tariff structures, and addressing issues related to safety, environmental protection, and quality control. OGRA may have the authority to resolve disputes within the industry and enforce compliance with regulations.	The regulations concerning OGRA and petroleum are not applicable as it is not a petroleum product.
8.	Petroleum Act, 1934	Regulates import, transportation, storage, production, refining and blending of petroleum products and other flammable substances	it is not a petroleum product therefore the act is not Applicable
9.	National Environmental Policy, 2005	In March 2005, the Government of Pakistan (GoP)	Section 5 (Policy Instruments): sub-section

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		launched its National Environmental Policy, which provides a framework for addressing environmental issues. Section 5 of the policy commits for integration of environment into development planning as instrument for achieving the objectives of National Environmental Policy. It also provides broad guidelines to the Federal Government, Provincial Governments, Federally Administered Territories and Local Governments to address their environmental concerns and to ensure effective management of their environmental resources.	5.1(Integration of Environment into Development Planning) of Clause (b) states that EIA/IEE related provisions in Environmental Protection Act, 1997, will be diligently enforced for all developmental projects.
10.	National Drinking Water Policy, 2009	The National Drinking Water Policy provides a framework for addressing the key issues and challenges facing Pakistan in the provision of safe drinking water to the people. Drinking water is the constitutional responsibility of the provincial governments and the specific provision function has been devolved to specially created agencies in cities and towns and Tehsil Municipal Administrations under the Local Government Ordinance 2001.	This policy is applicable for the proposed project during the construction and operational phase in terms of provision and regular water quality monitoring by a third party.
11.	Pakistan Labour Policy, 2010	The main objective of the Labour Policy, 2010 is the social and economic well-being of the labour of Pakistan. The Labour Policy, 2010 has the following 4 parts: • Legal Framework; • Advocacy: rights of workers and employers; • Skill development and employment; and • Manpower export.	During the construction and operation of the proposed project, labor will be utilized according to the established policy.
12.	National Disaster Management Act, 2010	National Disaster Management Act, 2010 was passed	This act applies to the proposed project. The

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		by Parliament of Pakistan in 2010. The Act applies to the whole of Pakistan. The Act was passed in the backdrop of the 2010 Floods in Pakistan and strengthens the Disaster Management system.	proposed project will require special consideration of disasters and risk management strategies as per the Act.
13.	National Climate Change Policy, 2012	The National Climate Change Policy provides a framework for addressing the issues that Pakistan faces or will face in the future due to the changing climate. In view of Pakistan's high vulnerability to the adverse impacts of climate change, in particular extreme events, adaptation effort is the focus of this policy document. The vulnerabilities of various sectors to climate change have been highlighted and appropriate adaptation measures spelled out. The policy covers measures to address issues in various sectors such as water, agriculture, forestry, coastal areas, biodiversity and other vulnerable ecosystems. Notwithstanding the fact that Pakistan's contribution to global Greenhouse Gas (GHG) emissions is very small, its role as a responsible member of the global community in combating climate change has been highlighted by giving due importance to mitigation efforts in sectors such as energy, forestry, agriculture and livestock. Furthermore, appropriate measures relating to disaster preparedness, capacity building, institutional strengthening; technology transfer; introduction of the climate change issue in higher education curricula; ensuring environmental compliance through IEE and EIA in the development process; addressing the issue	This policy document is a 'living' document and will be reviewed and updated regularly to address emerging concepts and issues in the ever-evolving science of climate change. The policy will be applicable However, SAF will save approximately 90% of greenhouse gas through its resource efficiency efforts.

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		of deforestation and illegal trade in timber; promoting Clean Development Mechanisms (CDM); and raising Pakistan's stance regarding climate change at various international forums, have also been incorporated as important components of the policy. The policy thus provides a comprehensive framework for the development of Action Plans for national efforts on adaptation and mitigation.	
14.	National Sustainable Development Strategy, 2012	The National Sustainable Development Strategy is an attempt to define sustainable development and the pathway to a "green economy" in Pakistan's context. It lays out an adaptive system and approach that can be continuously improved, through regular updates, to respond to evolving challenges. The focus has been on integrating not only across the three overall dimensions of economic, social and environmental but also integrating the goals with the existing development paradigm with the aim of shifting it onto a more sustainable pathway.	This strategy is applicable as the project is an extension of the existing plant. Biotech's large-scale production of biodiesel, plays a crucial role in promoting sustainability that aligns with several United Nations Sustainable Development Goals (SDGs) due to its potential to reduce greenhouse gas emissions, promote clean energy, and foster economic development.
15.	Pakistan Climate Change Act, 2017	This Act aims to meet obligations under international conventions relating to climate change and to provide for the adoption of comprehensive adaptation and mitigation policies, plans, programs, projects and other measures required to address the effects of climate change and for matters connected herewith and ancillary thereto.	This Act will accelerate due to the emissions from the construction machinery and during the production process.
16.	National Water Policy 2018	This first-ever water policy was unanimously approved in April 2018 by the Council of Common Interest (CCI). The Policy aims at efficient management and conservation of existing water	Applicable to ensure that all the workforce during the proposed project lifecycle will be provided with safe drinking water.

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		resources, optimal development of potential water resources, steps to minimize time and cost overruns in completion of water sector projects, equitable water distribution in various areas and canal commands, measures to reverse rapidly declining groundwater levels in low-recharge areas, increased groundwater exploitation in high-recharge areas, effective drainage interventions to maximize crop production, improved flood control and protective measures, steps to ensure acceptable and safe quality of water, minimization of salt build-up and other environmental hazards in irrigated areas, institutional reforms to make the managing organizations more dynamic and responsive. The policy covered all water-related issues, including water uses, allocation of priorities, integrated planning for development, use of water resources, the environmental integrity of the basin, impact of climate change, transboundary water sharing, irrigated and rain-fed agriculture, drinking water and sanitation, hydropower and industry, groundwater, water rights & sustainable water infrastructure, water-related hazards, quality management, awareness, conservation, legal and capacity building of infrastructure.	
17.	National Action Plan for COVID-19 Pakistan	The government of Pakistan has launched the National Action Plan for COVID-19 Pakistan to combat the challenge of the prevailing virus, also available at https://www.nih.org.pk/wp-content/uploads/2020/03/COVID-19-NAP-V2-13-March-2020.pdf. The Government of Pakistan has launched the real-time data portal for COVID-19	This action plan for COVID-19 is applicable to the proposed project as it was launched after this pandemic. BTE will prioritize the safety of all staff members/workers and adhere to appropriate PPEs throughout the production procedure.

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		http://covid.gov.pk/ . These measures are mostly related to containment and awareness and capacity building. Besides this COVID-19 daily situation, the report is also available at https://www.nih.org.pk/wp-content/uploads/2020/04/COVID-19-Daily-Updated-SitRep-03-April-2020.pdf .	
Legislative Acts Concerning Labor Rights			
18.	The Employer's Liability Act, 1938	The Act has been enacted to declare that certain defenses shall not be raised in suits for damages in Pakistan in respect of injuries sustained by workmen. The provisions of Section 3 of the Act states that the defence of common employment is barred in certain cases where personal injury is caused to a workman (a) by reason of the omission of the employer to maintain in good and safe condition any way, works, machinery or plant connected with or used in his trade or business, or by reason of any like omission on the part of any person in the service of the employer who has been entrusted by the employer with the duty of seeing that such way, works, machinery or plant are in good and safe condition; or (b) by reason of the negligence of any person in the service of the employer who has any superintendence entrusted to him, whilst in the exercise of such superintendence; or (c) by reason of the negligence of any person in the service of the employer to whose orders or directions the workman at the time of the injury was bound to conform and did conform, where the injury resulted from his having so conformed ; or (d) by reason of any act or omission of any person in the service of the employer done or made in obedience to any rule or	This act is applicable as the proposed project involves the employment of 80-100 persons during the construction phase and 200-250 persons during the operational phase. Locals will be hired to carry out unskilled work.

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		bye-law of the employer (not being a rule or bye-law which is required by or under any law for the time being in force to be approved by any authority and which has been so approved) or in obedience to particular instructions given by any person to whom the employer has delegated authority in that behalf or in the normal performance of his duties; However, it was clarified that a suit for damages in respect of the injury instituted by the workman or by any person entitled in case of his death shall not fail by reason only of the fact that the workman was at the time of the injury a workman of, or in the service of, or engaged in the work of, the employer.	
19.	The Employees' Old-Age Benefits Act 1976	The ACT has been enacted in Pakistan as a law relating to old-age benefits for the persons employed in industrial, commercial and other organizations and the Act shall continue to apply to every such industry or establishment even if the number of persons employed therein is, at any time after this Act becomes applicable to it, reduced to less than ten. The Act ibid states that the Employees' Old-Age Benefits Institution shall be a body corporate having perpetual succession and a common seal, with powers, subject to the provisions of this Ordinance, to acquire, hold and dispose of property, both movable and immovable and shall by the aforesaid name sue or be sued. whereas the Act further states that the general direction and superintendence of the affairs of the Institution shall vest in a Board, which may, with the	The act is applicable and BTE staff members are enrolled in EOIB to receive retirement benefits

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		assistance of the Head of the Institution, exercise all powers and do all acts and things which may be exercised or done by the Institution and in discharging its functions, the Institution shall be guided by such instructions on questions of policy as may be given to it, from time to time, by the Federal Government, which shall be the sole judge as to whether any instructions are on a question of policy or not. The most relevant provisions relate to Contributions which shall be payable every month by the employer to the Institution in respect of every person in his insurable employment, at the rate of five percent of his wages in the prescribed manner. (2) Where an insured person does not receive any wages from the employer for any period, the Institution shall, subject to regulations, determine the number of wages with reference to which the contributions shall be computed. However, the employer shall not deduct from the wages of an insured person or otherwise recover from him any portion of the contribution. Every employer is under obligations before the expiration of thirty days from the day on which this Act becomes applicable to the industry or establishment in respect of which he is the employer, communicate to the Institution the name and other prescribed particulars of the industry of establishment and every insured person employed in the industry or establishment with detailed procedure of it. The Act further focuses that in the event of default in payment of contributions by the employer in respect of an insured person, such insured person shall have	

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		and enjoy the same rights under this Act as if no such default had occurred and An employer shall be entitled to the refund of any contribution paid to the Institution under erroneous belief that it was payable under the provisions of this Act, and shall be entitled to the refund of excess amount of the contribution where such contribution had been paid at a higher rate than the rate prescribed. The other provisions relates to finance and audit, benefits so derived, and determination of relevant questions and claims and OFFENCES AND PENALTIES pursuant to Section 37 of the Act ibid which stated as “If any person– (a) for the purpose of obtaining an allowance, or denial of any payment or allowance, under this Act , whether for himself or some other person, or for the purpose of avoiding any payment to be made by himself or any other person under this Act – (i) knowingly makes or causes to be made false statement or false representation ; or (ii) produces or furnishes, or causes or knowingly allows to be produced or furnished, any document or information which he knows to be false in any material particular ; or (b) fails to pay any contribution which under this Act he is liable to pay ; or (c) recovers or attempts to recover from an insured person, or deducts or attempts to deduct from his wages, the whole or any part of the contribution ; or (d) fails or refuses to submit any return required by this Act, or regulations or makes a false return ; or (e) obstructs any official of the Institution in the discharge of his duties; or (f) is guilty of any contravention of, or non-	

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		compliance with any of the provisions of this Act or the rules or the regulations ; he shall be punished with imprisonment for a term which may extend to two years, or with fine which may extend to ten thousand rupees, or with both. Lastly, it postulates that no court shall take cognizance of any offense under the Act except on a complaint made in writing within six months of the date on which the offense comes to the knowledge of the Federal Government or an office.	
20.	The Workers' Welfare Fund Ordinance, 1971	The Ordinance ibid has been promulgated to provide for the establishment of a Workers' Welfare Fund for providing residential accommodation and other facilities for workers and matters connected therewith or incidental thereto to regard the provisions of the Ordinance. The Ordinance provides the Constitution of Workers Welfare Fund which shall consist of (a) an initial contribution of ten crores of rupees to be made by the Federal Government, (b) such money as may, from time to time, be paid by the industrial establishment under section 4 and section 4A, (bb) the amount transferred to the fund from time to time, under clause (d) of paragraph 4 of the scheme set out in the schedule to the Companies Profits (Workers' Participation) Act, 1968 (c) voluntary contributions in the shape of money or building, land or other property made to it from time to time by any Government or by any person ;(d) income from the investments made and properties and assets acquired from out of the	Applicable and BTE is already following and same will be followed in SAF as well.

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		Fund and (e) proceeds of loans raised by the Governing Body. The provisions relate to the Workers Welfare Fund particularly its mode of payment by, and recovery from, the industrial establishment with Liabilities to be discharged by certain persons associated with it. The provisions relate to the Purposes to which money in the fund may be applied, the Constitution of the Governing Body, the Appointment of the Secretary and other employers of the Fund and the Governing Body has to lay down procedure, etc. The Functions of the Governing Body has been defined including Maintenance of books of accounts, Constitution of workers Welfare Boards and Powers, etc, of the Board.	
21.	The Disabled Persons (Employment and Rehabilitation) Ordinance, 1981	The said Ordinance has been promulgated as a legal instrument to address the rights and needs of disabled individuals. It aimed to promote employment opportunities and rehabilitation for people with disabilities. The ordinance mandated that a certain percentage of jobs in both public and private sectors should be reserved for disabled individuals. The Disabled Persons (Employment and Rehabilitation) Ordinance 1981 lays down the constitution of the National Council with its assigned Functions and powers including its meeting schedules, procedures and Appointment of the Committee concerned and establishments to employ disabled persons. Functions of the national council include formulating policy for the employment, rehabilitation and welfare	The act is applicable and already BTE has reserved a few seats for the disabled. The same will be followed in the SAF

Sr. No.	Policy/Legislation/Guidelines	Brief Coverage/Requirement	Project Relevancy
		of disabled persons; evaluating, assessing and coordinating the execution of its policy by the Provincial Councils; and having overall responsibility for the achievement of the purposes of this Ordinance. The Ordinance further focuses on the establishment to pay the fund, the Registration process of disabled persons, and the establishment of training centers and establishments to furnish information required for the implementation of the provisions of this Ordinance in such form and in such manner as the National Council may, by notification in the official Gazette, specify. However, the National Council may delegate all or any of its powers under this Ordinance to any of its members or to a Provincial Council, subject to such conditions as it may specify.	

3.2 Provincial Environmental Policy, Legislation and Guidelines

Table 3-2: Main Legislation/Acts Related to Environment and Their Relevance to the Project

Sr. No.	Main Legislation	Act	Brief Coverage
1.	Punjab Environmental Protection Act, 1997 (Amended, 2012 & 2017)	The Punjab Environmental Protection Act, 1997 (Amended, 2012 & 2017) is a comprehensive legislation and provides the legislative framework for the protection, conservation, rehabilitation and improvement of the environment. The 'environment' has been defined in the Act as (a) air, water and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relationships; (e) buildings, structures, roads, facilities and works; (f) all social and economic	The provision of the act is applicable to the proposed Project for conducting an IEE/EIA according to section 12 and to obtain environmental approval from the EPA. Section 11 of the act is applicable in terms of compliance with Punjab Environmental Quality Standards (PEQS). Similarly, section 13 of the act prohibits the import of hazardous waste. The provisions of section 16 are also applicable to

Sr. No.	Main Legislation	Act	Brief Coverage
		conditions affecting community life; and (g) the interrelationships between any of the factors specified in sub-clauses 'a' to 'f'. The notable points of the law are: - No proponent of a project shall commence construction or operation unless he has filed an IEE with the Provincial Agency designated by the Provincial EPAs an IEE, and has obtained approval; - Establishment and formation of the Punjab Environmental Protection Council (PEPC); - Prohibition of certain discharges or emissions; - Punjab Environmental Quality Standards (PEQS) for wastewater, air emissions and noise; and - Provincial Government can issue notices and enforce them to protect the environment. In the recent amendment of 2012, legislative powers related to the environment and ecology are given to provincial governments from the Federal government. The provinces are required to enact their own legislation for environmental protection. Other amendments include increasing the penalties for violations. For the proposed Project, Environmental Protection Department (EPD)/Environmental Protection Agency (EPA), Government of Punjab (GoPb) is the concerned authority. The capability of regulatory institutions for environmental management is ultimately responsible for the success of environmental assessments and that development projects are environmentally sound and sustainable.	comply with the discharge or emission of any effluent, waste, air pollutant or noise or disposal of waste or handling of hazardous substances. Under section 17, penalties will apply if anyone fails to comply with the provisions of sections 11, 12, 13 and 16. The act is applicable and SAF needs to obtain the environmental approval by conducting IEE in accordance with IEE/EIA Regulations 2022 before the start of construction activities and adhere to the environmental approval conditions Although BTE already secured the construction and operational phase approval for its existing biodiesel facility
2.		These regulations set out:	The provisions of these regulations are applicable

Sr. No.	Main Legislation	Act	Brief Coverage
	Punjab Environmental Protection Agency, (Review of IEE and EIA) Regulations, 2022)	• Key policy and procedural requirements for filing an EIA/ESIA; • The purpose of environmental assessment; • The goals of sustainable development; • The requirement that environmental assessment be integrated with feasibility studies; • The jurisdiction of the Federal and Provincial EPA's and Planning & Development (P&D) Departments; • The responsibilities of proponents; • Duties of responsible authorities; • Provides schedules of proposals that the project requires either IEE or an EIA; • The environmental screening process of the projects under schedule I, II and III; and • The procedure for the environmental approval for filing the case with the concerned EPA for the granting of the NOC.	for environmental screening of the project, which implies that an IEE is required for the proposed project to fulfill EPA requirements and to ensure ongoing compliance and adherence to environmental standards.
		In Pakistan, the National Environmental Impact Assessment (EIA) process, governed by the Pakistan Environmental Protection Agency (Pak-EPA) and defined under the Pakistan Environmental Protection Act of 1997, outlines the requirements for Initial Environmental Examinations (IEEs) and EIAs. These regulations emphasize the importance of stakeholder engagement and information disclosure throughout the assessment process. Stakeholder Engagement and Information Disclosure Requirements 1. Public Consultation: The regulations mandate that project proponents engage with affected	As per National/Provincial requirements, an IEE study was conducted for the SAF project. There is very limited scope of stakeholder's engagement under the EIA/IEE Regulations 2022 and no public hearing (information disclosure) is required for an IEE study. Hence, only the information disclosure to consulted stakeholders is carried out.

Sr. No.	Main Legislation	Act	Brief Coverage
		communities and stakeholders early in the EIA process. This includes public meetings and consultations to gather input and address community concerns about potential environmental impacts. The proponent must provide clear, accessible information about the project and its potential environmental impacts to stakeholders. This often includes summaries of the EIA/IEE findings and the anticipated effects of the project. 2. Feedback: Stakeholder feedback must be documented, and the EIA/IEE report should reflect how stakeholder concerns were addressed. This fosters transparency and ensures that local perspectives are considered in decision-making. 3. Guidelines for public consultations under the IEE/EIA Regulations 2022 detail the necessary steps for stakeholder engagement, including requirements for public notifications and the availability of documents for public review. 4. Follow-up Reporting: The proponent may also be required to report on how stakeholder input was integrated into the project design and the measures taken to mitigate adverse impacts.	
3.	Punjab Environmental Quality Standards (PEQS), 2016	PEQS promulgated recently in 2016. Specified standards under PEQS are for: • Drinking Water; • Ambient Air; • Noise; • Industrial Gaseous Emissions; • Municipal and Liquid Industrial Effluents; • Motor vehicle exhaust and noise; and	The proposed project is to be implemented in Punjab and quarterly monitoring reports will be submitted during all the phases i.e. construction and operation to the Environmental Protection Agency (EPA) to ensure ongoing compliance and adherence to environmental standards (PEQS).

Sr. No.	Main Legislation	Act	Brief Coverage
		Treatment of Liquid and Bio-Medical Waste.	
4.	Guidelines for the Preparation and Review of Environmental Reports, 1997	These guidelines describe the format and content of IEE/EIA reports to be submitted to PEPA for obtaining NOC/approval. The guidelines present: - The environmental assessment report format; - Assessing impacts; - Mitigation and impact management and preparing an environmental management plan; - Reporting; - Review and decision making; - Monitoring and auditing; and - Project Management.	The guidelines are applicable for the preparation of the IEE of the project to meet local Statutory requirements.
5.	Guidelines for Environmental Assessment	Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development Projects. The guidelines that are relevant to the proposed Project are listed below. - Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997; - Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May, 1997; and - Sectoral Guidelines: Pakistan Environmental Assessment Procedures, Pakistan Environmental Protection Agency, October 1997.	The guidelines will be applicable for the preparation and review of the IEE report
6.	Punjab Wildlife Act, 1974	The Punjab Wildlife Act (1974) is developed for the regulation of activities relating to the protection, conservation and management of wildlife in Punjab.	The proposed project is the extension of the current project, falling in an industrial area and

Sr. No.	Main Legislation	Act	Brief Coverage
			therefore, there is no wildlife reported in and around the proposed project area. Hence, this act will not be applicable (also mentioned in the ecological section of this ESIA).
7.	Industrial Relations Act, 2012	Provides for the regulation of relations between employers and workers and the prevention and settlement of industrial disputes.	The act is applicable to the employment of workers or contractor(s) by addressing core labor relations, including the rights of workers to form and join trade unions, engage in collective bargaining, and participate in dispute resolution mechanisms. It also establishes standards for employment contracts, regulates the terms and conditions of work, and outlines the responsibilities of employers and workers. By covering these aspects, the act ensures a fair and structured framework for managing labor-related issues in industrial and organizational contexts.
8.	Punjab Plantation and Maintenance of Trees Act, 1974	The Punjab Plantation and Maintenance of Trees Act, (1974) regulates tree plantations and enforces measures for their protection.	The requirements of this act will be applicable in terms of planting trees near boundary walls and in open spaces in plant and their maintenance by the proponent.
9.	Protection of Trees and Brushwood Act, 1949	The Protection of Trees and Brushwood Act, 1949 prohibits cutting or chopping of trees and brushwood without prior permission of the relevant department in the provincial government.	The act will not be applicable as there will be no tree-cutting involved during the construction and operational phase as the site is brownfield and already in the industrial zone.
10.	Explosives Act, 1884	It provides regulations for the handling, transportation and use of explosives.	Not applicable as the Project will not involve the use of explosives either during the construction or operational phase.

Sr. No.	Main Legislation	Act	Brief Coverage
11.	Pakistan Antiquities Act 1975 & Punjab Antiquities Amendment Act 2012	The Punjab Antiquities Amendment Act, 2012 is adapted from the Pakistan Antiquities Act of 1975 with a few minor changes. The Antiquities Act, 1975 (amended in 1990) states the following: • “Ancient” is any object that is at least 75 years old; • All accidental discoveries of artifacts must be reported to the Federal Department of Archaeology; • The Government is the owner of all buried antiquities discovered on any site, whether protected or otherwise; • All new construction within a distance of 200 feet from protected antiquities is forbidden; • No changes or repairs can be made to a protected monument, even if it is owned privately, without the approval of the responsible authorities; and • The cultural heritage laws of Pakistan are uniformly applicable to all categories of sites regardless of their state of preservation and classification as monuments of national or world heritage.	• The act is applicable and if there are any accidental discoveries during the excavation of the site will be reported according to the act.
12.	The Punjab Special Premises (Preservation), Ordinance, 1985	The Punjab Special Premises (Preservation), Ordinance (1985) provides the legal framework for the preservation of premises of historical, cultural, archaeological, and architectural value in the Punjab province. This legislation empowers the provincial government to notify heritage sites and sites of cultural and archaeological importance and to prohibit the implementation of developmental schemes or new constructions within the notified areas around the special premises. So far 246 sites stand notified under the Punjab Ordinance.	The proposed project is the brownfield project and extension of the current facility falling in an industrial area and therefore no archeological or heritage site was found within its AoC.

Sr. No.	Main Legislation	Act	Brief Coverage
13.	The Protection against Harassment of Women at the Workplace Act, 2010	The Protection Against Harassment of Women at the Workplace Act (2010) refers to sexual harassment at the workplace.	This Act will be applicable to the project if women are employed during the construction and operational phase of the proposed Project. BTE ensures that there is no discrimination in the workplace in compliance with local legislative and regulatory requirements. It was ensured through HR policy that all workers are treated equally and fairly through enforcement of strict measures against harassment, intimidation and exploitation especially against women.
14.	Labor Laws as part of the Constitution of Pakistan, 1973	The Constitution of Pakistan contains a range of provisions with regard to labor rights, in particular: - Article 11 of the Constitution prohibits all forms of slavery, forced labor and child labor; - Article 17 provides a fundamental right to exercise the freedom of association and the right to form unions; - Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone; and - Article 37(e) makes provision for securing just and human conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment. Labor law is controlled at both provincial and national levels with compulsory employment agreements containing the terms set out by the labor laws. The labor laws are a comprehensive set of laws in Pakistan dealing with the following aspects:	The law will be effective, and BTE has already enlisted employees for its existing location and will also recruit for the new facility in accordance with this law.

Sr. No.	Main Legislation	Act	Brief Coverage
		• Contract of Employment; • Termination of Contract; • Working Time and Rest Time; • Working hours; • Paid Leave; • Maternity Leave and Maternity Protection; • Other Leave Entitlements; • Minimum Age and Protection of Young Workers; • Equality • Pay Issues; • Workers' Representation in the Enterprise; • Trade Union and Employers Association Regulation; and • Other Laws.	
15.	Punjab Protection of Women Against Violence Act, 2016	This act counters gender-based discrimination, violence against women, and economic and social empowerment of women.	This act will be enacted if gender-based violence is observed in the proposed project area during the construction and operational phases. BTE ensures that there is no discrimination in the workplace in compliance with local legislative and regulatory requirements. It was ensured through HR policy that all workers are treated equally and fairly through enforcement of strict measures against harassment, intimidation and exploitation especially against women.
16.	Employment of Children Act, 1991	Article 11(3) of the Constitution of Pakistan prohibits the employment of children below the age of 14 years in any construction, or any other hazardous employment. In accordance with this Article, the Employment of Child Act 1991 prohibits child labour (a child is under 14 years old).	The relevance of this act will be applicable to the proposed project to prohibit child employment during the construction and operational phase.

Sr. No.	Main Legislation	Act	Brief Coverage
17.	Punjab Forest Act (Amended), 2010	The Act empowers the provincial forest departments to declare any forest area as reserved or protected. It empowers the provincial forest departments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce, quarrying and felling, lopping and topping of trees, and branches in reserved and protected forests. There is no protected forest situated in and around the Project area.	This Act will not be triggered as there is no designated reserve forest situated in and around the industry.
18.	Seismic Building Code of Pakistan, 2007	This code stipulates the minimum requirements for the seismic safety of buildings and structures and the provisions of the Building Code of Pakistan (Seismic Provisions-2007) shall apply to the engineering design of buildings, like structures and related components. Construction of buildings shall be considered as a violation of professional engineering work specified under clause (XXV) of section 2 of the Act.	This Code is applicable to the proposed project as it includes the formation of structures.
19.	The Parks and Horticulture Authority Act, 2012	This act entails regulation, development, and maintenance of public parks, green belts and green areas in the Punjab; regulation of billboards, sky signs and outdoor advertisements; to promote open and unrestricted views of the Punjab.	This act is not applicable as no parks and horticulture areas exist within the AoC of the proposed SAF facility
20.	The Punjab Water Act 2019	An Act to provide for comprehensive management of all water resources in Punjab and to regulate their use in the interest of conservation and sustainability and matters connected with and ancillary thereto.	The law is applicable for taking licenses for abstraction and disposal of water for industrial use
21.	Fisheries Act, 1897	This Act aims at the protection of fish in water bodies by rules of the State Government.	No impact on fisheries due to the proposed project is anticipated therefore this Act is not applicable.
22.	Factories Act, 1934	Regulates working conditions, safety standards, and health measures within factories, and worker welfare, for factories that employ 20 or more workers so that	This act is applicable as there will be a number of workers during the construction phase as well as

Sr. No.	Main Legislation	Act	Brief Coverage
		workers are provided with proper facilities, safe environments, and appropriate working hours	the operational phase of the Project. Adherence to these regulations helps mitigate potential negative social and environmental impacts, fostering sustainable practices and minimizing risks to human health and the surrounding communities.
23.	Minimum Wages Ordinance, 1961	Requires employers to pay workers at least the prescribed minimum wage for their work, ensuring fair compensation and adherence to established wage standards.	Applicable as it mandates the payment of minimum wages to workers in industry, ensuring that workers receive at least the prescribed minimum wage for their work.
24.	Payment of Wages Act, 1936	Ensures the timely payment of wages to workers and regulates the timely and accurate payment of wages, permissible deductions, and payment intervals, ensuring workers receive their earned wages per legal standards	Applicable as compliance with the Act's provisions is crucial to uphold workers' wage rights and promote fair payment practices within the Project.
25.	The Punjab Polythene Bag Rules, 2004	This rule prohibits the manufacturing, sale, use and import of polythene bags that are below 15-micron thickness.	This rule will be applicable however, 15-micron thickness will be strictly prohibited during construction and operational activities of the SAF project
26.	Punjab Environmental Protection (Motor Vehicles) Rules, 2013	Subject to the provisions of this act, and the rules and regulations, no person shall operate a motor vehicle from which air pollutants and noise are being emitted in an amount, concentration, or level that is in excess of the Punjab Environmental Quality Standards, or where applicable the standards established under clause (g) of subsection (1) of section 6 of the act.	This act will be elicited during the construction and operational phase due to the use of motor vehicles and equipment that produces air pollutants and noise.
27.	The Punjab Occupational Safety and Health Act, 2019	This Act entails the provision of occupational safety and health for the workers at the workplace and protects them against risks arising out of occupational hazards;	Although this act is formed but there is no regulation or rules under this act. However, this act is applicable as it involves the

Sr. No.	Main Legislation	Act	Brief Coverage
		to promote a safe and healthy working environment catering to the physiological and psychological needs of the employees at the workplace.	workforce during the construction and operational stages of the project.
28.	Punjab Restriction on Employment of Children Act, 2016	According to sub-section 11(a) of this Act, an occupier who employs or permits a child (person under the age of 15 years) to work in an establishment shall be liable to punishment with imprisonment for a term which may extend to six months, but which shall not be less than seven days, and a mandatory fine between 10,000 and 50,000 rupees.	The legislation will apply, and child labor will be strictly prohibited throughout both the construction and operational phases of the project.
29.	Electricity Act, 1910	The Act provides a legal basis for the distribution of Power. It enables a licensee to conduct operations for the supply of electricity and binds the license to payment of compensation in respect of any damages caused during the construction, Operation and Maintenance (O&M) of Power distribution facilities.	This act will be applicable as the project involves the use of electricity.
30.	Cutting of Trees (Prohibition) Act, 1975	The Act was enforced in 1975 to place restrictions on the cutting of trees in order to restrain the unchecked trend of tree felling without replacement plantations.	The act will not be applicable as there will be no tree-cutting involved during the implementation of the proposed SAF project as the site is the brownfield.
31.	The Punjab Irrigation and Drainage Authority Act, 1997	It empowers the Punjab Irrigation and Drainage Authority to implement the strategy of the Government of Punjab for streamlining the Irrigation and Drainage System in the province, to achieve economical and effective operation and maintenance of the irrigation, drainage and flood control system; to make the irrigation and drainage network sustainable on a long-term basis and introduce participation of beneficiaries in the operation and management. It also enforces to	The act is applicable and involves the licenses for the disposal of wastewater during the operational phase of the project.

Sr. No.	Main Legislation	Act	Brief Coverage
		undertake anti-erosion operations including conservation of forests and reforestation, to restrict or prohibiting the clearing or breaking up of land in the catchment areas of any rivers, hill torrents and other streams and conducting studies to regularly analyze and evaluate the impact of the operations and policies of the Authority on the ecology and environment within the Province to establish the various available options for the minimization of the adverse impact of such operations and policies, if any, and to adopt the optimal options for further action.	
32.	The Canal and Drainage Act 1873, (amendment 2016)	The Canal and Drainage Act 1873 (CDA) focuses on the construction and maintenance of drainage channels and defines powers to prohibit obstruction or order their removal. It also covers issues related to canal navigation. It briefly addresses issues relating to environmental pollution. Section 70(5) of the CDA clearly states that no one is allowed to “corrupt or foul the water of any canal to render it less fit for the purposes for which it is ordinarily used.” In addition, Section 73 of the CDA gives power to arrest without warrant or to be taken before the magistrate a person who has willfully damaged or obstructed the canal or “rendered it less useful.”	Act is applicable as there are no. of canals in AOC.
33.	The Punjab Emergency Service Act, 2006	It deals with the establishment of emergency services to maintain a state of preparedness to deal with emergencies, providing timely response, rescue and emergency medical treatment to the affected persons and recommending measures to be taken by related organizations to avoid any emergency situation. It	This act applies to the proposed project to provide timely response, rescue and emergency medical treatment to the affected persons during the construction and operation phase of the project. It also enables to establish the plan to deal with emergency situations.

Sr. No.	Main Legislation	Act	Brief Coverage
		describes procedures to establish emergency services, emergency boards, emergency funds, emergency ambulance and rescue vehicles, offense and punishment, etc.	
34.	Hazardous Substance Rule, 2003	The rule describes the procedure of handling, transportation and disposal of hazardous substances and hazardous waste. Inter alia, general safety precautions for handling hazardous substances as well as safety precautions for workers, and notification requirements in the event of an accident are described in these rules. Requirements for project waste management plans are also defined. These include a requirement for updating the plan every three years, the need to provide for management of hazardous waste in a manner that will prevent adverse environmental impacts and to ensure that hazardous and non-hazardous waste are not mixed.	The rules will be applicable and hazardous waste or substances handling during construction and operational stages of the project will be according to these rules
35.	Building Code of Pakistan, 2007	The provision of the Building Code of Pakistan shall apply to the engineering design of buildings like structures and related components. The construction in violation of the building code shall be deemed as a violation of professional engineering work. Moreover, a certificate for the proposed action will be obtained from the Provincial Building Control Authority.	The regulation applies to all building designs, which must receive approval from the relevant authority. A completion certificate for the construction of the building will be obtained upon its completion.
36.	The Punjab Highway Authority Act, 1989	To meet the growing needs of traffic, a unified system of motorways, super highways and highways in the province needs to be established. This act deals with the establishment of an authority for the construction, development, improvement and maintenance of highways and other projects. It defines the procedures	This act is not applicable.

Sr. No.	Main Legislation	Act	Brief Coverage
		of the constitution of authority, its powers, members, responsibilities, etc.	
37.	The Provincial Employees' Social Security Ordinance, 1965	The Provincial Employees' Social Security Ordinance 1965 was promulgated to introduce a scheme of Social Security for providing benefits to certain employees or their dependents in the event of sickness, maternity, employment, injury, or death and for other matters ancillary thereto. The said Ordinance was bifurcated into different chapters focusing on its major provisions including Organization for the establishment and incorporation of Employees' Social Security Institution, its Management, Governing Body, Powers and functions of the Governing Body, its Meetings Schedules, the validity of orders, relevant Fees and allowances, the procedure for Resignation, Disqualifications and other provisions relating to Filling of casual vacancies, etc. The Act provides a scheme of Contribution amount and its payment ratio reflecting records and returns by Employees particularly increase of unpaid contributions and recovery of contributions, etc. as arrears of land revenue against any such default. The other provisions relate to fiancé and audit with schedules to regulate the same keeping annual reports and Benefits arising from Sickness, Maternity, and medical care including Death grants.	This regulation applies to both the construction and operational phases, requiring the registration of workers with the Punjab Employees Social Security Institution.

3.3 International Requirements

120. IFC and ADB define that ESIA's shall be conducted in line with national laws and regulations as well as in line with international environmental and social safeguard standards. To this end, projects financed by these institutions must meet the respective environmental, social and disclosure policies. From the policies and guidelines, the following are highlighted as of importance for the present ESIA:

- IFC Performance Standards on Social and Environmental Sustainability (IFC, 2012)
- IFC/ WB Environmental, Health and Safety (EHS) Guidelines
- WB Environmental, Health and Safety (EHS) Guidelines for Oleochemicals Manufacturing (2007)
- WB Environmental, Health and Safety (EHS) Guidelines for Petroleum Refining (2016)
- ADB Safeguard Policy Statement (SPS, 2009)

3.3.1 Environmental and Social Performance Standards of the International Finance Corporation

121. The International Finance Corporation has established eight Performance Standards, and project developers are required to adhere to the relevant PS when setting up a project that is funded by IFC or a multinational funding institution. The key requirements of the Performance Standards for the proposed project are outlined below:

Table 3-3: IFC's Environmental and Social Performance Standards

Sr. No.	Title of Performance Standard	Performance Standard (PS) requirements in brief	Project Relevancy
1.	Performance Standard (PS) - 1 Assessment and Management of Environmental and Social Risks and Impacts	This Performance Standard seeks to: • Conduct an Environmental and Social Impact Assessment appropriate to the project's risks and impacts. • Establish Environmental and Social Management Plans based on ESIA findings and community consultation. • Develop Action Plans for compliance with laws, regulations, and Performance Standards. • Provide capacity building, training, timely community engagement with a grievance mechanism to ensure access to project information free from external interference. • Implement procedures to monitor environmental and social management effectiveness through internal reporting, disclosure of Action Plans changes to affected communities, and external reporting on results commensurate with community concerns.	PS 1 applies to all projects that have environmental and social risks and impacts, and is there applicable to the project.
2.	PS 2: Labor and Working Conditions	• Establish a Human Resources Policy consistent with IFC PS2, covering the rights of employees under national labor laws and international standards, with provisions for: • Documenting and communicating terms of employment. • Prohibiting child and forced labor. • Promoting non-discrimination and equal opportunity in employment practices.	PS 2 is applicable to the project, and applies to workers directly engaged by the client (direct workers), workers engaged through third parties (contracted workers), as well as workers engaged by the client's primary suppliers (supply chain workers).

		• Providing workers with a safe and healthy work environment, including protective equipment, safety training, and workplace hazard assessments. • Implementing grievance mechanisms accessible to all workers. Supply Chain Workers/Third party workers: • Conduct risk assessments to identify issues such as forced labor, child labor, and unsafe working conditions within supply chains. • Require primary suppliers to comply with PS2 and national labor laws, ensuring proper documentation of employee terms, wages, and working hours. • Establish monitoring systems, including supplier audits, grievance mechanisms, and corrective action plans for non-compliance. • Provide training for suppliers on labor rights and workplace safety. • Engage with supply chain workers to ensure grievance mechanisms are accessible and confidential.	
3.	PS 3: Resource Efficiency & Pollution Prevention	• The project proponent should ensure that adequate control techniques are provided to minimize emissions or achieve a pre-established performance level and minimize pollution from project activities. The client will avoid the release of pollutants or, when avoidance is not feasible, minimize and/or	• PS-3 is applicable to projects resulting in increased levels of pollution and requires the project to avoid, minimize, or reduce adverse impacts on human health and the environment by adopting pollution preventive and control technologies throughout the Project life

		control the intensity and mass flow of their release. The client will implement technically and financially feasible and cost-effective measures for improving efficiency in its consumption of energy, water, as well as other resources and material inputs, with a focus on areas that are considered core business activities.	cycle. - PS3 refers to the World Bank Group (WBG) Environment, Health and Safety (EHS) - Guidelines, see section 3.4 below.
4.	PS 4: Community Health, Safety and Security	- Evaluation of risks and impacts of the project on the health & safety of the affected community during the project lifecycle and establish preventive/mitigation measures to reduce/minimize the impacts. Disclosure of action plans to the affected community and the government agency. - Design, construct, operate and decommission Structural elements or components in accordance with good industrial practice to reduce impact on community health & safety. - Minimization of impacts on the health and safety of the community caused by natural hazards that could arise from land use changes due to project activities. - Prevent or minimize the potential for community exposure to communicable diseases during project activities.	PS 44 applies to projects that entail potential risks and impacts to the health and safety of affected communities. Construction and operation of the project will involve potential community health & safety impacts, both locally adjacent the site, and regionally associated with feedstock collection and transportation. and . PS-4 is therefore applicable to the project.
5.	PS 5: Land Acquisition and Involuntary Resettlement	Minimizing and managing impacts associated with land acquisition and involuntary resettlement.	PS 5 is not applicable, as the proposed project is a brownfield project and the land is already owned by BTE. BTE acquired the land on a willing-seller willing-buyer basis in 2014. There is no land acquisition or resettlement involved.

6.	PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources.	PS6 is not applicable because the project is located in a brown field site, in modified habitat without significant biodiversity value, and adverse impacts on ecosystem services are not expected. The project does not involve any primary production nor using biomass for sourcing raw materials.
7.	PS 7: Indigenous Peoples	Minimizing and managing impacts on Indigenous Peoples.	PS 7 is not applicable because the project will not involve impacts on Indigenous People.
8.	PS 8: Cultural Heritage	Minimizing and managing impacts on Cultural Heritage.	PS8 is not applicable because impacts on cultural heritage are not expected.

3.3.2 IFC Access to information policy 2012

122. As part of disclosure requirements under IFCs Access to Information Policy, a non-technical summary in both English and Urdu will be disseminated to stakeholders. Moreover, the ESIA report and other pertinent project documents will be accessible on the websites of ADB, BTE, and IFC. Copies of the ESIA report can also be obtained from BTE's head office in DHA Lahore and at the project site in Sheikhpura. Additionally, information brochures will be distributed at local shops within the Area of Concern to ensure residents are informed about the project.

3.4 World Bank Group's EHS Guidelines and Applicable Sector Guidelines

123. IFC has issued Environmental, Health, and Safety Guidelines in 2007. The key requirements stated in the EHS guidelines have been discussed below:

Table 3-4: World Bank Group's EHS General Guidelines and Placement in the Report

Relevant Requirements as Stated in EHS Guidelines	The section in ESIA Report
Environmental Attributes	
• Air Emissions and Ambient Air Quality	Chapter 06
• Energy Conservation	Chapter 05
• Wastewater and Ambient Water Quality	Chapter 06
• Water Conservation	Chapter 05
• Hazardous Materials Management	Chapter 07
• Waste Management	Chapter 07
• Noise	Chapter 07
• Contaminated Land	Chapter 07
Occupational Health and Safety	
• General Facility Design and Operation	Chapter 05
• Communication and Training	Chapter 09
• Physical/Chemical/Biological Hazards	Chapter 07
• Personal Protective Equipment (PPE)	Chapter 07
• Monitoring	Chapter 06
Community Health and Safety	
• Water Quality and Availability	Chapter 06
• Structural Safety of Project Infrastructure	Chapter 05
• Life and Fire Safety (L&FS)	Chapter 07
• Traffic Safety	Chapter 08
• Transport of Hazardous Materials	Chapter 08

Relevant Requirements as Stated in EHS Guidelines	The section in ESIA Report
• Disease Prevention	Chapter 08
• Emergency Preparedness and Response	Chapter 08
Construction and Decommissioning	
• Environment	Chapter 07
• Occupational Health and Safety	Chapter 07
• Community Health and Safety	Chapter 07

124. The proposed project falls within the chemical industry sector, thus subject to industry-specific guidelines provided by the IFC. Specifically, the project aligns with the EHS Guidelines for the Chemicals sector, which include detailed instructions for Oleochemicals Manufacturing (2007), directly applicable to the proposed project.

Table 3-5: Identification of Requirements: WBG EHS Guidelines for Oleochemicals Manufacturing (2007) and Petroleum Refining (2016)

Aspect	Oleochemicals Manufacturing (2007)	Petroleum Refining (2016)
Wastewater Management	• Treat effluent to remove organic contaminants, fats, oils, and grease (FOG) • COD, BOD, and suspended solids limits • pH control for neutralization • Monitor nutrient levels (e.g., nitrogen and phosphorus)	• Meet specific pollutant limits (e.g., COD, ammonia nitrogen, sulfide, volatile phenols) • Continuous monitoring for key parameters • Effluent pre-treatment to remove hydrocarbons and other toxic substances • Ensure compliance with sector-specific discharge limits
Air Emissions	• Control volatile organic compounds (VOCs) and odor emissions • Use scrubbers or biofilters to mitigate air pollution • Monitor emissions periodically	• Meet stringent limits for NO_x, SO_x, particulate matter, and hydrogen sulfide (H₂S) • Regular monitoring of stack emissions • Use flue gas desulfurization (FGD) and other advanced control technologies
Hazardous Waste Management	• Identify and segregate hazardous waste (e.g., spent solvents, sludge) • Implement safe storage and disposal practices • Monitor waste quantities and disposal records	• Manage spent catalysts, heavy metals, and other toxic wastes • Ensure proper storage, transportation, and disposal • Maintain detailed records of hazardous waste streams and disposal methods

Energy Efficiency	- Focus on energy optimization in processing - Recover and reuse heat where feasible	- Use energy-efficient technologies and optimize refinery operations - Implement heat recovery systems and process integration.
Occupational Health and Safety	- Control exposure to process chemicals and dust - Implement PPE and safety protocols for handling hazardous materials - Provide training for workers on chemical safety	- Manage risks associated with high-pressure systems and flammable substances - Enforce strict PPE usage and conduct regular safety drills - Implement advanced monitoring systems for workplace safety.
Environmental Monitoring	- Regularly monitor effluent, air emissions, and solid waste management - Maintain records of environmental performance.	- Implement comprehensive monitoring programs for water, air, and waste - Use automated systems for continuous data collection and analysis
Odor Control	Emphasis on odor management through process controls and emissions abatement.	Address odors from sulfur compounds through advanced treatment systems and operational controls.

3.4.1 Performance Indicators Monitoring

Table 3-6: Air Emissions Levels

Pollutant	Units	For Oleochemicals Manufacturing Plants	For Petroleum Refining Facilities
VOCs	mg/Nm ³	100 ^a	NGVS
NOX	mg/Nm ³	NGVS	300 (100 for FCCU)
SOX	mg/Nm ³	NGVS	150 for SRU 300 for FCCU 500
Particulate Matter (PM10)	mg/Nm ³	NGVS	25
Vanadium	mg/Nm ³	NGVS	05
Nickel	mg/Nm ³	NGVS	01
H ₂ S	mg/Nm ³	NGVS	01

a. At 273 K (0 °C) and 101.3 kPa (1 atmosphere).

NGVS= No Guideline Value Set

FCCU= Fluid Catalytic Cracking Unit (FCCU)

SRU= Sulfur Recovery Unit

Table 3-7: Effluent Levels

Pollutant	Units	For Oleochemicals Manufacturing Plants	For Petroleum Refining Facilities
pH	S.U.	6 – 9	6 – 9
BOD5	mg/L	40	30
COD	mg/L	150	125
Total Suspended Solids (TSS)	mg/L	50	30
Oil and Grease	mg/L	10	10
Chromium (total)	mg/L	NGVS	0.5
Chromium (hexavalent)	mg/L	NGVS	0.05
Copper	mg/L	NGVS	0.5
Iron	mg/L	NGVS	3
Cyanide Total Free	mg/L	NGVS	1 0.1
Lead	mg/L	NGVS	0.1
Nickel	mg/L	NGVS	0.5
Mercury	mg/L	NGVS	0.003
Arsenic	mg/L	NGVS	0.1
Vanadium	mg/L	NGVS	1
Phenol	mg/L	NGVS	0.2
Benzene	mg/L	NGVS	0.05
Benzo(a)pyrene	mg/L	NGVS	0.05
Sulfides	mg/L	NGVS	0.2
Total Nitrogen	mg/L	30	10
Total Phosphorus	mg/L	05	2
Temperature increase	°C	NGVS	<3

NGVS= No Guideline Value Set

Table 3-8: Resource and Energy Consumption

Input per Unit Product	Unit	For Oleochemicals Manufacturing Plants Industry Benchmark
Water Use		
Biodiesel Production	m ³ /t product	1.6 – 2.0
Energy		
Biodiesel Production	Per ton product	600kg (vapor@ 5 bar) + 1.2*106 kJ + 40 kWh

Parameter	Unit	For Petroleum Refining Facilities Industry Benchmark
Total Energy Consumption	MJ per metric ton of processed crude oil	2,300–3,300
Electric Power Consumption	kWh per metric ton of processed crude oil	22–31

Table 3-9: Wastewater and Waste Generation

Output per Unit Product	Unit	For Oleochemicals Manufacturing Plants Industry Benchmark	For Petroleum Refining Facilities Industry Benchmark
Process Wastewater ⁽¹⁾			
Biodiesel Production	m ³ /t product	0.9 – 1.3	0.1–1.5 (m ³ /metric ton crude oil)
Solid Water			
Biodiesel Production	kg/t product	50 (potassium phosphates)	10–100 Metric ton /million metric tons of processed crude oil)
Emissions			
CO ₂ ²	Metric ton /million metric tons of processed crude oil	-	105,000–276,000
NO _x 3		-	70–450
Particulate matter		-	60–150
SO ₄ ⁴		-	60–300
VOC		-	65–300

Notes:

1. Cooling water is not included. The 90-95 percent of cooling water should be recycled
2. Based on one-ton raw material consisting of 900 kg of fatty acids and 100 kg of glycerin

3.4.2 Gap Analysis between National Legislations and WBG Guidelines (General/Oleo/Petroleum)

Table 3-10: Gap Analysis between National Legislations and WBG Guidelines (General/Oleo/Petroleum)

Key Area	WBG EHS Guidelines (General/Oleo/Petroleum)	Punjab Environment Protection Act (PEPA) /Punjab Environment Quality Standards (PEQS)	Gap
Air Emissions (VOCs, NO_x, SO_x)	VOCs: 100 mg/Nm ³ ; SO _x /NO _x limits vary based on technology (e.g., low-NO _x burners). Recommendations for VOC recovery and control.	SO _x : 400 µg/m ³ (24-hour avg.); NO _x : 40 µg/m ³ (annual avg.); VOCs not specified in PEQS.	Punjab standards lack specific VOC and fugitive emissions limits; NO _x /SO _x limits may differ for point sources.
Wastewater Standards (Effluents)	BOD: 30–50 mg/L, COD: 100–150 mg/L; TSS: 10–50 mg/L; Oil/grease: 10 mg/L. Focus on recycling and advanced treatment.	BOD: 80 mg/L, COD: 150 mg/L; TSS: 200 mg/L; Oil/grease: 10 mg/L. Punjab standards are higher than WBG recommendations.	PEQS effluent limits are less stringent for BOD, TSS.
Hazardous Material Management	Strict controls for storage, handling, spill prevention, and	General provisions for hazardous material management under PEPA. No specific	PEPA lacks detailed hazardous material

	secondary containment (e.g., bunded areas).	guidelines for secondary containment or spill management.	management provisions.
Waste Management	Recycling, reuse (e.g., spent catalysts, bleaching earths); specific disposal standards for hazardous wastes (e.g., landfills, incineration).	Hazardous waste provisions under PEPA are broad; no specific guidance for recycling/reuse of industry-specific wastes (e.g., oleo or petroleum by-products).	Lack of detailed guidance for industry-specific waste recycling and disposal.
Noise Levels	Workplace noise: 85 dB(A) (8-hour shift); Community: 55 dB(A) day, 45 dB(A) night (residential).	PEQS: 85 dB(A) for workplace; 65 dB(A) daytime, 55 dB(A) nighttime for general noise.	Punjab standards for workplace noise are aligned, but community noise limits are higher than WBG.
Monitoring & Reporting	Continuous monitoring for key emissions (e.g., stack emissions, effluents). Detailed reporting requirements for environmental compliance and performance.	PEPA requires monitoring but lacks specific provisions for continuous monitoring or advanced systems (e.g., real-time air and water quality monitoring).	Punjab lacks provisions for continuous monitoring or advanced technologies.
Occupational Health & Safety	Comprehensive process safety management, including HAZOP/QRA; detailed protocols for handling chemicals and fire/explosion prevention.	Limited occupational health and safety provisions under PEPA. No industry-specific guidelines for high-risk sectors like oleochemicals or petroleum.	Lack of industry-specific occupational safety guidelines.

Hence, PEQS and PEPA are less detailed and stringent compared to the WBG guidelines, especially in areas like air emissions, hazardous material handling, and wastewater treatment. Therefore, WBG guidelines has been preferred in the report.

3.5 ADB's safeguards Policy

3.5.1 ADB Safeguard Policy Statement, 2009

125. In July 2009, ADB's Board of Directors approved the new Safeguard Policy Statement (SPS) governing the environmental and social safeguards of ADB's operations. The SPS builds upon ADB's previous safeguard policies on the Environment, Involuntary Resettlement, and Indigenous Peoples, and brings them into one consolidated policy framework with enhanced consistency and coherence, and more comprehensively addresses environmental and social impacts and risks. The SPS also provides a platform for participation by affected people and other stakeholders in the project design and implementation.

126. The SPS applies to all ADB-financed and/or ADB-administered projects and their components, regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees. ADB works with borrowers and clients to put into practice the requirements of SPS.

127. 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
- Assist borrowers and clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

128. 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.

129. To help borrowers and clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers and clients are required to meet in addressing environmental and social impacts and risks. These safeguard requirements are as follows:

- Safeguard Requirements 1: Environment (Appendix 1 of SPS);
- Safeguard Requirements 2: Involuntary Resettlement (Appendix 2 of SPS);
- Safeguard Requirements 3: Indigenous Peoples (Appendix 3 of SPS); and
- Safeguard Requirements 4: Special Requirements for Different Finance Modalities (Appendix 4 of SPS).

130. In addition, ADB does not finance activities on the prohibited investment activities list (Appendix 5 of SPS). Furthermore, ADB does not finance projects that do not comply with its safeguard policy statement, nor does it finance projects that do not comply with the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law.

Table 3-11: ADB Safeguard Policies 2009 Relevant to Project

Sr. No.	Safeguard Policies	Key Requirements	Remarks
1.	Environment	Projects and subprojects need IEE/EIA to address important issues not covered by any applicable regional or sectoral EA.	According to ADB's Safeguard Policy Statement from 2009, the project is classified as Category B due to its relatively low potential for adverse environmental impacts. These impacts are

Sr. No.	Safeguard Policies	Key Requirements	Remarks
			mostly site-specific and can generally be minimized through mitigation measures. Normally, category B projects as per ADB require an Initial Environmental Examination, but the Environmental Impact Assessment Report will be prepared voluntarily to ensure comprehensive information and facilitate smooth financing with lenders.
2.	Involuntary Resettlement (IR)	Involuntary resettlement will be avoided <i>where</i> feasible, or minimized, exploring all viable alternative project designs. Where it is not feasible to avoid resettlement, resettlement activities will be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons will be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.	As per ADB Involuntary Resettlement Safeguards, the project is categorized as a category C project, where no involuntary resettlement impacts are foreseen.
3.	Indigenous Peoples	Measures to avoid potentially adverse effects on the Indigenous People's communities; and when avoidance is not feasible, minimize, mitigate, or compensate for such effects. Bank-financed projects are also designed to ensure that the Indigenous People receive social and economic benefits that are culturally appropriate and gender and inter-generationally inclusive.	As per ADB Indigenous Peoples Safeguards, the project is categorized as a category C project where No IP impacts are foreseen.

3.5.2 Implications of ADB's Safeguard Policies on Proposed Project

131. 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 below:

Table 3-12: ADB Policy Principles

Sr. No.	Policy Principle	Summary
1	Screening and Categorization	The screening process was initiated early to determine the appropriate extent and type of environmental assessment for this purpose, REA checklist is used for finalization of the category of the proposed Project.
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 and social Management Monitoring Program (ESMMP).
5	Public/Stakeholder 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 promptly, 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 ESMMP and monitor its effectiveness. Document monitoring results, and disclose monitoring reports.
8	Biodiversity	Not implemented for the proposed project, No net loss of biodiversity in Natural Habitats.
9	Pollution Prevention	Apply pollution prevention and control technologies and practices consistent with international good practices. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges. Avoid the use of hazardous materials subject to international bans or phase outs.
10	Occupational Health and 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

Sr. No.	Policy Principle	Summary
11	Physical Cultural Resources	Not implement for proposed project, no physical cultural resources exist near the proposed study area.

Policies/Strategy	Brief Coverage/Requirement	Project Relevancy
ADB Gender and Development Policy 2003	The Gender and Development Policy (GAD Policy) of ADB is aimed at integrating gender issues in the Bank's macroeconomic sector and project work. The GAD strategy is based on consideration of social justice, and gender equity and on substantial evidence that investments in women are vital to achieving economic efficiency and growth. The key elements of the GAD Policy include the following: • Gender Sensitivity: to observe how ADB operations affect women and men and to take into account women's needs and perspectives in planning its operations. • Gender Analysis: to assess systematically the impact of a project on men and women, and the economic and social relationship between them. • Gender Planning: to formulate specific strategies that aim to bring about equal opportunities for men and women. • Mainstreaming: to consider gender issues in all aspects of ADB operations, accompanied by efforts to encourage women's participation in the decision-making process in development activities. • Agenda Setting: to assist DMC governments in formulating strategies to reduce gender disparities and in developing plans and targets for women's and girls' education, health, legal rights, employment and income-earning opportunities.	The ADB Gender and Development Policy may not directly address SAF plant/biodiesel plant construction, but its principles of gender equality, inclusion, and women's empowerment can and should be applied to such projects to ensure that they benefit men and women equally and contribute to sustainable development. There are several ways in which it could be relevant to the proposed project: • Employment Opportunities: The construction of a SAF plant involves various phases such as planning, engineering, construction, and operation. Ensuring that women have equal access to employment opportunities in these phases aligns with the gender equality objectives of the ADB Gender and Development Policy. • Community Engagement: Biodiesel plant construction often involves engaging with local communities for land acquisition, environmental assessments, and other aspects. The ADB policy encourages inclusive participation, ensuring that women have a voice in decision-making processes related to the project. • Impact Assessment: The ADB policy emphasizes conducting gender impact assessments to understand how development projects affect men and women differently. In the case of a biodiesel plant, this could involve assessing the project's potential impacts on

Policies/Strategy	Brief Coverage/Requirement	Project Relevancy
		local livelihoods, access to resources, and socio-economic dynamics, particularly focusing on any differential impacts on women. Skills Development: Construction of renewable fuel projects typically requires a range of skills. Investing in training and capacity-building programs that target women can help enhance their participation in the project, promoting gender equality in traditionally male-dominated industries.
ADB's Access to Information Policy (AIP) 2018	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."	A comprehensive Stakeholder Engagement Plan (SEP) has been prepared based on Environmental and Social Standards (ESS-10) including stakeholder engagement process, identification and analysis of major stakeholders, information disclosure, outcomes of stakeholder's engagement and proposed future stakeholders' consultation.

International Environmental Treaties

Table 3-13: International Environmental Treaties Endorsed by Pakistan

Topic	Convention	Date of Treaty	Entry into Force in Pakistan
Climate Change and The Ozone Layer	United Nations Framework Convention on Climate Change – the primary objective is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the Earth's climate system.	1992	1994
	Kyoto Protocol to the United Nations Framework Convention on Climate Change – enabled by the Convention on Climate Change above. It has more powerful and legally binding measures. It sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas emissions.	1997	2005
	Vienna Convention for the Protection of the Ozone Layer – acts as a framework for international efforts to protect the Earth's ozone layer with a primary objective to protect human health and the environment against adverse effects resulting from human activities that modify or are likely to modify the ozone layer.	1985	1993
	Montreal Protocol on Substances that Deplete Ozone Layer and associated amendments – enabled by the Vienna Convention, is designed to protect the ozone layer by phasing out the production and consumption of several substances believed to be responsible for ozone depletion.	1987	1993
Waste and Pollution	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal – regulates the transboundary movement of hazardous waste and other waste with the stated purpose of protecting human health and the environment against the adverse effects from the generation and management of such waste. The Convention provides for three sets of measures with binding obligations: strict control of the transboundary movement of hazardous waste; environmentally sound management of hazardous waste; and enforcement and implementation of the provisions of the convention at international and national levels.	1989	1994
	International Convention on Oil Pollution Preparedness, Response and Co-operation	1990	1995
	Stockholm Convention on Persistent Organic Pollutants – seeks to protect human health and the environment from persistent organic pollutants (POPs),	2001	2008

Topic	Convention	Date of Treaty	Entry into Force in Pakistan
	which are chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissues of humans and wildlife.		
	The International Convention for the Prevention of Pollution from Ships (MARPOL) – is the main international convention that covers the prevention of pollution of the marine environment by ships from operational or accidental causes. The Convention includes regulations aimed at preventing and minimizing pollution from ships, both accidental pollution and from routine operations, and currently includes six technical Annexes.	1973/78	1978
Desertification	International Convention to Combat Desertification – to combat desertification and mitigate the effects of drought. It is supported by international cooperation and partnership arrangements, to achieve sustainable use of land and water resources and sustainable development in affected areas.	1994	1997
Biodiversity and the Protection of Plants and Animals	Convention on Biological Diversity – covering ecosystems, species, and genetic resources and the field of biotechnology. Its objectives are to conserve biological diversity, the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources.	1992	1994
	Cartagena Protocol on Biosafety to the Convention on Biological Diversity – addresses potential risks posed by living modified organisms resulting from modern biotechnology.	2000	2009
	Bonn Convention on the Conservation of Migratory Species of Wild Animals – aims to conserve terrestrial, marine and avian migratory species throughout their range. It is concerned with the conservation of wildlife and habitats on a global scale.	1979	1987
	Memorandum of Understanding Concerning Conservation Measures for the Siberian Crane – parties undertake to provide strict protection to Siberian Cranes, and to identify and conserve wetland habitats essential for their survival.	1993	1999
	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	1973	1976

Topic	Convention	Date of Treaty	Entry into Force in Pakistan
	International Plant Protection Convention (1997 Revised Text) – to prevent the international spread of pests and plant diseases. It requires the maintenance of lists of plant pests, tracking of pest outbreaks, and coordination of technical assistance between member nations.	1951	1954
	Agreement for the Establishment of the Near East Plant Protection Organization – to establish the Near East Plant Protection Organization (NEPPO), which promotes international cooperation to implement the International Plant Protection Convention.	1993	2009
	Plant Protection Agreement for the Asia and Pacific Region and amendments – establishes the Asia and Pacific Plant Protection Commission to review and promote the region's progress in the implementation of the Agreement. Trade in plants and plant products are regulated by certification, prohibition, inspection, disinfection, quarantine, destruction, etc., as necessary.	1995 (Amendment 1967)	1958 (Amendment 1969)
	Convention on Wetlands of International Importance especially as Waterfowl Habitat and associated protocols and amendments (Ramsar Convention) – to promote conservation and sustainable use of wetlands. The Ramsar List of Wetlands of International Importance now includes almost 1,800 sites (known as Ramsar Sites), of which 19 are in Pakistan.	1971 (Amendment 1987)	1976 (Amendment 1994)
Cultural Heritage	Convention Concerning the Protection of the World Cultural and Natural Heritage – requires parties to adopt a general policy on the protection of the natural and cultural heritage, to set up services for such protection, to develop scientific and technical studies, to take appropriate legal, technical, scientific and administrative measures and to foster training and education for such protection.	1972	1976

3.5.3 Comparison of International and Local Environmental Legislations

132. The ADB's SPS requires the 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.

133. In order to select the most stringent standards applicable, a mix of local (PEQS) and international (IFC) regulations have been adopted. The IFC Environmental, Health, and Safety (EHS) Guidelines, General EHS

Guidelines: Environmental, Noise Management has noise level guidelines for daytime and night time, which are applicable. Considering the high baseline noise levels in the project area, it shall be ensured that the increase in noise levels is minimized as far as possible. Also, project-related noise levels in the project area are not allowed to increase the existing levels by 3 dB(A) or more. Furthermore, it shall be ensured that all necessary noise mitigation measures are implemented to minimize the noise levels in the project area.

134. **Table 3-14** presents IFC workplace noise standards that apply to construction workers. It will also be noted that IFC EHS guidelines advise that where existing ambient noise levels already exceed thresholds, the Project will not result in an increase of more than 3 dB(A) over existing ambient noise at the nearest receptor location off-site.

Table 3-14: IFC Work Environment Noise limits

Sr. No.	Type of Work, Workplace	IFC General EHS Guidelines	Oleochemicals Manufacturing (2007)	Petroleum Refining (2016)
1	Heavy Industry (no demand for oral communication)	85 Equivalent level Leq,8h	Refer to IFC General EHS Guideline	
2	Light industry (decreasing demand for oral communication)	50-65 Equivalent level Leq,8h		

Ambient Air Quality

135. A comparison of applicable local and international guidelines for ambient air quality has been provided in **Table 3-15** below. In the case of most pollutants, the WHO/IFC standards for ambient air quality are more stringent in comparison to USEPA and PEQS standards. The applicable and most stringent parameters for each respective pollutant are highlighted in green.

Table 3-15: Comparison of International and Local Air Quality Standards*

Parameters	USEPA		WHO/IFC		PEQS		Oleochemicals Manufacturing (2007)	Petroleum Refining (2016)
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard		
Sulphur Dioxide (SO ₂)	1 hr 3 hrs	75 ppb 0.5 ppm	24 hr 10min	40 ug/m ³ 500 ug/m ³	24 hrs Annual Mean	120 ug/m ³ 80 ug/m ³	NGVS	150 for SRU 300 for FCCU 500 (for No _x)
Carbon Monoxide (CO)	1 hr 8 hrs	35 ppm (43 mg/m ³) 9 ppm (11 mg/m ³)	-	-	1 hr 8 hrs	10 mg/m ³ 5 mg/m ³	NGVS	NGVS
Nitrogen Dioxide (NO ₂)	1 hr Annual Mean	100 ppb 100 ug/m ³ (53 ppb)	24 Hour Annual Mean	25 ug/m ³ 10 ug/m ³	24 hrs Annual Mean	80 ug/m ³ 40 ug/m ³	NGVS	300 100 for FCCU (for No _x)
Ozone (O ₃)	8 hrs	0.07ppm (148 ug/m ³)	8hrs daily maximum 8hrs mean peak season	100 ug/m ³ 60 ug/m ³	1 hr	130 ug/m ³	NGVS	NGVS
Total Particulate Matter (TSP)	-	-	-	-	24 hrs Annual Mean	500 ug/m ³ 360 ug/m ³	NGVS	NGVS
Particulate Matter (PM ¹⁰)	24 hrs	150 ug/m ³	24 hrs Annual Mean	45 ug/m ³ 15 ug/m ³	24 hrs Annual Mean	150 ug/m ³ 120 ug/m ³	NGVS	25

Parameters	USEPA		WHO/IFC		PEQS		Oleochemicals Manufacturing (2007)	Petroleum Refining (2016)
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard		
Particulate Matter (PM ^{2.5})	24 hrs Annual Mean	35 ug/m ³ 15 ug/m ³	24 hrs Annual Mean	15 ug/m ³ 5 ug/m ³	1 hr 24 hrs Annual Average	15 ug/m ³ 35 ug/m ³ 15 ug/m ³	NGVS	NGVS
VOCs (mg/Nm ³)	NGVS	NGVS	NGVS	NGVS	NGVS	NGVS	100 ^a	NGVS
Vanadium(mg/Nm ³)	NGVS	NGVS	NGVS	NGVS	NGVS	NGVS	NGVS	05
Nickel(mg/Nm ³)	NGVS	NGVS	NGVS	NGVS	NGVS	NGVS	NGVS	01
H ₂ S(mg/Nm ³)	NGVS	NGVS	NGVS	NGVS	NGVS	NGVS	NGVS	01

* 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 to 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.

NGVS= No Guidelines Value Set

3.5.4 Noise

136. Similar to the standards for air quality, the comparison of noise standards provided in **Table 3-16** clearly shows that PEQS 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 i.e. 70 dB(A) in comparison to PEQS i.e. 75 dB(A) and so for this particular parameter, the IFC standard will be used. Apart from this one exception, the PEQS and WHO/IFC standards have been used for the proposed Project. Further, the IFC EHS guidelines advise that where existing ambient noise levels already exceed thresholds, the project will not increase by more than 3 dB over existing ambient noise at the nearest receptor location off-site.

Table 3-16: Comparison of International and Local Noise Standards

Sr. No.	Category of Area/Zone	Limit in dB(A) Leq			
		PEQS		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
1	Residential area (A)	55	45	55	45
2	Commercial area (B)	65	55	70	70
3	Industrial area (C)	75	65	70	70
4	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 to 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.

** For noise level, both Oleochemicals Manufacturing (2007) and Petroleum Refining (2016) refer to IFC General EHS Guideline

137. **Table 3-17** presents the maximum permissible vibration levels for the construction phase which have is no risk of damage to buildings. These limits apply to vibration frequencies below 15Hz where the most conservative limits are required and are presented for both transient and continuous vibrations. For protected or potentially vulnerable buildings, the recommended

construction vibration limit is reduced by half.

Table 3-17: Maximum Permissible Construction Phase Vibration Levels

Building Type	Vibration Limit - PPV for Transient Vibrations for Frequencies <15Hz	Vibration Limit – PPV for Continuous Vibrations for Frequencies <15Hz
Structurally sound and not protected structures	12.5 mm/s	6.25 mm/s
Protected and/or vulnerable structures	6 mm/s	3 mm/s

Source: British Standard (7385-2) 'Evaluation and Measurement for Vibration in Buildings, A Guide to Damage Levels Arising from Ground borne Vibration, 1993

3.5.5 Drinking/Ground Water Quality

138. The comparison of water quality standards provided in **Table 3-18** clearly shows the PEQS standards for drinking water quality are more stringent in comparison to WHO standards. The applicable and most stringent parameters for each respective are highlighted in green.

Table 3-18: Comparison of National and International Drinking Water Standards

Sr. No.	Parameter	Units	PEQS	WHO Standards
1	Temperature (During Sample Collection)	OC	NS	NS
2	Color	Pt-Co	≤15TCU	<15TCU
3	pH	pH unit	6.5-8.5	6.5-8.5
4	Turbidity	NTU	<5	<5
5	Total, Hardness	mg/L	<500.00	500 mg/L
6	Total Dissolved Solid (TDS)	mg/L	<1000.00	<1000.00
7	Total Suspended Solid (TSS)	mg/L	NS	NS
8	Ammonia	mg/L	NS	NS
9	Fluoride F-	mg/L	≤ 1.50	1.50
10	Sulfate (SO ₄ -2)	mg/L	NS	NS
11	Chloride (Cl-)	mg/L	<250.00	250
12	Nitrate (NO ₃ -)	mg/L	≤ 50.00	50.00
13	Odor	-	Non-Objectionable / Acceptable	Non-Objectionable / Acceptable
14	Taste	-	Non-Objectionable / Acceptable	Non-Objectionable / Acceptable
15	Sodium	mg/L	NS	NS
16	Iodine	ppm	NS	NS
17	Arsenic (As)	mg/L	≤ 0.05	0.01
18	Iron (Fe 3+)	mg/L	NS	NS
19	Zinc (Zn 2+)	mg/L	5.0	3.0
20	Conductivity	μS/cm	NS	NS
21	Bicarbonate	mg/L	NS	NS
22	Nitrite	mg/L	<3	3
23	Magnesium	mg/L	NS	NS
24	Calcium as Ca	mg/L	NS	NS
25	Phosphate	mg/L	NS	NS
26	Potassium	mg/L	NS	NS

Sr. No.	Parameter	Units	PEQS	WHO Standards
27	Boron	mg/L	≤ 3.0	2.4
28	SAR Iodine (I)	mg/L	NS	NS
29	Aluminum	mg/L	≤ 0.2	0.10
30	Antimony	mg/L	≤ 0.005	0.02
31	Cadmium	mg/L	0.01	0.003
32	Mercury	mg/L	≤ 0.001	0.001
33	Nickel	mg/L	≤ 0.02	0.07
34	Selenium	mg/L	0.01	0.04
35	Barium	mg/L	0.7	0.7
36	Total Chromium	mg/L	≤ 0.05	0.05
37	Copper	mg/L	2	2
38	Lead	mg/L	≤ 0.05	0.01
39	Cyanide (CN)	mg/L	≤ 0.05	0.07
40	Manganese	mg/L	≤ 0.5	0.05
41	Residual Chlorine (Cl ₂)	mg/L	0.5 - 1.5 mg/L	0.5 mg/L
42	Phenolic Compounds (as Phenols) *		<0.002	NGVS mg/L
43	Total Coliforms	cfu/100ml	0/100 ml	0/100 ml
44	Fecal Coli forms (E.Coli)	cfu/ml	0/100 ml	0/100 ml

NS = Not Specified

NGVS = No Guideline Value Set

* 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 apply to the Proposed Project. Others are the same in both cases.

3.5.6 Surface Water Quality

139. The comparison of surface water quality standards provided in **Table 3-19** clearly shows the US EPA standards for surface water quality are more stringent in comparison to FAO standards. The applicable and most stringent parameters for each respective are highlighted in green.

Table 3-19: Comparison of National and International Surface Water Standards

Sr. No.	Parameter	Units	FAO Standards	US EPA Standards
1	Temperature	°C	--	
2	pH	pH unit	6.0-8.5	6-9
3	COD	mg/L	--	NGVS
4	(BOD ₅)	mg/L	--	10

Sr. No.	Parameter	Units	FAO Standards	US EPA Standards
5	Solids, Total dissolved (TDS)	mg/L	0-2000	NGVS
6	Solids, Total suspended (TSS)	mg/L	--	NGVS
7	Chloride	mg/L	0-1065	NGVS
8	Fluoride (F ⁻)	mg/L	--	1
9	Oil & grease	mg/L	--	NGVS
10	Phenols, Total (Phenolic Compounds)	mg/L	--	NGVS
11	Cyanide (CN ⁻)	mg/L	--	NGVS
12	Anionic Detergents as MBAS	mg/L	--	NGVS
13	Sulfate (SO ₄ ⁻²)	mg/L	0-960	NGVS
14	Sulfide (S)	mg/L	--	NGVS
15	Ammonia NH ₃	mg/L	--	NGVS
16	Cadmium (Cd)	mg/L	--	0.01
17	Chromium (Cr) as Hexavalent & Trivalent	mg/L	--	0.1
18	Copper (Cu)	mg/L	--	0.2
19	Lead	mg/L	--	5
20	Nickel	mg/L	--	0.2
21	Zinc	mg/L	--	2.0
22	Iron	mg/L	--	5.0
23	Manganese	mg/L	--	0.2
24	Selenium	mg/L	--	0.02
25	Silver	mg/L	--	NGVS
26	Arsenic	mg/L	--	0.1
27	Barium	mg/L	--	NGVS
28	Magnesium	mg/L	0-61	-
29	Nitrate	mg/L	0-10	-
30	Sodium	mg/L	0-920	-
31	Boron	mg/L	0-2	0.75
32	Mercury	mg/L	--	NGVS
33	Residual Chlorine	mg/L	--	NGVS
34	Total Toxic Metals	mg/L	--	NGVS
35	Turbidity	NTU	--	
36	Oxygen, Dissolved	mg/L	--	-

Sr. No.	Parameter	Units	FAO Standards	US EPA Standards
37	Pesticides	µg/L	--	-
38	Nutrients as Potassium	mg/L	0-2	-
39	Nutrients as Nitrogen	mg/L	--	-
40	Nutrients as Phosphorous	mg/L	--	-
41	Total Coliform	MPN/100ml	--	0
42	Fecal Coliform	MPN/100ml	--	0

NS = Not Specified

* 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 to the Proposed Project. Other are the same in both cases.

Table 3-20: Gap Analysis between National Labour Laws and Performance PS2 of IFC and Bridging the Gap by Client

Aspect	Local Regulations	IFC PS 2 Requirements	Bridging the Gap by Client
Working Hours	Max 48 hours/week; 9 hours/day; 1 day off per week	Max 48 hours/week; voluntary overtime up to 12 additional hours (total 60 hours/week)	Both set a 48-hour workweek, but IFC PS 2 emphasizes that overtime must be voluntary.
Compensation and Benefits	Minimum wage set by Wage Boards; benefits include annual and sick leave as per local laws.	Must meet/exceed the national minimum wage and provide benefits as per law or agreements.	Both align on minimum wage and leave entitlements, with IFC PS 2 requiring compliance with national standards.
Overtime	Overtime paid at 200% of normal wage, with a 12-hour weekly limit.	Overtime must be voluntary and paid as per national laws, typically 150-200% of base rate.	Both agree on compensation standards, though IFC PS 2 reiterates the voluntary nature of overtime.
Labor Conditions	Safe, non-exploitative environment; breaks and child labor restrictions are enforced.	Safe, non-discriminatory environment with restrictions on child labor and no forced labor.	Local laws and IFC PS 2 align on ensuring worker safety and restricting child labor.
Health and Safety	Mandates safety equipment, fire safety, and proper working conditions.	Requires a robust OHS management system, including risk assessments, training, and PPE.	IFC PS 2 goes beyond local laws by emphasizing systematic management of OHS risks.
Freedom of Association	Unionizing and collective bargaining allowed with certain restrictions.	Ensures freedom of association and collective bargaining without retaliation.	IFC PS 2 provides stronger protections against retaliation compared to local laws.
Grievance Mechanism	Formal grievance procedures through labor courts and internal mechanisms.	Transparent, accessible grievance mechanisms without fear of retaliation.	IFC PS 2 emphasizes accessibility and protection from retaliation beyond the scope of local laws.

Accommodation	Basic hygiene and safety; water and sanitation facilities as per industry standards.	Specifies privacy, ventilation, potable water, and sanitation standards (e.g., 1 toilet per 6 persons).	IFC PS 2 provides detailed and stringent requirements for worker accommodations.
Non-Discrimination	Prohibits discrimination based on gender, religion, or race.	Equal opportunity for all; no discrimination based on gender, race, religion, etc.	Both frameworks prohibit discrimination, with IFC PS 2 emphasizing equal opportunities.
Child Labor	Minimum employment age is 14, with hazardous work restricted to those 18+.	Minimum employment age is 15, with hazardous work prohibited under 18.	IFC PS 2 sets a higher minimum employment age compared to local regulations.
Gender Diversity	Promotes workplace safety for women; maternity leave of 12 weeks.	Ensures equal opportunities and gender-sensitive accommodations and facilities.	Local laws and IFC PS 2 align, though IFC PS 2 emphasizes gender-sensitive considerations.
Workplace Harassment	Prohibits harassment; requires internal committees for resolution.	Requires zero tolerance for harassment with a robust grievance mechanism and anti-harassment policies.	IFC PS 2 provides a broader framework with mandatory grievance mechanisms and a zero-tolerance policy.

3.6 ISCC Regulations of Chain of Custody

140. Biotech Energy Private Limited is a state-of-the-art operation, producing high-quality biodiesel for the European market as per EN14214 standard. The Company is certified under EU renewable Energy Directive II, ISCC, ISO 45001 (attached as **Annexure 01**), being compliant with ISCC ensures:

- Governance
- Traceability
- Sustainability

141. Biotech Follows the ISCC regulations on chain of custody and adopts a mass balance approach. (The details are in Section 5.5.1 of this ESIA report).

CHAPTER - 4: ANALYSIS OF ALTERNATIVES

142. This section provides an analysis of alternatives in relation to both phases of the Project, particularly focusing on the initial project development and planning phase. This includes the following:

- No project Alternates
- Location Alternate/ Site Alternates
- Technology Alternates
- Transportation Alternates

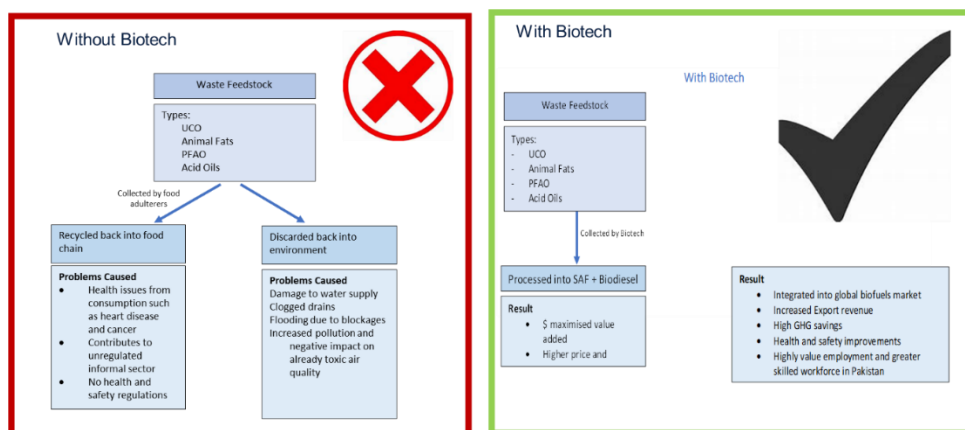
4.1 No Project Option (NPO) / No Project Alternative

143. The proposed project aims to convert waste into sustainable biodiesel fuel by establishing a Sustainable Aviation Fuel (SAF) facility using renewable biological sources. These include used cooking oil, poultry feather acid oil, soap stock acid oils, and edible oil refinery wastes. The total waste collected from these sources would be approximately 200,000 MT/year from various restaurants, households, and food processing industries.

144. By utilizing waste as a feedstock for the production of renewable diesel/SAF, the project contributes to effective waste management and reduces the burden on landfills. Furthermore, it may be added to the food chain, causing serious health implications. The production of renewable diesel/SAF from waste offers a sustainable alternative to conventional fossil fuels by reducing greenhouse gas emissions and dependence on non-renewable resources. This project aligns with the principles of environmental sustainability and promoting renewable energy sources.

145. The No Project Option (NPO) keeping the no installation of Sustainable Aviation Fuel (SAF) by BTE, will result in increased waste in waste streams which can have detrimental effects on the environment, economy, and global efforts toward combating climate change. Incorporating waste-to-energy technologies will reduce environmental implications.

146. All these benefits would not be realized if this project is not developed. Therefore, no project option is not acceptable for this project.



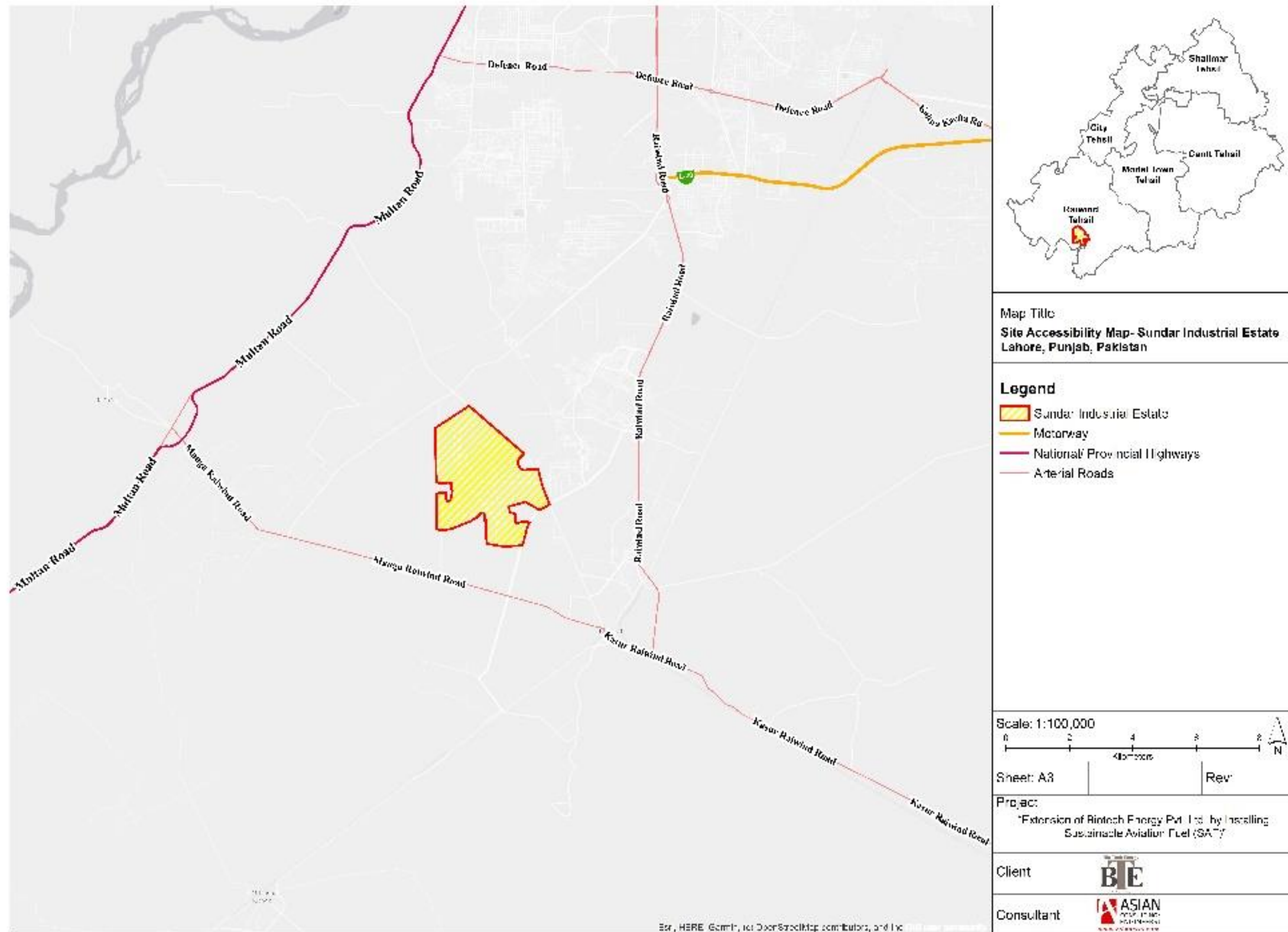
4.2 Location Alternatives / Site Alternatives

147. Two potential locations have been chosen during the site selection process:

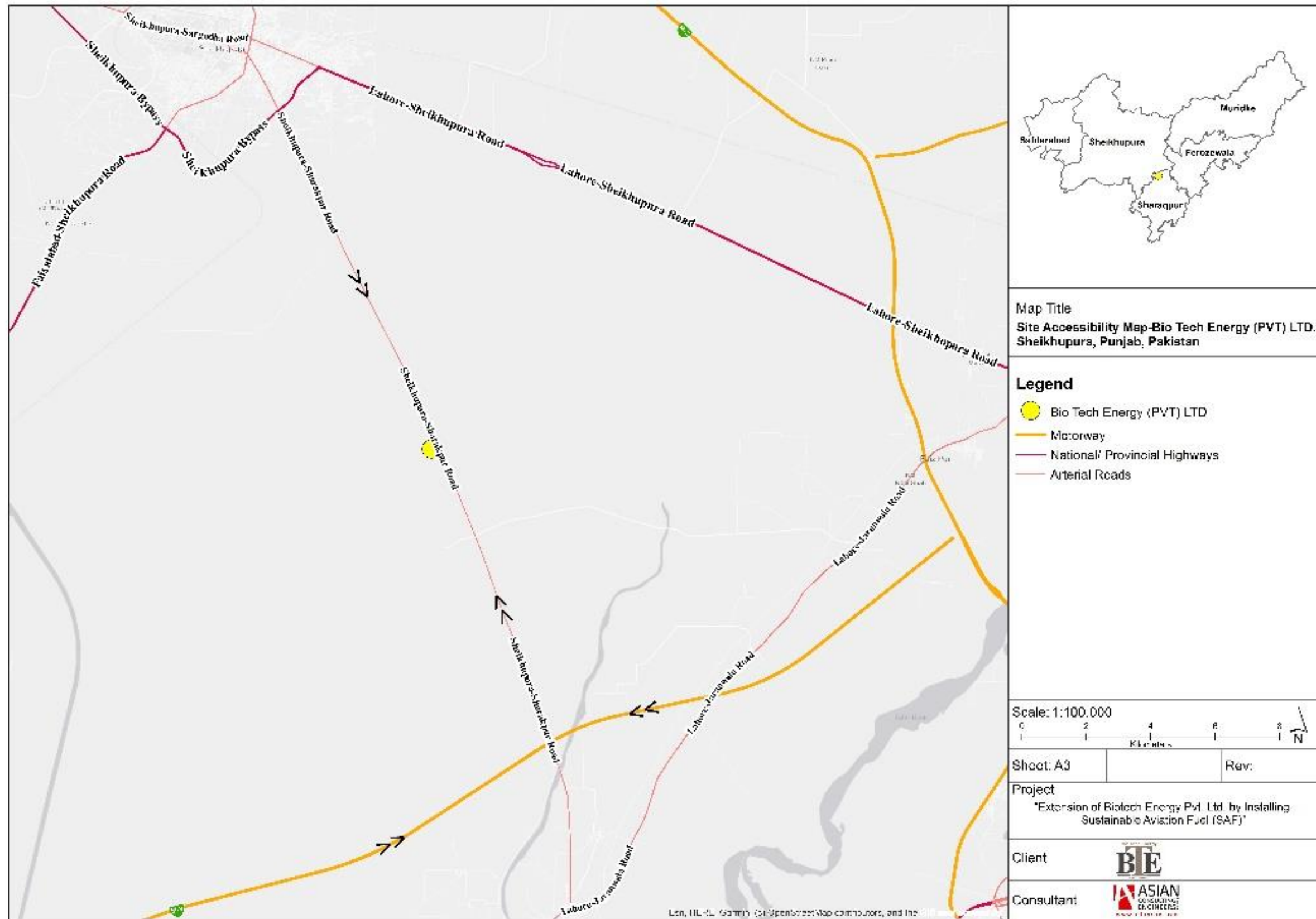
- **Option I:** Sunder Industrial Estate, located at Raiwind Road Lahore.

148. **Option-II:** Bio-Tech Energy (PVT) LTD, located at 14-km, Sharaqpur Road, District Sheikhpura. The two potential locations were identified based on factors such as proximity to transportation routes, availability of necessary infrastructure, and environmental considerations, while other options were not considered due to challenges like accessibility or environmental impacts.

149. The Sunder Industrial Estate is a well-established industrial hub located near Lahore, Pakistan, offering modern infrastructure, utilities, and a strategic location with access to key transportation routes, making it ideal for industrial activities.



(Option-I)



(Option-II)

Figure 4-1: Comparison of the Alternative Locations

150. Below table provides a comparison of the alternative locations in consideration with fire risks and response, accessibility and location in the designated industrial zone.

Aspects	Option-I	Option-II
Land Ownership	Need to take possession of this site.	Site is already owned by BTE.
Fire risks and response	Operates its own firefighting department. .	BTE relies on the district-level firefighting department.
Accessibility	The location of Sunder Industrial Estate on the outskirts of Faisalabad may present accessibility challenges for feedstock collection due to higher transportation costs and longer distances from suppliers and key markets. (as shown in Figure 4-1 comparison maps of the alternate locations).	The site has better accessibility with a more developed road network, reducing transportation and administrative costs (as shown in Figure 4-1 comparison maps of the alternate locations).
Location in designated industrial zone	The site is already is industrial zone therefor, there is no need of conversion.	The site is already is industrial zone therefore, there is no need of conversion.

4.2.1 Conclusion

151. The proposed project aims to expand the current biodiesel production operations of Biotech Energy Pvt. Ltd., situated at 14 km, Sharaqpur Road, District Sheikhpura. The plan is to establish a Sustainable Aviation Fuel (SAF) facility with a capacity of 200,000 MT/year at the existing plant location. The infrastructure and facilities of the current project are well-suited for SAF production, including energy infrastructure and transportation connectivity. This strategic alignment ensures that the site is not only technically feasible but also economically viable for hosting a state-of-the-art SAF.

4.3 Technology Alternatives

152. Sustainable aviation fuels are required, in order to decarbonize the Aviation fuel industry. Utilizing waste resources is the best available technology in order to do so:

Conventional jet fuel alternatives

SAF is the only viable option in the medium term to decarbonize the aviation industry, due to lower infrastructure complexity and impact on ability for long-haul travel

Severely challenged Some concerns Minimal concerns		SAF	Hydrogen	Full electric
Supply constraints – competition for feedstock and demand		Strong competition with renewable diesel, which requires the same inputs	Many other industries need green/blue hydrogen	Competition for batteries with automotive electric vehicles
Impact on existing assets	On airports	Minimal	Extreme	Moderate
	On existing aircraft	Existing assets utilized	Likely new fleets	New fleets required
Types of flights by 2050 (% of ASK)	Long-haul, >3K nautical miles (~30%)	Minimal	Severe	Severe
	Medium-haul, 1K-3K nautical miles (~30%)	Minimal	Intermediate	Severe
	Short-haul, 0.5K-1K nautical miles (~30%)	Minimal	Minimal	Intermediate
	Regional-haul, <0.5K nautical miles (~10%)	Minimal	Minimal	Minimal
Climate impact		30%-60% reduction (for e-fuels with fully decarbonized supply chain)	H₂ fuel cell 75%-90% reduction	H₂ turbine 50%-75% reduction
Lowest fuel cost vs. historical Jet A cost		~2x-3x	>3x	<1x

Figure 4-2: A Comparison of the Alternative locations

153. The above table represents the technology options for decarbonizing the airline sector – where H₂ and Full electrification are not available as working technologies and require over 15 years before commercialization as the concept stage according to the world economic forum.

Main SAF technologies

BTE elected to use the HEFA technology, a mature technology reducing CO₂ emissions by up to 80%

Overview of four main SAF technologies				
	HEFA	Alcohol-to-jet (AtJ)	Gasification/Fischer-Tropsch (FT)	Power-to-liquid (PtL)
Opportunity description	Safe, proven and scalable technology	Medium-term potential, but significant technological and economical uncertainty	Medium-term potential, but significant technological and economical uncertainty	Proof of concept, mainly where electricity is widely available
Lifecycle	Mature technology	Commercial pilot stage	Commercial pilot stage	In development
Feedstock	- Waste and residue lipids such as cooking oil and animal fats - Feedstock is limited and this might restrain supply - Potential to cover 5%-10% of total jet fuel demand	- Biomass such as agricultural and forestry residues, industrial waste and purposely grown energy cover crops - High availability of cheap feedstock but fragmented collection	- Same feedstock as AtJ plus municipal solid waste - High availability of cheap feedstock but fragmented collection - Feedstock is gasified to produce syngas (mix of hydrogen and carbon monoxide), which is then fed into a FT reactor	- Green electricity from renewables is used to convert water and CO₂ into liquid fuel - Similarly to the Fischer-Tropsch process, a FT reactor is then used to generate jet fuel
GHG reduction vs fossil jet	73%-84%	85%-94%	85%-94%	99%
Cost drivers	Price of feedstock, which is market-driven and hard to reduce due to scarceness of feedstock	Cost of refining ethanol into jet fuel, with Opex likely to stay high	Gasification costs driven by high Capex needs, although some cost savings are expected after 2025	Substantial cost of green electricity, although steep decline is expected in the long term

Figure 4-3: Methods to make SAF

4.3.1.1 For wastewater Treatment

154. Various best available technological options, in accordance with the World Bank Group (WBG) Environmental, Health, and Safety (EHS) Guidelines for Petroleum Refining, have been thoroughly analyzed and are summarized below:

Comparison Table for Primary Wastewater Treatment Technologies

Technology	Advantages	Disadvantages
API Separator	- Simple, cost-effective design. - Efficient for free oil and large suspended solids removal. - Low maintenance.	- Ineffective for emulsified or dissolved oil. - Requires large footprint. - Limited efficiency for fine particles - Prone to reduced performance if overloaded.
Parallel Plate Interceptor (PPI)	- Compact design compared to API separators. - Better efficiency for small oil droplets. - Reduces footprint.	- Higher capital cost than API separators. - Limited efficiency for emulsified oils - Requires regular cleaning to avoid fouling.

Dissolved Air Flotation (DAF)	- Highly efficient for removing fine oil droplets, emulsified oils, and solids. - Compact and flexible - Effective for a wide range of applications.	- Higher operational complexity. - Requires chemical coagulants or flocculants. - Higher operational and maintenance costs. - Energy-intensive.
Equalization Basin	- Stabilizes flow and pollutant concentrations for downstream processes. - Allows blending of multiple streams.	- Does not remove pollutants directly. - Requires a large footprint. - Potential for odor generation if not covered or aerated. - Requires proper mixing.

Key Considerations for Selection

- **API Separator:** Suitable for facilities with significant space and a need for basic primary treatment of free oil and solids.
- **PPI:** A good choice when space is limited and higher efficiency in oil removal is required.
- **DAF:** Ideal for treating effluents with fine oil particles, emulsified oil, or when high removal efficiency is needed.
- **Equalization Basin:** Essential for consistent operation of secondary and tertiary treatment processes by mitigating flow and load fluctuations.

Comparison Table for Secondary Wastewater Treatment Technologies

Technology	Advantages	Disadvantages
Activated Sludge Process (ASP)	- High removal efficiency for BOD, COD, and suspended solids. - Well-established and widely used technology. - Can handle large volumes of wastewater.	- High operational cost due to aeration energy needs. - Sensitive to changes in influent characteristics. - Requires large space for aeration tanks and clarifiers.
Aerated Lagoon (AL)	- Simple and cost-effective to construct and operate. - Suitable for smaller flows and less complex effluents. - Can integrate into natural landscapes.	- Requires large land area. - Limited efficiency for high strength wastewater. - Susceptible to temperature variations affecting treatment efficiency - Odor potential.
Sequencing Batch Reactor (SBR)	- Combines aeration and sedimentation in a single tank, saving space - Flexible operation for variable flows and loads.	- Complex operation and control. - Requires skilled operators - Limited capacity for very high flow rate.

	High removal efficiency for organics and nutrients.	May require additional tanks for equalization and sludge handling.

Key Considerations for Selection

- Activated Sludge Process (ASP):** Best suited for large-scale refineries with steady wastewater flows and sufficient space for aeration tanks and clarifiers. Effective for high-strength wastewater when consistent operation can be maintained.
- Aerated Lagoon (AL):** A cost-effective option for facilities in rural or low-density areas where land is available, and influent is less variable or not high in organic content.
- Sequencing Batch Reactor (SBR):** Ideal for facilities with space constraints or highly variable wastewater characteristics. Provides flexibility and high-quality effluent suitable for strict discharge standards.

Comparison Table for Tertiary Wastewater Treatment Technologies

Technology	Advantages	Disadvantages
Filtration (Sand/Multimedia)	- Effective at removing residual suspended solids. - Simple and widely used. - Low operational costs. - Reliable and robust.	- Limited removal of dissolved pollutants. - Requires periodic backwashing to maintain efficiency - Can be less effective with high influent turbidity.
Activated Carbon Adsorption	- Excellent at removing dissolved organics, hydrocarbons, phenols, and odor. - Produces high-quality effluent.	- High operational costs due to frequent media replacement or regeneration. - Not suitable for high contaminant concentrations. - Potential for fouling.
Reverse Osmosis (RO)	- Removes dissolved salts, organics, and heavy metals. - Produces very high-quality effluent. - Suitable for water reuse.	- High energy consumption. - Requires pre-treatment to prevent membrane fouling. - High capital and operational costs. - Generates brine that requires disposal.
Advanced Oxidation Processes (AOP)	Effective for breaking down refractory organics and reducing toxicity	- High operational costs due to chemicals and energy use. - Complex operation and maintenance.

	• High efficiency for micropollutants • Can reduce COD.	• Not suitable for large volumes or very high contaminant loads.
Chemical Treatment (Coagulation/Flocculation)	• Effective at removing fine particulates and colloidal matter. • Can aid in removing heavy metals and phosphorus.	• Requires chemicals, increasing operational costs. • Produces sludge that needs to be managed. • May require pH adjustments and post-treatment filtration.
Membrane Filtration (e.g., Ultrafiltration)	• Removes fine particles and pathogens. • Compact and modular design. • Prepares water for high-level reuse or RO systems.	• Requires regular cleaning to prevent fouling. • Limited capacity for high solids loads. • High capital and maintenance costs.

Key Considerations for Selection

- **Filtration (Sand/Multimedia):** Suitable for general polishing after secondary treatment, especially when budget and simplicity are priorities. Best for removing residual solids.
- **Activated Carbon Adsorption:** Ideal for removing trace organic pollutants and improving effluent quality for sensitive discharge or reuse applications.
- **Reverse Osmosis (RO):** Used when ultra-pure water is required for reuse or discharge into sensitive environments, but it requires significant energy and pre-treatment.
- **Advanced Oxidation Processes (AOP):** Suitable for treating effluents containing refractory or hazardous organics but may not be cost-effective for large volumes.
- **Chemical Treatment (Coagulation/Flocculation):** Effective for specific pollutants like heavy metals and phosphorus, often used as a pre-treatment step.
- **Membrane Filtration:** Useful for pathogen removal and pre-treatment before high-end processes like RO; effective but cost-intensive.

Conclusion:

155. Following a comprehensive analysis of the best available technologies, considering capital cost, operational and maintenance (O&M) expenses, site suitability, land area requirements, ease of maintenance, advantages and disadvantages, and potential impacts on the surrounding environment, the team of design engineers and environmental and social experts has selected the following wastewater treatment technologies for implementation:

- ✓ Dissolved Air Flotation (DAF): For primary treatment, effectively removing oil, grease, and suspended solids.

- ✓ Activated Sludge Process (ASP): For secondary biological treatment, ensuring efficient reduction of biochemical oxygen demand (BOD) and chemical oxygen demand (COD).
- ✓ Sand Carbon Filtration: For tertiary treatment, providing polishing to remove residual suspended solids and organic matter.
- ✓ Reverse Osmosis (RO): For advanced treatment, addressing dissolved salts, organics, and heavy metals to meet stringent discharge standards or enable water reuse.
- ✓ These technologies represent the best available options, carefully evaluated to ensure a high level of treatment efficiency while addressing economic, environmental, and operational considerations. This selection underscores a commitment to sustainable and responsible wastewater management.

4.4 For Air Pollution Control

156. Various technological options are available in order to control air pollution for instance; wet and dry scrubbers.

Aspects	Wet Scrubbers	Dry Scrubbers
Mechanism	Wet scrubbers use liquid, typically water or a water-based solution, to capture and remove pollutants. The gas stream comes into direct contact with the liquid, promoting absorption or chemical reactions that neutralize and capture contaminants.	Dry scrubbers use solid reactants, such as lime or sodium bicarbonate, to neutralize and capture pollutants. The solid material is typically injected into the gas stream, and the reaction products are then collected in a particulate control device.
Effectiveness	Wet scrubbers are highly effective in removing a wide range of pollutants, including gases and particulate matter.	While effective for certain pollutants, dry scrubbers may be less efficient in capturing fine particulate matter compared to wet scrubbers.
Applications	They are suitable for handling high-temperature and high-humidity gas streams and are often used in applications where there are significant variations in pollutant concentrations.	Dry scrubbers are commonly used in applications where water is scarce or where the pollutants are in a dry form, making wet scrubbing less suitable.
Cooling Effect	Wet scrubbers have a cooling effect on the gas stream, which can be advantageous in certain industrial processes.	Dry scrubbers may require more frequent maintenance due to the handling of solid materials and the potential for abrasion.

4.4.1 Conclusion

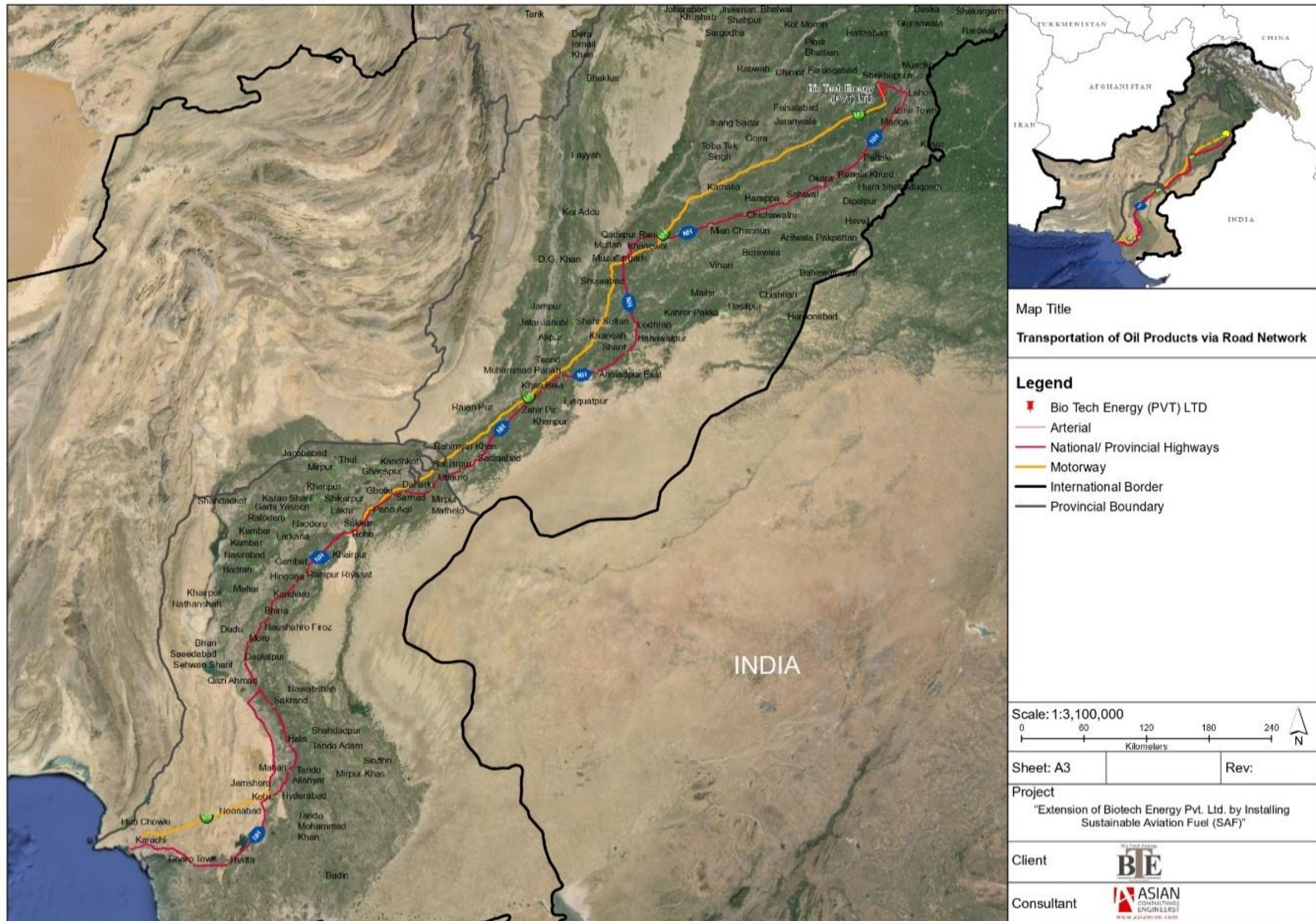
157. Wet scrubbers are versatile in handling a broad spectrum of pollutants and can provide a cooling effect, making them advantageous for processes where temperature control is important. They are generally more efficient in capturing both gases and particulate matter. The choice between wet and dry scrubbers depends on the specific requirements of the industrial process, the types of pollutants present, and environmental considerations. Hence, wet

scrubbers will be preferred for the proposed project for their versatility and comprehensive pollutant removal capabilities and their ability to deal with varied or high concentrations of contaminants.

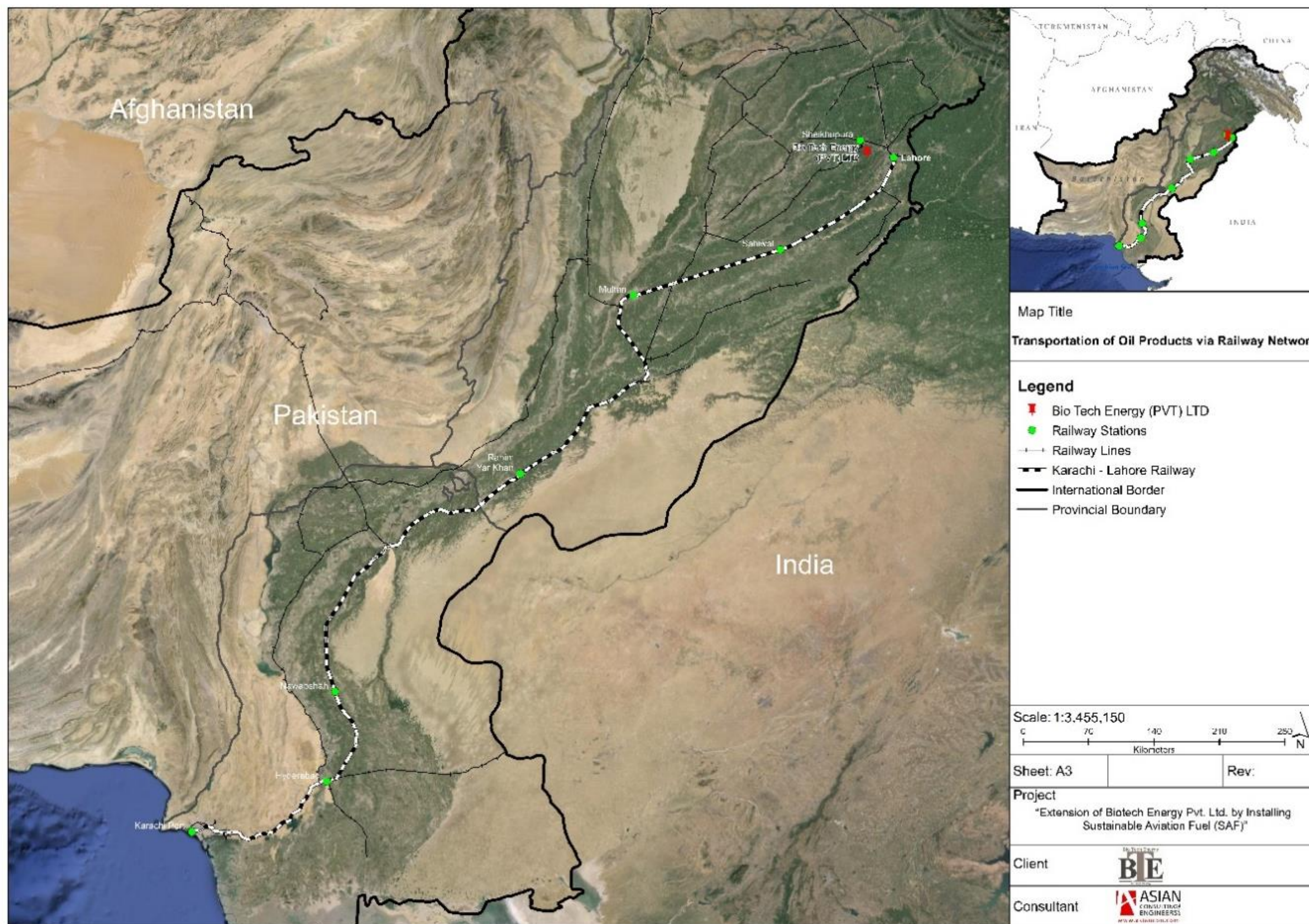
4.5 Transportation alternatives

158. The transportation of product oil through road and railway systems involves distinct considerations, each with its advantages and challenges. Here's a comparative analysis of product oil transportation through these two modes:

Aspects	Transportation of feed stock through Road	Transportation of feed stock through Railway
Cost Efficiency	Transportation by road can be cost-effective for short distances and smaller quantities. However, as the distance increases, fuel and maintenance costs may rise significantly.	Rail transportation is generally more cost-efficient for bulk and long-distance shipments due to economies of scale and lower fuel consumption per ton-mile.
Capacity and Volume	Trucks have limited capacity compared to trains, which may result in the need for more vehicles for large volumes, impacting road congestion and efficiency.	Rail transport has higher capacity, allowing for the movement of large volumes in a single shipment, making it suitable for bulk product oil transportation.
Speed and Transit Time	Trucks provide faster point-to-point transit times for shorter distances but may face delays due to traffic congestion, road conditions, and regulatory restrictions.	Trains are generally slower than trucks for short distances but excel in long-distance transportation, offering consistent speeds and fewer delays.
Infrastructure and Accessibility	Road transportation provides better accessibility to remote locations and can reach destinations that may lack rail infrastructure.	Rail transport requires established rail networks and terminals, limiting accessibility to areas with proper infrastructure.
Environmental Impact	Trucks contribute to higher emissions per ton-mile compared to trains, making road transport less environmentally friendly, especially for large-scale shipments.	Rail transport is more energy-efficient and has a lower carbon footprint per ton-mile, making it a more sustainable option for bulk transportation.
Reliability and Safety	Road transport can be more susceptible to disruptions such as accidents, road closures, or adverse weather conditions, affecting reliability.	Rail transport is generally considered more reliable and safer due to dedicated tracks, standardized procedures, and reduced exposure to external factors.
Flexibility	Road transport offers greater flexibility in terms of routes and schedules, making it suitable for just-in-time deliveries and flexible supply chains.	Rail transport may have limited flexibility in terms of routes and schedules but excels in handling regular, large-scale shipments.



(Transportation of oil products via road networks)



(Transportation of oil products via Railway Routes)

Figure 4-4: Comparison of Transportation Routs Map

4.5.1 Conclusion

159. While both road and railway transportation have their merits, a conclusion favouring road transport for product oil shipment can be drawn based on certain considerations. Road transport provides unparalleled flexibility, allowing for easy accessibility to diverse locations, accommodating just-in-time deliveries, and adapting to dynamic supply chain needs. The versatility of road networks enables the transportation of product oil to destinations that may lack rail infrastructure, contributing to a broader reach. Additionally, road transport is often more suitable for smaller volumes and shorter distances, making it a practical choice for businesses with specific logistical requirements. While acknowledging the environmental impact and potential for congestion, the advantages of flexibility and accessibility position road transport as a favourable option in certain scenarios, offering a tailored solution to meet the diverse demands of the product oil supply chain.

CHAPTER - 5: DESCRIPTION OF THE PROJECT

5.1 Introduction and Significance of Project

160. Commercially sensitive information has been redacted.
161. This section deals with the detailed project description, including its main components such as the collection and production process.

5.1.1 Why SAF in Pakistan

162. With a Population over 200 m, Pakistan Benefits from one of the largest feedstock resources in the world in addition to its strategic poisoning in the middle east.

1	Feedstock availability	- Pakistan is the world's 6th largest population with an estimated waste feedstock potential of over 2 million tons per year for SAF production and one of the world's lowest jet fuel per capita consumption, making Pakistan the world's best location for a SAF project based on export - BTE, as sole SAF player in Pakistan, is able to secure a large share of Pakistan's waste feedstock
2	Strategic location in the Middle East	10% of the world's jet fuel is consumed in the Middle East, with Pakistan the only country that can cater to this demand through SAF
3	First mover advantage	Pakistan would be the first country¹ not only in the Middle East but also in Southeast Asia to produce large scale SAF

5.1.2 SAF and Relationship to Climate Change Perspective

163. The issue of climate change is a pressing dilemma that necessitates

unified efforts to resolve, characterized by a common vision and cooperation among governmental bodies, businesses, and the public. The period leading up to 2030 presents an important chance for us to alter the worldwide course towards a sustainable future. In fact, the decisions made at present will impact the capacity of forthcoming generations to thrive on Earth.

164. Aviation is among the six difficult-to-reduce sectors that, together with cement, steel, plastics, trucking, and shipping, account for about 30% of the world's yearly carbon emissions. The European Commission projects that by the mid-21st century, the demand for air travel could lead to a more than 300% rise in aviation-related greenhouse gas emissions compared to 2005 levels. However, this increase has been temporarily mitigated by the impact of the COVID-19 pandemic.
165. The CST coalition aims to scale SAF as the most promising option to reduce the aviation industry's carbon emissions in the near term. Synthesized from sustainable, renewable feedstocks, such as municipal waste, agricultural residues and waste lipids, SAF has already fuelled more than 250,000 commercial flights. It is fully compatible with existing aircraft and fuelling infrastructure. A transition to SAF is in reach. From a feedstock perspective, enough raw material is available to fuel all aviation by 2030. To ramp up production, the industry will need to scale new technologies that run on less constrained feedstocks. To create commercial quantities of power-to-liquid fuels or e-fuels, made only from CO₂ and green electricity, technology will need to mature and much more renewable electricity must become available.

5.1.3 SAF and Relationship to Waste Management Perspective

166. The SAF Project will have a positive impact on the waste value chain by:
- Influencing job markets
 - Creating channels for income generation
 - Encouraging entrepreneurship
 - Boosting overall economic development
 - Creating significant environmental benefits
 - Encouraging more sustainable practices for energy production.
167. Commercially sensitive information has been redacted.
168. The Project enables the monetization of waste – through a legal channel. Further, as SAF is the highest economic value product that can be derived from the waste – it provides the maximum value creation for the waste available. The SAF produced at the plant is of global standard, and hence creates the highest economic value add product possible from the local waste.

169. The Project will further help save just under 1,000,000,000 kg/co₂ per year at max production. Exactly 704,500,766 kg/Co₂ per year, equivalent to:

- i. Planting 41,342,807 Trees per year; OR
- ii. The carbon footprint of 130,000 EU citizens (as per world bank average carbon footprint data); OR
- iii. Removing 312,000 full-size passenger vehicles from the road per year).

170. The project will also have a significant economic impact on development in Pakistan by converting local waste resources into a high-value export-based product.

5.1.4 Economic Growth and technology for Pakistan

171. The establishment of a Sustainable Aviation Fuel (SAF) plant in Pakistan is expected to bring substantial economic benefits. It will enable the production of a new, environmentally-friendly fuel product that can be traded globally. The plant will convert waste resources into high-value SAF, aligning with climate initiatives by reducing greenhouse gas emissions. Additionally, the project will create skilled jobs for Pakistani engineers through technology transfer and training, and it will help formalize and economically improve the existing illegal gutter oil market, positioning Pakistan as a key player in the global SAF industry.

172. Commercially sensitive information has been redacted

- i. Chemistry
 - ii. Environment
 - iii. Health and Safety
 - iv. Extended Safety
 - v. SAF product knowledge including market
 - vi. Emergencies and troubleshooting
- 1) Long-Term Technical Assistance Agreement – This will enable skill improvement and refreshing of BTE Staff.
 - 2) Overall, the transfer of technology allows Pakistan to address the challenge of attaining net zero carbon emissions by 2050 in the Aviation Industry. According to IATA, Sustainable Aviation Fuel will contribute significantly,

accounting for over 65% of the industry's reduction target. It has been projected that the SAF market will expand to 407 million metric tonnes by 2050.

- 7) Achieving global net zero targets is heavily reliant on Pakistan, and Biotech's technology transfer by AXENS is strategically positioned to make this possible. The project's wide-ranging effects will not only establish a new industry and generate exports, jobs, and innovative technology in Pakistan but also have a worldwide impact by harnessing the approximately 2 million metric tonnes of waste feedstock in Pakistan to help meet global carbon goals for SAF.

173. The likelihood of having the development impact is enhanced by:

- AXENS being the world's leading technology on SAF through its Vegan technology
- Skill Transfer to Biotech who have an existing foothold and expertise in the field, particularly with biofuels
- By the very nature of the technology, it will be based on waste inputs, and thus lead to the calculated GHG emissions saving.

5.1.5 Objective of Project

174. The following are the main objectives of the project:

- Transforming waste into sustainable energy
- Enhance the growth of the economy
- To increase exports of the country
- Create job opportunities for the local people, definitely.

Table 5-1: Summary of Project Indicators

Impact	
Customer Access	The project will enable suppliers of waste, to legalize and gain a high value for their waste, which they currently have to resale for illegal gutter oil purpose
	The suppliers of waste are generally underrepresented and from the informal segment. The roll out of the household collection plan will have an even greater significance in the case of Biotech's business model.
Customer Affordability	Suppliers of waste can be paid on time reliably and monetize their waste which forms a form of financial assistance. In addition to this, through the pricing model being linked to international waste prices, suppliers are able to improve the price of the waste.
Quality and Effectiveness	BTE will produce the highest quality SAF product, in line with EU and ASTM standards, SAF is one of the most sophisticated products in the waste-to-value chain.
	Customers of the end-product would benefit by improving their yield in terms of GHG obligations and emissions targets, as well as being able to meet new regulatory changes that make SAF a requirement.
	Technical assistance is further provided to waste collectors through training programs, with regards to sustainability practices in particular

Impact	
	which help to formalize the value chain.
Effects on Suppliers	The execution of the project would increase the total number of suppliers from around 4,000 currently, to reach close to 15,000 with a regional expansion (all of which will be local.)
	During the construction and operation, suppliers will benefit from technical transfer by developing a new skill set, and capability of advanced construction.
	With regard to SAF technology and supply of raw materials which currently does not exist, this will provide a large economic spill over to suppliers - as during the construction and erection for example, having the project experience of construction enables them to have key skills to work for, bid for and supply global SAF plants, which are likely to have over \$200 bn of investment over the next 10 years.
Effect on community	There is a significant impact on the wider community, as the project provides a diversion from gutter oil, which poses significant health hazards to all communities within Pakistan, whereby they unknowingly consume adulterated edible oil partially made from gutter oil. By providing a higher value economic end-use, oil which would go into this industry gets diverted to a clean green fuel.
Effects on the Government	The government of Pakistan benefits from increased exports and dollar earnings, close to \$500m/ year from a new and innovative industry,
	GOP benefits from increased Tax revenue, amplified by the supply chain, also moving from adulteration to sustainable supply.
Economy-Wide	This project provides the highest value add product, generates high-value employment and is 100% export-based on domestic feedstock.
Environment	The project has a full GHG audited and planning, whereby it will help to save over 704,500,766 CO ₂ per year - this would be the largest CO ₂ reduction from any single industrial unit across Pakistan.
	The project also assists the global aviation industry, helping to achieve its sustainability goal of 'Net Zero' by 2050.

Table 5-2: Summary of Market Indicators

Impact	
Competitiveness	The project creates a complete change in the market structure. Currently, the market is completely undeveloped and does not exist. Through this project, the structure and composition will shift from an informal, opaque market, to a transparent and developed structure. Whereas currently, waste can and is diverted into the gutter oil industry, a formal supply chain will become available for the domestic waste market.
	The price of domestic waste will become in line with international waste prices, removing the gap and distortion.
	Currently, there is no SAF production in Pakistan, the project will create a market for SAF through the adoption of Axens' new technology.

Impact	
	Market regulations around the globe have changed, most notably the EU REFUEL ACT, which makes the use of SAF mandatory and increasing across Europe.
Resilience	There is no negative impact, on domestic supply as the project is based 100% on waste, hence utilizing a resource that has no negative impact on domestic supply.
	The project generates 100% of its thermal energy, through the bio propane (off gases produced.) Thus, it is not dependent on the domestic energy or natural resources of the country at all.
Integration	The project has a high impact on International Trade and the global value chain, as there will be a global shortage of supply of SAF notably other governments are considering ensuring enough SAF supply a challenge. For example, the USA with the 'Grand SAF Challenge,' an initiative from the US department of energy, that is focused on ensuring enough SAF supply is available to meet the growing demand driven by regulation and climate goals.
	Domestic supply chains benefit from maximum value creation from the waste, as well as ancillary services.
	A new industry, of complex nature i.e. state of the art is created through the latest technology in a new market that has a significant market size.
Inclusiveness	The project is both inclusive and diverse, as the waste, i.e. feedstock input into the project provides an opportunity especially for SME households and sole traders to generate profit from a resource they are either throwing away or is being used for illicit practice. In addition, the effect of this is diverse as the project envisages collected throughout regions, and the market benefits are across all groups.
Sustainability	The project would be the most sustainable in the country, with GHG accounting policies, the plant would be regulated by ISCC sustainability requirements, and GHG emissions savings for the projects have been adopted. Overall, the entire technology is a climate-based one, with the goal being to reduce GHGs. The project also helps with recycling.

5.2 Location of Proposed Project for SAF

175. The project site location is situated along Sharaqpur Road in the Sheikhpura District. The site can be accessed via the main Lahore-Sheikhpura Road and Motorway M3. It is located in a designated industrial zone and is surrounded by a mix of agricultural, industrial, and residential areas. The nearest sensitive receptors within 01 km radius are village of Chah Shadulwala (1048 m) on eastern side,, Nagina Kids campus (non-functional 477 m) on northern side, Mohammad Educational Complex (831 m) on southern side and Aghosh Al-Khidmat Orphanage (305m) on eastern side of the project site. The other adjacent facilities within 01 km include f Prosperity Weaving Mills which is 325m away on western side, while Levon Pharmaceuticals is 312 m on northern side, Labaik Filling Station is situated

785 m away on northern side, Jhanda Poultry Farm is 620 m away on north-eastern side, and Ittefaq Construction Associates is located 831 m on southern side, Wahdat Industrial Services Pvt. Ltd. is 412 m away on southern side, while the non-functional poultry farm and Chadhar Agricultural Model Farm are both 425 m on western side from project site.

176. The location map of the site is given as under:-

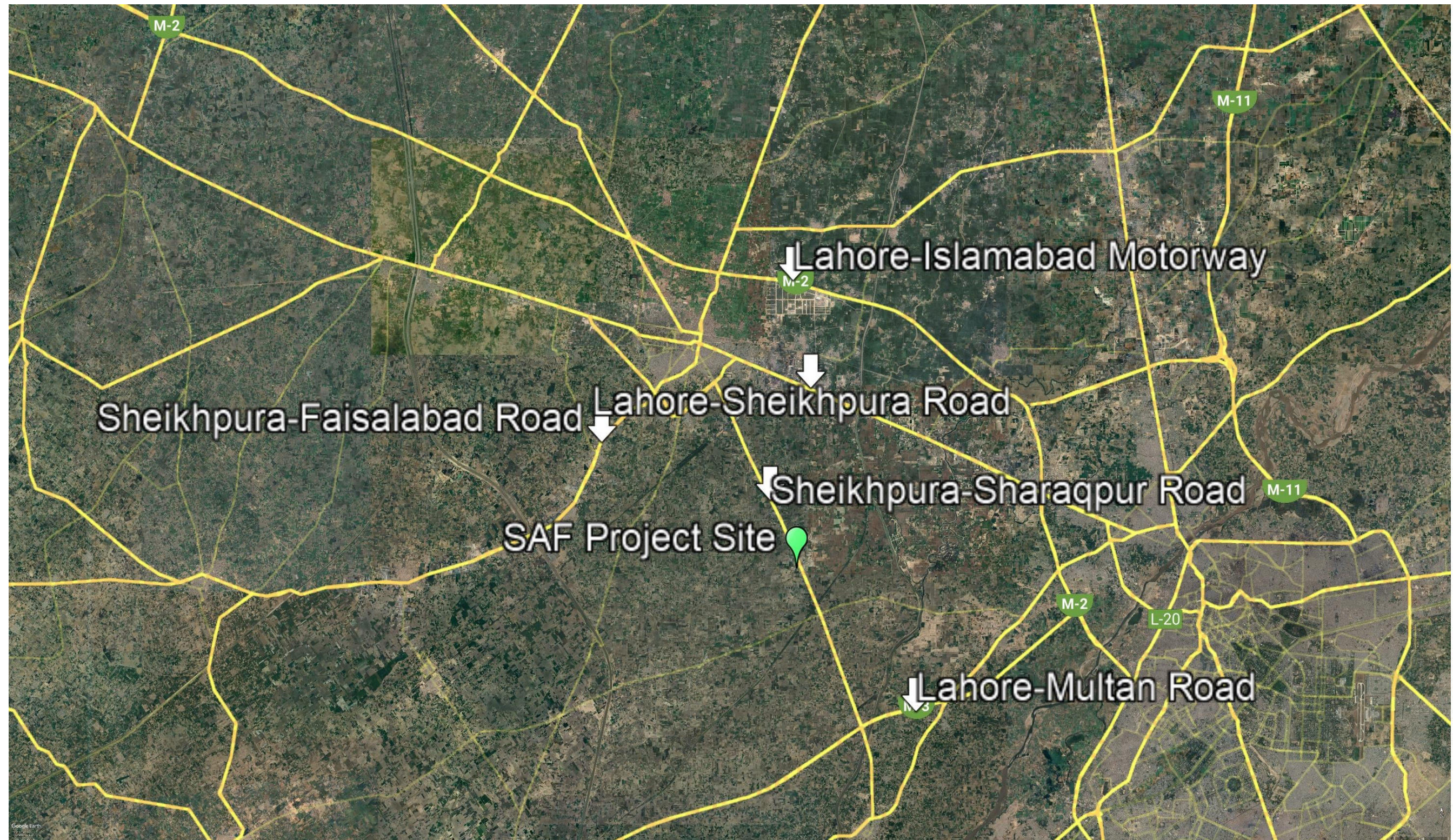


Figure 5-1: Location Map of Proposed Project Site

5.3 Land use

177. BTE owns 5.84 acres of industrial land, with an existing BTE plant developed on 2.66 acres. The rest of the 3.18 acres will be used to establish the SAF facility. The site is surrounding by the combination of a mix of agriculture and residential areas. The nearest settlement is the village Chah Shadulwala and is located around 1 KM from the site. Nagina Kids campus is located on northern side, Foundry, Itfaq Foundry, is located on the southern side and produces concrete-based items like slabs and roofs. On the western side, there is an open plot owned by another owner and beyond that is the Prosperity Weaving Mill unit which belongs to the textile sector and specializes in weaving whereas Agosh Alkhidmat (Orphanage) is located on eastern side of the project site.

178. The land use distribution of Area of Concern (AOC) is given below:

Land Use Classes	Area (sq. km)	Percentage (%)
Agricultural	75.62	96
Area under Water	0.02	1.1
Arterial and Circulations	0.03	1.5
Commercial	-	-
Cultural heritage	-	-
Education	0.08	0.1
Graveyard	0.09	0.1
Health Services	0.01	0.01
Industrial	0.62	0.78
Public Building	-	-
Religious Building	0.005	0.006

179. The land use map of AOC is given as under:-

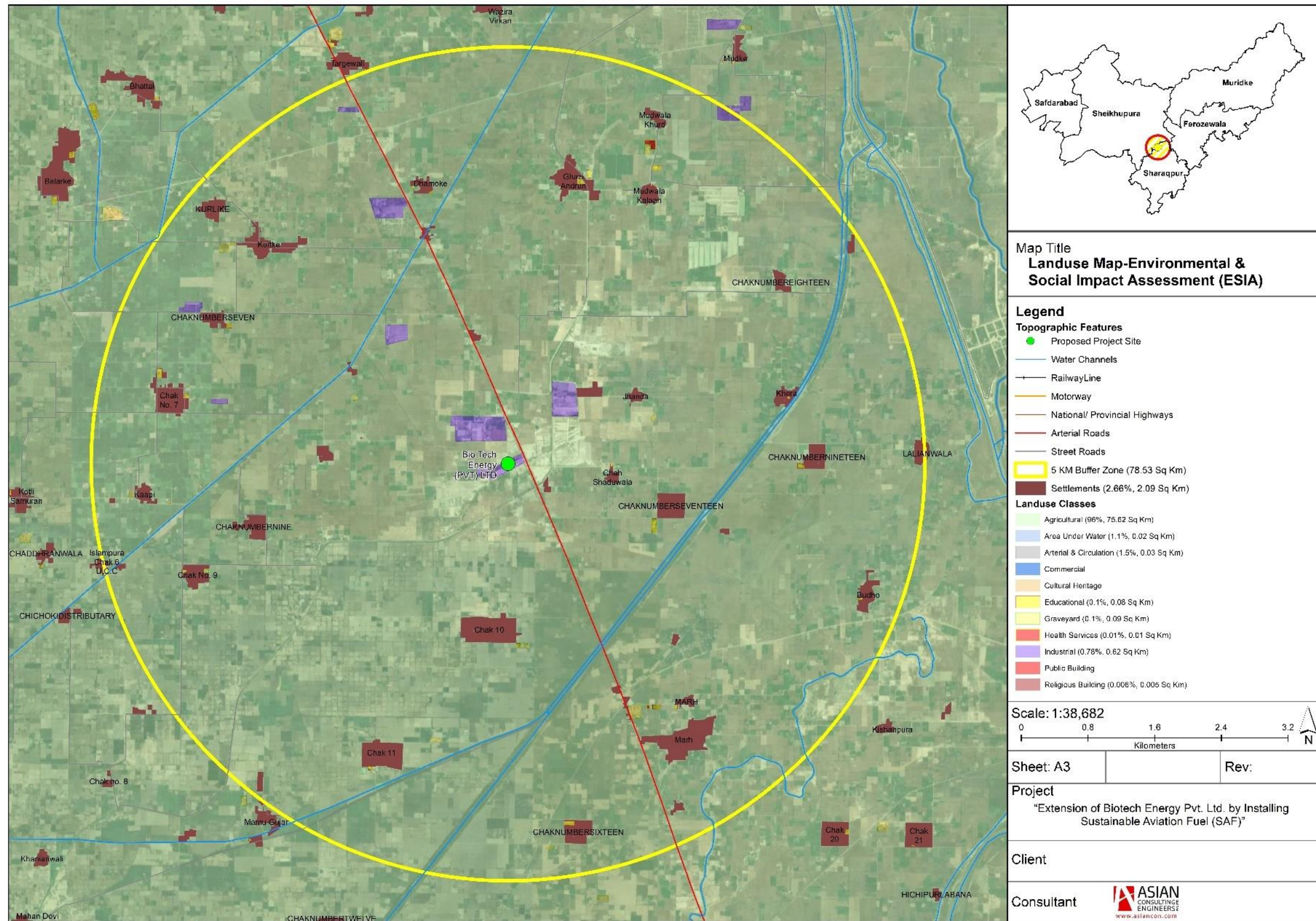


Figure 5-2: Land use Map of AOC



5-3: Map showing distances to adjacent activities

A-BIOTECH ENERGY (PVT) LTD (the distances of the adjacent activities are calculated by keeping "A" as reference)

Point Name	Vicinity Name	Distance from Point A in Meters (m)
B	Prosperity Weaving Mills Ltd.	325
C	Not used	412
D	Levon Pharmaceuticals	312
E	Labaik Filling Station	785
F	Residential Structures	434
G	Aghosh Al-Khidmat	305
H	Ark City	119
I	Shahzad Farms	373
J	Jhanda Poultry Farm	620
K	Ittefaq Construction Associates	831
L	Wahdat Industrial Services Pvt. Ltd.	412
M	Non-operational Poultry Farm	Adjacent to boundry wall
N	Chadhar Agricultural Model Farm	425
O	Agricultural Land	-

5.4 Differences in Processes Between the Existing FAME Biodiesel Project and the New SAF Project

180. The FAME biodiesel process focuses on converting feedstocks into biodiesel using a transesterification reaction with methanol and an alkaline catalyst. This mature technology involves steps such as feedstock pre-treatment, pre-esterification for managing free fatty acids, and transesterification to produce fatty acid methyl esters (FAME). Impurities are removed through distillation, and the by-products, such as glycerol, are either utilized internally or repurposed. The biodiesel produced is mainly used in diesel engines as a renewable fuel substitute.

181. In contrast, the SAF process, designed for aviation fuel, employs the more advanced Vegan® methodology. It begins with similar feedstock pre-treatment but diverges significantly in the production stages. The SAF process includes hydrotreatment to remove oxygen and contaminants, transforming feedstock into linear paraffins. This is followed by hydroisomerization, which adjusts the fuel's cold flow properties to meet aviation standards. The final steps involve high-pressure fractionation and product blending to create sustainable aviation fuel, capable of directly replacing jet fuel. Unlike biodiesel, the SAF process emphasizes creating high-energy-density fuels suitable for aviation applications.

5.5 Details of existing buildings and security system

182. The existing building comprises a main office and laboratory constructed using a combination of steel structure and civil works, covering an area of 3,163.4 ft². It is a double-story facility designed to accommodate administrative and operational needs.

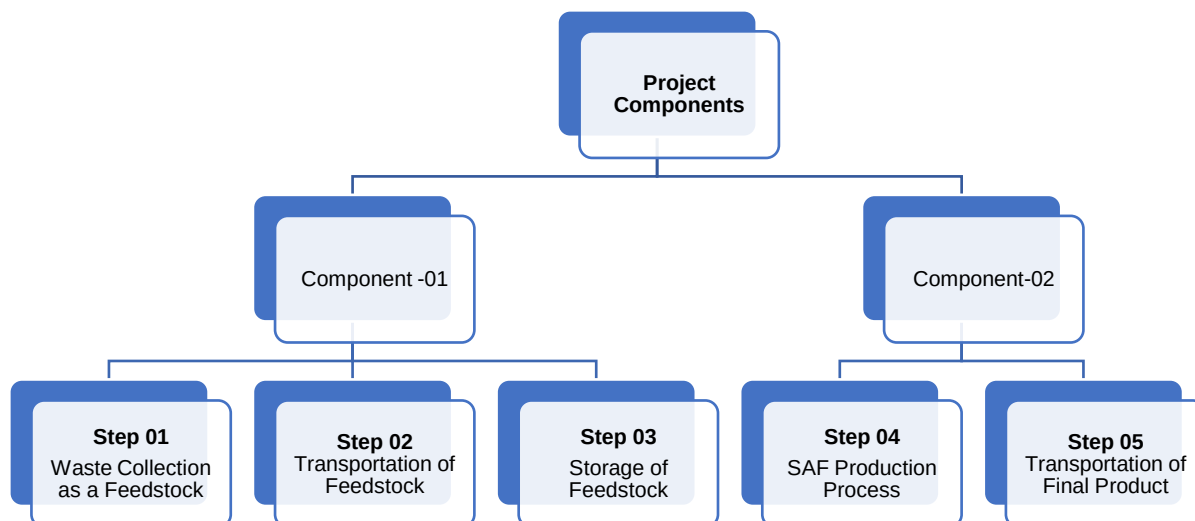
Existing Security System:

183. The existing security team includes 12 security guards (6 on day duty, 6 on night duty) and 2 supervisors for surveillance and monitoring. For the project, access will be controlled with a fenced perimeter and entrance gate. A licensed private security contractor will implement security measures, with connections to local authorities for any threats. BioTech Energy (BTE) will coordinate with local security to ensure comprehensive coverage. The ESIA will adopt a preventive security approach, fostering positive relationships with the local community through open dialogue and community liaison officers. Additionally, 12 extra security guards will be hired for surveillance and monitoring the SAF.

5.6 Description of Project for SAF

184. The Proposed SAF facility has the following two main components:

- **Component 1:** Enhancement + Improvement of the existing feedstock collection activity of BTE, across Pakistan, in Urban Areas.
- **Component 2:** SAF (Sustainable Aviation fuel) using Axens Vegan Technology.



185. The project is one using environmentally friendly technology for best-in-class technology, to bring Pakistan to the forefront of i) Circular collection ii) Renewable Energy production iii) GHG savings around the world.

186. **Component 1:** is an existing activity that is proposed to be further enhanced and improved, in terms of the positive E&S impacts, there are no adverse impacts of the activity, however a detailed description and risk mitigation plan as been included in the ESIA for good measures. Whereas a brief comparison of existing practices with and without Biotech as well as proposed improvements with expansion are given below:

Commercially sensitive information has been redacted

187. **Component 2:** This is a new facility as an extension of an already existing Biodiesel refinery. The Project is categorized as a low/ medium risk, ADB B category project. Overall, the project's environment and safety have largely positive impacts on stakeholders and the environment.

5.7 Component 1: Enhancement + Improvement of the existing feedstock collection activity of BTE, across Pakistan, in Urban Areas.

This component of the project involves three steps: Waste collection as a Feedstock, Transportation of Feedstock and Storage of Feedstock.

5.7.1 Step 01-Waste Collection as a Feedstock

Feedstock for SAF and Renewable Diesel Production

188. Feedstock refers to the raw materials, such as vegetable oils, animal fats, and recycled cooking oils, used to produce sustainable aviation fuel (SAF) and renewable diesel. These feedstocks, containing fatty acids, are converted through the SAF production process into environmentally friendly alternatives to conventional fuels. The selection of feedstocks is based on factors like availability, cost, sustainability, and compliance with local regulations. The collection process for all feedstock types follows a consistent methodology, ensuring proper transportation, handling, storage, and adherence to occupational health and safety (OHS) standards. This process has minimal negative environmental, societal, or safety impacts and yields significant positive outcomes, such as preventing waste adulteration into the food chain and avoiding drain blockages and water contamination.

Feedstock Collection and Supply Chain Operations

189. The feedstock supply chain engages around 150 part-time or full-time workers who are involved in transporting and collecting the feedstock, excluding Biotech Energy staff. The supply chain also includes over 3,000 suppliers and vendors. Currently, Biotech collects approximately 3,000 metric tons of feedstock per month, with plans to scale up to 15,000 metric tons per month. Approximately two to three transportation companies are formally working with Biotech Energy and are responsible for feedstock collection, utilizing vehicles of various capacities, including 3-metric ton, 5-metric ton, and 20-metric ton trucks, as well as small tankers and open trucks. The collection system ensures efficient logistics and sustainable supply chain management.

190. system ensures efficient logistics and

Supplier Identification and Compliance

191. Suppliers are selected through a formal system that ensures compliance with BTE's HR policies and code of ethics. All suppliers sign self-declaration forms to confirm adherence to ethical standards, such as the prohibition of child or forced labor. They undergo risk assessments and are subject to internal controls, including regular audits and a zero-tolerance

policy for child labor. Mandatory audits are conducted every three years to verify compliance. Supplier rates are negotiated based on market conditions, supply volume, and adherence to operational and ethical standards. Payments are processed through secure financial channels after delivery verification. Supply chain coordination is strengthened by traceability mechanisms, geo-tagging, and future blockchain integration. Regular compliance workshops and training programs foster collaboration and alignment across the supply chain.

5.7.1.1 Sustainability Criteria for Raw Materials used by BTE

- a) Sustainability Criteria and Traceability System

5.7.1.2 General Overview

192. Waste and residues shall be considered to have zero life-cycle greenhouse gas emissions up to the point of collection of those materials. This is irrespective of whether the materials are further processed to intermediate products before being processed into the final product. In this context, the “point of collection” is the point where the waste or residue occurs in the first place. Under ISCC the point where a waste or residue arises in the first place (i.e. is generated) is referred to as the “point of origin”. For UCO, for example, this would be the restaurants or plants producing fried products, for rendered animal fats the point of origin would be the rendering plant producing animal fat from animal by-products. Note that households will not be considered as potential suppliers in the case of BTE, taking into account the context of Pakistan.

5.7.1.3 Traceability System

- Mass Balance
- General Requirements The mass balance system is the chain of custody option under which the sustainability characteristics remain assigned to batches of material on a bookkeeping basis while the physical mixing of material with different sustainability characteristics and the mixing of sustainable and non-sustainable is allowed. Any kind of mass balance operation and calculation shall only be related to sustainable material. The allocation of sustainability characteristics to outgoing batches is limited by the conversion factor relevant to the biofuel-related supply route.
- Due to the physical mixing, the mixture loses its individual properties. The sustainability characteristics of materials can therefore only be determined via bookkeeping. This requires the calculation of mass balances and the verification of the mass balance calculation with respect to the chosen period for balancing.
- The mass balance has to contain information concerning all the sustainability characteristics and the sizes of the batches with the different sustainability characteristics that are mixed. The sum of all batches that are withdrawn from the mixture has to have the same sustainability characteristics in the same quantities as the sum of all the batches that were added to the mixture.

- Mass balances are kept material-specific indicating the respective raw material.
- If a company is operating mass balances under different certification schemes the auditor has to be able to access all mass balances of all certification schemes that the company is using.
- Mass Balance Period and Credit Transfer The mass balance calculation requires the definition of the timeframe for which the outgoing batches with specific sustainability characteristics have to be balanced with the incoming batches with respective sustainability
- Mass balance
- Site-specific
- Material-specific
- Access to all mass balances
- Maximum period
- According to the RED, the maximum timeframe (period) for a mass balance the calculation is three months.

193. The rationale for the maximum period of three months is twofold:

- A shorter mass balance calculation period does not offer additional security against fraud
- Reducing the period to much shorter timeframes will increase the costs and investment significantly and reduce the flexibility for the market players without improving the security and sustainability within the supply
- If more sustainable material (including the existing inventory of sustainable material) was received within one mass balance period than was dispatched, the surplus of sustainable material in the bookkeeping is called the 'positive credit'. It is only possible to transfer positive credits from one mass balance period to the next if at least the equivalent amount of physical material (sustainable and non-sustainable) is in stock, as positive credits are stated in the bookkeeping.
- This means it is not possible to transfer more positive credits into the next mass balance period than the quantity that is physically in stock at the end of the mass balance period.
- Negative credits would occur if, at the end of a mass balance period, less sustainable material (including existing stock) was received than dispatched. This would be equivalent to a negative mass balance, which is not allowed under ISCC.
- To verify if the sustainable amounts of input and output material are balanced at the end of the period or if a positive credit occurs the following calculation has to be done:

$$B = (A + a) \cdot xy + b$$

B - C > 0: positive credits

B - C < 0: negative credit (not allowed)

A: Incoming sustainable material for the entire mass balance period

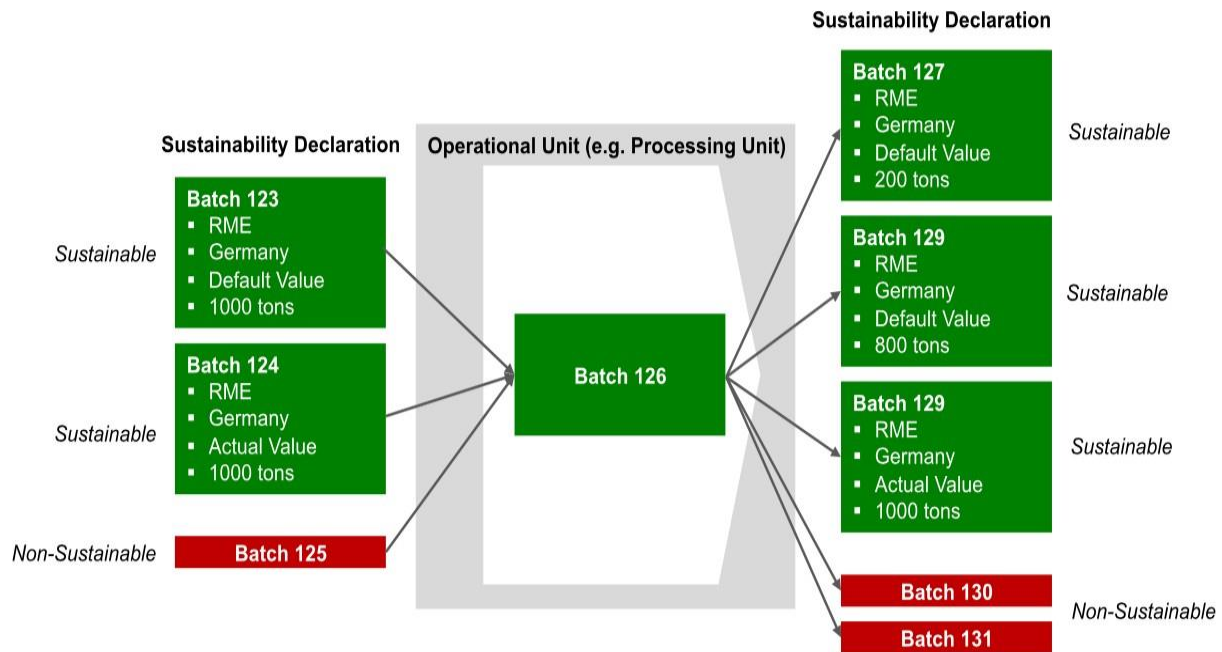
C: Outgoing sustainable material for the entire mass balance period

a: Inventory of sustainable material at the beginning of the period

b: Inventory of sustainable products at the beginning of the period

xy: Average conversion factor during the period

- Positive credits
- Negative credits not allowed
- Verification of credits
- A transfer of credits should reflect the products or product groups and the respective sustainability characteristics. It is not possible to transfer credits from materials that were certified according to the ISCC EU waste and residues process (i.e. the land-related sustainability criteria according to Art. 17 (3) to (6) RED are not fulfilled) to materials that were certified according to the regular ISCC certification process. It is also not possible to transfer credits if the respective materials have different conversion factors. This particularly applies if additional processing steps are required.
- Mass Balance Calculation Under the mass balance method, batches of sustainable material (which may have different sustainability characteristics) and non-sustainable material can be physically mixed within internal company processes. Within the mass balance period, batches of sustainable material with the same sustainability characteristics (including raw materials, country of origin, GHG emissions, etc.) can be arbitrarily merged or split within the bookkeeping as long as the total amount does not exceed the quantity credit.
- Biodiesel Factory
- Conversion Process (Conversion Factor xy)
- Incoming Sustainable Material
- Inventory Sustainable material
- Inventory Sustainable Main Product
- Outgoing Sustainable Main Product $A = a + b - C \cdot XY$
- Credit transfer between materials
- Credit transfer between certification periods
- Quantity credit method



194. Biotech only accepts raw materials traceable to the point of origin.

- All renewable raw materials used by biotech will meet the sustainability criteria as defined in EU RED II (EU2018/2001)
- All raw materials used by biotech are certified by ISSC and are compliant with EU waste codes.
- Biotech ensures that all renewable raw materials that they use enable them to produce fuels that have greenhouse gas savings of at least 80%

195. All material used by the project fulfill the Sustainability and Traceability criteria to the Point of Origin, the project will be audited under the EU RED II/ III directive for sustainability and traceability;

Commercially sensitive information has been redacted

- Is expected to rapidly grow over the next 10 years which will assist BTE in its feedstock sourcing.
- BTE collection system used BAT standard and D compliant with in systems certified by ISCC are attached as **Annexure-01**.

198. Being compliant with ISCC ensures:

- Governance
- Traceability
- Sustainability

199. BTE is currently developing its pilot programs demonstrated in our case study, about innovating and developing more feedstock collection routes.

5.7.1.5 Description of Each Feedstock

200. The Feedstock market in Pakistan is largely fragmented and dominated by the informal segment. Especially in the advanced feedstocks of poultry feather acid oil and soap stock acid oil wastes. Almost 100% of the poultry feather acid oil industry is informal and run by very small businesses generating a total low revenue. The businesses are not well documented and largely operate by partnerships where sole proprietorship partnerships, operate the entire chain of producing and disposing of the oil.

201. Biotech energy will use the following feedstocks for the proposed project:



202. The expansion of biofuel feedstock cultivation in developing countries

is widely embraced by producer country governments as a means to achieve energy security and stimulate rural economic development through employment and smallholder market integration.

203. It is important to mention, that Biotech Energy has made a significant contribute to alleviating the gutter oil industry in Pakistan.

5.7.1.6 Gutter Oil

204. It can be used to describe the illicit practice of restaurants reusing cooking oil that has already been cooked for longer than safety codes permit. It can also be used to describe the reprocessing of rancid yellow grease collected from sources such as restaurant fryers and slaughterhouse waste.

205. The usage of gutter oil is highly frowned upon and often leads to prosecution. "In Pakistan, Gutter oil is the only alternative use of the feedstocks used by BTE.

206. The detail of each feedstock used by biotech is given below:

5.7.1.7 Used Cooking Oil

207. Used Cooking Oil (UCO) is the low-carbon feedstock for the production of SAF or renewable diesel that is both technologically mature and commercially available. It refers to oils and fats that have been used for cooking or frying in various food processing industries and restaurants. UCO can come from both vegetable oil and animal fats used in cooking.

Major Sources of Used Cooking Oil Collection (UCO)

208. UCO consists of oils and fats that have been used by the food industry for human consumption. It is considered a waste no longer fit for humans.



Restaurants



Factories



Households

Figure 5-4: Sources of Used Cooking Oil Collection

UCO as a Feedstock for the Production of SAF Or Renewable Diesel

209. The use of UCO as a feedstock for the production of SAF or renewable diesel offers several benefits. Firstly, it provides an environmentally friendly way to dispose of waste cooking oil that would otherwise be discarded, potentially causing pollution. By converting UCO for the production of SAF or renewable diesel, it will be repurposed as a renewable and sustainable fuel source. Additionally, UCO as a feedstock reduces the demand for new vegetable oils or animal fats, thereby minimizing the competition with food production and reducing the potential negative impacts on food security.

210. The price of used cooking oil and other feedstocks will likely be negotiated based on market conditions and supply agreements. The collection of feedstocks is managed by third-party transport companies engaged by Biotech Energy (BTE), as specified in the data provided. These companies are responsible for collecting feedstocks using a variety of vehicles, including 3 MT, 5 MT, and 20 MT trucks, small tankers, and open trucks. The collection process does not directly involve BTE staff, but the overall supply chain is coordinated and monitored by BTE to ensure compliance with ethical and operational standards.
211. The collection and processing of UCO for the production of SAF or renewable diesel require proper handling to ensure the removal of impurities and contaminants. Once the UCO is treated and purified, it can undergo transesterification, a process that converts the triglycerides in the oil/fat into biodiesel.
212. The quality of Used Cooking Oil (UCO) is crucial for its transformation into advanced biofuels. Impurities like free fatty acids and water can pose challenges during the production process. High levels of free fatty acids can lead to soap formation, affecting the efficiency and quality of biodiesel. Water content can cause emulsion formation. Proper collection methods and pre-treatment techniques are necessary to ensure low levels of impurities in UCO for biodiesel production. Regular testing and quality control are important to maintain the desired specifications.
213. UCO-based biodiesel is in alignment with the European Commission's Renewable Energy Directive (RED), which focuses on reducing greenhouse gas (GHG) emissions, preserving biodiversity, and maintaining carbon stock. According to the RED, used cooking oil and certain types of tallows are categorized as "waste vegetable and animal oil." The utilization of these feedstocks for FAME (fatty acid methyl ester) production is considered to result in carbon savings of approximately 83%. This classification recognizes the environmental benefits of using UCO and specific tallows as feedstocks for biodiesel, contributing to the overall sustainability goals outlined in the RED.

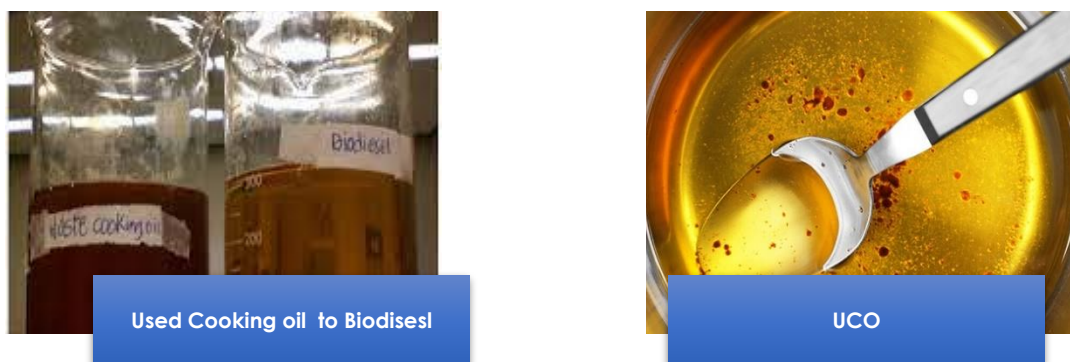


Figure 5-5: Used Cooking Oil as an Alternate Feedstock for Production of SAF or Renewable Diesel

UCO Vs Circular Economy

214. Using UCO as a feedstock for the production of SAF or renewable diesel promotes the circular economy by recycling waste materials and reducing environmental impact. It is an effective way to transform a waste product into a valuable resource for renewable energy production.



Comparative Analysis of Used Cooking Oil Collection in Different Countries

Commercially sensitive information has been redacted

Figure 5-7: Province Wise Micro Break Up of Total Collectable Used Cooking Oil

5.7.1.8 Poultry Feather Acid Oil (PFAO)

215. Poultry Feather Acid Oil (PFAO) is a byproduct derived from poultry feather processing. Feathers, which contain keratin, are subjected to

hydrolysis or thermal treatment to extract valuable components, including protein and fat. The fat obtained from this process is known as Poultry Feather Acid Oil.



Poultry Waste
(Chicken's Feather Meal)

PFAO as a Feedstock for Production of SAF or Renewable Diesel

216. The utilization of feather fats for production of SAF or renewable diesel is a good alternative to recycle these wastes. The transesterification method is commonly used for biodiesel production because of its higher yield and lower energy consumption.
217. Commercially sensitive information has been redacted

Commercially sensitive information has been redacted

218. Commercially sensitive information has been redacted

219. PFAO feedstock can be sourced from renewable or sustainable sources, aligning with environmental and sustainability goals. Proper risk assessment and management practices should be implemented to ensure the responsible and safe utilization of PFAO feedstock.
220. The assumption is that the poultry market in Pakistan will maintain a 9% growth rate. Thus, it is a very sustainable source of feedstock, unique to Pakistan.

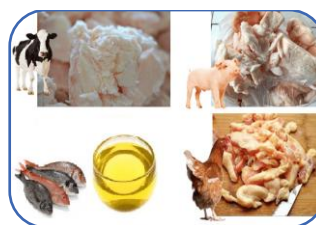
5.7.1.9 Soap Stock Acid Oil

221. Soap stock acid oil (SSAO) is a byproduct obtained during the refining process of vegetable oils or animal fats. It is derived from the acidulation or neutralization step, which is part of the oil refining process and can be utilized as a feedstock for the production of SAF or renewable diesel.

Sources of Soap Stock Acid Oil



Vegetable Oil Refining



Animal Fat Refining

222. Soap stock acid oil is obtained from the refining of vegetable oil and animal fats.
223. **Vegetable Oil Refining:** Soap stock acid oil is generated during the refining of various vegetable oils, such as soybean oil, canola oil, palm oil, sunflower oil, and others. When these oils undergo the acidulation or neutralization process to remove impurities and reduce free fatty acid content, SSAO is produced as a result.
224. **Animal Fat Refining:** Soap stock acid oil can also be obtained from the refining of animal fats, including tallow and lard. Similar to vegetable oil refining, the acidulation or neutralization step in animal fat refining leads to the formation of SSAO.

Soap Stock Acid Oil (SSAO) as a Feedstock for the Production of SAF or Renewable Diesel

225. SSAO can be utilized as a feedstock for the production of SAF or renewable diesel due to its high free fatty acid (FFA) content. Free fatty acids are essential for the transesterification process, which converts the fatty acids into renewable diesel/SAF.

Commercially sensitive information has been redacted

226. There is no significant growth expected in the Soap Sector, particularly in the informal soap sector.

5.7.1.10 Edible Oil Refinery Waste

227. Edible oil refinery waste refers to the byproducts and residues generated during the refining process of edible oils. Edible oil refineries are facilities where crude vegetable oils, such as soybean oil, palm oil, sunflower oil, or canola oil, undergo various processes to remove impurities, improve quality, and make them suitable for consumption.

Sources of Edible Oil



Soybean Oil



Palm Oil



Sunflower Oil

Edible Oil Refinery Waste as a Feedstock for Production of SAF or Renewable Diesel

228. Production of SAF or renewable diesel from edible oil refinery waste is an efficient and sustainable way to utilize the byproducts generated during the oil refining process. Edible oil refinery waste typically consists of various organic residues. These waste materials can be processed to produce biofuel, specifically biodiesel, through different conversion methods.

Commercially sensitive information has been redacted

Commercially sensitive information has been redacted

229. The Acid oil potential is expected to increase year on year.

5.7.1.11 Feedstock Collection Network

230. Biotech collects feedstock by third party, as waste from various regions of Pakistan, including Punjab, Sindh, and KP. The A3 maps for better visibility of the BTE feedstock collection network are provided as **Annexure-02**.

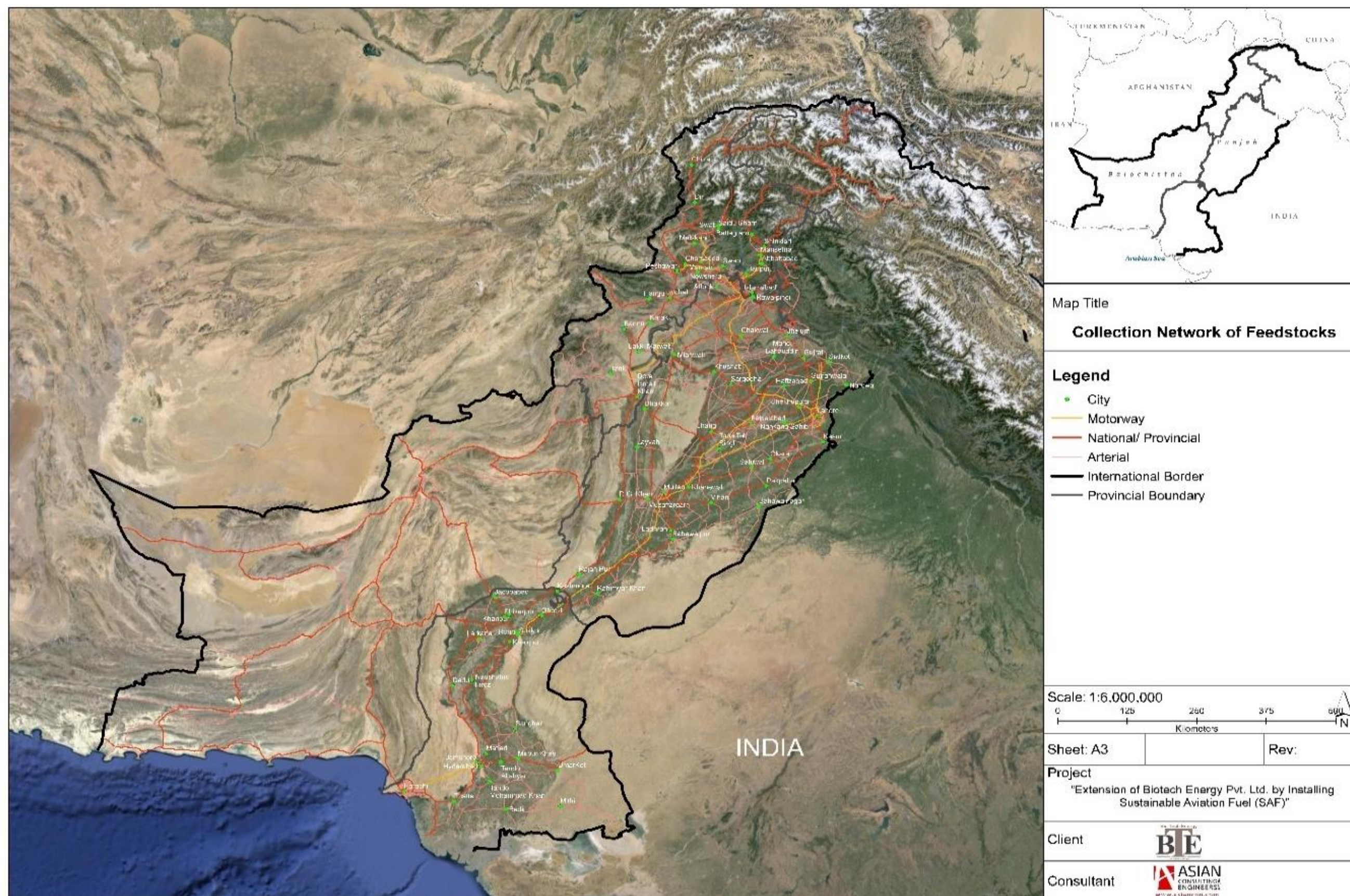


Figure 5-12: Collection Network of Feedstocks



Figure 5-13: Map of Collection Points from various regions of Pakistan 2023

Commercially sensitive information has been redacted

5.7.1.12 Point of Origin of feedstock

231. The feedstock comprises waste such as used cooking oil, Poultry Feather Acid Oil, Soap Stock Acid Oil, and waste from edible oil refineries. These are collected from various sources like restaurants before being transported to the manufacturing facility in Sheikhpura for processing by chemical reaction followed by distillation to produce SAF Products.

232. The feedstock collection procedure is given here under:

Feedstock Collection Procedure:

- Safe collection of used cooking oil from various sources (grills, restaurants, etc.).
- Proper labelling of UCO collection containers, and drums.
- Storing collected oil in designated areas away from heat sources.
- Use appropriate containers, use leak-proof, clean containers specifically designed for used cooking oil. Clearly label the containers with "Used Cooking Oil."
- Proper cooling, allows used oil to cool completely before collection to avoid spontaneous combustion.
- Straining and filtering, remove food particles and debris from the oil before collection to prevent clogging and contamination

Safety Precautions for Oil Collectors:

- **Personal Protective Equipment (PPE):** Wear gloves, aprons, safety glasses, and closed-toe shoes or PVC long shoes when handling UCO.
- **Training:** Provide collectors comprehensive training in safe UCO handling procedures, including spill responses.
- **Equipment Maintenance:** Ensure collection vehicles and equipment like drums, and containers are well-maintained to prevent accidents.

- **Hygiene:** Practice good hygiene after handling used cooking oil to prevent the spread of bacteria.
- **Spill prevention:** Use drip pans and take measures to prevent spills during the collection process.

5.7.1.13 Biotech Collection Criteria



233. **Feedstock collection:** Biotech's in-house salesperson or commission agent coordinates collection based on supplier location.
234. **Collection Routes:** Biotech's trucks or outsourced trucks, as well as agent trucks, follow a pre-planned collection route daily, scheduled at least 14 days in advance.
235. **Arrival at the factory:** Biotech collects feedstock from various collection points. It will then either be directly transported to the Biotech factory or bulked in a larger truck before moving to the factory. Visual quality checks and basic testing will be conducted during collection.
236. **Quality Assurance (QC):** At the Biotech factory, a quality check will conduct before offloading the collected feedstock. A proprietary route rating will be assigned to ensure that the collected feedstock meets the required standards. Biotech follows the ISCC regulations on the chain of custody and adopts a mass balance approach.

237. Commercially sensitive information has been redacted



Figure 5-15: Pictorial pieces of evidence of Feedstock Collection by BTE

5.7.2 Step-02 Transportation of Feedstock

238. The transportation of feedstock would be carried out using drums, open trucks, and tankers from commercial businesses. All vehicles will safely pack following all standard operating procedures and be tested on site.

5.7.2.1 Safety Precautions during Transportation of Feed Stocks

- **Secure containers:** BTE will ensure that all containers are tightly sealed and secured in the vehicle to prevent leaks or spills.
- **Safe driving:** Following traffic regulations, taking designated routes, and avoiding sudden stops or sharp turns are recommended.
- **Emergency plan:** An emergency response plan will be established and implemented in case of oil spills or accidents.
- **Transportation Routes:** Transportation routes will be planned to minimize environmental risks by avoiding sensitive areas such as water bodies, environmentally protected zones, and densely populated areas as much as possible.
- **Follow SOPs and Training of Drivers:** The transport vehicles will be equipped with emergency response equipment, including spill kits, personal protective equipment (PPE), and communication devices. Drivers should

be trained to respond promptly to spills or emergencies and to notify relevant authorities as per regulatory requirements.

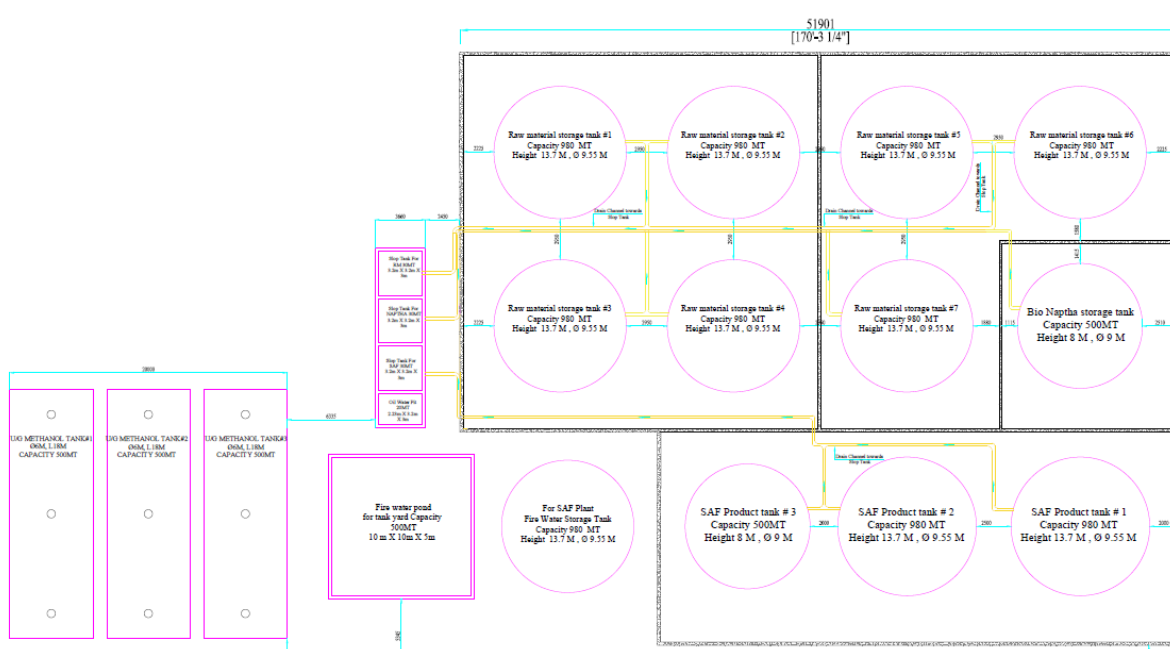
- **Vehicles Sealed with BTE Logo:** All vehicles must be sealed with BTE-provided seals which will be checked before receiving all raw materials.

	
Open Trucks with a Capacity of 4000Liters/5000Liters	Open trucks with Securely Tied used Oil Drums
Vehicles used for the Transportation of Oil	

5.7.3 Step-03 Storage of Feedstock

5.7.3.1 Storages/ Tank Farm

239. Raw Material, SAF and its by-products will be stored on site:



Commercially sensitive information has been redacted

Commercially sensitive information has been redacted

Commercially sensitive information has been redacted

Section IV: Fire and Explosion Hazard Data	
Flash Point (Method Used):	460°F, Open Cup
Flammable Limits:	N/A LEL: N/A UEL: N/A
Extinguishing Media:	Type B (Flammable Liquids)
Special Fire Fighting Procedures:	None
Unusual Fire and Explosion Hazards:	None

240. The storage of Raw materials and End Production, are not of petroleum in nature and follow Oleochemical industry standards, however, the construction of the same will follow the below standards and codes:

5.7.3.2 Codes & Standards for Tankage

API 2510	Design and Construction of LPG Installations
API 616	Combustion Gas Turbines for General Refinery Service
API 2510A	Fire–Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities
API Std 620	Design and Construction of Large, Welded, Low-Pressure Storage Tanks
API Std 650	Welded Steel Tanks for Oil Storage
API Std 2000	Venting Atmospheric and Low-Pressure Storage Tanks: Nonrefrigerated and Refrigerated
API Std 2015	Requirement for Safe Entry and Cleaning of Petroleum Storage Tanks
API Std 2508	Design and Construction of Ethane and Ethylene Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants, Refineries, Petrochemical Plants, and Tank Farms.
API RP 2003	Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents
API Publication 2015B	Cleaning Open –Top and Covered Floating Roof Tanks

5.8 Component 2- SAF (Sustainable Aviation fuel) using Axens Vegan Technology.

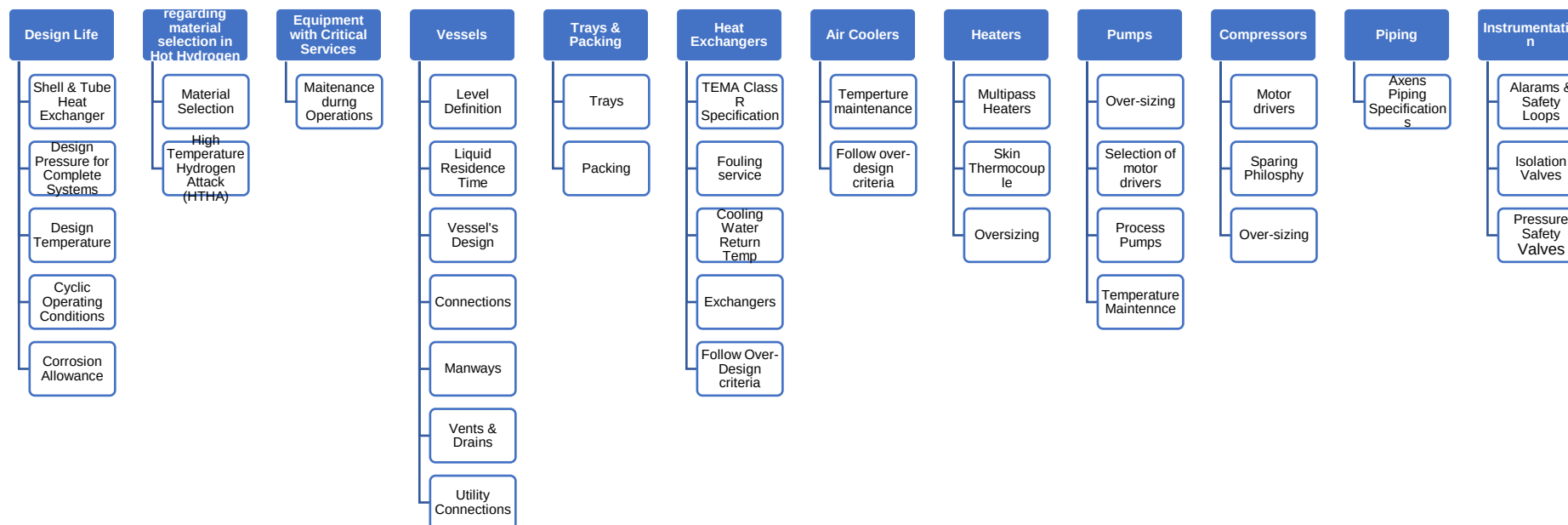
5.8.1 Step 04-SAF Production Process:

241. The project will use the AXEN's Vegan technology to make SAF:
242. Axens Vegan technology includes:
 - A Hydrotreatment (HDT) section to deoxygenate renewable lipids in the presence of hydrogen to produce linear paraffin.
 - A Hydro isomerization (HDI) section to upgrade the linear paraffin produced in the previous step into real drop-in middle distillate biofuels. The Hydro isomerization section can be tuned to produce different grades of Renewable Diesel or Renewable Jet, according to market needs mostly by turning the HDI section severity higher.
243. The figure below on the right details the evolution of the product quality during the different steps of Vegan® technology.

Commercially sensitive information has been redacted

Commercially sensitive information has been redacted

244. The design criteria and components of the layout include:



The details of each component are provided in Annexure-16 as Equipment and Piping design life.

Commercially sensitive information has been redacted

245. The four steps in the SAF production plant are described briefly in the below process scheme:

Section	Description of main function
1. Hydrotreatment (HDT)	Hydrotreatment of oxygenated compounds and contaminants from the pretreated lipids.
2. Inter-stage stripper (ISS)	Stripping of HDI catalyst inhibitors from the HDT effluent.
3. Hydro-isomerization (HDI)	Improvement of final product(s) cold flow and distillation properties.
4. Product fractionation	Fractionation of the desired products.
5. Amine regeneration (ARU)	Regeneration of the amine used in HDT section.

Commercially sensitive information has been redacted

Commercially sensitive information has been redacted

5.8.1.2 SAF Production Process

246. SAF process will be designed with enough flexibility to process all currently available feedstocks from vegetable oils to residual oils and animal fats to either produce exclusively 100% renewable diesel or 100% renewable jet, or both products at the same time in co-production mode.

Production of Sustainable Aviation Fuel (SAF)

247. The production of sustainable Aviation fuel (SAF) from feedstock or vegetable oil pre-treatment to ensure that the feedstock is suitable for conversion into a high-quality and environmentally friendly aviation fuel.

Feedstock/Vegetable Oil Pre-treatment

248. The vegetable oil pre-treatment process is to select the appropriate feedstocks. Common vegetable oils used by biotech for SAF production include used cooking oil and edible oil refinery and others. The choice of feedstock can impact the properties of the final SAF product.
249. Recycled oil is processed to remove impurities from cooking, storage, and handling, such as dirt, charred food, and water. Degumming to remove phospholipids and other plant matter is common, though refinement processes vary. Regardless of the feedstock, water is removed as its presence during base-catalysed transesterification causes the triglycerides to hydrolyse, giving salts of the fatty acids (soaps) instead of producing biodiesel.
250. The four steps in the SAF production plant are described briefly in the below process scheme:

5.8.1.3 Production Methods

1. **Step 1: HDT Reactor**
Commercially sensitive information has been redacted
251. This reactor saturates feed olefins and performs deoxygenation

reactions selectively by the hydrogenolysis pathway to create water and propane by-products.

Commercially sensitive information has been redacted

2. Step 2: Inter-Stage Stripping (ISS)

252. ISS is used to improve HDI Performance. It removes dissolved carbon oxides from the HDT reactor effluent utilizing natural gas (or biomethane) as the stripping medium. The result is a methane and propane-rich ISS vapor effluent ideal for feeding syngas plants or a propane-rich vapor ideal for product recovery or fuel utilization.

3. Step 3: HDI Reactor

253. This reactor performs hydro isomerization and/or hydrocracking to tune HVO cold flow properties or produce SAF.

Commercially sensitive information has been redacted

4. Step 4: Stripper and/or Splitter

254. The product fractionation section recovers stabilized, on-spec HVO and/or SAF, depending on project objectives.

5.8.1.4 Final Product and its Specifications

1. Renewable Diesel

255. Renewable Diesel produced in the production process complies with

EN 15940 except for Lubricity, and presents the following main properties:

Renewable Diesel fuel properties	
d15/4	0.784
Sulfur, ppm wt	< 1
Cetane Number	> 70
CFPP, °C	0°C
Lubricity, µm	(1)
Flash point, °C	55°C
ASTM D-86 Distillation, °C	
IBP	As required
FBP	< 320

Renewable Jet

256. Renewable Jet fuel properties comply with ASTM D7566 Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons.

Typical Renewable Jet properties	Range
Density @ 15°C	0.730 - 0.772
Freezing point, °C	< -47
Flash point, °C	38
ASTM D-86 Distillation, °C	
10%	< 205
FBP	< 300

Renewable Naphtha

257. Renewable naphtha is perfectly suitable as a petrochemical feedstock. It is a very pure paraffinic naphtha, ideal as a steam cracker feedstock.

258. It might also be an interesting candidate for pool blending as it is an aromatic and olefins-free stream. On the other hand, due to the nearly exclusive paraffinic content, the octane number is low.

Typical Naphtha properties	
d15/4	0.670 - 0.690
Sulfur, wppm	< 5
RVP, psi	< 11.8 (1)
PONA, wt%	98 / 0 / 2 / 0
ASTM D-86 Distillation, °C	
FBP	< 130

Reuse of Naphtha

259. Renewable naphtha can also be used as feedstock for hydrogen production, reducing the unit Carbon Intensity (CI) score.
260. If needed, this naphtha RON might be increased in standard refinery units such as Reforming or Isomerization units.

5.8.1.5 Effluents from SAF Plant

261. The effluents from a Sustainable Aviation fuel facility can be repurposed within a production plant as part of a circular economy strategy.

HDT HP Purge

262. The purge gas from HDT section HP amine absorber unit has the following typical composition:

HP Purge, vol %	
H2	80-85%
CO	0.5%
H2S	< 50 ppm vol
CO2	< 100 ppm vol
C1	1-2%
C2	0.1%
C3	10-15%
C4+	< 3%
H2O	0.3%
N2	-
O2	-

Reuse of Purge:

263. In the production of SAF, natural gas undergoes cracking in the Hydrogen production unit. H2 serves as a raw material for SAF production in HDT section and generates HDT HP Purge gas as a by-product, containing 80-85% composition of H2. This purge is then directed to a Hydrogen purification unit to reclaim the remaining H2 and reduce the overall consumption of H2 by the unit. It is also possible to foresee a dedicated H2 membrane for hydrogen recovery.

Low Pressure off-gases

264. The low-pressure off-gases from HDT and HDI sections have the following typical composition:

Commercially sensitive information has been redacted

Commercially sensitive information has been redacted

Reuse of LP Gases:

265. HDT and HDI low-pressure off-gases can generally be used as fuel gas and/or in hydrogen production plants.

CO₂ Rich gas

266. Typical properties of the CO₂-rich gas from the Amine Regeneration unit (ARU) are indicated below:

	CO ₂ rich gas, %vol
CO ₂	95
H ₂ O	4
H ₂ S	0.2
H ₂	0.3
C ₁ +	0.5

Reuse of CO₂ Rich Gas:

267. Based on this composition (approx. 2000 ppmv H₂S) the acid gas could be sent to the acid gas flare.

Sour Water

268. Sour water from the cold separator and the reflux drums is sent to the Sour Water Stripper (SWS) for recovery of SAF product.

269. Typical composition is as follows:

Sour Water to SWS	
CO ₂	0.07 wt%
C ₃	0.02 wt%
H ₂ S	0.08 wt%

Sour Water to SWS	
NH ₃	0.08 wt%
H ₂ O	Balance
Hydrocarbons	Solubility

5.8.1.6 Sour Water Management (Process Description of Sour Water Stripping Process along Wastewater Treatment Plant):

270. The sour water feed is preheated with the stripped water to 60 ° C before entering the stripper. The purity requirement of the stripped water is maintained by providing heat through the reboiler. Liquid phase side draw is withdrawn which is then cooled down to 65 ° C using an air-cooler and returned back to the top of the column. The vapor stream leaves at the top of the column mainly comprises H₂S, NH₃ and water.

271. The cooling water consumption is 24m³/day. The rest of the water will be evaporated in the cooling process.

Quantitative Assessment of Wastewater Generation and WWTP Unit Process

272. Stripping steam and make-up water for washing are considered process streams. 04 m³/hr (61% wastewater) being generated as sour water from SAF production process. This sour water undergoes treatment through a Sour Water Stripper and then passes through a wastewater treatment plant for additional processing, before being sent through an RO system.

273. The treated water is then divided into demineralized water, amounting to 2.57m³/hr (64% of the treated water), which will be reused within the production process in the plant.

274. The remaining portion is RO Rejected water, accounting for 1.43m³/hr (36% of the treated water). This rejected water will be used for washing proposes and remaining will be disposed of.



5.8.1.7 Detail of Wastewater Treatment Plant

Equalization Tank

275. An equalization tank is installed at the beginning of the treatment plant. The purpose of an equalization tank is to neutralize the properties of the raw wastewater. It also regulates flow and balances the pH of the waste water.

Aeration Tank

276. The wastewater overflow from the primary clarifier and return activated sludge from the secondary clarifier is collected at the inlet of the aeration tank. The design of the aerobic reactor is based on aerobic treatment through complete mixed return activated sludge technology.
277. In this process, atmospheric air is bubbled through wastewater combined with organisms to develop a biological floc which reduces the organic content of the wastewater. The combination of raw wastewater and biological mass is commonly known as Mixed Liquor. In all activated sludge plants, once the wastewater has received sufficient treatment, excess mixed liquor is discharged into the settling tank and the treated supernatant is disposed of if reuse is not required. Part of the settled material, the sludge, is returned to the head of the aeration system to re-seed the new wastewater entering the tank. This fraction of the floc is called Return Activated Sludge (R.A.S.). Excess sludge that eventually accumulates beyond what is returned is called Waste Activated Sludge (W.A.S.). W.A.S is removed from the treatment process to keep the ratio of biomass to food supplied (wastewater) in balance. This is called the F:M ratio. Aeration tanks are proposed for the biological treatment of the wastewater. The aeration tank is designed for 8 hours of retention time. The volume of the aeration tank is 16m^3 with a total depth 1.5 m. The aeration system comprises fine bubble-diffused aeration through air blowers installed in the factory. DO level in the aeration tank shall be maintained about 1 to 2 mg/l.

Secondary Clarifier (SC)

278. A secondary Clarifier is used to remove solid particulates or suspended solids from liquid for clarification and (or) thickening. Clarifiers are settling tanks for continuous removal of solids being deposited by sedimentation.
279. Concentrated impurities, discharged from the bottom of the tank are known as sludge, while the particles that float to the surface of the liquid are removed as scum. Secondary clarify is used to remove the biological flocks that are produced during the process of aeration.
280. The biodegraded effluent from the aeration tank overflow from aeration tank will move to the circular secondary clarifier. Part of the settled sludge will be recycled to the inlet of the aeration tank to maintain the quantity of biomass, i.e. mixed liquor suspended solids (MLSS) and the remaining/excess sludge will be diverted to the sludge drying beds. The treated effluent will be collected in the treated water storage tank.

Collection Tank

281. Treated water from the secondary clarifier is stored in a collection tank.

From this tank, the treated effluent is fed to the filtration system prior to the RO plant.

Filter RO Treatment Plant

282. Water treated in the storage tank will be sent to the RO plant. This plant includes a sand filter, carbon filter, and cartridge filter.
283. The treated water is stored in a storage tank, which will be reused within the production process in the plant. The rejected water by the RO will be used in washing purposes and remaining will be disposed of.

Sand Filter

284. The FRP sand filter should use a multimedia filtration process. Coarser, lighter media should be at the top of the filter bed capable of capturing large particulate matter. Smaller particles should continue down to the successive lower media levels where particles as small as 25 microns should be retained by finer heavier media. The density differences between the media should allow for layer separation after backwashing.
285. Since the sand filter has to be backwashed with raw water, therefore, rinse step should be provided in a backwash sequence. The filters should be designed for manual operation, non-clogged type, and low-pressure drop and should contain a minimum of five separate layers.



• Filter media, Material	Silica Sand
• Volume	50% of Vessel
• Pore size	0.15 of grain size
• Size of Media	0.750 to 1.5 mm
• Particle removal range	Below 10 microns
• Cleaning Process	Automatic backwash
• Working Temperature	1 to 50 °C
• Working Pressure	2 bar

Carbon Filter

286. FRP GAC (Granular Activated Carbon) used in this filter should be specially graded for water purification. It should have the capability to adsorb most organic chemicals, chlorine, insecticides, pesticides, THMs, TCE and PCBs, etc. It should remove Odor and give water a natural taste. The filter should have a Spherical top and the bottom ends of the tank should be designed to give uniform flow from both the inlet distribution and outlet

collection assemblies. The system should provide adequate distribution to uniformly expand the filter bed during backwash and the entire media bed should be utilized during the filter cycle.

Activated Carbon

• Base Material	Coconut Shell
• Brand	Norit
• Origin	Netherland
• Volume	50% of Vessel
• Surface Area	800m ² /gm
• Bulk Density	5gm/cm ³
• Hardness No.	80
• Ash Contents	5%

RO Product

287. Treated water from filtration and RO plant is stored in a storage tank. From the storage tank, the treated effluent is sent to the production process for reuse. The rejected water by the RO process will be used in washing process and remaining will be disposed out.

Solid Waste from Process

288. Spent catalysts that have been wasted during production are classified as waste. This waste could be taken into account for recycling during the production process, and after the materials have been reused, the resultant waste can be sold to local markets.

5.8.1.8 Details of Equipment and Machinery

289. Details of Equipment and Machinery for Proposed Project are given as under:-

Below please find a full list of equipment for the project, with projected noise level, in the next station the safety impacts and mitigations concerning each type of equipment are discussed.

Commercially sensitive information has been redacted

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5.8.1.9 Basic Safety and Environmental Criteria

SIF (Safety Instrumented Functions) related to chemical reactions

290. In case of risk of uncontrolled temperature excursion of the reaction, Minimum to be adhered by the Project will be a SIL (Safety Integrity Level)⁽¹⁾ for any SIF (Safety Instrumented Function) used as a barrier in the scenario. The SIL will be indicated on Axens Cause & Effect Diagram.
291. Where Axens recommends a SIL, a typical SIF configuration will be represented **only for concerned loop(s)**, and the following note will be indicated:
- “This Safety Instrumented Function (SIF) has to be in accordance with Safety Integrity Level (SIL x) for this instrumented loop.”
292. ⁽¹⁾ According to IEC-61511, SIL is defined in terms of Probability of Failure on Demand (PFD) in the following table:

Table 5-15: Demand Mode of Operation

Safety integrity level (SIL)	PFDavg	Required risk reduction
4	$\geq 10^{-5}$ to $< 10^{-4}$	$> 10\ 000$ to $\leq 100\ 000$
3	$\geq 10^{-4}$ to $< 10^{-3}$	$> 1\ 000$ to $\leq 10\ 000$
2	$\geq 10^{-3}$ to $< 10^{-2}$	> 100 to $\leq 1\ 000$
1	$\geq 10^{-2}$ to $< 10^{-1}$	> 10 to ≤ 100

5.8.1.10 Emergency Depressuring

- Emergency depressuring is provided to:
 - Reduce the risk of catastrophic equipment failure during a fire exposure.
 - Reduce the amount of hazardous material in case of loss of containment.
 - Reduce the risk of catastrophic equipment failure during an exothermic runaway.
- Emergency depressuring criteria:
- Depressuring shall meet one of the following criteria depending on the process technology:
 - Depressure the equipment from normal operating pressure to 6.9 barg (100 psig) or 50% of design pressure, whichever is lower, within 15 minutes – or less if required by process reasons.
 - Depressure the equipment from normal operating pressure to pressure and time criteria specific to the application (end pressure and time or peak rate).
- Applications for emergency depressuring:
 - Equipment containing at least 8 m³ (280 ft³) of a light mixture⁽¹⁾. This is not applicable to pressurized storage.

- To prevent loss of containment due to exothermic reaction (e.g. runaway reaction).
- Equipment containing flammable product, at a normal operating pressure above 17.2 barg (250 psig).
- Equipment containing material in vapour condition or in supercritical conditions (unwetted vessel).
- Arrangement for emergency depressuring:
 - In case operating pressure is lower than 69 barg (1000 psig), one depressuring system is installed for all contingencies (fire, leakage, runaway reaction if relevant) to depressurize the equipment from normal operating pressure to 6.9 barg or 50% of the design pressure whichever is lower within 15 minutes – or less if required by process reasons.
 - In case operating pressure is above 69 barg (1000 psig), two depressuring systems are installed: one depressuring system for the fire case to depressurize the equipment from normal operating pressure to 50% of the design pressure within 15 minutes – or less if required by process reasons, and the other depressuring system for the leakage case and runaway reaction (if relevant) to depressurize the equipment from normal operating pressure to 6.9 barg within 15 minutes – or less if required by process reasons.
 - In case operating pressure is above 139 barg (2000 psig), the emergency depressuring system for leakage case and runaway reaction (if relevant) could be equipped with staggered valves.

293. Depressuring shall be done manually by operator from a push button (on field and in Control Room). In case of exothermic reaction, the emergency depressuring is activated automatically by TSHH.

1. The term light mixture includes any flammable liquid that, on release, will vaporise rapidly or substantially:
 - LPG⁽²⁾ and lighter flammable liquids e.g. LNG (Liquefied Natural Gas).
 - Any flammable liquid at a temperature sufficient to produce, on release, more than 40 % vaporisation with no heat input other than from the surroundings.
2. **LPG:** Any product in liquid form composed predominantly of any of the following (or mixture thereof) propane, propylene, butanes, butadienes and butylenes that is totally vaporized at 20°C and atmospheric pressure.

5.8.1.11 Centrifugal pumps protection by low low level in upstream vessel

294. Axens will specify automatic trip of the centrifugal process pumps by Level Switch Low Low (LSLL) via an independent Level Transmitter (LT) in the following cases:

- Commercially sensitive information has been redacted; commercially sensitive information defined in paragraphs 2.12 and 2.13 dedicated to aromatics and H₂S.

- pumped light mixture (refer to definition in § 2.3),
- the pump differential pressure is higher than or equal to 35 bar (500 psi),
- the pump driver power is higher than 160 kW (215 HP),
- temperature higher than 250 degree C (480-degree F),
- temperature higher than auto-ignition temperature.

5.8.1.12 Centrifugal pump protection by minimum flow

295. Axens will indicate a minimum flow bypass with flow control valve for centrifugal pumps in the following cases:

- differential pressure pumps higher than or equal to 35 bar (500 psi),
- large pumps with driver power higher than 160 kW (215 HP),
- for process reason (turndown), flowrate lower than or equal to 30 percent of max flowrate.

296. The pump datasheet will specify the process flow and the minimum flow will be specified by the pump's vendor.

5.8.1.13 Automatic isolation valves between process vessel and pumps

297. Axens will consider automatic isolation valves activated by operator with a push button (on field or in Control Room) for:

- an inventory of the process vessel over 8 m³ (280 ft³) of light mixture (refer to definition in § 2.3),
- an inventory of the process vessel over 8 m³ (280 ft³) of a product above its autoignition temperature or at a temperature above 250 degree C (480-degree F),
- an inventory of the process vessel above 16 m³ (560 ft³) of flammable product.
- Overfilling protection in feed/surge drum

298. To avoid overfilling in feed / surge drum, an independent Level Switch High High (LSHH) via a Level Transmitter (LT) will be specified and connected to SIS (Safety Instrumented System).

5.8.1.14 Isolation of compressor

299. To reduce the consequences of a leak in compressor area, automatic isolation valves will be installed in the suction and discharge of any compressor with a power higher than or equal to 150 kW (200 HP) and handling flammable or toxic gases.

5.8.1.15 Prevention of backflow overpressure

300. Following devices will be considered at the pump discharge to prevent backflow overpressure:

- P lower than or equal to 40 barg (600 psig): one check valve for centrifugal pumps and one non-slam check valve for positive displacement pumps.

- P higher than 40 barg (600 psig) and smaller than 80 barg (1200 psig): two non-slam check valves of different type.
 - P higher than or equal to 80 barg (1200 psig): two non-slam check valves of different type plus an automatic shut-off valve in case of low flow.
301. Where P is the operating discharge pressure.
302. Following devices will be considered at the compressor discharge to prevent backflow overpressure:
- P lower than or equal to 40 barg (600 psig): one non-slam check valve.
 - P higher than 40 barg (600 psig): two non-slam check valves of different type.
303. Where P is the operating discharge pressure.

5.8.1.16 Isolation of a fired heater

304. In case of tube rupture in a fired heater and to minimize the consequences of a fire, the following valves will be considered:
- Downstream of the fired heater (on the common line) to prevent backflow from downstream equipment
 - P higher than 14 bar (200 psi): one check valve when possible. If a check valve cannot be used for process reason, one remote operated valve (MOV type) will be installed.
 - P higher than 69 bar (1000 psi): one remote operated valve (MOV type) and one check valve.
 - Where P is the operating pressure.
 - Upstream of the fired heater (on the common line)
 - one remote operated isolation valve, if no possibility to shut down the feed flow.

5.8.1.17 Seals on centrifugal pumps

305. Dual mechanical seals shall be considered in the following cases:
- Light mixture.
 - Hydrocarbons above their auto ignition temperature or at a temperature higher than 250 degree C (480-degree F),
 - Toxic or carcinogenic fluid,
 - Pump operating at high pressure higher than or equal to 50 barg (700 psig).

5.8.1.18 Additional constraints due to streams containing H₂S

306. This paragraph describes additional constraints to those listed in the above paragraphs concerning streams containing H₂S.
307. Due to the known toxicity of H₂S (Hydrogen Sulfide), the following provisions shall be taken to avoid release of H₂S to atmosphere:
- closed sampling: the proper sampling arrangement shall be specified by Axens within the corresponding datasheet for all streams containing 10 ppm weight (or more).

- closed disposal system: a proper destination of these unit effluents (dedicated closed hydrocarbons collection system) shall be indicated by Axens on PID for all process streams containing 10 ppm weight (or more); as an alternate, the following note shall be added by Axens on PID if a general-purpose-network is used "This stream contains 10 ppm weight (or more) of H₂S and has to be handled in a closed system to be defined by Detail Engineering Contractor".
- sour water treatment: a proper destination of these unit effluents (SWS) shall be indicated by Axens on PID for all water streams which could release H₂S after flashing.

Indicate the preferred closed drain in case of streams containing H ₂ S	
Minimum to be adhered by the Project	
Closed Drain: CD	

5.8.1.19 Additional constraints due to streams containing light mixture

308. This paragraph describes additional constraints to those listed in the above paragraphs concerning streams containing light mixture.
309. Due to the known hazards (e.g. important temperature drop, release and spread of vaporized hydrocarbons etc.) induced by vaporization of light mixtures such as LPG, the following provisions shall be taken to avoid or to reduce the occurrence of an accident:
- closed sampling: the proper sampling arrangement shall be specified by Axens within the corresponding datasheet.
310. Hence, Emergency depressurization rapidly reduces pressure in a system to prevent hazards, and safety flares burn off the released gases safely, minimizing risks during this process. The details of a safety flare for emergency depressurizing is explained below.

5.8.1.20 Preliminary Specification for Flare Tip and Ignition Package:

311. Bio Tech Energy Private Limited plans to construct a Renewable Oils & Fats Hydro processing Refinery with a 200 KTY capacity. A summary of the technical requirements for the design, procurement, fabrication, inspection, testing, painting, preparation for shipment, and delivery of the Flare Tip and Ignition Package for this project is provided below. A detailed document is attached as **Annexure -15** of this report.
312. The flare tips will be smokeless and meet the specified thermal radiation, liquid carryover, noise level, and ground-level concentration requirements in API STD 521. The flare will be equipped with pilots, ignition, flame failure thermocouples, fluid seals, and a windshield to ensure a stable flame even in adverse wind conditions. The flare tips, stacks, and seal drum sizing will be designed to handle the required gas flow rates within the maximum allowable pressure drop. The Flare Front Generator is designed to ignite and maintain a pilot flame, with the flame transported to the igniter tip through a closed conduit. The electronic flame ignition system includes an ignition transformer, pilot gas panel, power converter, and manual/automatic

lighting system, along with the necessary piping connections. The flare system aims to prevent air from entering and forming an explosive mixture, with methods of flashback prevention and air ingress in the stack. The flare stack piping is made of carbon steel with a 3mm corrosion allowance. The ignition panel, mounted in a rain-shielded panel, is certified for hazardous area usage, has efficient ignition, manual operation, and an LPG bottle as a backup fuel.

5.8.2 Fire Explosion and Process Safety Management

313. The SAF Fire Explosion and Process Safety is designed in accordance with the NFPA standards. Both BTE and Sustainable Aviation Fuel (SAF) plants are designed and constructed in accordance with applicable NFPA standards, ensuring compliance, even exceeding the required limits with inter-tank and inter-building distance requirements.
314. The details of Fire Explosion and Process Safety for both BTE and SAF in accordance with NFPA standards are given as under:-
315. NFPA 30 (Flammable and Combustible Liquids Code): This standard governs the safe storage and handling of flammable and combustible liquids, which are prevalent in both biodiesel and SAF production. It ensures proper spacing between tanks, buildings, and equipment, reducing the risk of fire spread.
316. NFPA 5000 (Building Construction and Safety Code): NFPA 5000 provides requirements for building construction and occupancy, ensuring that the buildings within the biodiesel and SAF plants are properly designed for fire resistance and safe egress, and meet the minimum distance between structures.
317. NFPA 101 (Life Safety Code): This code focuses on protecting occupants by specifying requirements for safe building design, means of egress, and fire protection. It ensures that both plants' structures are equipped with adequate fire safety measures, reducing the need for additional separation if the facilities are properly protected.
318. NFPA 72 (National Fire Alarm and Signalling Code): Both plants are equipped with dedicated fire suppression and detection systems in compliance with NFPA 72. This includes alarms, sprinklers, and emergency response systems to ensure timely action in case of fire or explosion, further mitigating potential hazards.
319. By complying with these NFPA standards, the plants meet the required safety measures for inter-tank and inter-building spacing, ensuring that even though they are adjacent, the risks of fire or explosion are minimized. Each plant's fire suppression system, along with these spacing guidelines, acts as an additional safeguard to contain incidents and protect against cascading failures from one facility to the other. Following table illustrates the safety measures taken (exceedances above the required standards) for inter-tank and inter-building spacing:

Inter Building NFPA Compliance

The relevant NFPA standards that address inter-building separation distances are:

- NFPA 30: Flammable and Combustible Liquids Code (Table 22.4.1.2(b))
- NFPA 5000: Building Construction and Safety Code
- NFPA 101: Life Safety Code
- NFPA 2: Applies to the hydrogen sections (including H₂ storage, processing, and handling areas).

For Biodiesel Plant						
Sr. No.	Distance between Buildings	Actual Distance	NFPA code reference	Minimum separation distance as per NFPA	Compliance	Notes
1	Production Hall to Admin Building	21.541 m	NFPA 30, NFPA 101	15 m	Yes	NFPA 101 for life safety in the admin area. Sufficient distance with fire hydrants and extinguishers in place.
2	Production Hall to Storage Area	19.628 m	NFPA 30	15 m	Yes	Sufficient distance with fire hydrants and extinguishers in place.
3	Production Hall to Utility Area	25 m	NFPA 30	15 m	Yes	Sufficient distance with fire hydrants and extinguishers in place.
4	Production Hall to HFO Area	23.669 m	NFPA 30,31	15 m	Yes	Sufficient distance with fire hydrants and extinguishers in place.
5	Utility Area to Tank Farm Area	17.547 m	NFPA 30,58	15 m	Yes	Compliant with NFPA 58 as well as NFPA 30 for flammable liquid storage.
6	Utility Area to HFO Area	12.715 m	NFPA 30,31	15 m	No	Slightly below NFPA recommendations but due to additional safety measure and protective barriers required like fire hydrant system, portable fire extinguishers, etc. its well protected

For Biodiesel Plant						
Sr. No.	Distance between Buildings	Actual Distance	NFPA code reference	Minimum separation distance as per NFPA	Compliance	Notes
7	Utility Area to Admin Building	74.189 m	NFPA 101	15 m	Yes	Significant distance ensuring safety in case of fire or explosion near utility.
8	Admin Building to SCADA/E&I Room	17.321 m	NFPA 72, NFPA 101	15 m	Yes	Adequate distance according to NFPA 101 and NFPA 72 for fire alarm and safety systems in control rooms.
9	Utility Area to SCADA/E&I Room	48.262 m	NFPA 72, NFPA 101	15 m	Yes	Large separation distance ensuring the safety of critical infrastructure.
SAF Plant						
10	Tank Farm to Gantry Area	4.766	NFPA 30	4.57	Yes	Compliance achieved; additional protective measures in place.
11	Tank Farm to Flare	16.41	NFPA 30	15.24	Yes	Adequate distance for flare operation.
12	Flare to Gantry Area	56.331	NFPA 30	15.24	Yes	Sufficient clearance for safety.
13	Flare to Amine Recovery Unit	104.907	NFPA 2 (for Hydrogen)	15.24	Yes	Distance exceeds minimum requirements.
14	Flare to Hydrogenation Area	132.1	NFPA 2	15.24	Yes	Meets safety standards for flammable gas dispersion.
15	Flare to Hydro Isomerization Area	189.415	NFPA 2	15.24	Yes	Extensive distance enhances safety protocols.
16	H ₂ Section to Day Tanks Area	136.586	NFPA 2	15.24	Yes	Sufficiently distanced for operational safety.
17	H ₂ Section to Amine Recovery Unit	73.347	NFPA 2	15.24	Yes	Exceeds minimum safety distance.

For Biodiesel Plant						
Sr. No.	Distance between Buildings	Actual Distance	NFPA code reference	Minimum separation distance as per NFPA	Compliance	Notes
18	H ₂ Section to Hydro Isomerization Unit	19.045	NFPA 2	15.24	Yes	Just meets minimum requirement; monitoring recommended.
19	H ₂ Section to Hydrogenation Section	89.351	NFPA 2	15.24	Yes	Adequate distance ensures safety.
20	Amine Recovery to Gantry Area	27.945	NFPA 30	4.57	Yes	Compliance maintained with safety protocols.

INTER-TANK NFPA COMPLIANCE TABLE

Inter Building NFPA Compliance	
The relevant NFPA standards that address inter-building separation distances are:	
• NFPA 30:	Flammable and Combustible Liquids Code (Table 22.4.1.2(b))
• NFPA 5000:	Building Construction and Safety Code
• NFPA 101:	Life Safety Code
• NFPA 2 :	Applies to the hydrogen sections (including H ₂ storage, processing, and handling areas).

For Biodiesel Plant						
Sr. No.	Distance between buildings	Actual Distance	NFPA code reference	Minimum separation distance as per NFPA	Compliance	Notes
1	Production Hall to Admin Building	21.541 m	NFPA 30,NFPA 101	15 m	Yes	NFPA 101 for life safety in the admin area. Sufficient distance with fire hydrants and extinguishers in place.
2	Production Hall to Storage Area	19.628 m	NFPA 30	15 m	Yes	Sufficient distance with fire hydrants and extinguishers in place.
3	Production Hall to Utility Area	25 m	NFPA 30	15 m	Yes	Sufficient distance with fire hydrants and extinguishers in place.
4	Production Hall to HFO Area	23.669 m	NFPA 30,31	15 m	Yes	Sufficient distance with fire hydrants and extinguishers in place.
5	Utility Area to Tank Farm Area	17.547 m	NFPA 30,58	15 m	Yes	Compliant with NFPA 58 as well as NFPA 30 for flammable liquid storage.
6	Utility Area to HFO Area	12.715 m	NFPA 30 31	15 m	No	Slightly below NFPA recommendations but due to additional safety measure and protective barriers required like fire hydrant system, portable fire extinguishers, etc. its well protected

For Biodiesel Plant						
Sr. No.	Distance between buildings	Actual Distance	NFPA code reference	Minimum separation distance as per NFPA	Compliance	Notes
7	Utility Area to Admin Building	74.189 m	NFPA 101	15 m	Yes	Significant distance ensuring safety in case of fire or explosion near utility.
8	Admin Building to SCADA/E&I Room	17.321 m	NFPA 72, NFPA 101	15 m	Yes	Adequate distance according to NFPA 101 and NFPA 72 for fire alarm and safety systems in control rooms.
9	Utility Area to SCADA/E&I Room	48.262 m	NFPA 72, NFPA 101	15 m	Yes	Large separation distance ensuring the safety of critical infrastructure.
SAF Plant						
10	Tank Farm to Gantry Area	4.766	NFPA 30	4.57	Yes	Compliance achieved; additional protective measures in place.
11	Tank Farm to Flare	16.41	NFPA 30	15.24	Yes	Adequate distance for flare operation.
12	Flare to Gantry Area	56.331	NFPA 30	15.24	Yes	Sufficient clearance for safety.
13	Flare to Amine Recovery Unit	104.907	NFPA 2 (for Hydrogen)	15.24	Yes	Distance exceeds minimum requirements.
14	Flare to Hydrogenation Area	132.1	NFPA 2	15.24	Yes	Meets safety standards for flammable gas dispersion.
15	Flare to Hydro Isomerization Area	189.415	NFPA 2	15.24	Yes	Extensive distance enhances safety protocols.
16	H ₂ Section to Day Tanks Area	136.586	NFPA 2	15.24	Yes	Sufficiently distanced for operational safety.
17	H ₂ Section to Amine Recovery Unit	73.347	NFPA 2	15.24	Yes	Exceeds minimum safety distance.

For Biodiesel Plant						
Sr. No.	Distance between buildings	Actual Distance	NFPA code reference	Minimum separation distance as per NFPA	Compliance	Notes
18	H ₂ Section to Hydro Isomerization Unit	19.045	NFPA 2	15.24	Yes	Just meets minimum requirement.
19	H ₂ Section to Hydrogenation Section	89.351	NFPA 2	15.24	Yes	Adequate distance ensures safety.
20	Amine Recovery to Gantry Area	27.945	NFPA 30	4.57	Yes	Compliance maintained with safety protocols.

INTER-TANK NFPA COMPLIANCE TABLE

NFPA 30 (Flammable Liquids Code) is the primary standard for the storage, handling, and transportation of flammable liquids. It provides detailed guidelines for intertank distances, based on the classification of the flammable liquid.

Flammable Liquid Classifications

NFPA 30 classifies flammable liquids into three categories based on their flash points:

Class I: Liquids with a flash point below 73°F (23°C).

Class II: Liquids with a flash point between 73°F (23°C) and 100°F (38°C).

Class III: Liquids with a flash point above 100°F (38°C)

Aboveground Tanks:

Minimum Intertank Distance

Flammable Liquid Class	Minimum Intertank Distance	Tank Capacity (Gallons)
Class I	6 feet(1.8 meters)	5,001 – 30,000
Class II	3 feet(0.9 meters)	30,001 – 100,000
Class III	1 foot(0.3 meters)	30,001 – 100,000

Underground Tanks:

Flammable Liquid Class	Minimum Intertank Distance
Class I	10 feet (3 meters)
Class II	6 feet (1.8 meters)
Class III	3 feet (0.9 meters)

From Buildings

Class I liquids: Tanks should be located at least 30 feet (9.1 meters) away from buildings.
Class II and III liquids: Tanks should be located at least 15 feet (4.6 meters) away from buildings.

Bio Diesel Plant													
Sr. No.	Tank ID	Make	Store Material	Capacity (M ³)	Tank Dia (M)	Tank Height (M)	NFPA 30 Material Class	NFPA 30 Standard Distance B/W Tanks	Current Bio Diesel plant tanks Intertank Distance (M)	NFPA 30 InterTank Distance Compliance	NFPA 30 Standard Buildings Distance from Tanks	Nearest Building From tanks	Current Control Measure
1	BST	C.S	Bio Diesel	500	7.55	11	Class III	0.8 m	2.4 m	Yes with in range	4.6 m	12.439 m From Process Hall distance but 4.5 m distance from Pump room	Regular inspections for leaks and corrosion. Proper ventilation to prevent the buildup of flammable vapors. Grounding and bonding to prevent static electricity buildup. RDL and RTD installed for monitoring purpose. Fire suppression systems (e.g, foam systems, Fire Knockout trolleys present).Using Explosion proof motors and pumps for safety.
2	RMST	C.S	Raw Material	500	7.55	11	Class III	0.8 m	2.59 m	Yes with in range	4.6 m	19.6 m from Process Hall and 5.9 from Pump room	Same as above mitigation measures installed
3	RMST 1	C.S	Raw Material	100	5.616	4.05	Class III	0.8 m	2.45 m	Yes with in range	4.6 m	12.95 m from Process Hall and 1.5 from Pump room	Same as above mitigation measures installed
4	RMST 2	C.S	Raw Material	100	5.616	4.05	Class III	0.8 m	2.62 m	Yes with in range	4.6 m	21.5 m from Process Hall	Same as above mitigation measures installed
5	TST	C.S	Tar	100	5.616	4.05	Class III	0.8 m	3.5 m	Yes with in range	4.6 m	20.74 m from Process Hall and 4.1 from Pump room	Same as above mitigation measures installed
6	UGM	C.S	Underground Methanol Storage Tank	200	13.575X3.5X4		Class I	1.8m	9.9 m	Yes with in range	9.1 m	19.62 m from Process Hall	1. Explosion-Proof Ventilation: Ensure the installation of explosion-proof ventilation systems to prevent the accumulation of methanol vapors in confined spaces.

													2. Secondary Containment: Design the tank with a double-walled construction or provide external secondary containment systems to capture any leaked methanol and prevent environmental contamination. 3. Corrosion Protection: Use cathodic protection and corrosion-resistant materials to prevent tank degradation over time. 5. Emergency Venting and Pressure Relief: Install pressure and vacuum relief valves to safely manage pressure fluctuations during a fire or thermal event. 5.Fire Emergency Arrangement is in place for immediate Responce and controlling.
SAF Plant													
Sr. No.	Tank ID	Make	Store Material	Capacity (M ³)	Tank Dia (M)	Tank Height (M)	NFPA Material Class	NFPA Standard Distance B/W Tanks	Current SAF plant tanks Inter-tank Distance (M)	NFPA Inter-Tank Distance Compliance	NFPA Standard Buildings Distance from Tanks	Nearest Building From tanks	Current proposed Mitigation Measure
1	RMST #1	C.S	Raw Material	980	9.55	13.7	Class III	0.8 m	2 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 86.3 m	1. Fire Suppression Systems: Install automatic water-based sprinklers or foam-based systems to suppress fire. 2. Secondary Containment: Ensure bund walls or spill containment systems are present to prevent environmental contamination in case of leaks. 3. Thermal Insulation: Apply thermal insulation to reduce the risk of heating the oil to its auto-ignition point.

													- Gas and Vapor Monitoring: Install continuous gas and vapor monitoring systems to detect leaks and prevent explosive atmospheres. - Emergency Shutdown Systems: Equip the tanks with emergency isolation valves that can be activated remotely to prevent spills during emergencies. - Fire Detection Systems: Install heat and flame detectors around the tank to provide early warnings. - Ventilation: Ensure proper ventilation to dissipate flammable vapors.
2	RMST #2	C.S	Raw Material	980	9.55	13.7	Class III	0.8 m	2 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 74.8 m	
3	RMST #3	C.S	Raw Material	980	9.55	13.7	Class III	0.8 m	2 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 63.2 m	
4	RMST #4	C.S	Raw Material	980	9.55	13.7	Class III	0.8 m	2 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 51.7 m	
5	RMST #5	C.S	Raw Material	980	9.55	13.7	Class III	0.8 m	2 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 40.1 m	
6	RMST #6	C.S	Raw Material	980	9.55	13.7	Class III	0.8 m	2 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 28.6 m	
7	RMST #7	C.S	Raw Material	980	9.55	13.7	Class III	0.8 m	3.5 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 78.7 m	
8	SPT#1	C.S	SAF Product	980	9.55	13.7	Class II	0.9 m	2.5 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 28.35 m	- Foam-Based Fire Suppression: Install automatic foam-based fire suppression systems to handle Class B fuel fires. - Fire-Resistant Coatings: Apply fire-resistant coatings to the tanks to delay the progression of fire and minimize structural damage. - Thermal Expansion Relief Systems: Include thermal relief valves to prevent over-

													pressurization due to temperature fluctuations. 4. Emergency Shutoff Valves: Equip the tanks with remote-controlled emergency shutoff valves for rapid isolation in case of fire or leaks. 5. Ventilation and Vapor Recovery: Install vapor recovery units to reduce emissions and prevent the accumulation of flammable vapors. 6. Lightning Protection Systems: Install grounding and lightning protection to reduce the risk of ignition from electrical storms. 7. Perimeter Water Spray System: Use water deluge systems to cool tank surfaces and reduce the risk of fire spreading.
9	SPT#2	C.S	SAF Product	980	9.55	13.7	Class II	0.9 m	2.5 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 40.85 m	
10	SPT#3	C.S	SAF Product	500	9	8	Class II	0.9 m	2 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 52.85 m	
11	BNST	C.S	Bio Naptha Floating roof	500	9	8	Class IB	0.9 m	3.3 m	Yes with in range	4.6 m	Distance from Amine Recovery Unit 66.35 m	1. Explosion-Proof Equipment: Use explosion-proof motors, pumps, and electrical fittings to prevent ignition of vapors. 2. Foam Fire Suppression: Install foam-based fire suppression systems to control Class B fires associated with flammable liquids. 3. Inert Gas Blanketing: Use nitrogen or another inert gas to blanket the surface of the liquid and minimize vapor emissions. 4. Bonding and Grounding: Implement bonding and grounding for all equipment to prevent static electricity buildup and potential ignition. 5. Secondary Containment: Design bunds or dikes to

												capture and control spills, ensuring they do not escape the containment area. 6. Automatic Tank Gauging: Use automated level monitoring to avoid overfilling, which can lead to spills and vapor releases. 7. Emergency Relief Vents: Install pressure and vacuum relief valves to prevent over-pressurization and explosions during a fire.
12	MT#1	C.S	UG Methanol	500	13X7X5.5	Class I	3 m	3 m	Yes with in range	9.1 m	Distance from gantry Area 11 m	1. Explosion-Proof Ventilation: Ensure the installation of explosion-proof ventilation systems to prevent the accumulation of methanol vapors in confined spaces. 2. CO2 Fire Suppression: Install a carbon dioxide (CO2) fire suppression system to displace oxygen in case of a fire, reducing the chances of combustion. 3. Leak Detection Systems: Implement continuous leak detection systems, including liquid sensors and vapor monitoring, to detect leaks early and initiate automatic shutdown protocols. 4. Secondary Containment: Design the tank with a double-walled construction or provide external secondary containment systems to capture any leaked methanol and prevent environmental contamination. 5. Corrosion Protection: Use cathodic protection and corrosion-resistant materials to prevent tank degradation over time. 6. Emergency Venting and Pressure Relief: Install pressure and vacuum relief

													valves to safely manage pressure fluctuations during a fire or thermal event. 7. Groundwater Protection: Include impermeable liners and drainage systems to prevent methanol from contaminating the soil and groundwater in case of a tank breach. 8. Inert Gas Blanketing: Use nitrogen blanketing to reduce the formation of flammable vapor-air mixtures in the tank.
13	MT#2	C.S	UG Methanol	500	13X7X5.5		Class I	3 m	3 m	Yes with in range	9.1 m	Distance from Gantry Area 29 m	
14	MT#3	C.S	UG Methanol	500	13X7X5.5		Class I	3 m	3 m	Yes with in range	9.1 m	Distance from Gantry Area 29 m	
15	FWST	C.S	Raw Water	980	9.55	13.7	-	-	15			Distance from Amine Recovery Unit 103.8 m	
16	RMSD #1	C.S	Raw Material Day Tank	500	6.55	15	Class III	0.8 m	2.25	Yes with in range	4.6 m	Distance from Amine Recovery Unit 9.2 m	Same as RAW Material mitigation Measures
17	RMSD #2	C.S	Raw Material Day Tank	500	6.55	15	Class III	0.8 m	2.25	Yes with in range	4.6 m	Distance from Amine Recovery Unit 4.6 m	
18	SDT	C.S	SAF DAY Tank	650	7.44	15	Class II	0.9 m	2.23	Yes with in range	4.6 m	Distance from Amine Recovery Unit 8.8 m	Same as SAF Material mitigation Measures
19	NDT	C.S	Naptha Storage Day Tank floating roof	250	5.7	10	Class IB	0.9 m	2.23	Yes with in range	4.6 m	Distance from Amine Recovery Unit 5 m	Same as Naptha Material mitigation Measures
20	MDT	C.S	UG Methanol Day Tank	200	13.575X3.5X4		Class I	3 m	2.1	Yes with in range	9.1 m	Distance from Amine Recovery Unit 9.1 m	Same as Methanol Material mitigation Measures

5.8.3 Step 05-Transportation and Storage of Final Product

320. The storage of final product will be carried out by third party, at a commercial storage facility named Keamari Port Terminal (KPT). For transportation to the facility, the final product will be temporarily stored in containers and transported via GT road and Motorway (M3) from Sheikhpura. BTE has set up a secure and effective process for transferring the final product from Bio-Tech Energy Pvt. Ltd to KPT, guaranteeing product integrity and compliance with all applicable safety regulations. (A compliance checklist of the final product storage is attached as **Annexure-17** of this report).

321. The oil tankers for the transport of the SAF product are given below:

	
Used for Transport fuel with capacity 20,000L-25,000L	
	
Used for Oil Transport with the capacity of 40,000L-50,000L	
Vehicles used for Transportation of SAF Product	

5.8.3.1 Vehicle Safety Instructions for SAF Transportation

Route Planning:

- Select designated routes for transporting SAF Products, avoiding high-traffic areas.
- Conduct a route assessment to identify potential risk areas (sharp turns, steep grades, schools, populated areas).

Driver Training:

- Drivers must have specific training in hazardous materials transport and SAF Product handling.
- Drivers should be familiar with emergency response procedures.

Vehicle Inspection:

- Pre- and post-trip vehicle inspections to ensure truck and tank are in safe operating condition.

Speed Limits:

- Strict adherence to speed limits and traffic regulations for hazardous materials transport.

Communication:

- Drivers to maintain communication with dispatch, reporting any incidents or delays.

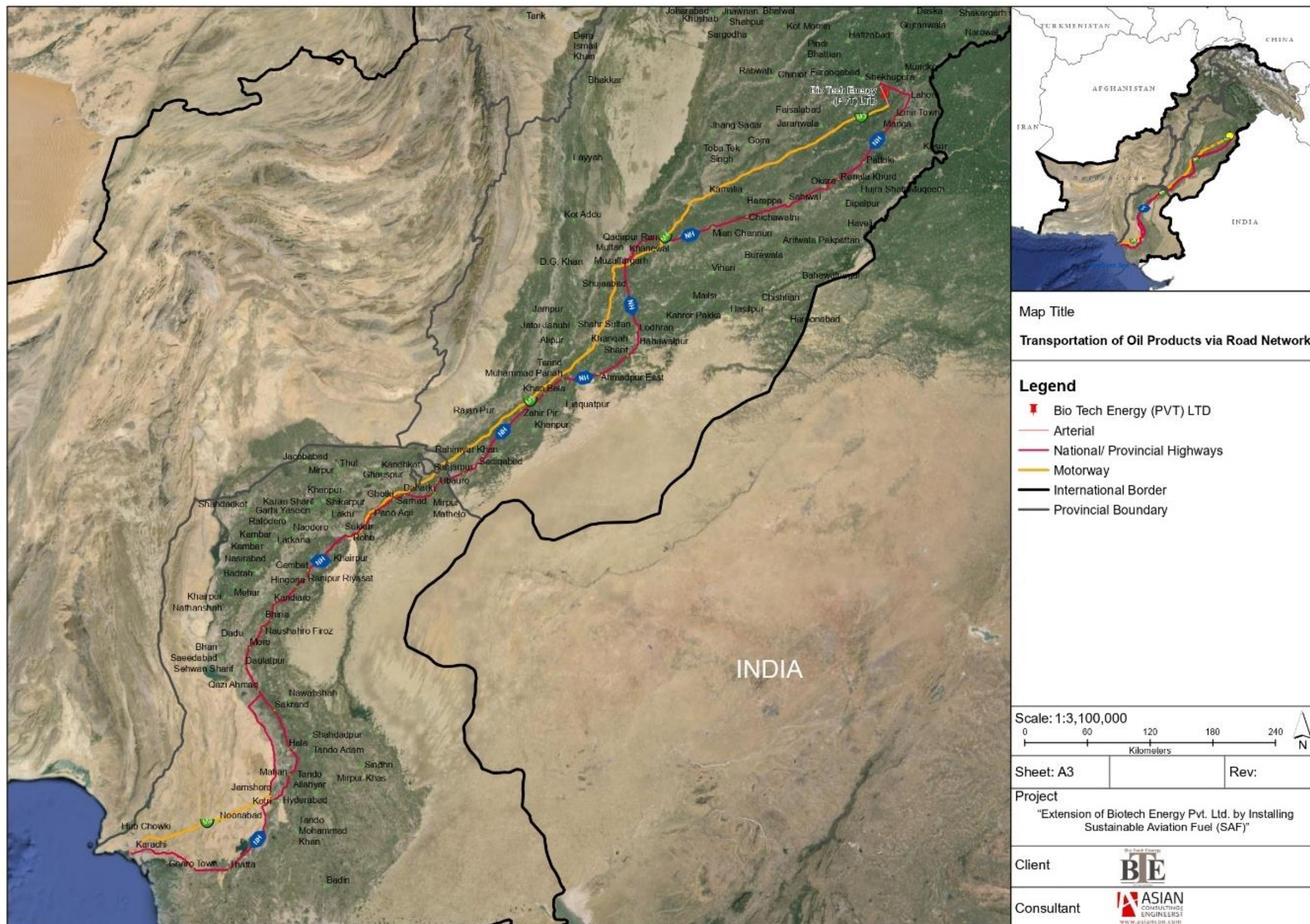


Figure 5-18: Transportation Routes of Product Oil from Project Site

5.8.3.2 KPIs Standards

322. Key Performance Indicators (KPIs) are measurable values that help organizations/industries to track and assess the effectiveness of their efforts in achieving specific business objectives. KPIs can be both quantitative (such as sales numbers, revenue growth, or website traffic) and qualitative (like customer satisfaction or employee engagement). By setting clear KPIs, companies can monitor progress, identify areas for improvement, and make data-driven decisions to enhance performance. These indicators vary by industry and department, aligning with the goals and priorities of the organization to ensure sustained growth and success. The below mentioned KPIs are for the SAF.

Activities	KPIs Standards
Materials	• Total consumption of non-renewable fuels • Total consumption of renewable fuels • Total consumption of other energy sources • Total energy consumed
Water and Effluents	• Total water withdrawal • Total reused water • Fresh water used • Total water disposal • Total water consumption
Biodiversity	• Significant impacts of activities, products, and services on biodiversity • Protected or restored habitats
Emissions	• Total GHG emissions, Scope 1 • Total GHG emissions, Scope 2 • Total GHG emissions, Scope 3 • GHG emissions intensity • Reduction of GHG emissions • Nitrogen oxides (NOx), sulfur oxides (SOx) and other significant atmospheric emissions
Waste	• Total weight of waste generated • Total weight of hazardous waste • Total weight of non-hazardous waste
Supplier Environmental Assessment	• Negative environmental impacts of the supply chain and measures taken
Labour	• Compliance with Safety Protocols • Training and Certification • Employee Satisfaction
Grievance Related	• No. of complains from local communities and labours • Number of complains disposed of.

A SAF facility contributes to achieve this goal by producing clean and renewable aviation fuels, reducing the reliance on fossil fuels in the aviation sector.

7 AFFORDABLE AND
CLEAN ENERGY



The production of renewable biodiesel from sustainable sources promotes responsible resource utilization and reduces environmental impact..

12 RESPONSIBLE
CONSUMPTION
AND PRODUCTION



Expanding the biodiesel production plant for SAF production promotes sustainable industrialization, innovative technologies, and resilient infrastructure for clean energy.

9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



SAF reduces greenhouse gas emissions, contributing to global efforts to combat climate change.

13 CLIMATE
ACTION



Collaboration between governments, industry stakeholders, and International organizations is essential to advance the development and adoption of SAF technology.

17 PARTNERSHIPS
FOR THE GOALS



By establishing (SAF) facility, will help to reduce air pollution and its associated impacts on nearby communities and its surroundings.

11 SUSTAINABLE CITIES
AND COMMUNITIES



The responsible sourcing of feedstocks for renewable biodiesel production ensures the protection of land and water resources..

14 LIFE
BELOW WATER

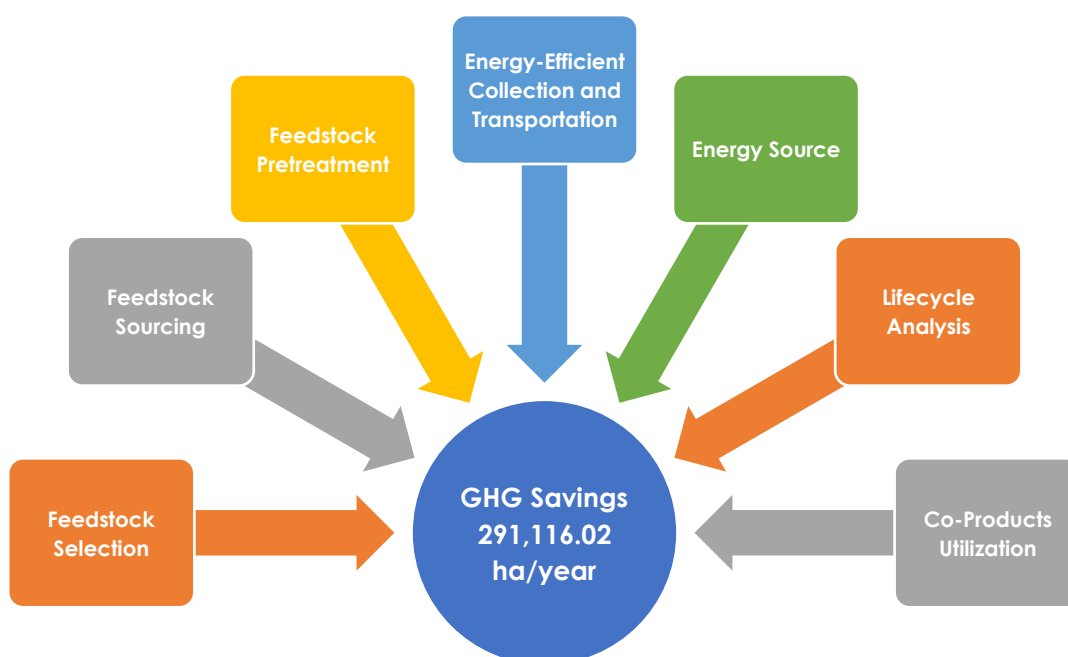


15 LIFE
ON LAND



5.8.3.3 GHG Emissions Reduction and GHG Savings for SAF Plant

323. Biotech Energy Private Limited plays a vital role in mitigating greenhouse gas emissions by actively engaging in the production of sustainable aviation fuel (SAF) and renewable diesel. Annually, the biotech maintains a comprehensive record sheet to evaluate and quantify the reduction in greenhouse gas emissions achieved through these production processes.
324. Below are the key points related to Biotech Energy Private Limited's efforts to reduce greenhouse gas emissions and their annual record-keeping process to assess the savings and reductions in greenhouse gas emissions for the production of sustainable aviation fuel (SAF) and renewable diesel:



325. **Feedstock Selection:** Biotech Energy prioritizes feedstocks with reduced carbon intensity in order to contribute positively to the food chain. UCO, for instance, proves to be an excellent choice due to its status as a waste product that would otherwise be discarded. By utilizing UCO for SAF production, biotech not only reduces emissions linked to its disposal but also fosters a sustainable link in the food chain.
326. **Feedstock Sourcing:** Biotech uses UCO feedstock for the production of SAF or renewable diesel from sustainable sources that minimize the environmental impact of feedstock collection and processing.
327. **Feedstock Pretreatment:** In the pretreatment of UCO, it's essential to properly treat it to eliminate impurities and contaminants that could hinder SAF production efficiency and increase emissions. Effective pretreatment enhances the overall process efficiency while reducing GHG emissions.
328. **Energy-Efficient Collection and Transportation:** Biotech focuses on minimizing energy consumption and emissions during the collection and

transportation of UCO to the SAF production facility. Efficient logistics play a crucial role in significantly reducing emissions.

329. **Lifecycle Analysis:** Biotech maintains comprehensive GHG emissions or savings records to evaluate the overall GHG emissions associated with the production and usage of SAF or renewable diesel. This analysis encompasses emissions from feedstock production, transportation, processing, and end-use.
330. **Co-Products Utilization:** Biotech ensures the environmentally friendly utilization of co-products generated during the SAF production process, such as renewable naphtha. This approach minimizes waste and enhances the overall environmental sustainability of the SAF facility.
331. Promoting environmental sustainability in the production of SAF or renewable diesel, especially when it comes to reducing GHG emissions from feedstocks like UCO, is intrinsically linked to the broader food chain. This endeavor hinges on a harmonious fusion of effective feedstock management, streamlined production processes, and the integration of clean energy sources across the production chain. By doing so, biotech energy ensures that biofuels contribute positively to the overall health and sustainability of the food chain and GHG Savings of 704,500,766 kg of CO₂.



5.9 Detailed Description of GHG methodology Used along with GHG Calculation for the Project

332. The Project's current GHG accounting that all production emissions, including those for all energy requirements and transport emissions for both upstream and downstream, are incorporated in the GHG calculation, in line with the EU-approved methodology and that the GHG calculation is fully comprehensive. To calculate the GHG emissions for **Biotech Energy Limited**, the *IPCC Guidelines for National Greenhouse Gas Inventories* was followed to ensure transparency, consistency, and accuracy. A detailed methodology is provided in Annexure-03.
333. The GHG projections for the SAF plant, are based on actual guaranteed utility, process yields and energy.
334. The collection operation utilizes the EU methodology as described above, which equates a per KM reading for collected UCO, or advanced feedstock*.

Commercially sensitive information has been redacted

335. The emissions from the Transport of UCO / or another feedstock and increased collection points are also incorporated in line with the approved EU Renewable Energy Council methodology, which allocates on a per km/ per ton basis.

336. The overall project will still result in the following GHG savings:

Annual Production	Saving for whole production	
200,000 ton	704,500,766.12 kg CO ₂	
Transport, passenger aircraft, long haul {GLO} market for transport, passenger aircraft, long haul Cut-off, U		(source: Ecoinvent 3.
0.10708154 kg CO ₂ -eq	Passenger/km	
So, a full A380 carrying 525 passengers between London and Los Angeles, a distance of 8750km, will produce :		
491,905.82 kg CO ₂ -eq		
CO ₂ Saved correspond to	1,432 flights	
Annual absorption rate when the forests are mature		
Fir and Larch	24.20 Ton CO ₂ /ha/year	
	2,420.00 kg CO ₂ /ha/year	

Note

*GHG of the plant is audited yearly and compliant with EU RED III/II

337. The full GHG calculation has been attached as **Annexure-03**.

5.10 Restoration and Rehabilitation Plans

338. All possible precautions will be taken to prevent an untoward incident in terms of life and property losses. On completion of the proposed project, solid waste will be removed from the site in order to maintain the aesthetics of the area. All measures will be undertaken to ensure occupational safety, security and a clean environment during working hours. Plantation and landscaping will also be done by the proponent after the completion of the proposed project.

5.10.1 Details of Restoration and Rehabilitation at the End of the Project Life

339. There will be no matter of rehabilitation as the site is already owned by the project proponent. At the end of the life of the proposed project, it will be duly dismantled with special precautions to avoid/ minimize pollution and at the same time take all safety precautions to protect human life and property around the building.

340. The materials capable of recycling/reuse will be either sold in the market or to be reused for other suitable purposes.

5.10.2 Project Cost

341. The total project cost is \$ 76,960,000. The details are given below:

Commercially sensitive information has been redacted

342. The above table provides the split between local and imported items during construction, around 40% of the Project's construction costs will be allocated to local resources and suppliers.
343. In the decision matrix used by the company to access local a preference is given to Local Contractors, in order to maximize the local impacts of the project.
344. All suppliers selected will adhere to BTE human rights policy, including pre-qualification for suppliers.

5.11 Construction Aspects

5.11.1 Water Requirement

Total Daily Water Consumption during construction phase is: 13 m³/day.

The breakdown is given below:

Concrete Work (mixing + curing): ~02 m³/day.

Dust Suppression: ~06 m³/day.

Equipment Cleaning: ~03 m³/day.

Worker Usage: ~02 m³/day.

5.11.2 Contractor Mobilization

345. It involves the transportation of construction machinery and equipment to the proposed project site, and the establishment of the construction site. contractor's camp and office.

5.11.3 Site Preparation

346. Usually, this activity involves the operation of heavy earth-moving machinery and substantial land clearing, leveling and grading, as well as cutting and filling activities.

5.11.4 Construction Materials

347. The materials used in the construction of the proposed project will include cement, sand, crush, bricks, steel bars, paint, piping material, electrical material and finishing material. The Bills of Quantities of the material will depend upon the construction activities.
- **Cement:** Ordinary Portland cement containing appropriate pozzolanic materials i.e. Ground Granulated Blast Furnace Slag (GGBFS) in proportion to 40% of the cement content in the concrete.
 - **Concrete:** Four classes of concrete shall be used as given below.
 - Concrete Type A (nominal Mix 1:1:2)
 - Concrete Type B (nominal mix 1:1 1/2:3)
 - Concrete Type C (nominal mix 1:2:4)
 - Lean Concrete (nominal mix 1:4:8)
 - Concrete strength of concrete barriers, sign foundations, chute, catch pit curb stone, duct marker, ROW marker and foundations for posts chain link fabric/wire rope safety fence/ curve delineator/lighting poles shall be Class B, whereas for approach slab, curtain wall, wing wall, foundation, transom, abutment seat, diaphragm, deck slab, counterfort and concrete pads it shall be Class B.
 - Concrete strength for piers and piles shall be Class B, whereas for cast-in-situ post-tensioned voided slab Flyovers and post-tensioned I Girders it shall be Class A. The concrete strength for median lining, pipe surrounds, service ducts, and duct marker surrounds foundation for steel post of median opening and hunching behind concrete curb shall be Class B.
 - **Reinforcing Steel:** High yield strength deformed billet steel bars conforming to Grade 60 AASHTO M31, ASTM A615 shall be used.
 - **Pre-stressing Steel Bridges:** Pre-stressing steel 12.7 mm diameter seven wire Normal Relaxation Grade 270 Strands conforming to AASHTO M 203, (ASTM A416) Supplement SI, shall be used.

5.11.5 Construction Work Force

348. The project involves professional, administrative, skilled and unskilled labor which will be deployed for the construction activities. About 100

numbers of crew, skilled and unskilled labor to be employed will depend on the Contractor's activity schedule at the time when the contract is awarded. The Contractor will be advised to hire unskilled labor from the local communities. A training program will be conducted for unskilled workers.

5.11.6 Construction Machinery

349. The table shows the list of expected lists of machinery and equipment required for construction. The number of these machines will be finalized with the detailed design of the proposed project:

Table 5-16: List of Expected Machinery/Equipment for Proposed Project

Sr. No.	Machinery and Equipment	Sr. No.	Machinery and Equipment
1.	Dump Truck	2.	Self-Propelled Pneumatic Roller
3.	Front End Loader	4.	Asphalt Distributor
5.	Dozer	6.	Batching Plant
7.	Grader	8.	Concrete Transit Truck
9.	Vibratory Roller	10.	Concrete Pump
11.	Water Tankers	12.	Excavator
13.	Aggregate Spreader	14.	Water Pumps
15.	Sheep Foot Rollers (10tons)	16.	Cranes
17.	Tandem Roller	18.	Vibrators
19.	Asphalt Plant	20.	Generators
21.	Steel Cutting/Bending Machine	22.	Leveling Equipment
23.	Paver		

5.11.7 Construction of MS Tanks

350. The construction of MS (Mild Steel) tanks involves several steps to ensure the structural integrity, safety, and functionality of the tanks.

- **Design and Planning:** This is the initial phase where engineers and designers plan the specifications of the tank based on the intended use, capacity requirements, location, and applicable regulations and codes. Detailed drawings and calculations are prepared during this stage.
- **Material Procurement:** Once the design is finalized, the materials required for construction, including mild steel plates, structural supports, welding materials, and other components, are procured from reliable suppliers.
- **Fabrication of Tank Components:** The tank components, such as the shell, base, roof, nozzles, manholes, and other fittings, are fabricated according to the design specifications. This involves cutting, bending, rolling, and welding of mild steel plates and sections.

- **Welding and Assembly:** Skilled welders join the fabricated components together using appropriate welding techniques such as arc welding, MIG welding, or TIG welding. Care is taken to ensure proper alignment, fit-up, and welding quality to maintain structural integrity.
- **Surface Treatment:** After fabrication and welding, the tank's surfaces are cleaned to remove any contaminants, rust, or scale. Surface treatment methods such as sandblasting, shot blasting, or chemical cleaning are used to prepare the surfaces for painting.
- **Painting and Coating:** A protective coating system is applied to the tank surfaces to prevent corrosion and extend the service life of the tank. This may include primers, intermediate coats, and topcoats suitable for the intended service environment.
- **Testing and Inspection:** Various non-destructive testing methods such as hydrostatic testing, ultrasonic testing, radiographic testing, or magnetic particle testing are conducted to ensure the integrity of welds and the overall construction of the tank. Inspections are carried out by qualified personnel to verify compliance with design specifications and regulatory requirements.
- **Installation and Commissioning:** Once the tank construction is completed and inspected, it is transported to the installation site and placed on the foundation prepared according to the design requirements. Piping connections, instrumentation, and safety systems are installed, and the tank is commissioned for operation.
- **Quality Assurance and Documentation:** Throughout the construction process, quality assurance measures are implemented to ensure that the tank meets the specified standards and requirements. Documentation of design calculations, material certifications, welding procedures, inspection reports, and other relevant records is maintained for future reference and regulatory compliance.

5.11.8 Construction of Foundation for Tanks (Concrete work)

351. Constructing a foundation for tanks, especially for large and heavy tanks requires careful planning and execution to ensure stability, load-bearing capacity, and durability. Here are the steps typically involved in constructing a concrete foundation for tanks:

- **Site Preparation:** Excavate the area to the required depth and dimensions according to the engineering design. Ensure proper drainage provisions to prevent water accumulation around the foundation.
- **Soil Investigation:** Conduct soil testing and analysis to determine the soil bearing capacity, soil type, and other geotechnical properties. Use this information to design the foundation to withstand the anticipated loads and soil conditions.
- **Foundation Design:** Engage a structural engineer to design the foundation based on the tank size, weight, loading conditions, soil properties, and other relevant factors. Determine the type of foundation suitable for the specific

site conditions, such as shallow spread footing, mat foundation, or deep pile foundation.

- **Reinforcement and Formwork:** Install reinforcement bars (rebar) according to the design specifications to provide structural strength and prevent cracking. Construct formwork to define the shape and dimensions of the foundation. The formwork should be sturdy, properly aligned, and adequately braced to withstand the weight of the concrete.
- **Concrete Mixing and Placement:** Prepare concrete mixtures with the appropriate proportions of cement, aggregates, water, and admixtures as per the project requirements. Transport the concrete to the site and pour it into the formwork in layers. Consolidate the concrete using vibrators to remove air voids and ensure proper compaction.
- **Anchor Bolt Installation:** If the tank requires anchor bolts for attachment to the foundation, embed the anchor bolts into the fresh concrete before it sets. Ensure precise placement and alignment of the anchor bolts according to the tank specifications.
- **Finishing and Surface Treatment:** Finish the exposed surfaces of the foundation to achieve the desired texture and appearance. Apply curing compounds or water curing methods to promote proper hydration and prevent cracking during the initial curing period. Protect the foundation from environmental factors such as rain, extreme temperatures, and chemical exposure during the curing process.
- **Quality Control and Inspection:** Conduct quality control checks throughout the construction process to verify compliance with design specifications, concrete mix requirements, and construction standards. Inspect the completed foundation for any defects, cracks, or imperfections that may compromise its structural integrity.
- **Backfilling and Grading:** Once the concrete has sufficiently cured, backfill any excavated soil around the foundation and compact it to provide additional support and stability. Grade the surrounding area to ensure proper drainage away from the foundation and prevent water accumulation.
- **Documentation and Record-Keeping:** Maintain detailed records of all construction activities, including materials used, testing results, inspection reports, and any modifications made during the construction process. Document as-built drawings and specifications for future reference and maintenance purposes.

5.11.9 Construction Camps

352. There will be no Camp Management Plan because there will be no construction camp within the BTE premises. This is because all the workforce will be hired from Sheikhpura and transported back through the project vehicles after working hours. The Contractor shall prioritize hiring of local skilled and un-skilled workforce during construction phase of the project. Although a specific target could not be set at the moment depending on the availability of relevant staff within the area and if required, EPC will arrange rented accommodation outside the BTE premises adhering to the IFC/EBRD

Guidance Note on Worker's Accommodation (2009). The EPC shall establish a labour office in which EPC shall depute one or two staff members to publish vacancies, receive applications from the locals and also record grievances related to workforce and communities

5.12 Utilities

5.12.1 Water Mass Balance

5.12.1.1 Biodiesel Water (Current)

Water Consumption – Sources and Uses			
Source	Uses	Net Use per day, M ³	Net Use per year, M ³
Ground Bore: Water sourced from underground aquifers accessed through drilled boreholes	Process Water	8.5	2805
	Cooling Water	24	7,920 (250 m ³ /hr cooling water)
	Steam Generation (Boiler)	2.4	792 (4.2 MT/hr)
	Domestic Water	10	3,650
Total Used		44.9	15,167

Wastewater Summary – Biodiesel

Uses	Net Use per day, M ³	Net Use per year, M ³
Total water used	44.9	14,817
Blowdown water (losses) + Domestic	21.5	7,095
Total sent to wastewater treatment plant	23.4	7,722

5.12.1.2 SAF

Water Consumption – Sources and Uses			
Source	Uses	Net Use per day, M ³	Net Use per year, M ³
Ground Bore: Water sourced from underground aquifers accessed through drilled boreholes	H ₂ Generation	61.8	20,384
	Stripping Steam	18.2	6,003 (Maximum water reused)
	Cooling Tower Blowdown	12	3,960 (41 m ³ /hr cooling water)
	Boiler Blowdown	2.4	876 (4.2 MT/hr)
	Domestic Water	10	3,650
Total Used		104.4	34,883

Water Consumption -SAF

Water Consumption	Net Use per day, M ³	Net Use per year, M ³
Total Water Used	104.4	34,883
Total water used per MT product	-	0.198

Wastewater Summary- SAF

Wastewater Consumption	Net Use per day, M ³	Net Use per year, M ³
Total Water sent to WWTP	96	34,560
Total water used per MT product	-	-
Recycling back to the system	58.5	21,060

5.12.2 Energy Mass Balance

5.12.2.1 Biodiesel Energy Mass Balance (Current) - Electricity

353. BTE last 9 months electricity consumption monitoring data – pie chart showing average over last 9 months.

5.12.2.2 Biodiesel Energy Mass Balance (Current) – Heat

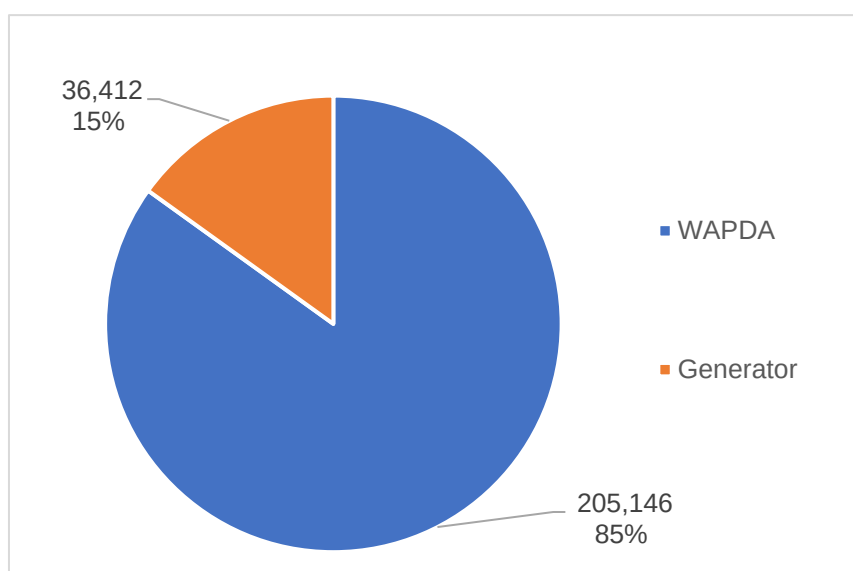


Figure 5-19: BTE Heat Consumption at full capacity

Heat Uses	Net use per day	Net Use per day, Gcal/hr
Steam	33.3 KTA/hr	7.7
Thermic Oil	350 M3/hr	2.5
Total heat energy demand		10.2
Net Use per year, Gcal		89,352
Gcal per production MT		1.99

Heat Generated - Gcal from Bio Heat Oil	
Total Bio Heat generated per year, MT	2,250 (0 emissions as Bio heat is made from waste)
Gcal per unit	18
Generated per year, Gcal	40,500

Net Gcal used in Biodiesel plant 89,352 - 40,500 = **48,852**
Gcal per MT **1.09** (Used for Biomass / Wood)

5.12.3 SAF Mass Balance: Inputs and Outputs for SAF plant and H2 plant

5.12.3.1 SAF Energy Mass Balance

Sustainable Aviation Fuel (SAF) Plant		
Input	Unit	Consumption
Pre-treated feed	KTA	200
H2 chemical consumption	KTA	7.20
Stripping steam	KTA	6.00
Lean Amine	KTA	Circulated (close loop)
Output	Unit	Consumption
Renewable Diesel	KTA	0.00
Renewable Jet	KTA	145.00
Renewable Naphtha	KTA	31.20
HP purge	KTA	1.00
Off-gases	KTA	6.00
Sour Water	KTA	27.00
Rich Amine	KTA	Circulated (close loop – lean to rich amine)

Hydrogen (H2) Plant

Input	Unit	Consumption
Output	Unit	Consumption
Utilities	Unit	Consumption

Commercially sensitive information has been redacted

Steam MT/Hour: 0.758

Steam MT/Hour: 4.200

5.12.3.2 SAF Energy Mass Balance – Electricity

Uses	Net Use per day, M3
Electricity, kWh	1,583
Electricity, KW per year	11,397,600
Electricity per MT product, KW per MT SAF	64.7

5.12.3.3 SAF Energy Mass Balance – Heat

Uses	Net Use per day, M3
MP Steam, KTA	4.8
LP Steam, KTA	33.3
Steam used per Kg of product	216.0

5.12.4 Solid Waste Generation

5.12.4.1 Construction phase

354. A solid waste management plan has been prepared by the contractor attached as **Annexure- 8C** of this report. During the construction phase of a project, several types of solid waste are typically generated, including:

- Scraps
- Concrete and masonry debris
- Metals
- Drywall and plaster
- Packaging materials
- Insulation
- Roofing materials
- Flooring materials
- Excavation and land clearing debris
- Miscellaneous waste

5.12.4.2 Operational Phase

355. During the operational phase the BTE WMP existing plan will be updated and will be followed during the operational phase of SAF. During the operational phase following waste will be generated.

- Oil and Lubricants contaminated clothes from workshop and spill cleanups
- Chemical waste from laboratory
- Plastics
- Paper and Cardboard
- General Domestic waste

- Sludge from WWTP
- Spent Catalyst from Process.

5.12.5 HR Requirements and Arrangements for the Proposed Project

Table 5-17: HR Requirements and Arrangements for the Proposed Project

HR Requirements and Arrangements for the Proposed Project:	Per shift	Shifts	Total Staff
Chief Executive Officer	1	1	1
Chief Financial Officer	1	1	1
Chief Operating Officer	1	1	1
General Manager	9	1	9
Office Staff	40	1	40
Engineering Staff	17	3	50
Project Engineer (Mechanical)	6	1	6
Project Engineer (Civil)	6	1	6
Project Engineer (Commercial)	3	1	3
Skilled Engineers + Diploma Skilled Staff	67	3	200
Total			317

356. Approximately 317 number of jobs will be created by the SAF Project.

357. The Employment Opportunity created by the project will:

1. Help create higher value jobs for Pakistani Staff, and develop their skills through the AXENS training program
2. As SAF is a straight of the art industrial technology, the opportunity provided to the staff will be unique, as innovation is enabled.
3. Increase competitiveness thanks to adoption of new technology
4. Utilizing the Axens design will promote health, safety, and optimal working conditions for the employees.

358. All employment will be in accordance with BTE Human Rights policy, attached as **Annexure-04**.

5.13 Work Plan and Timeline for the Construction of SAF

359. The total project duration for construction is approximately 02 years. The breakup is given as under:-

Phase 1: Contractual Obligations

- Signing of Contract – 0 days
- Commencement of Works – 0 days

Phase 2: Design Phase (68 days)

- Surveys and Studies (25 days)
- Topographic Survey – 15 days
- Geotech Investigation – 15 days
- Studies (15 days):
- Transportation Study – 15 days
- Flood Assessment Study – 15 days
- Feed Stock Collection Study – 15 days
- Preliminary Design – 18 days
- Preparation of Environmental Impact Assessment (EIA/IEE) – 44 days
- Detailed Design of SAF – 28 days

Phase 3: Project Tender Document (7 days)

- Bill of Quantities (BOQ) – 7 days
- Cost Estimates – 7 days

Phase 4: Construction Supervision and Management (272 days)

- Construction Management:
- Construction Management Plan – 22 days
- Work Schedule Management – 22 days
- QA/QC Monitoring of Works – 250 days
- Measurement and Interim Payment Certifying – 250 days
- Contractual Administration – 250 days
- Progress Reports (Weekly/Monthly) – 250 days

Phase 5: Construction of Tanks (272 days)

- Fabrication of MS Tanks – 75 days
- Site Preparation and Excavation Works – 44 days
- Construction of Foundations for Tanks – 88 days
- Erection of Tanks & Associated Tasks – 90 days
- Connectivity of Tanks – 50 days

Phase 6: Closure and Demobilization

- Closure of Works and Demobilization – 15 days

CHAPTER - 6: DESCRIPTION OF ENVIRONMENTAL & SOCIAL BASELINE CONDITIONS

360. Baseline conditions refer to the existing physical, environmental and socio-economic status of the area proposed for the project and surroundings.

361. The objectives of developing these baselines are to:

- Study and understand the physical, ecological, and socioeconomic aspects of the environment before the Project is developed.
- Use this information to predict, evaluate, and assess changes to the physical, ecological, and socioeconomic environment due to the anticipated impacts (negative and positive) from the Project activities.

362. The baseline data was collected using primary and secondary sources of information for the physical environment, ecological environment, and socioeconomic environment. Primary sources involved surveys, interviews and collection of samples and analysis at laboratories.

6.1 Desk Studies

363. Project design data was collected from the proponent. This data included the available documents, drawings, reports, etc related to the proposed project. The experts conducted a detailed desk study of the above available data before the field visit. Salient features of the Project were thoroughly reviewed to assess their environmental & social implications.

6.2 Site Visits

364. A team of experts visited the proposed site for the collection of baseline environmental data including ambient air, noise levels, drinking water and wastewater sampling, public consultation, baseline ecological environment data, etc.

365. A social survey of the proposed area was carried out in which people living around the proposed site were interviewed to ascertain their views about the project planning, implementation and operational activities to perceive the impacts on the natural and socioeconomic environment around the proposed project site.

6.3 Physical Environment

366. The physical environment consists of existing landforms and land use at the project site including geology, hydrology, meteorology and climatology. The pre-project condition (i.e., baseline) of these components of the physical environment is described hereunder; the secondary data has been for the weather baseline information is generated for 20 years.

6.3.1 Geography & Geology

367. The proposed project site is situated 14 kilometers along Sharaqpur Road in the district of Sheikhupura. The city is well connected with its surrounding big urban centers like Lahore (35 km) Faisalabad (94 km), Sargodha (143 km) and Gujranwala (54 km). Sheikhupura has also a railway junction. The area is a part of Rachna Doab and consists of some recent sediment brought by a spill channel from River Chenab. There are some old channel levee remnants and old basins filled up with clay materials. It is probably of the Late Pleistocene Age derived from mixed calcareous, sedimentary and metamorphic rocks of the lower Himalayas.

6.3.2 Topography

368. The topography of Sharaqpur City is flat. The area is a part of Rachna Doab and consists of sub-recent sediments brought by a spill channel from the River Chanab. There are some old channel levee remnants and old basins filled up with clay materials. The material is probably from the Late Pleistocene Age derived from mixed calcareous sedimentary and metamorphic rocks of the Lower Himalayas. The area of the Sheikhupura District is comprised of the fluvial deposits of the Ravi River.

6.3.3 Climate

6.3.3.1 Temperature

369. The proposed project site is located in Sheikhupura, which has extreme climate conditions and the summer season starts from April and continues till October. During the summer season, the temperature ranges from 30°C to 48°C. The winter season starts in November and continues till March. December and January are the coldest months with a mean minimum temperature of about 3-5°C. The dust storms occur occasionally during the hot season, June, July and August.

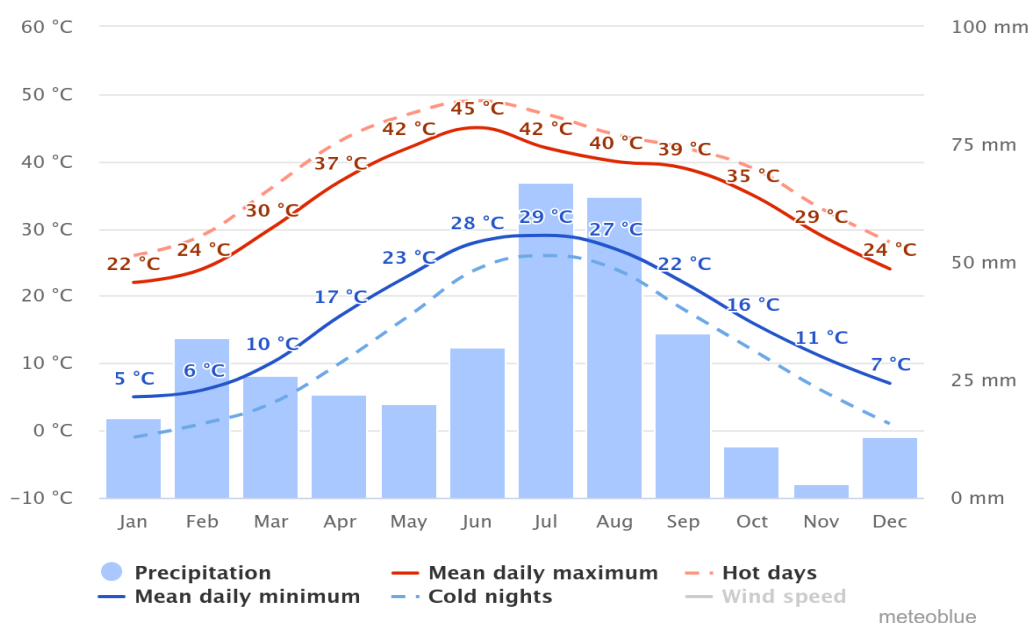


Figure 6-1: Average Temperatures and Precipitation

6.3.3.2 Precipitation

370. Rainy weather alternates with oppressive weather. The rainfall is 500 mm per annum. In the recent year, the maximum average precipitation occurred in July, and it was around 67 mm.

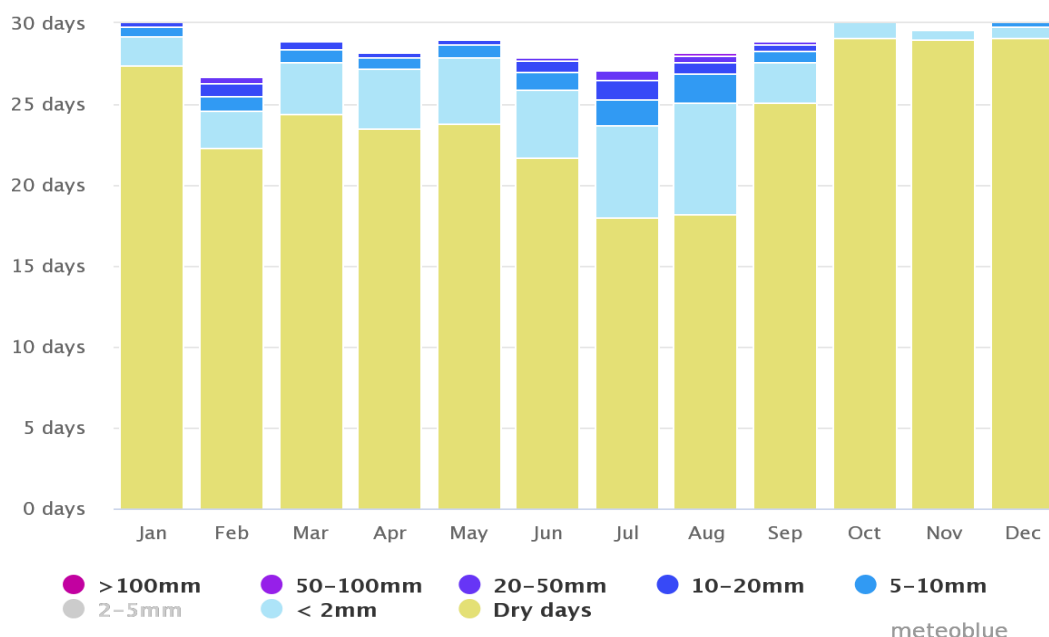


Figure 6-2: Mean Precipitation

6.3.3.3 Wind Speed

371. The average daily wind speed was highest in July, which was **38 km/h**. In recent years, the maximum sustained wind speed has reached **38 km/h**. The diagram shows how many days within one month can be expected to reach certain wind speeds. Monsoons create steady, strong winds on the Tibetan Plateau from December to April, but calm winds from June to October. The wind speed directly affects the dispersion and transport of plumes. So, the greater the wind speed, the greater will be the dispersion and the distance at which the plume strikes the ground, and the lesser will be the pollution concentration.

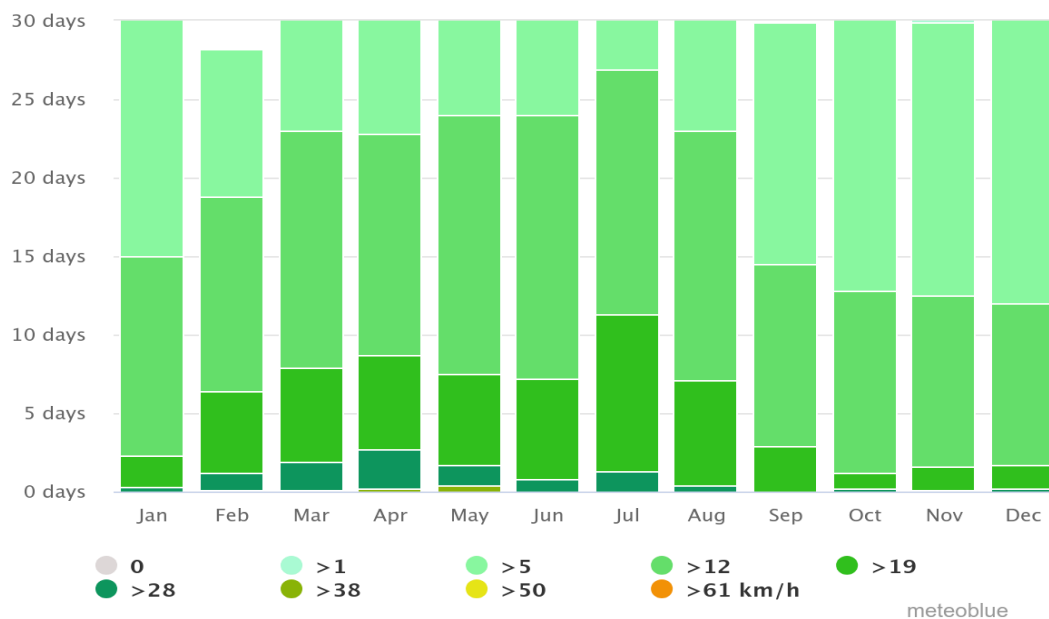


Figure 6-3: Average Wind Speed (Meteoblue)

6.3.3.4 Wind Rose

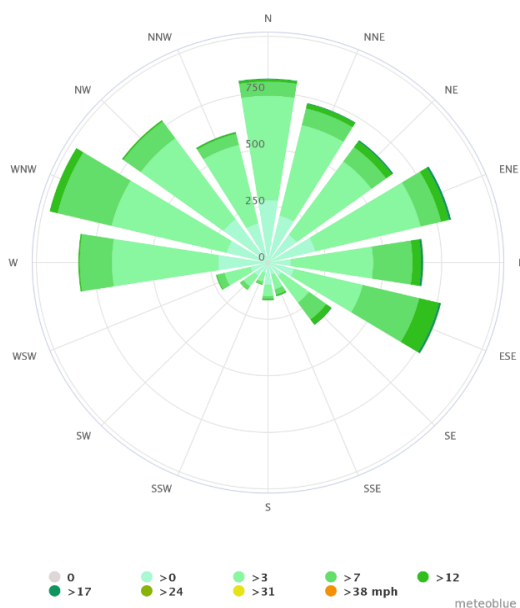


Figure 6-6, Wind Rose

6.3.4 Climate Change Trends

372. The estimated annual mean temperature for the larger region of Sheikhpura is shown below. The dashed blue line is the linear climate change trend. The trend line is going up from left to right, the temperature trend is positive and it is getting warmer in Sheikhpura due to climate change over time (the temperature variation is shown by purple line). In the lower part of the graph, the so-called warming stripes are shown. Each colored stripe represents the average temperature for a year - blue for colder and red for warmer years.

373. Hence, it is reported that the temperature in Sheikhpura has increased

by approximately 1°C from 1979 to 2023 due to variations in climate change.

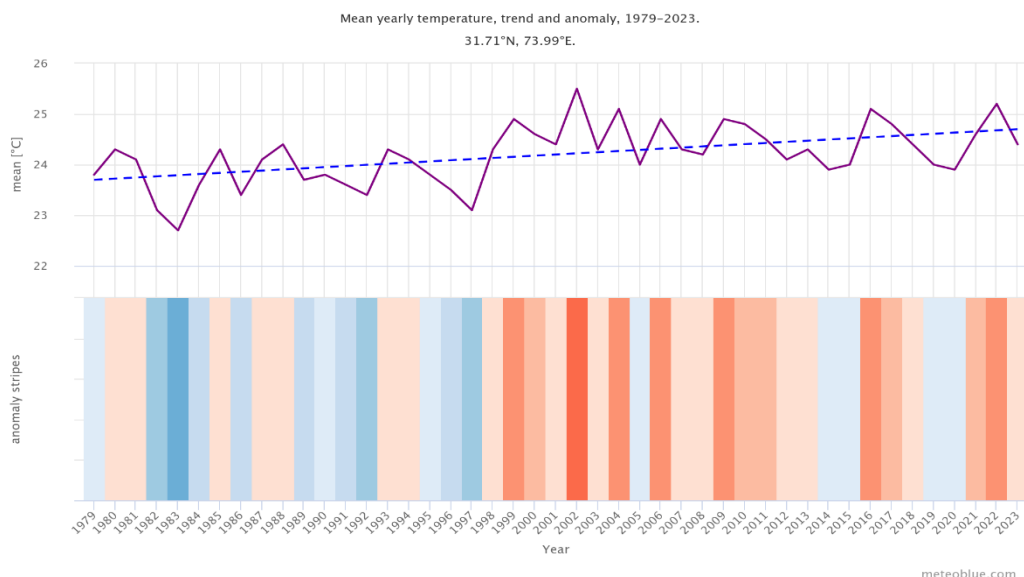


Figure 6-7: Annual Mean Temperature Trend

374. The estimate annual mean precipitation for the larger region of Sheikhpura is shown below. The dashed blue line is the linear climate change trend. The trend line is going down from left to right, the precipitation trend is negative and it is getting drier in Sheikhpura due to climate change over time (the precipitation variation is shown by the purple line). In the lower part, the graph shows the so-called precipitation stripes. Each colored stripe represents the total precipitation of a year - green for wetter and brown for drier years.

375. Hence, it is reported that the precipitation in Sheikhpura has continuously decreased from 1979 to 2023 due to variations in climate change.

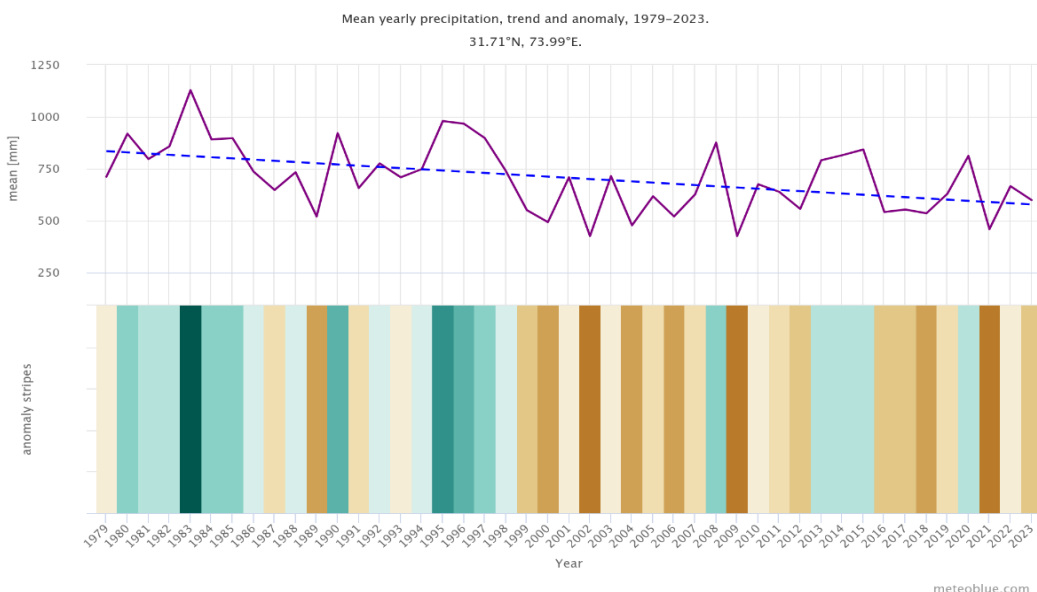


Figure 6-8: Mean Yearly Mean Precipitation Trend

6.3.5 Disaster risk Assessment

A disaster risk assessment has been carried out for the proposed project by BTE and the scouring is given below:

Hazard	Likelihood	Impact	Risk	Risk Category
Flood	1	3	4	low
Urban Flooding	0	0	0	-
Flash Floods	0	0	0	-
Hill Torrent	0	0	0	-
Glacial Lake Outburst Flood (GLOF)	0	0	0	-
Landslide	0	0	0	-
Tornado	0	0	0	-
Earthquake	1	2	3	Low
Drought	0	0	0	-
Epidemic (COVID-19)	3	3	9	Medium
Fire Incidents	3	4	12	Medium
Other Major Accidents (Building Collapse, road traffic accidents, train accident, Stampede, plane crash)	3	4	12	Medium
Environmental Hazards (industrial accidents, severe pollution etc.)	3	4	12	Medium

Risk = Impact x Likelihood **Low: 1-7 Medium: 8-14 High: 15-25**

376. Hence, major identified risks are epidemics, fire incidents, Other Major Accidents including (Building Collapse, road traffic accidents, train accidents, Stampedes, and plane crashes) and Environmental Hazards (industrial accidents, severe pollution, etc.).

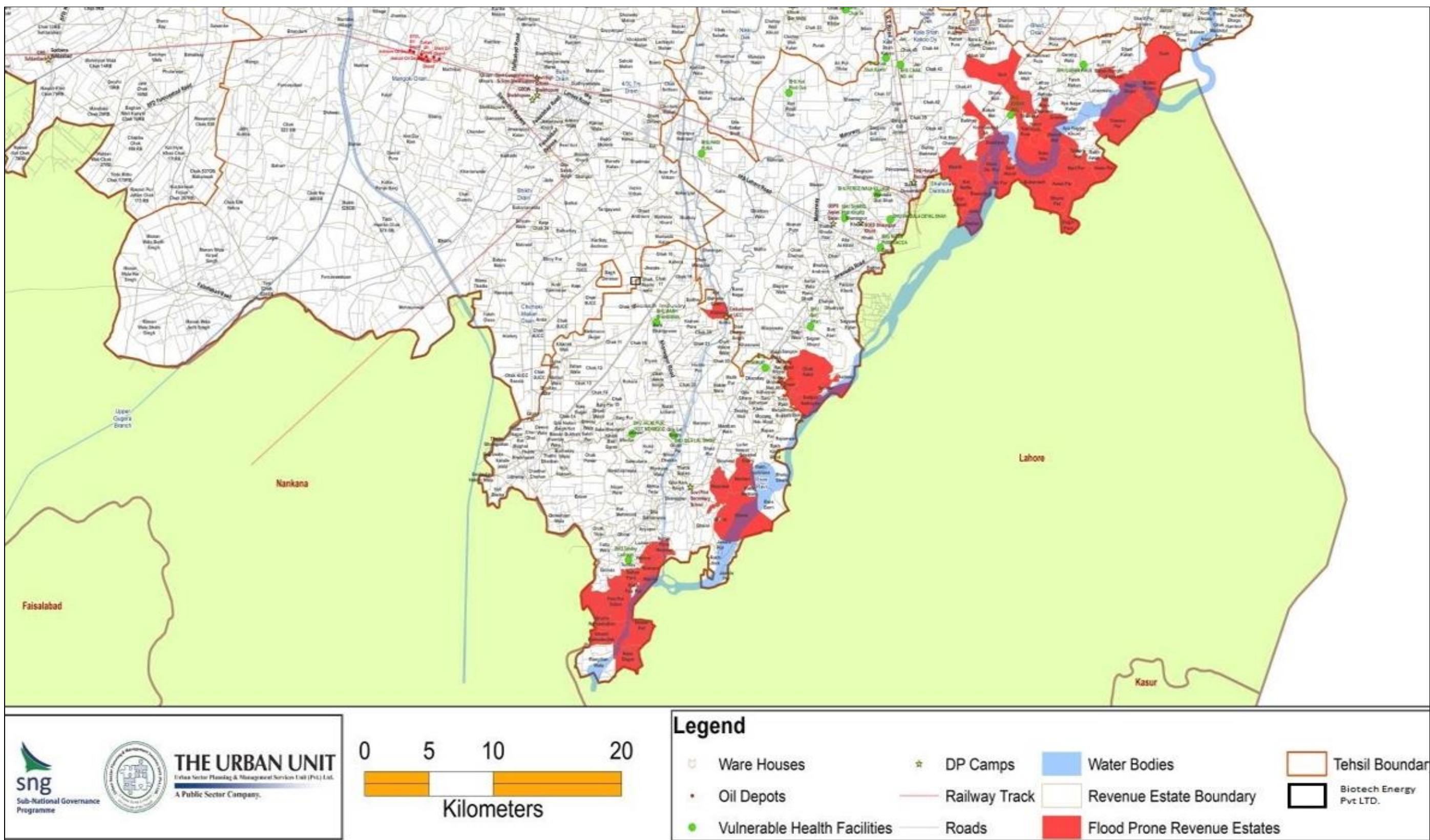


Figure 6-4: DDMP District Sheikhupura, 2021

6.3.6 Flood Assessment

377. Sheikhpura is situated at a distance of about 36 Km from Lahore, the provincial headquarters. The River Ravi in Sheikhpura is a significant waterway that flows through the city. It is situated approximately 31.39 kilometers away from the city. The river Ravi is the only river in Sheikhpura that poses a potential flooding risk. According to the PDMA-DRP, the River Ravi belongs to the category B flooding (medium-level flood). Two categories of flood can occur in the areas i.e., urban and riverine. The recent flood noted in River Ravi is at Shahdara Gauging Station is 250,000 cusecs and is considered a medium flood level. This is the highest flood level noted in River Ravi after the year 2000 as construction of Thein Dam on the Indian side greatly reduced the flows in River Ravi while the highest flood observed in River Ravi was in 1988 which was around 586,000 cusecs.
378. Flood is considered as most drastic and re-occurring hazards in Pakistan. Roughly 1.84 million people across Pakistan have been affected by floods triggered by heavy monsoon rains. At least 346 people have been killed and 620 others have been injured in flood-related incidents, according to the latest figures released by the National Disaster Management Authority (NDMA).

6.3.7 Flood Assessment Near Proposed Project Site

379. The proposed project is situated within the Sheikhpura district, encompassing the river Ravi at a distance of 18.73 km from the project site, along with several canals and drainage systems near the project site.
380. The Upper Chenab Canal is located approximately 5.9 kilometres away from the project site while Nikki Degh Drain is approximately 6.1 kilometres from the project site.
381. The proposed project site is situated at a substantial distance from vulnerable areas that are prone to flooding, ensuring minimal risk of inundation stemming from nearby drainage systems.
382. To determine the potential flood extent, an analysis was conducted utilizing data provided by NDMA and focusing on a 100-year return period. The findings derived from this flood extent map below indicate with confidence that the likelihood of any form of flooding occurring at the proposed site is virtually negligible.

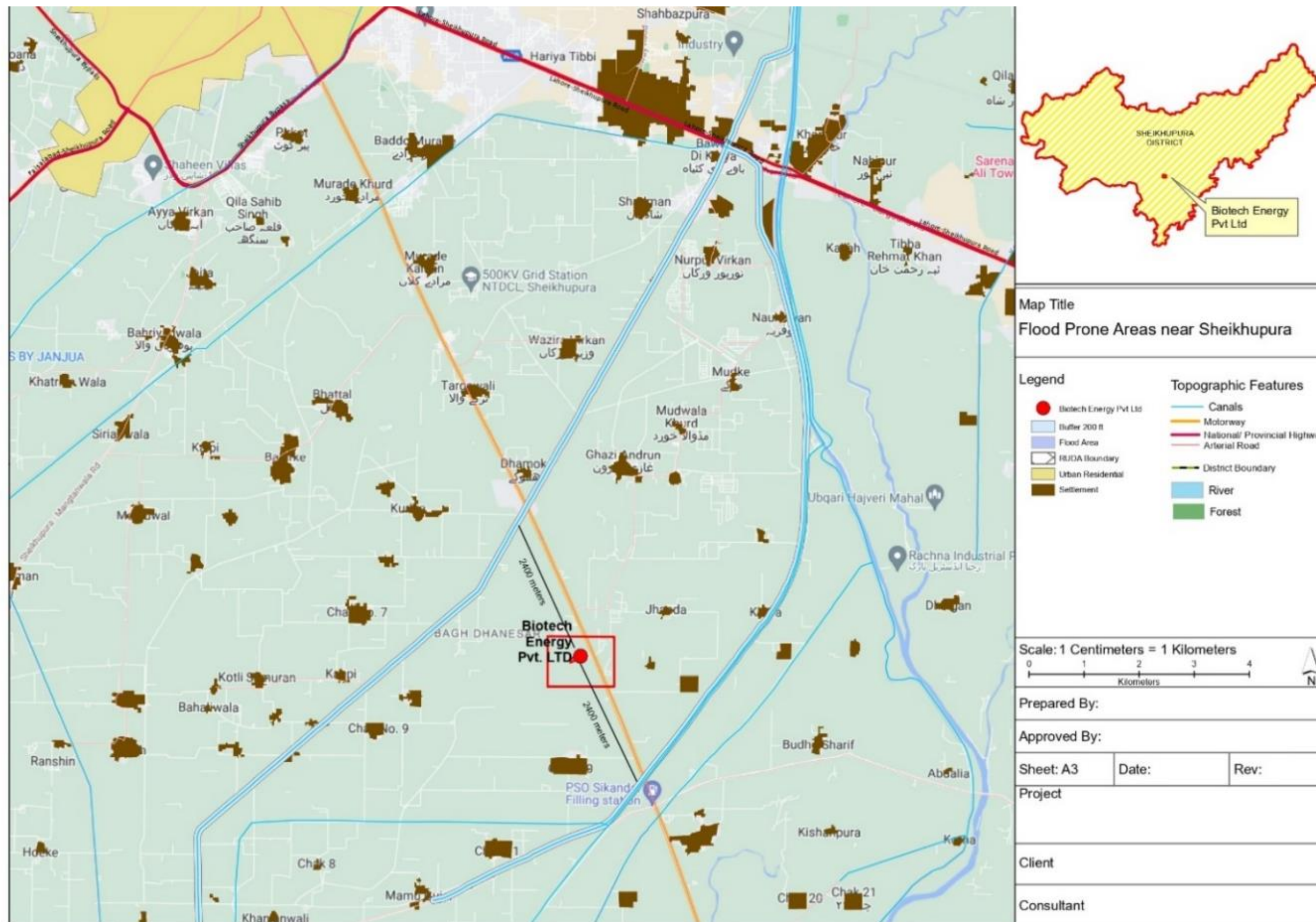


Figure 6-5: Flood Prone Areas Near Sheikhupura

6.3.8 Seismicity

383. According to the Seismic Zoning of Pakistan, the project area lies in Zone 2A and represents minor to moderate damage due to earthquakes.

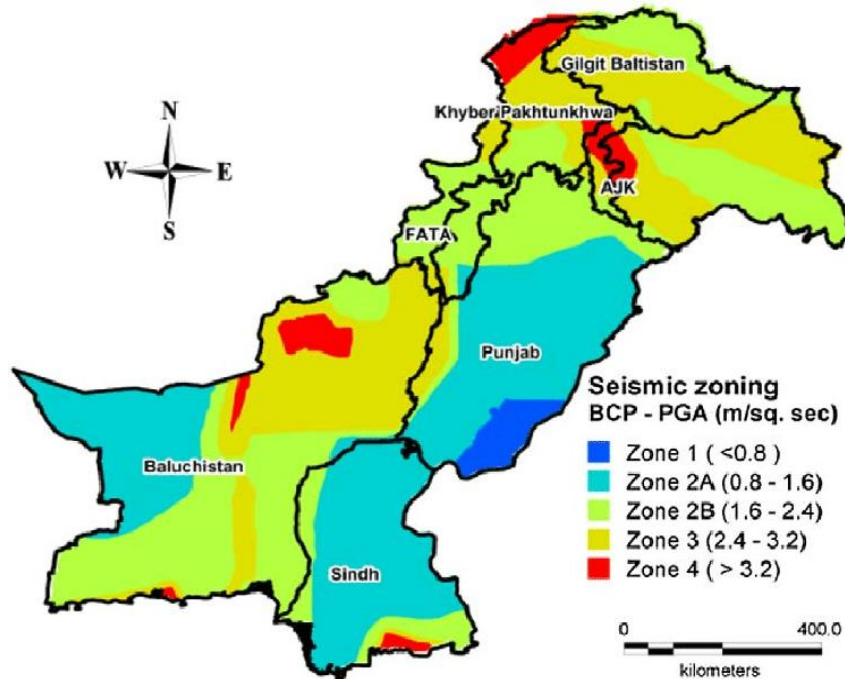


Figure 6-6: Seismic Zones of Pakistan (Geological Survey of Pakistan)

6.3.9 Soil

384. Geographically, Pakistan is highly diversified in its environment and landscape. Lofty snow-clad mountains, extensive rivers, piedmont plains, and vast sandy deserts have resulted in variations in soil-forming elements. Accordingly, in order to have a generalized account of the various kinds of soils that are available in Pakistan, the country has been divided into nine broad ecological zones. The project area falls in the Western Mountainous Region.

385. The soil of the project area is made up of river Alluvia brought down from the Himalayas and deposited during the Pleistocene epoch. The sediments are generally loamy in the northern reaches and become silty southward. Finer materials settled in the digressional parts and coarse materials on higher undulations; the intermediate-level area received the particle-sized fractions in between. The sediments are characteristically calcareous and have a mixed mineral makeup. The soils are typically deep calcareous, weakly structured, bright colored, and have a zone of secondary lime accumulation at or near one meter depth.

6.3.10 Surface Water Resources

386. The nearest surface water bodies from the SAF plant are the Mangtawala Feeder Canal at a distance of 2.40 km and the Dhamoki Canal at a distance of 2.93 km. To check the quality of the surface water near the

proposed project site, 03 samples from each canal are collected, one from upstream, the second one from midstream, and the third one from downstream. The samples were analyzed by an EPA-certified and ISO 17025-accredited testing facility.

387. One surface water sample is also collected from a seasonal drain named as Ghazi drain near to project site. The result of the analysis are given below in Table 6-2.

388. Surface water samples were collected on a single occasion during the spring season across 7 different locations

389. **Table 6-1** presents the surface water sampling locations and rationale for selection, and **Figure 6-7** depicts the sampling locations on a map. **Figure 6-8** shows the photographs of surface water quality sampling. The detail of the surface water quality results and its comparison applicable standards are given in **Table 6-2** and reports are attached as **Annexure-13**.

Table 6-1: Surface Water Quality Sampling Locations and Rationale of Their Selection

Points	Coordinates	Description/Rational for Selection
SW01	31°38'13.93"N 74° 3'20.80"E	This sample was collected from Dhamoki Canal at 4.30 km on the northeast side of the SAF plant location and represents the baseline surface water quality condition at the upstream side.
SW02	31°37'24.38"N 74° 2'48.86"E	This sample was collected from Dhamoki Canal at 2.90 km on the northern side of the SAF plant location and represents the baseline surface water quality condition at midstream (nearest to the proposed project site) before the construction and operation of the SAF plant.
SW03	31°35'44.56"N 74° 1'13.16"E	This sample was collected from Dhamoki Canal at 3.50 km on the northern-west side of the SAF plant location and represents the baseline surface water quality condition downstream.
SW04	31°36'41.52"N 74° 5'46.68"E	This sample was collected from the Mangtwala feeder canal at 3.95 km northeast of the SAF plant location and represents the baseline surface water quality condition at the upstream side.
SW05	31°34'41.00"N 74° 4'7.00"E	This sample was collected from the mid-stream of the Mangtwala feeder Canal at 2.45 km South side of the SAF plant location and represents the baseline surface water quality at midstream (nearest to the proposed project site) before construction and operation of the SAF plant.
SW06	31°34'14.00"N 74° 3'43.00"E	This sample was collected from downstream of the Mangtwala feeder canal at the 3 km southwest side of the SAF plant location and represents the baseline surface water quality condition before the construction and operation of the SAF plant.
SW07	-	This sample was collected from the Ghazi drain located nearby project site and represents the baseline surface water quality condition before the construction and operation of the SAF plant.

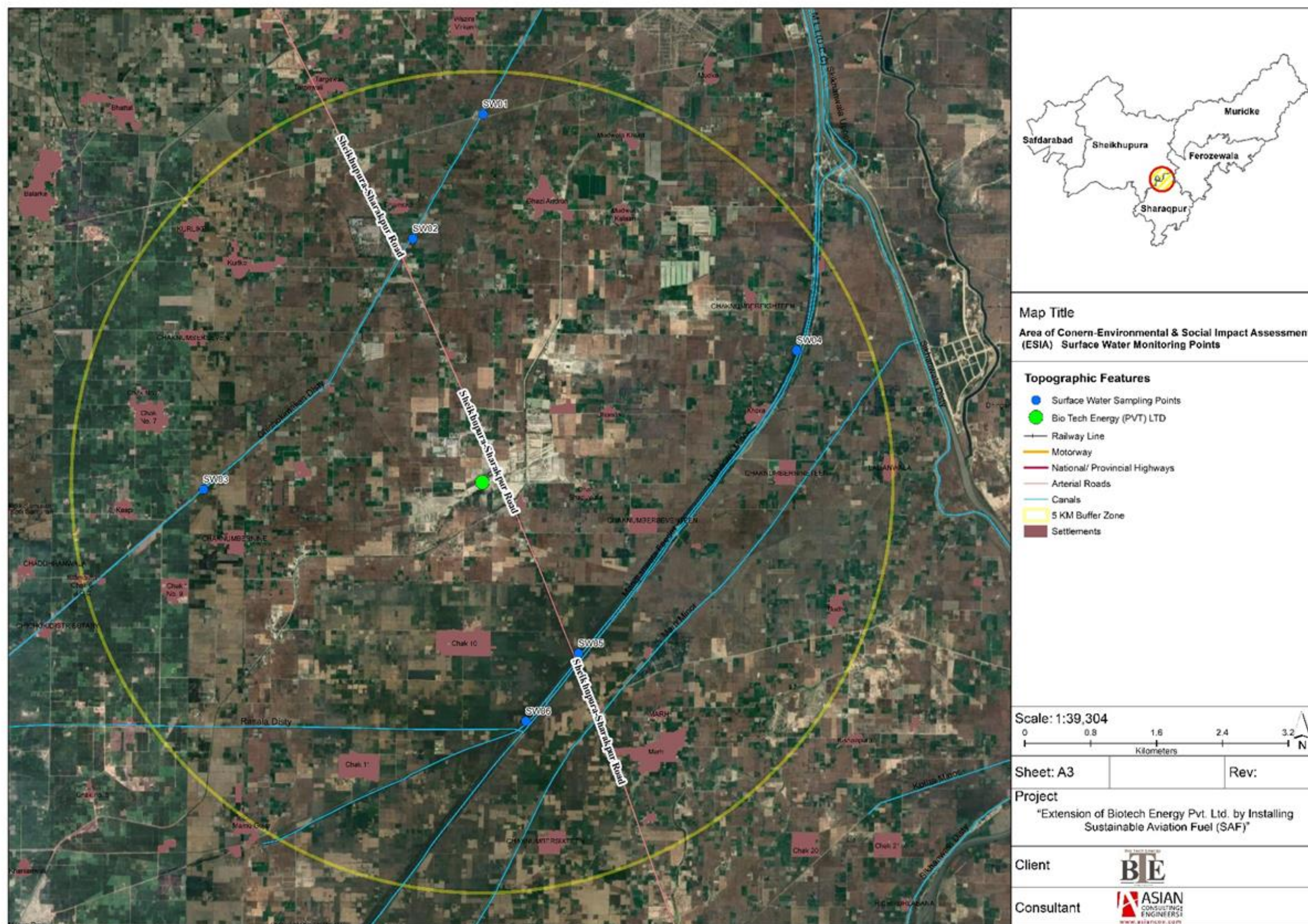


Figure 6-7: Surface Water Sampling Location



Figure 6-8: Surface Water Quality Sampling Photographs

Table 6-2: Surface Water Quality Results

Parameter	Units	FAO Standards	US EPA Standard	SW01	SW02	SW03	SW04	SW05	SW06	SW07
pH	pH unit	6.0-8.5	6-9	7.64	7.77	7.98	8.07	8.01	7.18	8.07
Total Dissolved Solids (TDS)	mg/L	0-2000	NGVS	192	188	170	172	173	237	2296
Total Suspended Solids (TSS)	mg/L	--	NGVS	37.6	17.6	18.4	13.6	9.2	63.2	336
Chemical Oxygen Demand (COD)	mg/L	--	NGVS	<5	<5	24	<5	<5	<5	489
Biochemical Oxygen Demand (BOD ₅)	mg/L	--	10	<5	<5	9	<5	<5	<5	270
Grease and Oil	mg/L	--	NGVS	0	1	7	2.5	1.5	30	4.9
Phenolic Compounds (as Phenols)	mg/L	--	NGVS	0	0	0	0	0	0	0
Ammonia (NH ₃)	mg/L	--	NGVS	0	0	0	0	0	0	0

Parameter	Units	FAO Standards	US EPA Standard	SW01	SW02	SW03	SW04	SW05	SW06	SW07
Fluoride (F ⁻)	mg/L	--	1	0.21	0.21	0.2	0.20	0.20	0.25	0.20
Sulfate (SO ₄ ²⁻)	mg/L	0-960	NGVS	47.4	47.6	48.2	43.5	38.2	58	269
Sulfide (S ₂ ⁻)	mg/L	--	NGVS	0	0	0	0	0	0	0
Anionic Detergents as MBAS	mg/L	--	NGVS	0	0	0	0	0	0.9	0
Residual Chlorine (Cl ₂)	mg/L	--	NGVS	0	0	0	0	0	0	0
Cyanide (CN ⁻)	mg/L	--	NGVS	0	0	0	0	0	0	0
Chloride (Cl ⁻)	mg/L	0-1065	NGVS	6	6	3	6	5	11	223
Turbidity	mg/L	--	--	39.5	14.9	13.1	5.3	9.1	69.3	19.6
Dissolve Oxygen (DO)	mg/L	--	--	7.66	7.74	7.97	7.88	7.86	7.77	7.95

✓ NGVS = No Guideline Value Set

✓ The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations.

390. The analysis of the results shows that all parameters of surface water sampling are within compliance with respect to standard limits.

6.3.11 Ground Water Quality

391. To check the quality of the groundwater in the proposed project area, a total of five samples were collected within 5 km area of concern of the proposed project area. One groundwater was collected from a turbine motor in the exiting unit of Biotech Energy (Pvt) Ltd, and the other four samples were collected within 5 km area of concern of the proposed project area. The samples were analyzed by an EPA-certified and ISO 17025-accredited testing facility.

392. Ground water samples were collected on a single occasion during the spring season across 5 different locations.

393. **Table 6-3** shows the selected ground water sampling locations and rationale for selection and **Figure 6-9** depicts the sampling locations on a map. **Figure 6-10** shows the photographs of groundwater sampling. The monitoring results are presented in **Table 6-4** and reports are attached as **Annexure-13**.

Table 6-3: Ground Water Quality Sampling Locations and Rationale of Their Selection

Points	Coordinates	Description/Rational for Selection
GW01	31°35'47.86"N 74° 3'17.22"E	This sample was collected from near the SAF Plant site and represents the baseline groundwater quality condition of the proposed project site.
GW02	31°34'21.00"N	This sample was collected at the 3.08 km southeast side of the

Points	Coordinates	Description/Rational for Selection
	74° 4'12.00"E	SAF plant location and represents the baseline groundwater quality conditions along the Lahore side prior to the construction and operation of SAF plant.
GW03	31°37'10.28"N 74° 5'52.56"E	This sample was collected at the 4.50 km eastern side of the SAF plant location and represents the baseline groundwater quality conditions along nearby villages and prior to the construction and operation of SAF plant.
GW04	31°37'19.00"N 74° 2'43.00"E	This sample was collected at 2.80 km on the Northern side of the SAF plant location and represents the baseline groundwater quality conditions along the Sheikhpura site prior to the construction and operation of SAF plant.
GW05	31°35'18.00"N 74° 0'49.00"E	This sample was collected 4.30 km Northwest of the SAF plant location and represents the baseline groundwater quality conditions along the nearby village and prior to the construction and operation of SAF plant.

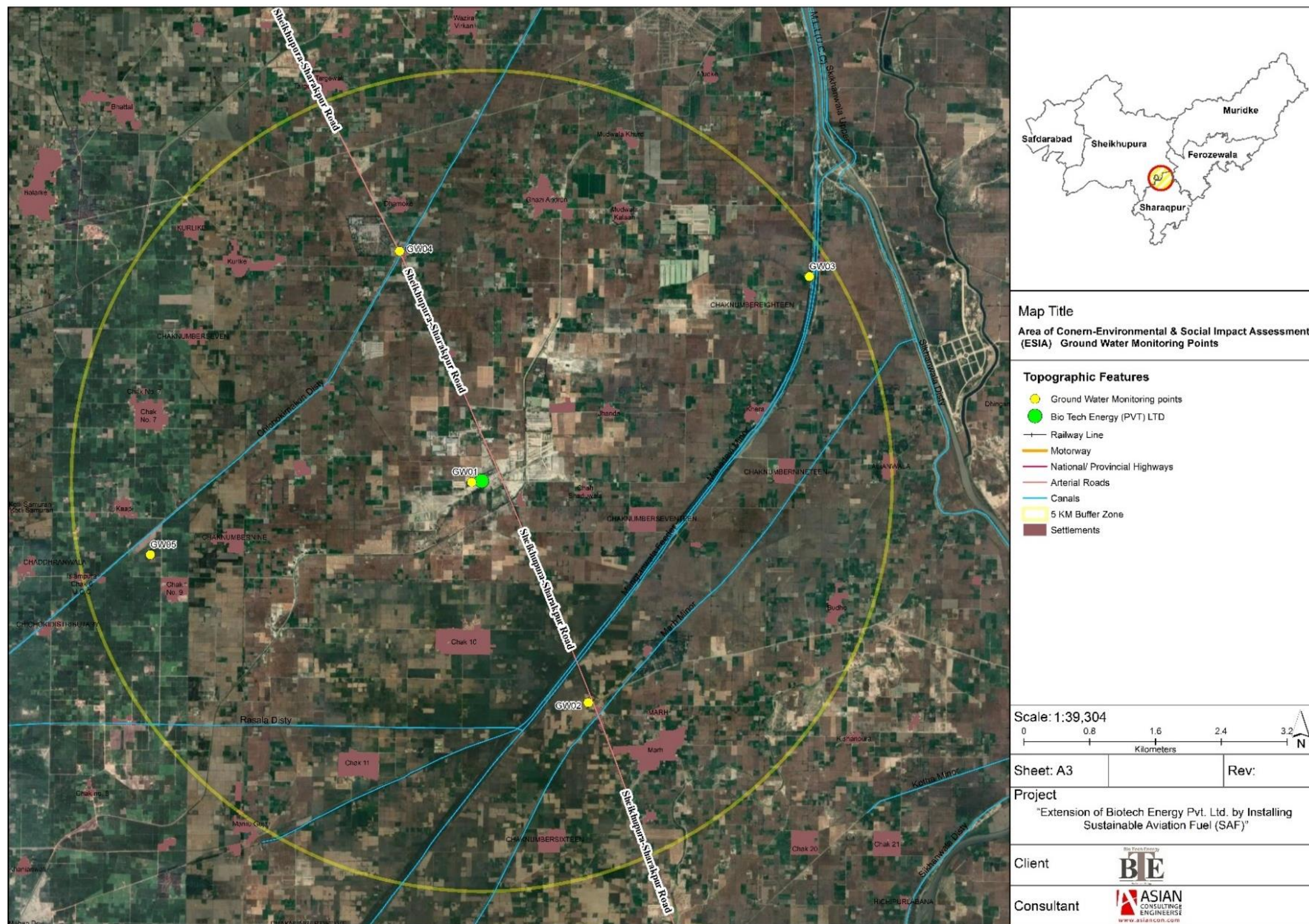


Figure 6-9: Ground Water Sampling Locations



Figure 6-10: Ground Water Quality Photographs

Table 6-4: Ground Water Quality Results

Parameter	Units	PEQS	WHO Standards	GW01	GW02	GW03	GW04	GW05
Lab Analysis								
Color	Pt-Co	≤15TCU	<15TCU	0	0	0	0	0
Taste	-	Non-Objectionable / Acceptable	Non-Objectionable / Acceptable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable
Odor	-	Non-Objectionable / Acceptable	Non-Objectionable / Acceptable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable
Turbidity	NTU	<5	<5	0	7.91	3.72	45.3	0
Total Hardness (as CaCO ₃)	mg/L	<500.00	500 mg/L	72	316	312	216	240
Total Dissolved Solids (TDS)	mg/L	<1000.00	<1000.00	438	394	269	626	655
pH	pH unit	6.5-8.5	6.5-8.5	8.09	7.24	7.35	7.32	7.39
Aluminum (Al)	mg/L	≤ 0.2	0.10	<0.005	<0.005	<0.005	<0.005	<0.005
Antimony (Sb)	mg/L	<0.005	0.02	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic (As)	mg/L	< 0.05	0.01	<0.005	<0.005	<0.005	<0.005	<0.005
Barium (Ba)	mg/L	0.7	0.7	<0.02	<0.0035	<0.0035	0.0035	0.0035
Boron (B)	mg/L	<0.3	0.3	<0.0035	<0.02	<0.02	<0.02	<0.02
Cadmium (Cd)	mg/L	0.01	0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chloride (Cl ⁻)	mg/L	<250.00	250	65	9	7	21	66
Chromium (Cr)	mg/L	<0.05	0.05	<0.004	<0.004	<0.004	<0.004	<0.004
Copper (Cu)	mg/L	2	2	0.164	0.164	<0.164	0.165	0.166

Parameter	Units	PEQS	WHO Standards	GW01	GW02	GW03	GW04	GW05
Cyanide (CN ⁻)	mg/L	<0.05	0.07	0	0	0	0.00	0.00
Fluoride (F ⁻)	mg/L	<1.50	1.50	1.61	0.1	0.1	0.45	1.07
Lead (Pb)	mg/L	<0.05	0.01	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese (Mn)	mg/L	≤ 0.5	0.05	<0.015	<0.015	<0.015	<0.015	<0.015
Mercury (Hg)	mg/L	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (Ni)	mg/L	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate (NO ₃ ⁻)	mg/L	<50.00	50.00	2.9	1.33	1.15	5.28	9.74
Nitrite (NO ₂ ⁻)	mg/L	<3	3	0	0	0.01	0.04	0.05
Selenium (Se)	mg/L	0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01
Residual Chlorine (Cl ₂)	mg/L	0.5 - 1.5 mg/L	0.5 mg/L	0	0	0	0	0
Phenolic Compounds (as Phenols)	mg/L	<0.002	NGVS mg/L	0	0	0	0	0
Zinc (Zn)	mg/L	5.0	3.0	0.038	0.038	0.036	0.037	0.04
Total Coliform	CFU/100ml	0/100 ml	0/100 ml	0	0	0	0	0
Fecal Coliforms	CFU/ml	0/100 ml	0/100 ml	0	0	0	0	0

- ✓ NS = Not Specified
- ✓ NGVS = No Guideline Value Set
- ✓ The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations.
- ✓ The red bold values are above standard limits.

394. The analysis of the results shows that all parameters of groundwater sampling are within compliance except turbidity in the GW02 (southeast side of the SAF plant along the Lahore side) and GW04 (northern side of the SAF plant along the Sheikhpura side) samples. The high value of turbidity is experienced due to shallow water depth.

6.3.12 Hydrological Analysis

395. Biotech Energy's hydrology analysis was carried out which concludes that groundwater usage for biodiesel and SAF production is minimal, with a total water consumption of 149.3 m³/day. Comprehensive assessments using water balance and GIS techniques reveal an average groundwater depletion of 0.06 m/year over 17 years, which is considered negligible. The groundwater system benefits from natural recharge through rainfall (705 mm/year) and irrigation systems. Mitigation measures like treated water reuse significantly minimize the impact of the project on groundwater resources, ensuring sustainability in the surrounding agricultural and industrial regions.

6.3.13 Ambient Air Quality

396. Ambient air quality criteria, or standards, are concentrations of pollutants in the air, and typically refer to outdoor air. The most common air pollutants of ambient air include: Particulate matter (PM₁₀ and PM_{2.5}).

397. As per the EIA study of Amendment Master Plan 2016, ambient air quality was monitored for the whole Lahore Division. The ambient air quality of the Sheikhpura District was mostly in compliance with PEQS standards. However, PM_{2.5} was found to be high at GT road Muridke and PM₁₀ was high in 02 points i.e., GT road Muridke and Sargodha Road near Farooqabad points as these were taken majorly from road sides and industrial zone¹.

398. As per the EIA study conducted in 2022 for the Master Plan for Lahore Division 2050, the Ambient Air Quality of Sheikhpura District mostly falls in the unhealthy for sensitive groups and very unhealthy category in urban areas. As analyzed by AQI, the air quality in pre-monsoon mostly falls unhealthy for sensitive groups and predominately very unhealthy in post-monsoon. The reason for the drastic change in the air quality index between pre-monsoon and post-monsoon seasons was the incidence of high smog levels in Sheikhpura during the post-monsoon season (winter).

399. Air quality sampling was conducted within the area of concern at five different sites. The primary source of air pollution at the project sites is vehicular emissions, industries and the key pollutants likely to be found at project proposed locations are Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), Sulfur Dioxide (SO_x) and Particulate Matter (PM). In order to determine the air quality of the area, the Laboratory had the requisite air sampling device and expertise for the collection of samples. A single round of air quality monitoring was carried out during the spring season, which spans from February to April, using the USEPA/PEQS methodology.

400. The monitored parameters included Carbon monoxide (CO), Nitrogen oxides (NO_x), Sulphur oxides (SO_x), and Particulate Matter (PM₁₀). The parameters for assessment were selected according to the anticipated emissions from the proposed construction activities and operations, with a focus on evaluating the potential risk to human health and the local

¹ EIA Report Amendment Master Plan, 2016

environment caused by these pollutants.

401. **Table 6-5** shows the selected air quality sampling locations and rationale for selection and **Figure 6-11** depicts the sampling locations on a map. **Figure 6-12** shows the photographs of air quality sampling. The monitoring was carried out for a period of 24 hours and results are presented in **Table 6-6** and reports are attached as **Annexure-13**.

Table 6-5: Air Quality Sampling Locations and Rationale of Their Selection

Points	Coordinates	Description/Rational for Selection
AA01	31°35'53.99"N 74° 3'18.61"E	This sample was collected near the SAF plant site and represents the baseline air quality condition of the proposed project site.
AA02	31°34'13.86"N 74° 4'8.49"E	This sample was collected at the 3.15 km southeast side of the SAF Plant location and represents the baseline air quality conditions along the Lahore side prior to the construction of SAF Plant.
AA03	31°37'8.05"N 74° 5'54.20"E	This sample was collected at the 4.45 km eastern side of the SAF Plant location and represents the baseline air quality conditions in nearby villages prior to the construction of SAF Plant.
AA04	31°37'13.00"N 74° 2'38.00"E	This sample was collected at 2.75 km on the Northern side of the SAF Plant location and represents the baseline air quality conditions along the Sheikhpura site before the construction of SAF Plant.
AA05	31°35'17.00"N 74° 0'53.00"E	This sample was collected at 4.20 km Northwest of the SAF Plant location and represents the baseline air quality conditions in nearby villages before the construction of SAF Plant.

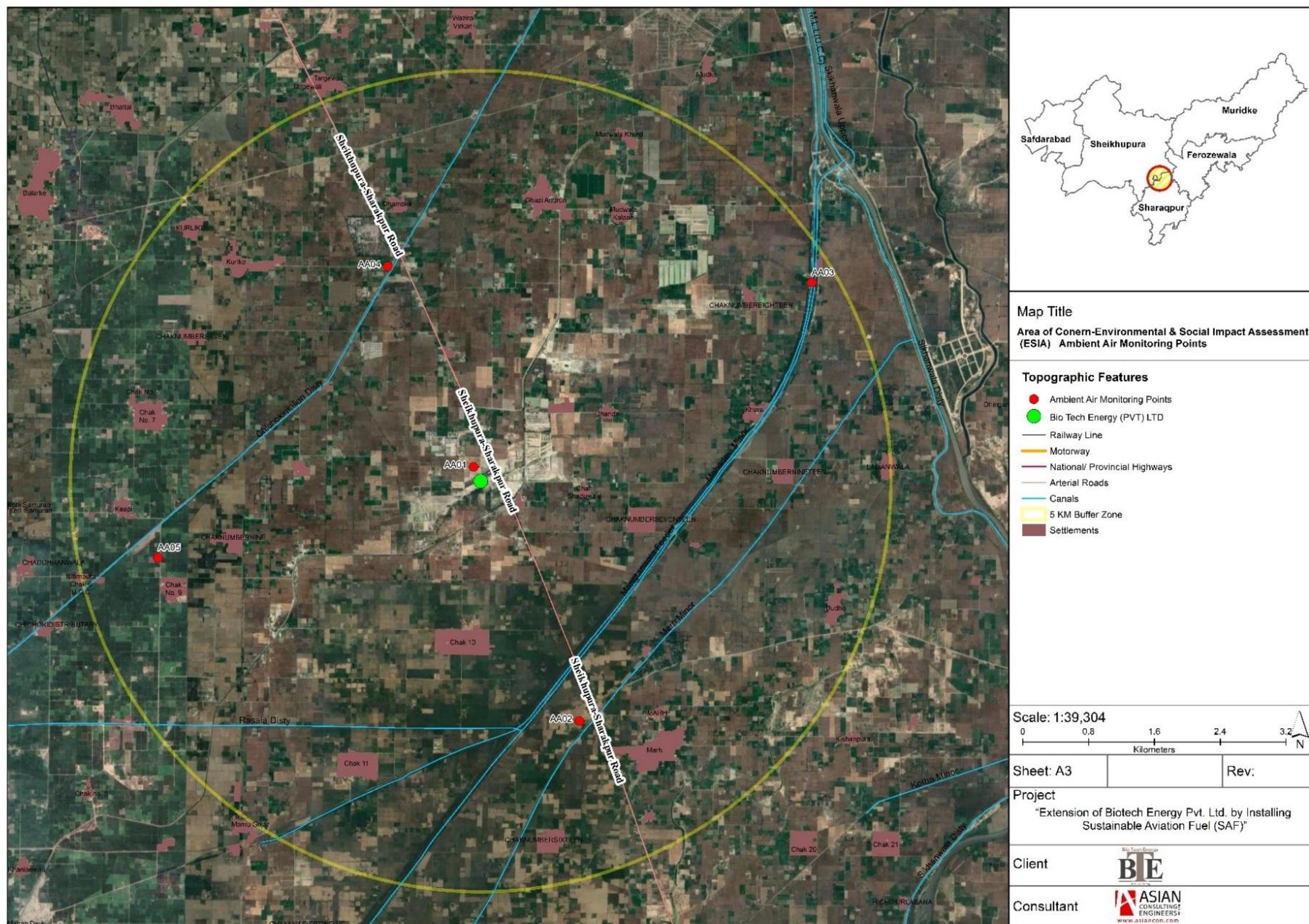


Figure 6-11: Ambient Air Sampling Locations



Figure 6-12: Ambient Air Quality Photographs

Table 6-6: Ambient Air Quality Results

Parameters	USEPA		WHO/IFC		PEQS		Monitoring Duration	LDL	AA01	AA02	AA03	AA04	AA05
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard							
Sulphur Dioxide (SO ₂)	1 hr 3 hrs	75 ppb 0.5 ppm	24 hr	40 ug/m ³	24 hrs Annual Mean	120 ug/m ³ 80 ug/m ³	24Hours	1.00	29.10	7.88	8.45	10.8	14.92
Carbon Monoxide (CO)	1 hr 8 hrs	35 ppm (43 mg/m ³) 9 ppm (11 mg/m ³)	-	-	1 hr 8 hrs	10 mg/m ³ 5 mg/m ³	24Hours	1.00	1.34	0.96	1.11	1.21	0.41
Nitrogen Dioxide (NO ₂)	1 hr Annual Mea	100 ppb 100 ug/m ³ (53 ppb)	24Hour Annual Mean	25 ug/m ³ 10 ug/m ³	24 hrs Annual Mean	80 ug/m ³ 40 ug/m ³	24Hours	1.00	34.75	14.68	11.39	20.88	11.92
Ozone (O ₃)	8 hrs	0.07ppm (148 ug/m ³)	8 hrs daily maximum 8hr mean peak season	100 ug/m ³ 60 ug/m ³	1 hr	130 ug/m ³	24Hours	1.00	67.13	58.76	55.8	46.5	51.76
Total Particulate Matter (TSP)	-	-	-	-	24 hrs Annual Mean	500 ug/m ³ 360 ug/m ³	24Hours	0.01	180.19	331.54	283.08	298.67	328.71
Particulate Matter (PM ₁₀)	24 hrs	150 ug/m ³	24 hr Annual Mean	45 ug/m ³ 15 ug/m ³	24 hrs Annual Mean	150 ug/m ³ 120 ug/m ³	24Hours	1.00	97.49	161.80	157.42	162.71	158.80

Parameters	USEPA		WHO/IFC		PEQS		Monitoring Duration	LDL	AA01	AA02	AA03	AA04	AA05
	Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard							
Particulate Matter (PM _{2.5})	24 hrs Annual Mean	35 ug/m ³ 15 ug/m ³	24 hr Annual Mean	15 ug/m ³ 5 ug/m ³	1 hr 24 hrs Annual Average	15 ug/m ³ 35 ug/m ³ 15 ug/m ³	24Hours	1.00	21.52	55.88	51.68	44.58	60.08

*The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations.

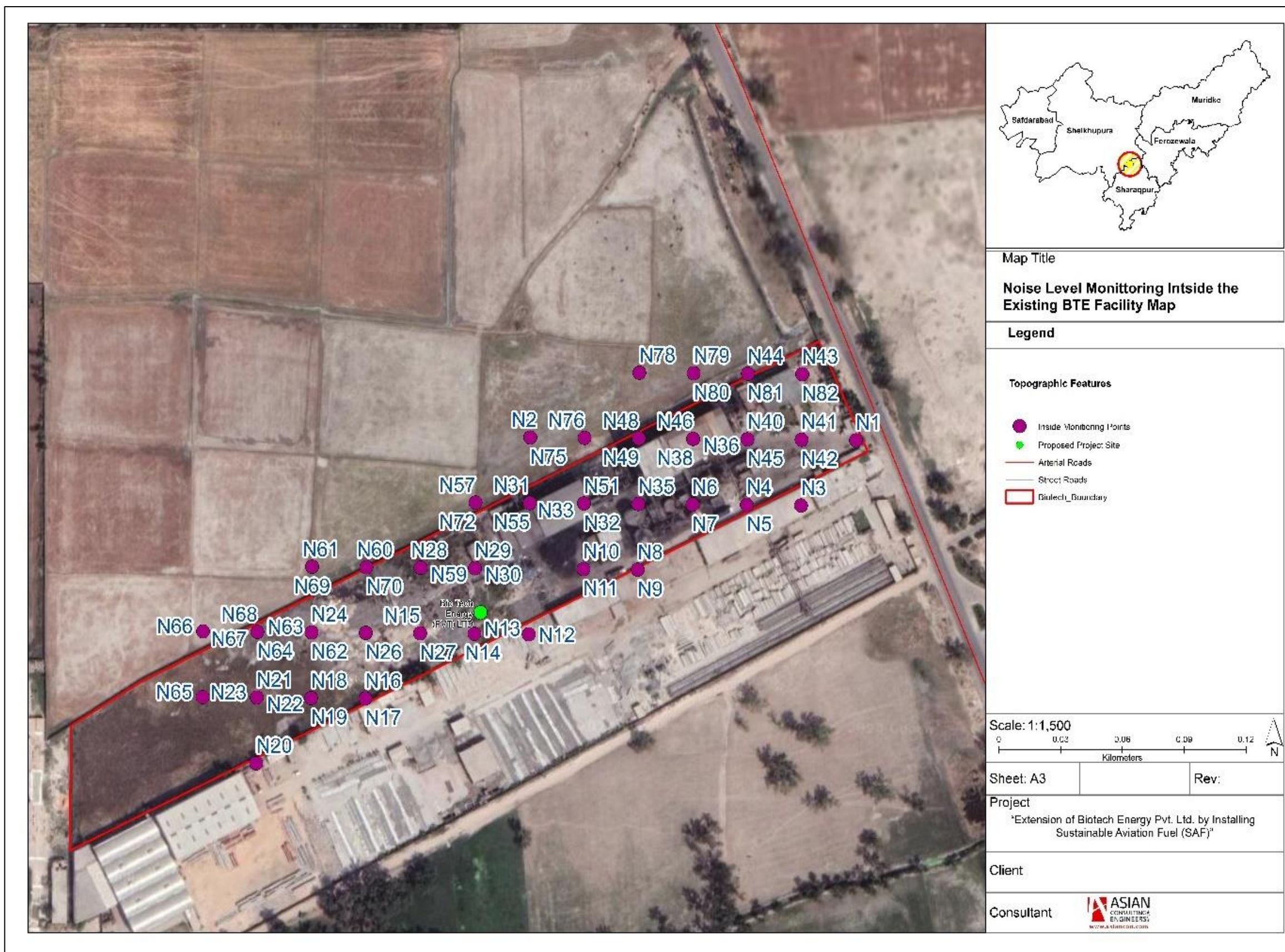
*The red bold values are above standard limits.

402. The analysis of the results shows that all parameters of ambient air quality comply, except PM_{2.5} and PM₁₀ in all samples are in non-compliance with respect to standard limits. The PM_{2.5} and PM₁₀ are generally high in ambient air of Lahore Division.

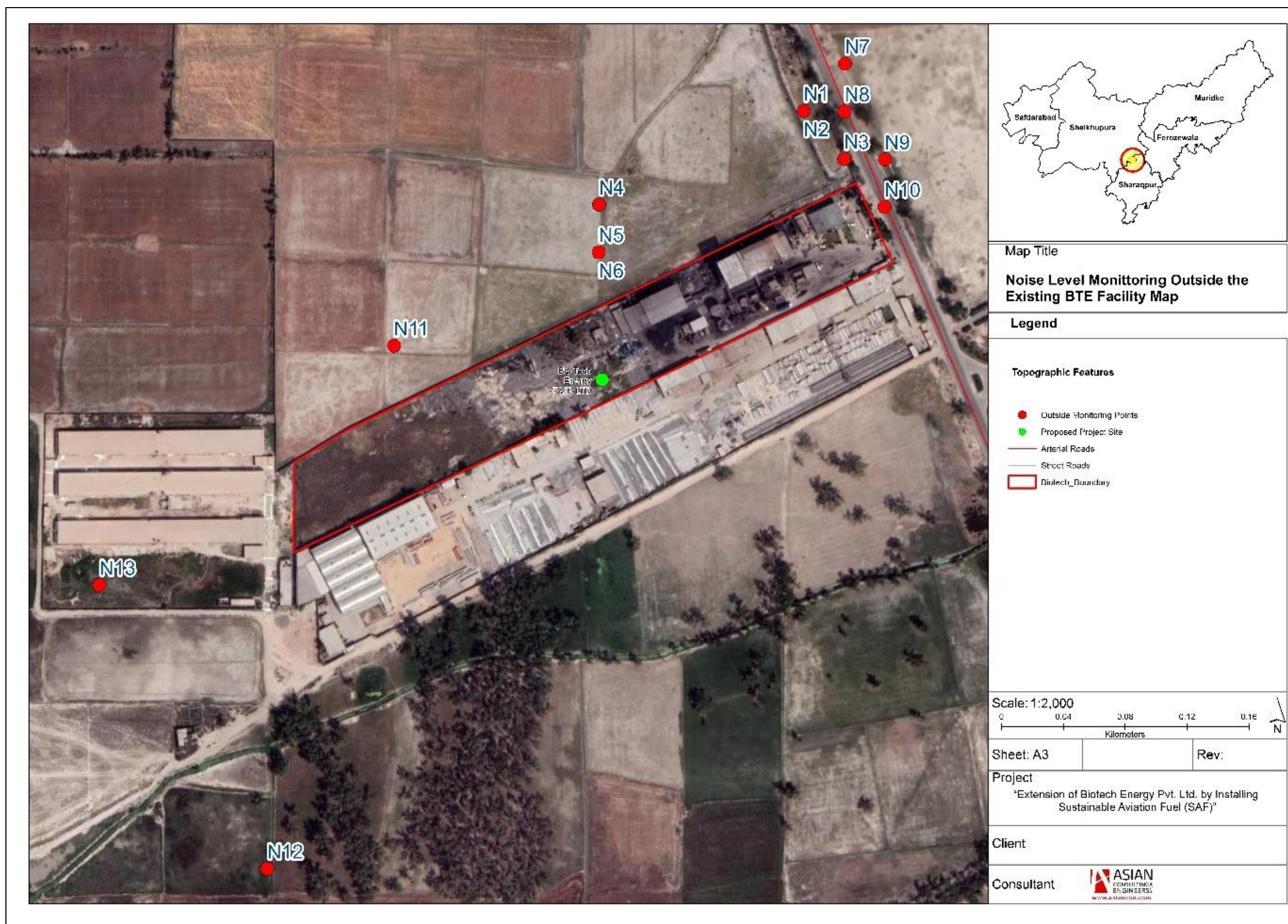
6.3.14 Noise

403. The baseline environmental monitoring for the proposed SAF (Sustainable Aviation Fuel) plant was conducted within a core zone area of 500 meters. The existing BTE plant operating under normal conditions was also considered as part of the baseline assessment for the proposed SAF plant. Continuous noise monitoring was performed during both day and night to meet the standards set by the International Finance Corporation (IFC) and the Pakistan Environmental Quality Standards (PEQS). Specific monitoring points were selected within the 500-meter core zone area and inside BTE during normal operation to capture baseline data on noise levels for the proposed SAF plants. The specific monitoring locations and details of the noise monitoring process are provided below: and reports are attached as **Annexure-13**.

404. Noise Level Monitoring Locations are provided below:



(inside the existing BTE Facility)



(outside the existing BTE Facility)

Figure 6-13: Noise Level Monitoring Locations

Table 6-7: Noise Levels at Project Site

Sr no.	Coordinates		Minimum dB(A)	Maximum dB (A)
N1	31° 35 55" N	74°3 27" E	52.4	62.8
N2	31° 35 55" N	74°3 27" E	55.2	67
N3	31° 35 54" N	74°3 28" E	60.5	67.7
N4	31° 35 53" N	74°3 22" E	63.2	68.2
N5	31° 35 52" N	74°3 22" E	64.8	67.2
N6	31° 35 52" N	74°3 22" E	64.1	68
N7	31° 35 56" N	74°3 28" E	67.2	86.4
N8	31° 35 55" N	74°3 28" E	61.7	77.6
N9	31° 35 54" N	74°3 29" E	58.5	76.5
N10	31° 35 53" N	74°3 29" E	74.6	81.6

Table 6-8: Noise Levels inside BTE Facility

Sr. No.	Coordinates		Minimum dB (A)	Maximum dB (A)
N1	31°35'52" N	74°3'29" E	55	67
N2	31°35'52" N	74°3'23" E	59	67
N3	31°35'51" N	74°3'28" E	72	85
N4	31°35'51" N	74°3'27" E	77	78
N5	31°35'51" N	74°3'27" E	73.1	73.4
N6	31°35'51" N	74°3'26" E	73.3	74.7

Sr. No.	Coordinates		Minimum dB (A)	Maximum dB (A)
N7	31°35'51" N	74°3'26" E	71.7	72.5
N8	31°35'50" N	74°3'25" E	72.5	72.9
N9	31°35'50" N	74°3'25" E	75.7	78.9
N10	31°35'50" N	74°3'24" E	73.1	73.8
N11	31°35'50" N	74°3'24" E	66.2	67.6
N12	31°35'49" N	74°3'23" E	65.7	67.2
N13	31°35'49" N	74°3'22" E	63.5	67.1
N14	31°35'49" N	74°3'22" E	62.5	64
N15	31°35'49" N	74°3'21" E	58.2	61.3
N16	31°35'48" N	74°3'20" E	53.1	58.7
N17	31°35'48" N	74°3'20" E	52.6	59.7
N18	31°35'48" N	74°3'19" E	55.4	55.4
N19	31°35'48" N	74°3'19" E	52.6	61.4
N20	31°35'47" N	74°3'18" E	53.3	65
N21	31°35'48" N	74°3'18" E	53.6	64.8
N22	31°35'48" N	74°3'18" E	54.8	60
N23	31°35'48" N	74°3'18" E	56.3	63.1
N24	31°35'49" N	74°3'19" E	57.8	65.5
N25	31°35'49" N	74°3'20" E	56.5	65
N26	31°35'49" N	74°3'20" E	58	65.6

Sr. No.	Coordinates		Minimum dB (A)	Maximum dB (A)
N27	31°35'49" N	74°3'21" E	58.4	77.2
N28	31°35'50" N	74°3'21" E	61.2	65.4
N29	31°35'50" N	74°3'22" E	67.3	74.9
N30	31°35'50" N	74°3'22" E	71.7	77
N31	31°35'51" N	74°3'23" E	73.2	79.9
N32	31°35'51" N	74°3'24" E	78.2	82
N33	31°35'51" N	74°3'24" E	91.2	92.2
N34	31°35'51" N	74°3'24" E	91	93.3
N35	31°35'51" N	74°3'25" E	76.4	77.5
N36	31°35'52" N	74°3'26" E	76.2	78.4
N37	31°35'52" N	74°3'26" E	74.2	75.3
N38	31°35'52" N	74°3'26" E	74.5	75
N39	31°35'52" N	74°3'26" E	74	76.3
N40	31°35'52" N	74°3'27" E	66.9	75.7
N41	31°35'52" N	74°3'28" E	59.9	73.3
N42	31°35'52" N	74°3'28" E	58.3	60.5
N43	31°35'53" N	74°3'28" E	55.9	66.3
N44	31°35'53" N	74°3'27" E	55.2	64.7
N45	31°35'52" N	74°3'27" E	59.4	68.3
N46	31°35'52" N	74°3'26" E	70.9	78.1

Sr. No.	Coordinates		Minimum dB (A)	Maximum dB (A)
N47	31°35'52" N	74°3'26" E	71.4	72
N48	31°35'52" N	74°3'25" E	82	86.2
N49	31°35'52" N	74°3'25" E	83.7	89.4
N50	31°35'52" N	74°3'25" E	85	85.9
N51	31°35'51" N	74°3'24" E	66.2	87.7
N52	31°35'52" N	74°3'26" E	80.9	85
N53	31°35'51" N	74°3'24" E	76.4	77.4
N54	31°35'51" N	74°3'24" E	79.9	81
N55	31°35'51" N	74°3'23" E	80	84.6
N56	31°35'51" N	74°3'23" E	77.5	86.5
N57	31°35'51" N	74°3'22" E	53.7	58.3
N58	31°35'51" N	74°3'24" E	54.7	64.7
N59	31°35'50" N	74°3'21" E	57.8	62
N60	31°35'50" N	74°3'20" E	53.5	63.2
N61	31°35'50" N	74°3'19" E	51.7	57
N62	31°35'49" N	74°3'19" E	51.4	59.1
N63	31°35'49" N	74°3'18" E	50.7	67.9
N64	31°35'49" N	74°3'18" E	52.6	63.3
N65	31°35'48" N	74°3'17" E	53.2	58.6
N66	31°35'49" N	74°3'17" E	55	57.3

Sr. No.	Coordinates		Minimum dB (A)	Maximum dB (A)
N67	31°35'49" N	74°3'18" E	55.1	64.3
N68	31°35'49" N	74°3'18" E	53.6	64.7
N69	31°35'50" N	74°3'19" E	55	64
N70	31° 35 50" N	74°3 20" E	54	56.6
N71	31° 35 50" N	74°3 21" E	56.8	62.6
N72	31° 35 51" N	74°3 22" E	67.7	68.4
N73	31° 35 51" N	74°3 23" E	82.1	82.6
N74	31° 35 51" N	74°3 23" E	90.3	91
N75	31° 35 52" N	74°3 23" E	80.8	83.9
N76	31° 35 52" N	74°3 24" E	76.4	78.6
N77	31° 35 52" N	74°3 25" E	78.2	80.1
N78	31° 35 53" N	74°3 25" E	84.1	85.5
N79	31° 35 53" N	74°3 26" E	82.4	83.9
N80	31° 35 53" N	74°3 26" E	65.6	67.5
N81	31° 35 53" N	74°3 27" E	63.8	65.6
N82	31° 35 53" N	74°3 28" E	63.1	67.6

405. The BTE facility has both high and low noise areas based on dBA levels. High-noise zones (above 75 dBA) include areas like N33, N34, and N49, where levels reach up to 93.3 dBA, suggesting these areas may require hearing protection. Low-noise areas, below 75 dBA, include locations such as N16 to N71, where exposure risks are minimal. This categorization aids in identifying sections where noise control may be necessary. More details are provided in Annex 7 C.

406. The noise levels range from a minimum of 52.4 dBA (N1) to a maximum of 86.4 dBA (N7). The highest noise levels are observed at N7- Road Side (86.4 dBA) and N10- Road Side in front of Gate- BTE (81.6 dBA), indicating significant noise concentration in these areas. Lower noise levels are recorded at N1 (52.4 dBA) and N2 (55.2 dBA) which points were taken in open area away from road side.

6.3.15 H2S Monitoring

407. H2S has been monitored at the existing biotech plant site using H2S gas detector. No traces of H2S have been detected in any location within the existing plant

6.3.16 Testing Team

408. All laboratory tests for water, noise and ambient air were conducted by Asian Environmental Services Private Limited which is certified laboratory form EPA-Punjab and also accredited by ISO 17025. The testing team of expertise is presented in **Table 6-9**.

Table 6-9: Testing Team

1	Ashir Shahbaz	Technical Manager	BS. Chemistry, University of The Punjab
2	Musharaf Jabeen	Deputy Technical Manager	MSc. Chemistry University of the Punjab, Lahore
3	Kashaf Amjad	Microbiologist	BS. Food science & Technology, University of Central Punjab
4	Umair Tallat	Field Analyst	BS. Environmental Engineering, University of Agriculture, Faisalabad
5	Anas Ali	Field Analyst	BS. Environmental Sciences, University of Okara
6	Faizan Ali	Field Analyst	BS. Environmental Sciences, University of Okara

6.4 Ecological Environment

409. A field assessment was carried out to understand the ecological environment in the project area. Published data and Research papers was used to screen out while secondary information was also collected from government officials, and residents of the area. This information will further enable us to gauge potential ecological resources within the AOC/AOI. The

project site comprises mostly agricultural vegetation with sparsely distributed natural vegetation. The ecological survey was conducted once during the spring season, specifically from February to March. This timing ensured the observation of flora and fauna during a period of active growth and activity, providing valuable insights into the ecological dynamics of the study area

6.4.1 Main objectives for Ecological surveys

6.4.1.1 Flora

- Identification of floral species, endangered as well as endemic species (if any), important habitats, forests area within the study area;
- Surveys to identify local, widespread floral species, any endangered or endemic species and protected species in the study area;
- Identification of any notified area under international conventions, and national or local legislation for their ecological, landscape, cultural, or other related values within the study site.

6.4.1.2 Fauna

- Identification of fauna (terrestrial and aerial) by direct sighting and through secondary means like nests, pug marks, droppings, etc.
- Identification and classification of species recognized as critically endangered, endangered, threatened, etc. as per IUCN Red List and scheduled species.²
- Identification of areas important for breeding, foraging, nesting, resting, or over-wintering areas includes migratory corridors/ avian migratory routes.
- Identification and assessment of aquatic fauna near the study area.

6.4.2 Methodologies for Ecological Survey

410. Studies were conducted to determine the land use and land cover, vegetation type³ and Secondary baseline data regarding sensitive ecological habitat (National Park, Sanctuary, Ecological Sensitive Area, Migratory Corridor, habitat of endangered, vulnerable and range-restricted species, etc.), flora & fauna in the AOC/AOI. Consultations were carried out with local people during site visits to understand major flora & fauna in the study area, the presence of any IUCN v2020-2 listed threatened species and Schedule I species or other species having conservation value and pressures on forest resources. The Flora and Fauna survey was conducted during the month of February 2024 with team of ecologists visited the project site AOC. The plants and animal species were observed, identified and recorded using standard biological methods. Further, the consultation with wildlife and forest department was conducted to have information about species of concern. In order to provide representative ecological status for the project a study area is defined for ecological study. The AOI/AOC defined for the project has been taken for the ecological study.

² www.tropicos.org (Flora of Pakistan).

³ Champion, H.G. and Seth, S.K. (1968) *A Revised Forest Types of India*. Manager of Publications, Government of India, Delhi

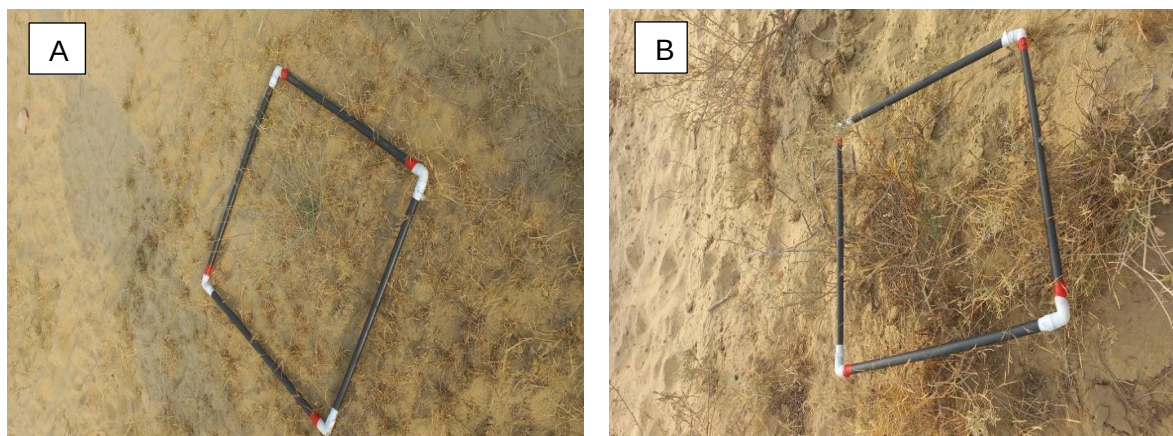
6.4.2.1 Flora surveys

411. Ecological surveys implemented various methods to analyze plant species within the Project's Area of Concern (AOC), referencing the Flora of Pakistan.⁴

6.4.2.2 Sample size and Vegetation Sampling

412. The sites are based on the presence of vegetation selected and surveys conducted. Transect walks were carried out for the study of flora. Within each sample plot, all plants were divided into four layers, i.e. tree, shrub, herb and grass layer, and we surveyed each of the layers. The size of the sample was 100 m² at each sampling site. A long measuring tape (25m) was laid across the stand in the communities under study and fixed with two hooks at two ends.⁵

413. The individual plants recorded touching the measuring tape and the distance from a particular end. For abundance and measurement 10×10m, quadrats were used for tree vegetation, 5×5m quadrats for shrubs and 1×1m were taken for herbs and grasses (**Figure 6-14**)⁶.



A and B Quadrat method in Project site for species abundance

Figure 6-14: Vegetation Sampling

6.4.3 The DAFOR Scale

414. The abundance of species in the project areas was determined using the DAFOR scale. Specifically, the Dominant, Abundant, Frequent, Occasional, Rare and Absent (the DAFOR) scale records the vegetative

⁴ Ali, S.I. and M. Qaisar. 1992-2007. *Flora of Pakistan*. Nos. 194-208. Department of Botany, University of Karachi and National Herbarium, PARC, Islamabad.

Ali, S.I. and Y.J. Nasir. 1990-92. *Flora of Pakistan*. No. 191-193. Department of Botany, University of Karachi and National Herbarium, PARC, Islamabad.

⁵ Fang, Jingyun & Shen, Zehao & Tang, Zhiyao & Wang, Xiangping & Wang, Zhiheng & Feng, Jianmeng & Liu, Yining & Qiao, Xiujuan & Wu, Xiaopu & Zheng, J. Chengyang. (2012). *Forest community survey and the structural characteristics of forests in China*. *Ecography*.

⁶ Sadia, Sehrish & Ahmad, Khawaja & Mehmood, Ansar & Nawaz, Fahim & Ahmed, Haroon & Hameed, Mansoor & Ahmad, Farooq & Rani, Wasifa & Abbasi, Arshad. (2021). *Plant resources and their uses in salt range, Pakistan*.

Sharma, P., Rana, J. C., Devi, U., Randhawa, S. S., & Kumar, R. 2014. *Floristic diversity and distribution pattern of plant communities along altitudinal gradient in Sangla Valley, Northwest Himalaya*. *The Scientific World Journal*, 2014.

cover of an area and represents the abundance of species.⁷

Table 6-10: The DAFOR Scale

Abundance (% age)	DAFOR Class	Abbreviation
51 – 100	Dominant	D
31 – 50	Abundant	A
16 – 30	Frequent	F
6 – 15	Occasional	O
1 – 5	Rare	R
0	Absent	X

6.4.4 IUCN Categories

415. The IUCN Red List Categories of Flora of Punjab visited to collect the relevant Data on the Flora of Punjab. An easily and widely understood system for classifying species at high risk of global extinction was used. The general aim of the system is to provide an explicit, objectives framework for the classification of the broadest range of species according to their extinction risk. However, while the Red Data List may focus attention on those taxa at the highest risk, it is not the sole means of setting priorities for conservation measures for their protection. The following categories are proposed in the IUCN Red Data Listing (IUCN, 2021)

Extinct (EX)

416. A taxon is Extinct when there is no reasonable doubt that the last individual has died.

Extinct in the Wild (EW)

417. A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity, or as a naturalized population (or populations) well outside the past range. A taxon is presumed extinct in the wild if exhaustive surveys in its known habitat in its historical range have failed to record an individual.

Critically Endangered (CE)

418. A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

- Range reduction of 80% over 3 generations or 10 years;
- Occurrence of less than 100sq km or occupancy of less than 10sq km and decline in populations;
- Less than 250 plants and decline;
- Less than 50 matured plants;

⁷ Hearnshaw, E. J., & Hughey, K. F. 2010. A tolerance range approach for the investigation of values provided by Te Waihora/Lake Ellesmere. Lincoln University, Christchurch.

- The probability of extinction of 50% in 10 years or 3 generations.

Endangered (EN)

419. A taxon is endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

- A. Range reduction of 50% over 3 generations or 10 years;
- B. Occurrence of less than 5,000 km or occupancy of less than 500 Sq. km and decline in populations
- C. Less than 2,500 plants and decline;
- D. Less than 250 mature plants;
- E. The probability of extinction of 20% in 20 years or 5 generations.

Vulnerable (VU)

420. A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

- A. Range reduction of 20% over 3 generations or 10 years;
- B. Occurrence of less than 20,000 Sq. km or occupancy of less than 2,000 Sq. km and decline in
- C. Less than 10,000 plants and decline;
- D. Less than 1 000 mature plants, or low occupancy (<100km²), or less than 5 locations;
- E. The probability of extinction of 10% in 100 years.

Lower Risk (LR)

421. A taxon is Lower Risk when it has been evaluated and does not fall into the categories of Critically Endangered, Endangered, or Vulnerable. There are three subcategories:

Conservation Dependent (CD)

422. Taxa which are the focus of a continuing conservation program, and which would become threatened if such actions stopped.

Near Threatened (NT)

423. Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

Least Concern (LC)

424. Taxa, which do not qualify for Conservation Dependent or Near Threatened.

Data Deficient (DD)

425. A taxon is Data Deficient when there is inadequate information to make an assessment based on its distribution and population status.

Not Evaluated (NE)

426. A taxon is Not Evaluated when it has not been assessed against the

criteria.

6.4.5 Fauna Surveys

427. Surveys were conducted in the month of February 2024 for the study of the fauna of the Project site. An active search method was adopted whereby debris, logs, wetlands and ponds searched for reptiles and amphibians for signs such as shed skin. Therefore, the survey primarily focused on the search for indirect evidence through active searching. Direct observations were also done during the survey using Roberts, T.J (2005), for the identification key and distribution of species. In consideration of the hibernation period, the interviews with local people were conducted regarding the variety and abundance of the reptiles and amphibian's species in AOC/AOI. The interview data served as the secondary source to confirm the presence of these species.

6.4.6 Results

6.4.6.1 Types of Habitats in AOC

428. As per IFC, habitats are divided into - Natural, Modified, or Critical for the purpose of implementation of IFC Performance Standard-6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources). Critical habitats are subsets of Natural habitats. Two types of habitats in AOC were found in AOC described below:

6.4.6.2 Natural and Critical Habitats

429. The AOI did not contain any natural or critical habitats. This indicates the absence of ecologically sensitive zones requiring special conservation measures within the surveyed region

430. This type of vegetation is extensively found in cultivated and non-cultivated lands, located within the study area. This type of land is grown by

6.4.6.3 Modified Habitat- Agriculture Field

431. The Area of Interest (AOI) is classified as a modified habitat, primarily shaped by agricultural activities. Major crops cultivated in the region include wheat (*Triticum aestivum*), oat (*Avena sativa*), sorghum (*Sorghum vulgare*), and rice (*Oryza sativa*). Abandoned agricultural fields and barren lands are typically overgrown with thorny shrubs, predominantly *Prosopis juliflora*. This species is utilized by local communities for charcoal production, using its mature logs.

432. Tall trees are generally absent or sparsely distributed within the AOI. However, solid wood thorny species such as *Acacia nilotica*, *Prosopis juliflora*, *Dalbergia sissoo*, and *Eucalyptus* species are commonly observed in open areas.

6.4.6.4 Establishing ecological hot spots and Critical Habitats of AOC

433. A database review was conducted to determine the presence of any hot spots or sightings around the project area. All with available literature reviews, research papers, websites, and consultation with forest and wildlife

department about bird distribution and abundance were used. Through this review, it was established that there were no forest areas around the project area and there were no hot spots around the project area as well.

434. According to IFC Note-6 guidelines⁸ of Critical habitats and critical species, none of the flora and fauna species has been evaluated as critical habitat triggers from the AOC of the project site. In this regard, the Wildlife Department of Punjab was consulted about any critical or endangered species in the area of Concern (AOC) and no species qualified for that criterion.

6.4.6.5 Flora of the AOC

435. Species belonging to 16 families reported 55 plant species from the project site and adjacent areas⁹. Among them, 16 tree species, 09 shrubs, 20 herbs and 10 grass species were found. *Acacia modesta*, *Dalbergia sissoo* and *Albizia lebbek*, *Phoenix dactylifera*, *Prosopis juliflora* and *Tamarix aphylla* were common trees. *Capparis decidua*, *Ziziphus nummularia*, *Calotropis procera*, *Parthenium hysterophorus*, *Convolvulus arvensis*, *Achyranthes aspera* and *Citrullus colocynthus* were commonly found herb and shrub species. *Arundo donax*, *Aristida depressa*, *Eleusine indica*, *Cynodon dactylon* and *Saccharum munja* were common grasses. (Table 6-11 to Table 6-14 and Figure 6-15).

Table 6-11: Tree Diversity

TREES					
Sr. No.	Scientific Names	Common Names	Families	DAFOR Scale	IUCN Red List Status
1	<i>Acacia nilotica</i>	Wild Acacia	Fabaceae	F	NE
2	<i>Acacia modesta</i>	Small Acacia	Fabaceae	A	NE
3	<i>albizia lebbek</i>	Siris	Fabaceae	R	NE
4	<i>Azadirachta indica</i>	Neem tree	Malvaceae	O	LC
5	<i>Callistemon lanceolatus</i>	Bottlebrush	Myrtaceae	O	NE
6	<i>Dalbergia sissoo</i>	Indian rosewood	Fabaceae	F	LC
7	<i>Eucalyptus camaldulensis</i>	Eucalyptus	Myrtaceae	D	NT
8	<i>Ficus virens</i>	Wild Fig	Moraceae	R	LC
9	<i>Ficus religiosa</i>	Sacred fig	Moraceae	R	NE
10	<i>Melia azedarach</i>	Chinaberry tree	Malvaceae	O	LC
11	<i>Morus alba</i>	Mulberry	Moraceae	O	LC
12	<i>Phoenix dactylifera</i>	Dates	Arecaceae	O	LC

⁸ IFC (International Finance Corporation) 2012, (Updated 2019). Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

⁹ Afzal, A. Jabeen, M. Nawaz, and S.S. Ahmad, I (2014) "Vegetation classification and its response to soil organic matter along Simly Lake using ordination technique". Int. J. Sci. & Eng. Res., Volume 5, Issue 11, pp. 1286-1289.

Sadia, Sehrish & Ahmad, Khawaja & Mehmood, Ansar & Nawaz, Fahim & Ahmed, Haroon & Hameed, Mansoor & Ahmad, Farooq & Rani, Wasifa & Abbasi, Arshad. (2021). Plant resources and their uses in salt range, Pakistan

TREES					
Sr. No.	Scientific Names	Common Names	Families	DAFOR Scale	IUCN Red List Status
13	<i>Prosopis cineraria</i>	Jand	Fabaceae	O	NE
14	<i>Prosopis juliflora</i> *	Mesquite	Fabaceae	F	NE
15	<i>Tamarix aphylla</i>	Athel tree	Tamaricaceae	O	NE
16	<i>Ziziphus jujuba</i>	Jujube	Rhamnaceae	F	LC
* = Invasive, D = Dominant, A= Abundant, F= Frequent, O = Occasional and R=Rare X= Absent. IUCN Red List Status: LC=Least Concern, NE=Not Evaluated DD= Data Deficient					

Table 6-12: Shrubs Diversity

SHRUBS					
Sr. No.	Scientific Names	Common Names	Families	DAFOR Scale	IUCN Red List Status
1	<i>Abutilon indicum</i>	Abutilon	Malvaceae	F	NE
2	<i>Alhagi maurorum</i>	Alhagi	Fabaceae	F	NE
3	<i>Calotropis procera</i>	Apple of sodom	Apocynaceae	A	NE
4	<i>Capparis decidua</i>	Karira	Capparaceae	A	DD
5	<i>Nerium oleander</i>	Kaner	Apocynaceae	F	LC
6	<i>Suaeda fruticosa</i>	Suaeda	Amaranthaceae	F	LC
7	<i>Ricinus communis</i>	Arind	Euphorbiaceae	O	NE
8	<i>Xanthium strumarium</i>	devil fruit	Solanaceae	O	LC
9	<i>Ziziphus nummularia</i>	Lotebush	Rhamnaceae	A	NE
* = Invasive, D = Dominant, A= Abundant, F= Frequent, O = Occasional and R=Rare X= Absent. IUCN Red List Status: LC=Least Concern, NE=Not Evaluated DD= Data Deficient					

Table 6-13: Herbs Diversity

HERBS					
Sr. No.	Scientific Names	Common Names	Families	DAFOR Scale	IUCN Red List Status
1	<i>Achyranthes aspera</i>	Devil's horsewhip	Amaranthaceae	F	NE
2	<i>Aerva javanica</i>	kapok bush	Amaranthaceae	O	NE
3	<i>Ageratum conyzoides</i>	Ageratum	Asteraceae	R	NE
4	<i>Alternanthera sessilis</i>	Joyweed	Amaranthaceae	A	LC
5	<i>Amaranthus viridis</i>	Slender amaranth	Amaranthaceae	F	NE
6	<i>Anagallis arvensis</i>	scarlet pimpernel	Primulaceae	F	LC
7	<i>Atriplex vesicaria</i>	Atriplex	Amaranthaceae	O	LC
8	<i>Carthamus oxyacantha</i>	Thistle	Asteraceae	O	LC
9	<i>Cirsium arvense</i>	Lay	Asteraceae	R	LC
10	<i>Convolvulus arvensis</i>	Convolvulus	Convolvulaceae	F	NE
11	<i>Conyza canadensis</i>	Fleabane	Asteraceae	O	NE
12	<i>Citrullus colocynthus</i>	Bitter cucumber	Cucurbitaceae	F	NE
13	<i>Datura innoxia</i>	Datura	Solanaceae	F	NE
14	<i>Echinops echinatus</i>	Globe Thistle	Asteraceae	O	NE
15	<i>Euphorbia prostrata</i>	Prostrate sandmat	Euphorbiaceae	R	NE
16	<i>Helianthus petiolaris</i>	Prairie Sunflower	Asteraceae	O	LC
17	<i>Oxalis corniculata</i>	Oxalis	Oxalidaceae	O	NE
18	<i>Parthenium hysterophorus*</i>	Parthenium	Asteraceae	F	NE
19	<i>Solanum xanthocarpum</i>	Yellow berry	Solanaceae	F	NE
20	<i>Trianthema portulacastrum</i>	It sit	Euphorbiaceae	O	NE

* = Invasive, D = Dominant, A= Abundant, F= Frequent, O = Occasional and R=Rare X= Absent. IUCN Red List Status: LC=Least Concern, NE=Not Evaluated DD= Data Deficient

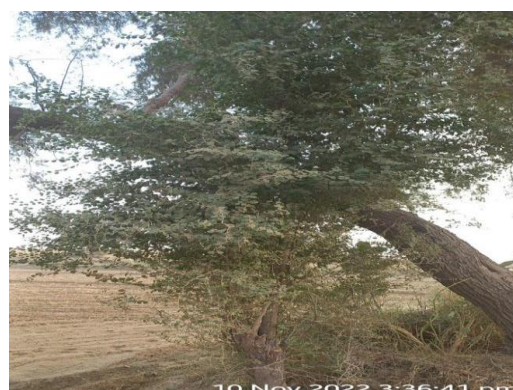
Table 6-14: Grasses Diversity

Grasses					
Sr. No.	Scientific Names	Common Names	Families	DAFOR Scale	IUCN Red List Status
1	<i>Arundo donax</i>	Giant reed	Poaceae	F	LC
2	<i>Aristida depressa</i>	<u>Wiregrasses</u>	Poaceae	A	LC
3	<i>Cenchrusbiflorus</i>	Bhurrand	Poaceae	F	LC
4	<i>Cenchrus ciliarus</i>	Cenchrus	Poaceae	A	NE
5	<i>Cynodon dactylon</i>	Dub grass	Poaceae	A	NE

Grasses					
Sr. No.	Scientific Names	Common Names	Families	DAFOR Scale	IUCN Red List Status
6	<i>Eleusine indica</i>	Crows feet	Poaceae	F	LC
7	<i>Phragmites karka</i>	Common reed	Poaceae	A	LC
8	<i>Poa annua</i>	Poa grass	Poaceae	O	LC
9	<i>Saccharum munja</i>	Munj sweetcane	Poaceae	F	NE
10	<i>Saccharum spontaneum</i>	Wild sugar	Poaceae	O	LC
* = Invasive, D = Dominant, A= Abundant, F= Frequent, O = Occasional and R=Rare X= Absent. IUCN Red List Status: LC=Least Concern, NE=Not Evaluated					



A) Acacia modesta



B) Ziziphus jujuba



C) Phoenix dactylifera



D) Calotropis procera



E) *Saccharum munja*



F) *Alhagi maurorum*



G) *Eucalyptus* sp.



H) *Triticum aestivum*

Figure 6-15: Diversity of Floral Species BTE Site

6.4.6.6 Fauna of AOC

436. The fauna species were observed and recorded at and around the project site. A total of sixteen bird species, ten mammal species, five reptiles, two amphibians, three fishes and three grazing mammal species were observed. The common birds include Common Myna, Laughing Dove, Common Quail, and Collared-Dove, Cattle egret, Indian Robin, Indian Roller, House crow, Black partridge, Common Babbler and Grey partridge. Dogs, Donkeys, squirrels, Jackals and mongoose were common mammals. Some species of birds, amphibians and reptiles were also noted (**Table 6-15** and **Figure 6-16**).

Table 6-15: Fauna of AOC

Scientific Names	Common Names	IUCN Status	Scientific Names	Common Names	IUCN Status
BIRDS			MAMMALS		
<i>Acridotheres tristis</i>	Common Myna	LC	<i>Vulpes vulpes</i>	Red Fox	LC
<i>Spilopelia senegalensis</i>	Laughing Dove	LC	<i>Bos Taurus</i>	Cow	LC
<i>Alcedo atthis</i>	Common Kingfisher	LC	<i>Canis aureus</i>	Golden jackal	LC
<i>Coturnix coturnix</i>	Common Quail	LC	<i>Canis familiaris</i>	Dog	LC
<i>Streptopelia decaocto</i>	Collared-Dove	LC	<i>Equus asinus</i>	Donkey	LC
<i>Bubulcus ibis</i>	Cattle egret	LC	<i>Felis catus</i>	Cat	LC
<i>Centropus sinensis</i>	Greater or Brown Coucal	LC	<i>Funambulus palmarum</i>	Indian squirrel	LC
<i>Copsychus fulicatus</i>	Indian Robin	LC	<i>Herpestes edwardsi</i>	Mongoose	LC
<i>Corvus splendens</i>	House crow	LC	<i>Rattus rattus</i>	Common rat	LC
<i>Dicrurus macrocercus</i>	Black drongo	LC	<i>Sus Scrofa</i>	Wild Boar	LC
<i>Eudynamys scolopaceus</i>	Asian koel	LC	AMPHIBIANS		
<i>Francolinus francolinus</i>	Black partridge	LC	<i>Hoplobatrachus tigerinus</i>	Indian Bull Frog	LC
<i>Argya caudata</i>	Common Babbler	LC	<i>Duttaphrynus melanostictus</i>	Asian Toad	LC
<i>Ortygornis pondicerianus</i>	Grey partridge	LC	FISHES		
<i>Passer domesticus</i>	House Sparrow	LC	<i>Gibelion catla</i>	Thaila	LC
<i>Pycnonotus cafer</i>	Red-vented bulbul	LC	<i>Channa punctata</i>	Daula	LC
REPTILES			<i>Labeo rohita</i>	Rahu	LC
<i>Hemidactylus frenatus</i>	Common house gecko	LC	GRAZING MAMMALS		
<i>Anguis fragilis</i>	Slow worm	LC	<i>Bos Taurus</i>	Cow	LC
<i>Bungarus caeruleus</i>	Common krait	LC	<i>Capra hircus</i>	Domestic goat	LC
<i>Urosaurus ornatus</i>	Tree lizard	LC	<i>Equus asinus</i>	Donkey	LC
<i>Testudines spp.</i>	Turtle	LC			



a) Common Myna



b) Tree lizard



c) Hare



d) Common rat



e) Laughing Dove



f) Turtle



g) Indian squirrel



h) House Sparrow

Figure 6-16: Diversity of Fauna at Project site (AOC)

6.4.7 Major Crops

437. Major crops of Sheikhpura district are sugarcane, wheat, rice, and guava. A variety of vegetables is also grown in the district. Cultivated area details are not available, however, assumed to be in the same range as the Kasur District. The local agri-production drives the local small and medium industries and contributes to the export of rice, fructose, corn oil, and vegetable ghee.

6.4.8 Endangered, Critically Endangered and Vulnerable Species

438. No endangered or critically endangered and vulnerable species were observed near the proposed project Area of Concern.

6.5 Socio-Economic and Cultural Environment

439. This section addresses the socio-economic and cultural aspects of the project area (AOI). The available reports and documents were thoroughly examined during the desk study. A group of specialists conducted on-site visits to assess the proposed project of “Establishment of Sustainable Aviation Fuel (SAF) Facility”, gathering baseline data from both directly and indirectly affected individuals including perspectives related to SAF plant. The information revealed in this report aids the project planners, local authorities, and policymakers in making informed decisions to ensure the adequacy and suitability of the proposed project.

6.5.1 Objectives

440. The basic objectives of the social surveys were to:

- Get the primary data from the various sources.
- Informed people about the objective and purpose of the proposed project.
- Understand the specific needs and concerns of the local community regarding the construction of the proposed project.
- Identify the potential impacts associated with the implementation of the proposed project.
- Assess the potential health and safety risks posed by the SAF plant, such as air and water pollution, noise, smell, traffic congestion, and occupational hazards.
- Identify opportunities for capacity building and skills development within the local community to enhance their ability to participate in and benefit from the proposed project.
- Get feedback from the community about the project-related social issues.
- And address the mitigation measures for the social issues in the report.

6.5.2 Methodology

441. A socio-economic survey of the settlements around the project area was conducted by a team of experts using a specific methodology which is described and discussed in this section. The methodology, underlying principles, and practices adopted for the survey were designed to ensure that

accurate and comprehensive data could be collected, that would accurately reflect the true socio-economic characteristics of the respondents. A Socio-economic Performa is attached as **Annexure -05**.

6.5.2.1 Data Collection

442. Data collection is a process that requires careful planning and implementation to ensure the accuracy and reliability of the collected information. Without proper data collection, the decision-making process becomes compromised and may lead to suboptimal outcomes. For the proposed project, both Quantitative and Qualitative Data collection techniques were used. Data collection for the socioeconomic study of the proposed project involved Primary Data for the socio-economic baseline study and Secondary Data to know the latest statistics of the project area. Primary data was collected through Surveys, Focus Group Discussions and Interviews. The number of participants and data collection methods are shown in the Table.

Sr. No.	Primary Data Method	Details	No. of Participants
1.	Surveys	General Population of AOI	69
2.	Focus Group Discussions	1 session with 8 BioTech Energy workers/laborers	42
		2 sessions with women (14 and 20 participants, respectively)	
3.	Interviews	6 senior officials and 4 junior managers at BioTech Energy Unit	18
		8 farmers	

6.5.2.2 Population

443. For the proposed project area, the population statistics were derived using GIS (Geographic Information System) calculations. According to the GIS-derived estimates, the population of the AOC is approximately 29,010 individuals.

6.5.2.3 Villages in the AOI / AOC

444. The following villages were identified within a 05-km radius of the proposed project site:

- Chah Shaduwala
- Chak 10
- Chak 07
- Chak 09
- Chak 11
- Dhamoke
- Bhag Dhanisher

- Jhanda
- Chak 17
- Kurlike
- Chak 18
- Chak 19
- Mudwala Kalaan
- Mudwala Khurd
- Ghazi Andrun
- Khera
- Budho
- Marh Bhangwan

6.5.2.4 Survey Sample

445. When conducting a project survey, it is crucial to determine the appropriate sample size in order to ensure that results are statistically significant and reliable. For the proposed project survey, the sample size of 69 individuals were determined using the online Standard Statistical Calculator with a confidence level of 90% and a confidence interval (Margin of Error) of 10%. The respondents were selected through Simple Random Sampling, a type of Probability Sampling technique that ensures each individual in the population has an equal chance of being selected.

6.5.2.5 Surveys, Focus Group Discussions (FGDs) and Interviews

446. Initially, a reconnaissance (preliminary) survey was conducted by the team of experts then comprehensive field surveys were carried out afterwards.

447. Data from the respondents was collected using interview Schedule technique. A total of 69 questionnaires were designed to collect baseline data on demographic and socio-economic indicators. In addition, extensive Consultations and Focus Group Discussions (FGDs) were conducted during the socio-economic survey in order to inform individuals about project-related activities and to record their opinions. Furthermore, interviews were conducted with senior BioTech officials and workers to assess the occupational health and safety conditions for employees. Inform individuals about project-related activities and to record their opinions. Additionally, direct observations were also conducted to record the behavior and interactions of the participants in the study.

448. During the survey, participants were asked for information regarding their Demographic characteristics including name, age, location, education level, language, marital status, and caste, etc.

449. In the Occupation and Income section of the survey questionnaire, respondents were asked about their occupation, income, and expenditure.

450. In the Housing Condition Part, the ownership status of houses and the

type of construction were assessed.

451. In the Health section of the survey, the questionnaire included questions on facilities like health services, common diseases, and waterborne diseases, etc.
452. The infrastructure present in the Project Area part of the survey questionnaire sought information from respondents regarding amenities such as water supply, electricity, sewerage/drainage system, and telephone facilities, etc.
453. Other indicators assessed included mode of transportation, women's participation and decision-making, educational services, sources of drinking water, and home appliances etc.

6.5.2.6 Area of Concern (AOC) / Area of Influence (AOI)

454. The Area of Concern (AOC) encompasses the geographical area directly affected by the construction and operations of the SAF plant. This includes the 05-kilometer radius around the immediate vicinity of the proposed plant site as well as surrounding areas that may experience environmental, social, and economic impacts as a result of the project. Thus, most of the respondents included in the survey were selected from within a 05-kilometer radius from where the project is set to be located. The following settlements, industries, farmhouses, and commercial establishments were identified within a 05-km radius of the proposed project site:

- Chah Shaduwalla
- Chak 10
- Chak 07
- Chak 09
- Chak 11
- Dhamoke
- Bhag Dhanisher
- Jhanda
- Aghosh Al-Khidmat Foundation
- Nagina Kids Campus School (Non-Functional)
- MFTC Research Farm
- Ittefaq Group
- Prosperity Weaving Mills
- Muhammadan Educational Complex
- Shahzad Farms
- Chak 17
- Rana Mukhtar Agriculture Farm
- Dera Haji Karamat
- Dera Irshad Solgi
- Labbaik Filling Station

- Wahdat Industrial Services Pvt. Ltd
- Kurlike
- Chak 18
- Chak 19
- Mudwala Kalaan
- Mudwala Khurd
- Ghazi Andrun
- Khera
- Budho
- Marh Bhangwan
- Kaapi
- Chadhar Agricultural Model Farm
- Etihad solvent plant Pvt. Ltd
- PESSI Social Security Emergency Centre Rupafil

6.5.2.7 Analysis

455. In order to quantify the existing baseline conditions of the study area, collected data was digitized and analyzed by using Statistical Package for Social Sciences (SPSS) software and Microsoft Excel because they offer quicker and easier access to basic functions and are also useful for obtaining precise and accurate baseline data results.

6.5.3 Secondary Data Analysis

6.5.3.1 Socio-economic Environment of Project Area

456. The proposed project is situated in the industrial area of Sheikhpura District, within Lahore Division, which falls under Punjab Province. The estimated number of households present in the project area (AOI) is 4144 houses with an average household size of 7 individuals. The nearest settlements/villages within the AOI are shown below:



Figure 6-17: Distance of Nearby Villages/Settlements from the project Site (AOI)

457. The proposed project is situated around industries, farmhouses, welfare organizations, and residential areas, making it a prime location for economic growth and development. Furthermore, the project's proximity to major transportation route, that is the Grand Trunk Road (GT Road), a major highway in Pakistan, passes through the district, connecting it to other major cities such as Lahore, Islamabad, and Peshawar and industrial infrastructure enhances its potential for success in attracting businesses and promoting job creation.
458. Convenient transportation option connects the project area to other cities and towns through an established road network, including buses and private vehicles that are widely utilized for commuting purposes.
459. Project area is an economically significant area with a diverse socio-economic environment. The project region is known for its fertile agricultural land, producing a variety of crops including wheat, rice, sugarcane, maize, and vegetables. Among the fruits, leechi, and guava are also sources of income for the agriculture community. A significant portion of its population derives their livelihood from farming and related activities.
460. Project area is also home to several industrial zones and manufacturing facilities. Industries in the project area include textile and weaving mills, rice and processing mills, bricks companies, chemicals, pharmaceuticals, and ceramics. These industries play a vital role in generating employment opportunities in the project area.
461. The project area is characterized by a strong presence of Punjabi culture. Inhabitants of this area come from diverse backgrounds, with the majority belonging to low-income and middle-income socioeconomic classes, although there are also some individuals from higher income brackets. The most prevalent dress style among the people in the project area is Shalwar Kameez. Traditional attire is commonly worn by females, who often embellish their outfits with ornamental accessories as well.

6.5.3.2 Political and Administrative Setup

462. The designated project site is situated at 14-Km, Sheikhpura-Sharakpur road, District Sheikhpura which is a part of the province of Punjab in Pakistan. The political setup includes representation at various levels of government such as the National Assembly, Provincial Assembly and Local Government.
463. Project area has an administrative setup as well. At the district level, project area is administered by the Deputy Commissioner (DC), who is responsible for overseeing various administrative functions and implementing government policies.

Law enforcement in the project area is primarily the responsibility of the district police, headed by a District Police Officer (DPO). The police force maintains law and order, prevents crime, and ensures public safety.

6.5.3.3 Industries in the Project Area

464. Project area is home to a diverse range of industries, contributing significantly to the areas's economy and providing employment opportunities to its residents. The industries present in the AOC/AOI are:

- Ittehad Solvent Plant
- Ittefaq Precast
- Prosperity Weaving Mills
- Wahdat Industrial Services Pvt.
- Cheema Rice and Processing Mills
- Rupafil Limited
- Ch. Sabar Hussain Dhilllo Bricks Company
- Chaman Dhilllo Bricks Company
- Levon Pharmaceuticals
- Sahil Ceremics
- Al-Noor Bricks Company
- Shah Jahan Rice Mills

6.5.3.4 Forced Labor

465. Forced labor, also known as involuntary servitude refers to any work or service that people are forced to do against their will, under threat of punishment. It's a form of exploitation where individuals are coerced to work through violence, intimidation, or other forms of coercion. Forced labor is a violation of human rights and is prohibited under international law. The International Labor Organization (ILO) and other organizations work to combat forced labor through advocacy, awareness-raising, and policy initiatives.

466. The proposed project firmly prohibits forced labor and requires that all workers must be treated with dignity and ensured fair wages and safe working conditions. This commitment to eradicating forced labor and promoting fair treatment aligns with international labor standards and demonstrates a commitment to upholding human rights.

1. Child Labor

467. Child labor refers to the employment of children in any work that deprives them of their childhood, potential, and dignity, and is harmful to their physical and mental development. Child labor is a violation of children's rights and is detrimental to their well-being, education, and prospects. It perpetuates cycles of poverty and inequality, as children who are engaged in labor are often deprived of opportunities for education and skill development. It's a widespread issue, particularly in developing countries, where poverty, lack of access to education, and weak enforcement of child labor laws

contribute to its prevalence.

468. Child labor in Pakistan affects an estimated 3.3 million children, with their involvement spanning various sectors. Approximately 60% of these children work in agriculture, performing tasks like farming and livestock care. Around 20% are engaged in industries such as brick kilns, carpet weaving, and garment production, where they face hazardous and exploitative conditions. The services sector, including restaurants, employs about 15% of child laborers, with children working long hours in tasks like dishwashing, cleaning, and food preparation, often at the cost of their education. The remaining 5% are involved in street work, such as vending, scavenging, and begging. Poverty, lack of enforcement of child labor laws, and limited access to education perpetuate this issue, demanding urgent intervention¹⁰.
469. As per the preliminary supply chain survey, the team identified instances of child labor, but the data gathered did not yield concrete figures of the current situation. However, secondary data sources offer more insights into the extent of child labor.

6.5.3.5 Rescue Services

470. The rescue services (fire brigade, paramedics, and ambulance services), also known as Rescue 1122, are present 15-km away from the proposed project site. In the AOI, there are two hospitals present.

6.5.4 Primary Data Analysis

6.5.4.1 Indigenous Groups

471. According to the World Bank Definition, "Indigenous Peoples are distinct social and cultural groups that share collective ancestral ties to the lands and natural resources where they live, occupy or from which they have been displaced". For example, the native people of Kalash, and Makaran. They have a unique relationship and connection to their traditional territories, often based on spiritual, economic, and social practices that have sustained them for generations.
472. During the survey, no indigenous group of people has been identified in the project area.

6.5.4.2 Vulnerable Groups

473. A vulnerable person is someone more likely to face adverse impacts from a project or face challenges due to his/her particular characteristics, circumstances, or conditions. This may include individuals with disabilities, economically disadvantaged, elderly women, widows, transgender, homeless, displaced children, and households headed by women. These individuals may face greater difficulties in accessing resources, fulfilling their basic needs, and exercising their rights.
474. The present survey identified two widows, ten low-income households, and fourteen women (due to their rural living conditions) as vulnerable groups

¹⁰ RSIL Pakistan - Pakistan's Socioeconomic Problems and Child Labour

within the Area of Interest (AOI). However, their vulnerability is not due to the result of the project activities. Nevertheless, the proposed project would suggest targeted interventions and support mechanisms through its Corporate Social Responsibility (CSR). These efforts could help uplift and empower vulnerable individuals, fostering sustainable community development in the AOI.

6.5.4.3 Security and Conflicts

475. Conflict in a proposed SAF plant project can arise from a variety of internal and external drivers.

1. Internal Drivers of Conflict

476. Conflict of interest related to ethnic and religious minorities would not be a concern, as no specific ethnic or religious groups are identified. Additionally, there is no land acquisition, no loss of livelihoods and resettlement issues, therefore,

477. Concerns related to conflicts of interest involving ethnic and religious minorities are not applicable in this context, as there are no specific ethnic or religious groups identified. Furthermore, there is no indigenous community involved, nor any issues pertaining to land acquisition, livelihood loss, or resettlement. Additionally, there is no impact on health due to pollution. Therefore, no conflict of interest will arise.

6.5.4.4 Demographic Profile

478. A demographic profile or information is the gathering of data about individuals concerning certain characteristics such as gender, age, occupation, income, qualification, and residence. A detailed description of the socio-demographic characteristics of the respondents is given below.

1. House-Holds Surveyed in the Residential Areas

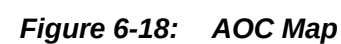
479. For the present study, the major settlements (areas), number of respondents and number of households surveyed within the vicinity of the study area are shown in **Table 6-16**.

Table 6-16: No. of House-Holds and Respondents Surveyed in the Residential Areas

Sr. No.	Settlement Name	No. of Respondents Surveyed	No. of Households (HH) Surveyed
1.	Chah Shaduwalla	14	05
2.	Chak 10	08	04
3.	Bhag Dhanisher	21	15
4.	Jhanda	10	08
5.	Kurlike	03	03
6.	Ghazi Andrun	09	07
7.	Chak 17	04	03
		69	45

480. The table indicates that the all of the Households (HH) surveyed were

present within a radius of 05-kilometer from the proposed project site. However, the proposed project site is located within an industrial zone and surrounded by existing factories and rural settlements in Sheikhpura District. Therefore, it is important to prioritize the viewpoints of these stakeholders to ensure a comprehensive and representative understanding of the impacts and benefits of the project.



2. Gender Ratio of Respondents

481. The gender ratio of respondents contacted is shown in the **Table 6-17**.

Table 6-17: Gender Ratio of Respondents

Sr. No.	Gender	Frequency	Percentage (%)
1.	Male	55	79.7
2.	Female	14	20.3
3.	X-Gender	0	0
	Total	69	100

482. According to the table, the majority of the respondents i.e., 79.7% identify as Male, while 20.3% of respondents identifies as Female.

483. This data highlights the need for a targeted approach in the proposed project by taking into account the specific needs and concerns of both male and female residents.

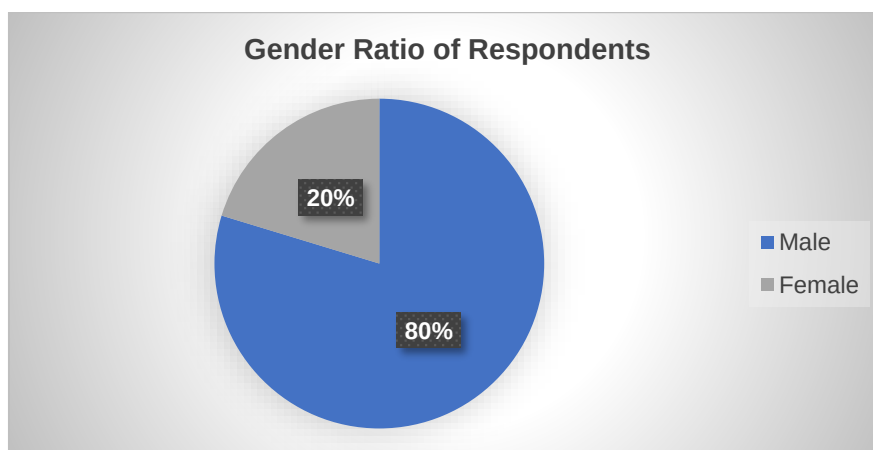


Figure 6-19: Gender Ratio of Respondents

3. Age

484. The demographic characteristic of age is shown in the Table.

Table 6-18: Age Composition of the Respondents

Sr. No.	Frequency Distribution	Number	Percentage (%)
1.	15 - 25	12	17.4
2.	26 - 35	32	46.4
3.	36 - 45	11	15.9
4.	46 & Above	14	20.3
	Total	69	100

485. Based on the data in this table, it can be observed that 17.4% of participants fall within the age range of 15-25 years, while 46.4% are aged between 26-35 years. Additionally, individuals ranging from 36-45 years

make up 15.9% of respondents, and those aged above 46 constitute a further 20.3%.

486. These figures in the table show that respondents are mature enough to express their opinions about the project. Furthermore, respondents belonging to younger age brackets indicate that they could be a suitable target audience or can be employed as project personnel for the proposed project.

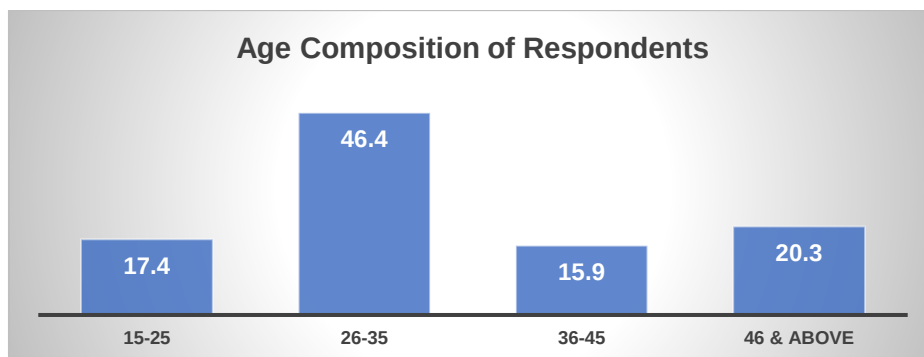


Figure 6-20: Age Composition of the Respondents

4. Caste

487. The survey revealed that the study area predominantly consists of the following major castes: Cheema, Virk, Arain, Syed, Qureshi, Rajpoot, Joiya, Jatt, Gujjar, Awan, Nai, Chaudhry, Khan, and Sheikh.

5. Language

488. The most common widely spoken primary language in the project area is Punjabi which is also known as the mother tongue in Sheikhpura District. Additionally, Urdu, and English are also spoken and understood by residents of this region.

489. The prevalence of Punjabi as the primary and widely spoken language, coupled with the familiarity of residents with Urdu, and English, holds vital implications for project communication and outreach. To ensure effective community engagement and dissemination of information, project materials, awareness campaigns, and public consultations should primarily be conducted in Punjabi, respecting it as the mother tongue of Sheikhpura District. Simultaneously, providing information in Urdu, and English can enhance accessibility for a wider audience, fostering inclusivity and understanding among diverse linguistic groups. Tailoring communication to align with these languages can bridge potential communication gaps and promote a more comprehensive engagement with the local community in the proposed project.

6. Religion

490. Religion plays a vital role in people's lives. Project Area is predominantly mainstream of Muslims and according to this survey, all respondents of the project area are Muslim. However, Christians also exist in smaller numbers in Project Area. Religion plays a significant role in shaping the cultural and social fabric of the region, with Islam being the predominant faith. Cultural festivals are mostly related to religious traditional events and several mosques are located in the study area.

7. Ethnicity

491. The ethnic composition in project area (AOI) like much of Punjab, primarily includes Punjabis, which is the largest ethnic group in the area. Within the Punjabi community, there are various sub-groups/ castes based on clan, tribe, or family lineage, including Jatt, Rajpoot, Arain, Gujjar, and others, each with its own distinct cultural and social traditions.

492. During the survey, it was found that the sampled respondents are solely belonged to Punjabi ethnicity

Minority / Marginalized Groups

493. Minority groups, including ethnic, religious, or socioeconomic minorities, can be particularly impacted by the development of the proposed project. Therefore, this assessment ensures that these groups are included in decision-making processes and benefit equitably from the project while mitigating any adverse impacts.

8. Education

494. The education distribution of the survey is shown in the **Table 6-19**.

Table 6-19: Education Level of the Respondents

Sr. No.	Education Level	Number	Percentage (%)
1.	Illiterate	17	24.6
2.	Primary	08	11.6
3.	Middle	19	27.6
4.	Matric	08	11.6
5.	Intermediate	0	0
6.	Graduate	06	8.7
7.	Post Graduate	11	15.9
8.	Other	0	0
	Total	69	100

495. Based on the information provided in this table, the majority of the participants (24.6%) have no reading or writing skills, 11.6% have attended primary school, and 27.6% have finished middle school. Moreover, 11.6% possess matriculation qualifications, none are reported to have completed intermediate education, and 8.7% hold graduate degrees; interestingly, another 15.9% hold postgraduate degrees. The educational background of the respondents varies significantly, with a large portion having limited literacy skills and a relatively small percentage holding advanced degrees.

496. This information is important for the project planners as it suggests that a substantial number of residents in the district, especially those with graduate and post graduate degrees, are likely to comprehend and engage effectively with this project. This considerable level of education among the residents can be leveraged to enhance awareness, community engagement,

and successful implementation of the proposed project. Additionally, it indicates a potential resource of skilled labor and expertise within the local population, which could be valuable for the project's long-term sustainability and success.

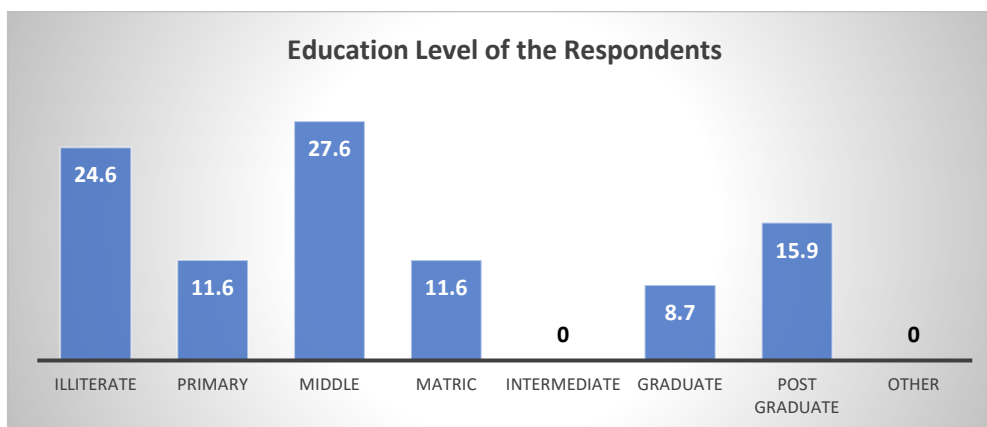


Figure 6-21: Education Level of the Respondents

9. Family System

497. Project Area, like the rest of Pakistan, typically follows a strong and close-knit family system, which plays an important role in the social fabric of the district. The family is considered a fundamental unit of society, and its structure is often extended, encompassing multiple generations living together or in close proximity. The present survey indicates the family system of respondents in the study area.

Table 6-20: Family System

Sr. No.	Education Level	Number	Percentage (%)
1.	Nuclear	12	17.4
2.	Extended (Joint)	48	69.6
3.	Single Parent / Single Mother	02	2.9
4.	Childless	07	10.1
Total		69	100

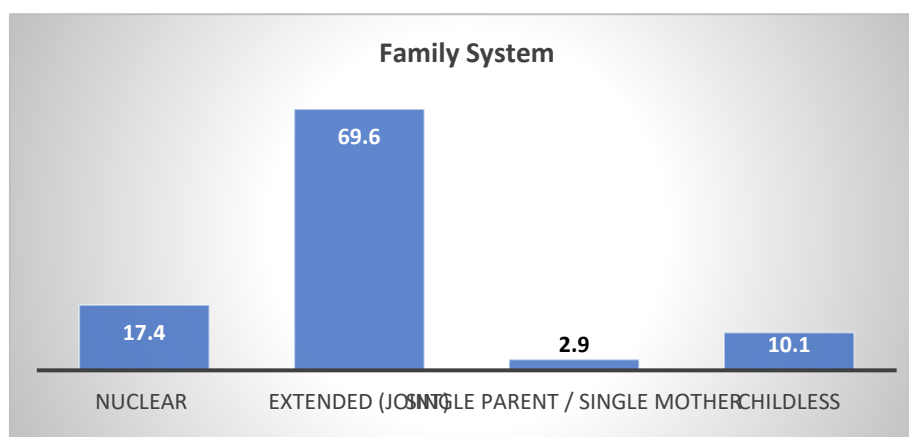


Figure 6-22: Family System

498. The analysis indicated that most of the respondents reside in an extended or joint family structure. Understanding this social dynamic is important for implementing effective and inclusive measures.

10. Marital Status

499. The marital status distribution of the survey is shown in **Table 6-21**.

Table 6-21: Marital Statuses of the Respondents

Sr. No.	Marital Status	Number	Percentage (%)
1.	Married	46	66.7
2.	Single / Unmarried	21	30.4
3.	Divorced / Separated	0	0
4.	Widowed	02	2.9
5.	Preferred not to Say	0	0
	Total	69	100

500. The survey results indicate that most of the respondents who participated are married, with a small number being unmarried or single, and a minimal percentage being widowed. These marital status variations are essential for tailoring project initiatives to the diverse needs specifically for the unique challenges and opportunities associated with different marital statuses, ensuring the project's effectiveness and inclusivity for all participants.

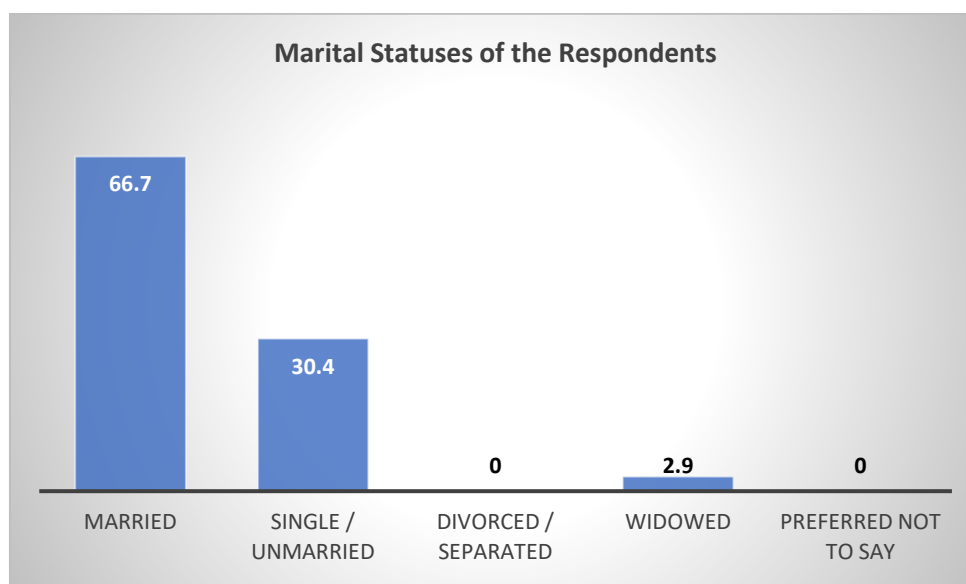


Figure 6-23: Marital Statuses of the Respondents

6.5.4.5 Occupation and Income

501. The economic characteristics include occupation, income, and expenditure etc.

1. Occupation

502. Occupations of the selected respondents are shown in the

503. **Table 6-22.**

Table 6-22: Occupational Status of the Respondents

Sr. No.	Occupation	Number	Percentage (%)
1.	Service (Govt/pvt)	15	21.7
2.	Agriculture / Live Stock	20	29
3.	Business / Freelance	08	11.6
4.	Labor	12	17.5
5.	Unemployed	07	10.1
6.	Any Other	07	10.1
	Total	69	100

504. The table above illustrates the distribution of occupations among the survey participants. Based on the data, 10.1% of respondents are unemployed. Of those classified as "economically active," 21.7% work in public or private sector positions, while 29% are involved in agricultural or animal husbandry activities. Furthermore, 11.6% of respondents engage in entrepreneurial ventures or freelance work, 17.5% work as laborers, and another 10.1% pursue various other occupations such as being students (home tutors), housewives (stitching, embroidery), or residing overseas.

505. The provided data sheds light on the occupational landscape of the respondents. The substantial 10.1% of individuals without employment underlines the prevalent joblessness in the area, signifying a significant area of focus for project planners. Among the economically active respondents, the dominance of farming/livestock at 29% showcases the agricultural nature of the region's economy. Understanding these occupational dynamics is vital for tailoring employment-focused strategies and community engagement programs connected to the proposed project in Sheikhpura District.

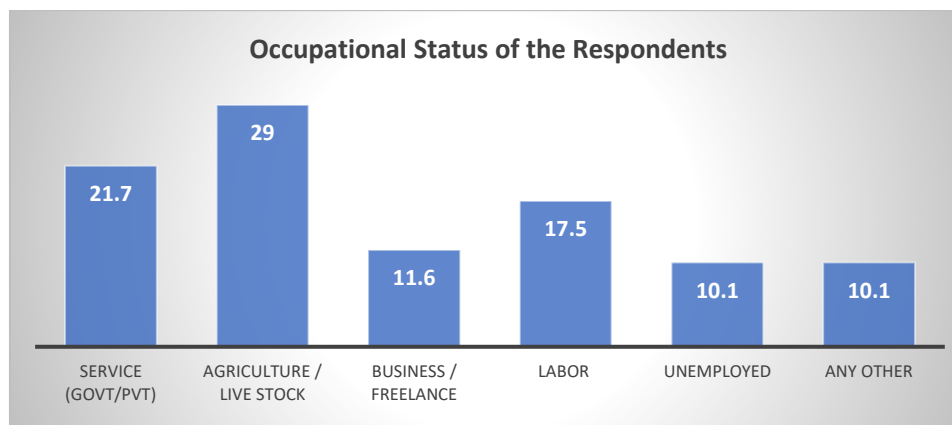


Figure 6-24: Occupational Status of the Respondents

2. Household Income Levels

506. During the socio-economic survey, respondents were inquired about their total family monthly income from all sources. The table shows the income levels of the respondents.

Table 6-23: Household Income Levels

Sr. No.	Income Level (Pak rupees)	Number	Percentage (%)
1.	Less than Rs. 32,001	10	16.1
2.	Rs. 32,001-50,000	17	27.4
3.	Rs. 50,001-75,000	20	32.2
4.	Rs. 75,001-90,000	08	12.9
5.	More than Rs. 90,000	07	11.3
	Total	62	100

507. The data indicates the income of economically active respondents. Based on the data presented in the table, it can be observed that 16.1% of the participants receive a monthly income below Rs. 32,001. Additionally, 27.4% fall within the income bracket of Rs. 32,001 to Rs. 50,000 per month, while 32.2% earn between Rs. 50,001 and Rs. 75,000 monthly. Furthermore, 12.9% have a monthly income ranging from Rs. 75,001 to Rs. 90,000, and 11.3% of respondents earn more than Rs. 90,000 monthly.

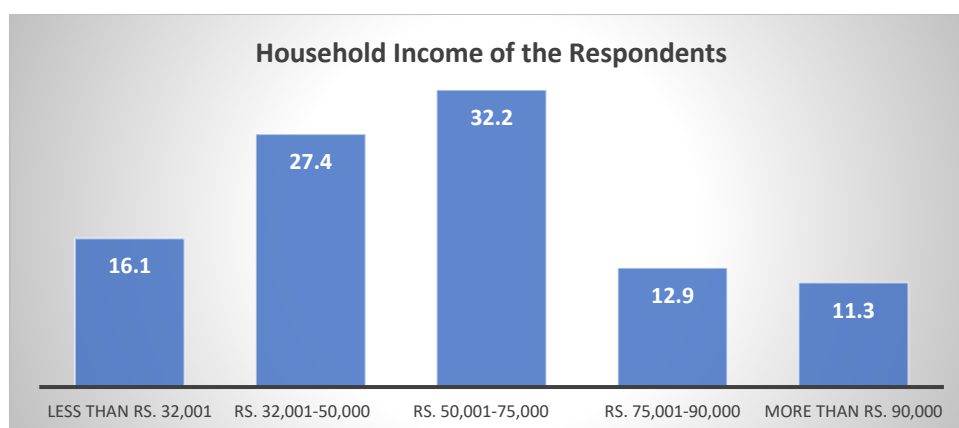


Figure 6-25: Household Income of the Respondents

3. Household Expenditure Levels

508. During the socio-economic survey, respondents were inquired about their monthly expenditures. Table shows the income levels of the respondents.

Table 6-24: Household Expenditure Levels

Sr. No.	Expenditure Level (Pak rupees)	Number	Percentage (%)
1.	Less than Rs. 32,001	07	11.3

Sr. No.	Expenditure Level (Pak rupees)	Number	Percentage (%)
2.	Rs. 32,001-50,000	16	25.8
3.	Rs. 50,001-75,000	19	30.6
4.	Rs. 75,001-90,000	09	14.5
5.	More than Rs. 90,000	11	17.7
	Total	62	100

509. The data reveals the spending habits of individuals who are active in the economy. As depicted in the table, it is evident that 11.3% of the survey participants have monthly expenses lower than Rs. 32,001. Moreover, 25.8% fall into the expenditure range of Rs. 32,001 to Rs. 50,000 per month, while 30.6% have monthly expenditures between Rs. 50,001 and Rs. 75,000. In addition, 14.5% of the participants report a monthly spending between Rs. 75,001 to Rs. 90,000, while 17.7% indicate expenses exceeding Rs. 90,000 per month.

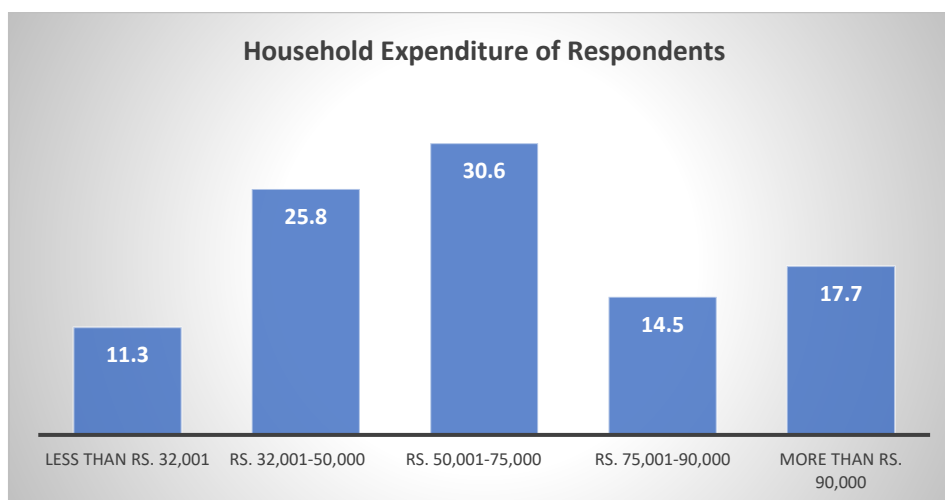


Figure 6-26: Household Expenditure of Respondents

6.5.4.6 Housing Profile

510. The housing profile shows the housing conditions of the respondents.

1. Types of Construction

511. The table shows the type of construction of the house in the project area.

Table 6-25: Types of Construction

Sr. No.	Construction Type	Number	Percentage (%)
1.	Pacca Houses	34	49.3
2.	Katcha Houses	13	18.8
3.	Semi Pacca Houses	22	31.9
	Total	69	100

512. Based on the information presented in the table, it is evident that 49.3% of participants indicated their residence in pacca (concrete) houses, while 18.8% reported living in kacha (mud) houses and 31.9% reside in semi-concrete dwellings.

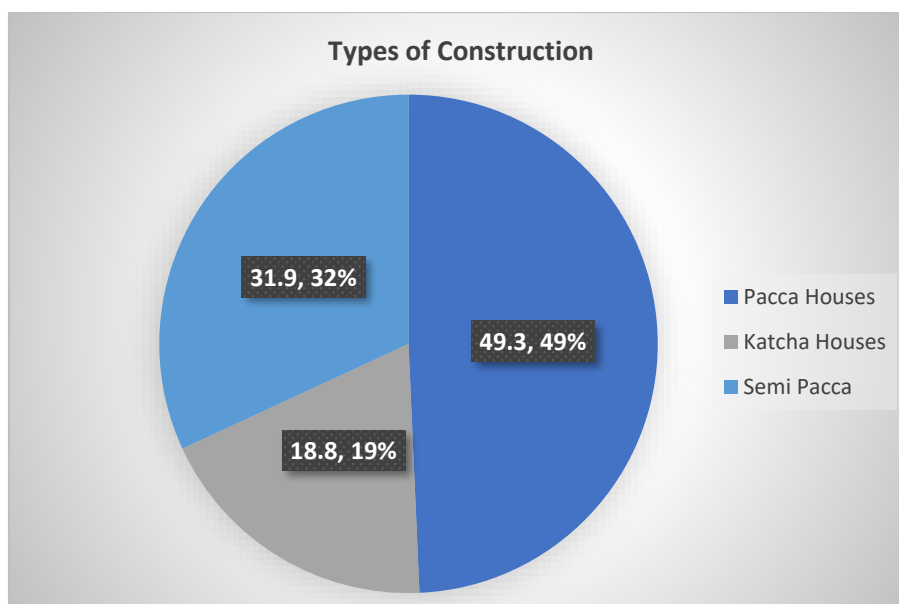


Figure 6-27: Types of Construction

2. Type of House

513. Type of houses in the project area is shown in the **Table 6-26**.

Table 6-26: Types of Houses

Sr. No.	House Type	Number	Percentage (%)
1.	Residential House	50	72.5
2.	Apartment	0	0
3.	Hostel	09	13
4.	Farm House	10	14.5
5.	Other	0	0
Total		69	100

514. The table data suggests that the majority of participants (72.5%) live in residential housing, with 13% residing in hostels. Moreover, 14.5% are located in farmhouses.

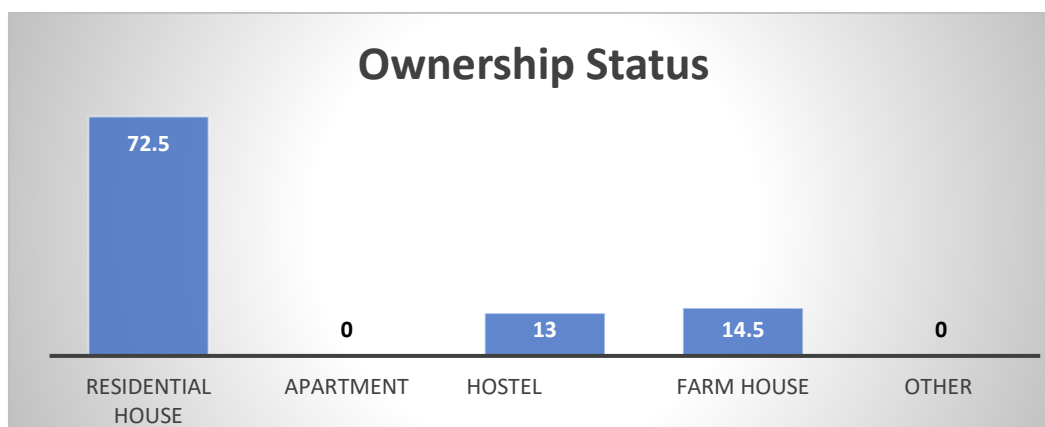


Figure 6-28: Ownership Status

3. Ownership Status

515. Ownership status of houses in the project area is shown in the Table.

Table 6-27: Types of Houses

Sr. No.	House Type	Number	Percentage (%)
1.	Owned	56	81.1
2.	Rented	13	18.9
3.	Other	0	0
Total		69	100

516. Based on the data presented in the table, it is evident that a majority of the respondents (81.1%) live in their own residences, with 18.9% residing in rented accommodations.

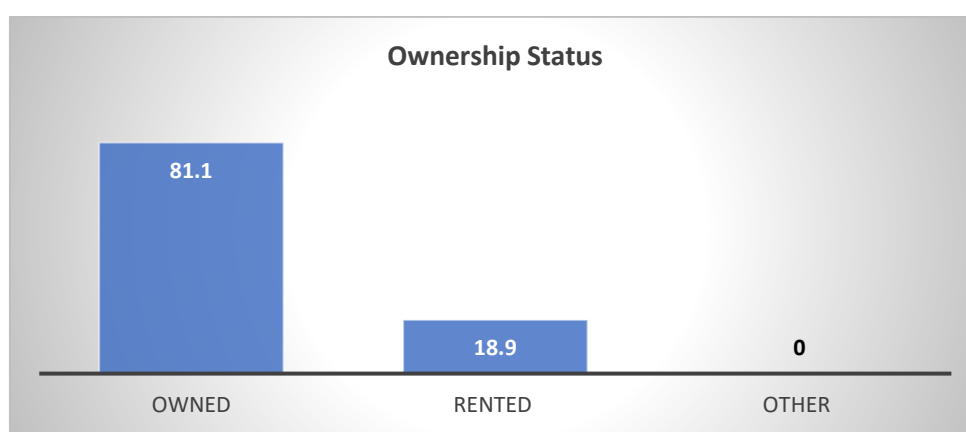


Figure 6-29: Ownership Status

4. Household Items

517. Respondents were surveyed about their household possessions, and most of them reported owning televisions, kitchen appliances, fans, lights/bulbs, refrigerators/ freezers, cell phones, irons and furniture. However, some respondents also possessed luxury items such as motor vehicles, solar panels, WiFi/internet connectivity devices, and air conditioners/coolers.

Others mentioned ownership of motorcycles, washing machines, gas water heaters, and power generators/UPS systems while a few also had bicycles and sewing machines in their possession. The diversity of household items owned by respondents reflects variations in lifestyles and economic statuses.

6.5.4.7 Diseases

518. There are many different kinds of diseases depending on conditions and factors. For the present study, the respondents were inquired about common, and water-borne diseases, the findings of which are presented below:

1. Common Diseases

519. During the survey, it was identified that malaria, diabetes, high blood pressure, flu, fever, diarrhea, and cardiovascular diseases are prevalent in the study area. Nonetheless, there is also a high incidence of other common and long-term illnesses such as asthma, cancer, arthritis, chronic respiratory conditions and mental health disorders in these areas.

2. Waterborne Diseases

520. Based on the consultations with the respondents, it was identified that Diarrhea, Cholera, Hepatitis, Typhoid, Gastroenteritis, and Jaundice are the most common waterborne diseases present in the study area. These illnesses are caused by the consumption of contaminated water or exposure to water that harbors pathogenic microorganisms. Contaminated water can contain various disease-causing agents such as bacteria, viruses, parasites, and other pathogens. Ingesting or coming into contact with such microorganism-contaminated water can lead to the development of waterborne ailments.

6.5.4.8 Physical Cultural Resources / Sensitive Receptors

521. Sensitive receptors, including mosques, graveyards, schools, universities, hospitals, and clinics, are located near the project site. During the construction phase, mitigation measures such as using muffling devices, localized noise barriers, and regular machinery maintenance will minimize impacts on these receptors. Additionally, air emissions controls, water treatment, and proper waste management will be implemented during the operational phase to protect the environment and local communities. The increase in traffic during construction is expected to have minimal impact on sensitive receptors along transportation routes, with measures in place to prevent significant disturbance.

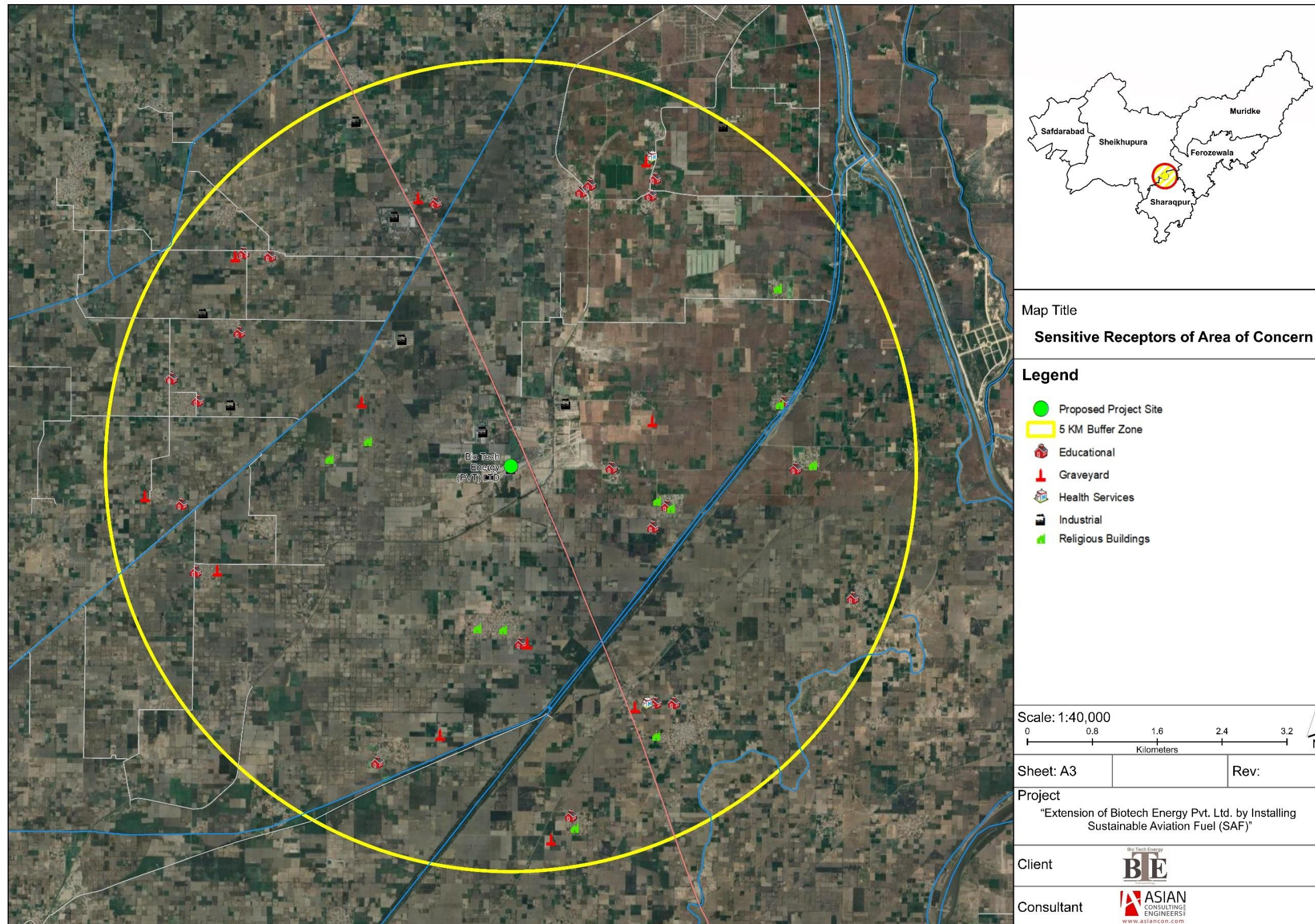


Figure 6-30: Sensitive Receptors

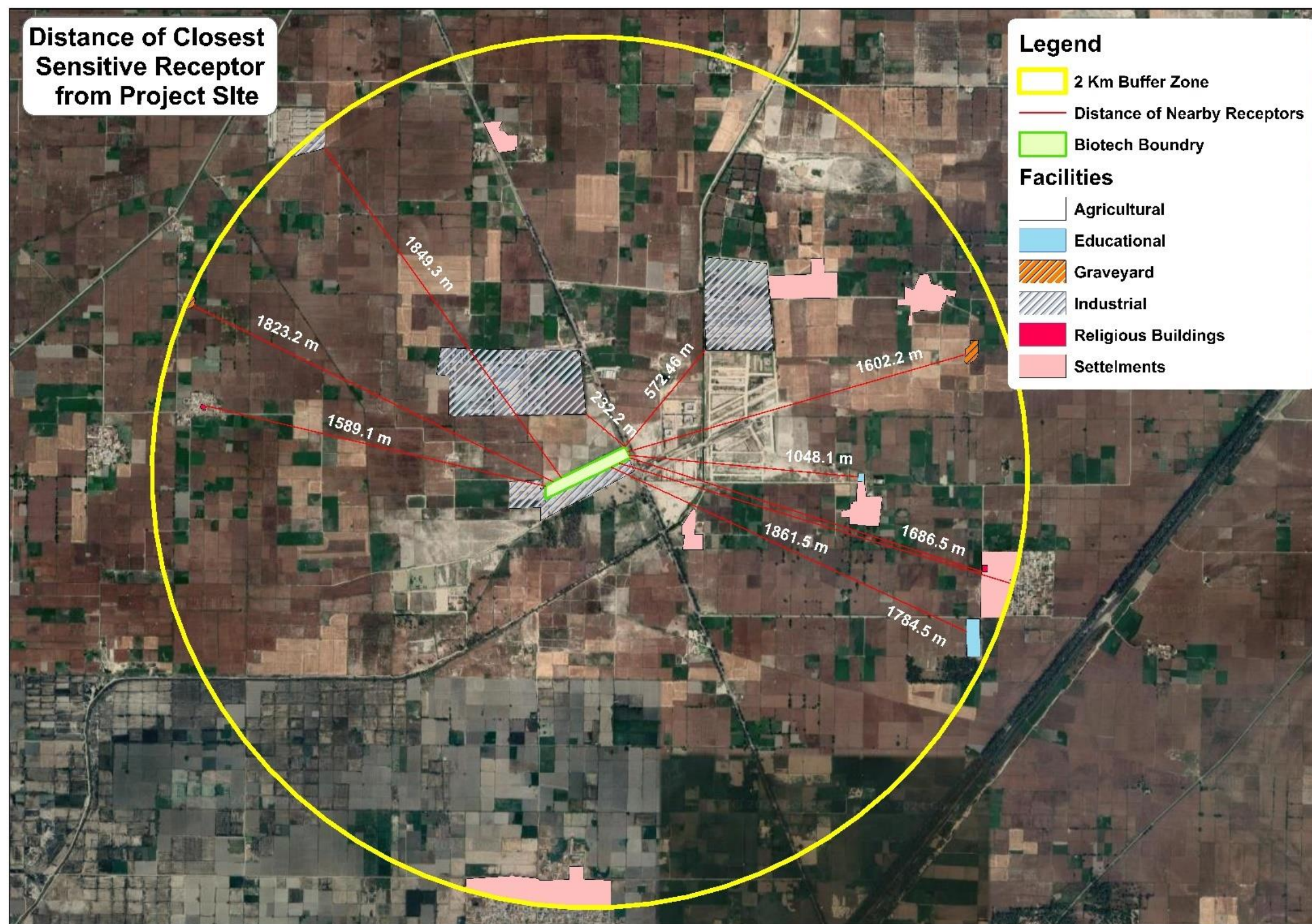


Figure 6-31: Map Showing the Closest Sensitive Rors from the project sire

522. The list of sensitive receptors in AOC/AOI includes:

Educational Institutes

- Aghosh Al-Khidmat School, Sheikhpura (Infront of BioTech Energy)
- Nagina Kids Campus School (Non-Functional)
- Muhammadan Educational Complex (1 KM away from project site)
- Government Girls Primary School, Bagh Dhanisher
- Government Elementary School, Marh Bhangwan
- Government High School, Chak 07
- Government Boys High School, Chak 10
- Government Girls Primary School, Chak 10
- Government Primary School, Chak 17
- Government Primary School, Chah Shaduwalla
- Government Primary School, Chak 19 UCC
- Government Boys Primary School, Chak 17
- Government Elementary School, Kaapi Bhattiyan
- Ahmad Public School
- Al Shaheen Science Academy

Health Institutes

- Rural Health Centre, Mudwala Kalaan
- EPI Center BHU Marh Bhangwan

Shrines/Mosques/Graveyards

- Shrine of Hazrat Baba Syed Shah Jan Wali, Dhamoke
- Ratti Tibbi Graveyard
- Imam Bargah Wali ul Asr
- Masjid Anwar e Madina, Chah Shaduwalla
- Jamia Masjid Allah Wali, Chak 10
- Masjid Ibrahim, Chak 10
- Jamia Masjid Shair e Rabbani, Chak 10
- Graveyard, Chak 10
- Janazgah, Chak 10
- Noor Mosque, Ghazi Andrun
- Darbar Peer Sawaab Shah
- Jamia Masjid Hinjarwan Wali, Marh Bhangwan

Non-Government Organizations (NGOs)

- Aghosh Al-Khidmat (Infront of Biotech Energy)

6.5.4.9 Mode of Transport

523. The survey revealed that a significant portion of the participants opt for cars and motorcycles as their primary mode of transportation. However, some respondents rely on cycles and public transport to commute.

6.5.4.10 Infrastructure Present in the Area

524. In the socio-economic survey conducted to establish the social foundation of the project area, participants were asked about the social amenities (utilities) in their locality. All respondents reported having access to electricity in their homes. PTCL services were accessible in various areas, and a majority of participants owned mobile phones. Some households use solar panels for electricity and water supply. Tubewells are present within the Area of Interest (AOI); however, the majority of them are non-functional. However, the majority of respondents expressed discontent with the sewerage and drainage facilities. It's important to note that there is no availability of Sui Gas in the study area. The table illustrates the status of infrastructure present in the project area on a scale.

Table 6-28: Infrastructure in the Project Area

Sr. No.	Infrastructure	Scale	Number	Percentage (%)
1.	Road Network / Bus – Truck Terminals	Yes	38	55.1
		No	31	44.9
		Total	69	100
2.	Electricity Transmission Lines	Yes	69	100
		No	0	0
		Total	69	100
3.	Gas Pipelines	Yes	27	39.1
		No	42	60.9
		Total	69	100
4.	Shopping Area / Markets / Shops	Yes	69	100
		No	0	0
		Total	69	100
5.	Tubewells	Yes	69	100
		No	0	0
		Total	69	100
6.	Telephone Lines	Yes	69	100
		No	0	0
		Total	69	100

Sr. No.	Infrastructure	Scale	Number	Percentage (%)
7.	Banks	Yes	69	100
		No	0	0
		Total	69	100
8.	Sewerage System / Drainage System	Yes	25	36.2
		No	44	63.8
		Total	69	100

6.5.4.11 Availability of Social Services

525. Social services include healthcare, education and employment support, etc. Social services are vital to ensure the well-being and socio-economic development of local population present in the AOI. BioTech Energy is committed to supporting the well-being of the local community by providing essential social services. As part of this initiative, the company has installed a water cooler near the wall adjacent to the main gate, ensuring free and easy access to clean drinking water for everyone. Additionally, BioTech Energy actively contributes to social welfare by providing financial support to Agosh Alkhidmat, an orphanage located directly across from the BioTech Unit, helping to improve the lives of vulnerable children. These efforts reflect BioTech Energy's dedication to fostering community development and social responsibility.

6.5.4.12 Cultural, Archaeological and Historical Monuments/Sites

526. Significant efforts were made to identify the archaeological/historical sites falling within the proposed project site, but no historical/archaeological site was found in the AOC/Project Area. Gender Component

527. Gender is a critical issue that is connected to any sustainable development process, which is usually perceived as woman specific issue. In order to assess the socioeconomic condition of the women in the project area, the Women's Participation and Decision Making in different household activities have been included. In this survey, 14 out of the total 69 participants are identified as female respondents. Table shows the participation and decision-making in different household activities by these female respondents.

Table 6-29: Participation and Decision-Making in Different Household Activities by Women

Sr. No.	Activities	Participation and Decision Making	Number (yes)	Percentage (%)
1.	Household Activities	Participation	14	100
		Decision Making	13	92.8
2.	Child Caring	Participation	14	100

Sr. No.	Activities	Participation and Decision Making	Number (yes)	Percentage (%)
		Decision Making	07	50
3.	Farm/Crop/Livestock rearing	Participation	08	57.1
		Decision Making	0	0
4.	Working woman	Participation	08	57.1
		Decision Making	06	42.8
5.	Sale & Purchase of properties	Participation	08	57.1
		Decision Making	0	0
6.	Social obligations (marriage, birthday & other functions)	Participation	14	100
		Decision Making	12	85.7
7.	Local representation (councilor/political gathering)	Participation	14	100
		Decision Making	10	71.4
8.	Access to health facilities	Participation	14	100
		Decision Making	11	78.6
9.	Access to education	Participation	14	100
		Decision Making	10	71.4

528. According to the data, all women took part in household tasks, while only 92.8% of them had decision-making authority in these activities. Additionally, every woman participated in childcare responsibilities but only half of them could make decisions regarding it. In agricultural and livestock rearing activities, 57.1% were involved with no decision-making power concerning farm/crop-related tasks. Moreover, 57.1% engaged in income-generating work with 42.8% having decision-making authority over this aspect. Regarding property transactions, although 57.1% of women participated, none had the power to decide on sales or purchases of properties. In the sphere of social responsibilities, all women were involved, with 85.7% having authority in decision-making processes. While every woman had the opportunity to engage in local representation, 71.4% held power over decisions related to this matter within the project area. Access to healthcare facilities was universally available for all women; however, only 78.6% could determine aspects concerning these provisions themselves. Furthermore, all women had educational access although decision-making control was limited to just 71.4%. These findings indicate that a significant proportion of women in the study area possess the capacity to take part and make decisions across various activities.

529. The findings suggest that while women are actively participating in various spheres of life, their decision-making power is not equally distributed across all areas. This indicates a need for efforts to empower women further, ensuring their participation in decision-making processes across different aspects of life.

530. Furthermore, the female participants suggested that women should be given employment opportunities in the proposed project, allowing them to contribute to the economy and advance their own economic empowerment.

6.5.4.13 Gender-based Violence, Sexual Exploitation and Abuse, Sexual Harassment or Domestic Violence

531. Based on the survey results, it was found that a significant number of female respondents reported no instances of gender-based violence, sexual exploitation and abuse, or sexual harassment. Few women have expressed that they are experiencing domestic violence in their personal lives. However, due to cultural and societal norms, they may be reluctant to seek help or discuss the issue openly.

Women Assessment Implications

532. Construction and operation of the proposed project may create job opportunities. However, women often face barriers to employment (e.g., lack of skills, discrimination, or cultural restrictions). The proposed project must ensure that women are trained and employed in both construction and operational phases, especially in technical roles. Additionally, the plant might generate indirect economic opportunities (e.g., women running small businesses related to the renewable fuel plant). Empowering women to take part in these opportunities strengthens community benefits.

6.5.4.14 Source of Water

533. The construction of SAF plant will pose impacts on the local community's water supply, which is a critical consideration. The plant's water requirements can strain local resources, particularly in areas where water is scarce or where the community relies on the same sources. Therefore, it is important for the proposed project to carefully manage the water usage during the construction and operational phases and consider the community needs.

1. Source of Water for Domestic Use

534. Sampled respondents depend upon a few sources of water for domestic use which is shown in the Table.

Table 6-30: Source of Water for Domestic Use

Sr. No.	Source of Water	Number	Percentage (%)
1.	Tube-well	14	20.3
2.	Bore Hole / Hand Pump	53	76.8
3.	Any Other	02	2.9
Total		69	100

535. According to the table, 20.3% of respondents use tubewell water, 76.8% use bore hole as the main source of water for domestic use in the proposed project area, while 2.9% use other sources of water.

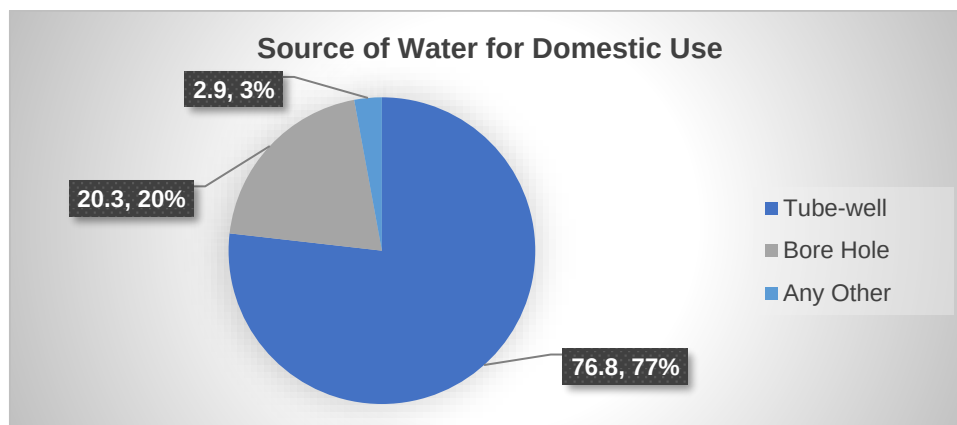
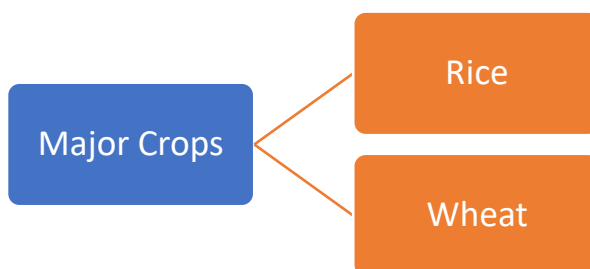


Figure 6-32: Source of Water for Domestic Use

2. Major Crops

536. In the nearby villages of the proposed project area, the major crops cultivated are rice and wheat.



537. These crops serve as the primary agricultural commodities and sources of income for the local communities as well as these crops provide the raw materials, known as feed stock for renewable/biodiesel fuel production. For example, crops like corn, sugar cane and soybean can be used to produce biofuels such as ethanol and biodiesel. Additionally, vegetables like onions and potatoes are also grown in the region to supplement the local diet and provide additional income for farmers. In order to ensure a successful project implementation, it is important to understand the local agricultural practices and the specific crops grown in the target area so that renewable/biodiesel fuel projects can be tailored and integrated effectively with existing farming systems and benefit the farmers as well.

3. Livestock

538. People in the study area have common livestock which include; cows, buffalos, goats and hens. These livestock serve as a valuable source of income and food security for rural households. Additionally, livestock fats or manure, and poultry waste such as poultry feather acid can be used as a feedstock for renewable/biodiesel fuel production.

4. Main Source of Water for Farming and Livestock

539. Sampled respondents depend upon a few sources of water for farming and livestock which is shown in the Table.

Table 6-31: Source of Water for Farming and Livestock

Sr. No.	Source of Water	Number	Percentage (%)
1.	Public Water Supply/Tube-well	05	7.2
2.	Private Water Supply/Electric Motors	37	53.6
3.	Canal/Stream/River	11	15.9
4.	Bore Hole/Hand Pump	16	23.2
5.	Any Other	0	0
	Total	69	100

540. According to the table, 7.2% of respondents use public water supply for irrigation and livestock rearing while 53.6% use electric motors or private water supply. Additionally, 15.9% use Canal or stream water and 23.2% use boreholes or hand pumps for farming and livestock.

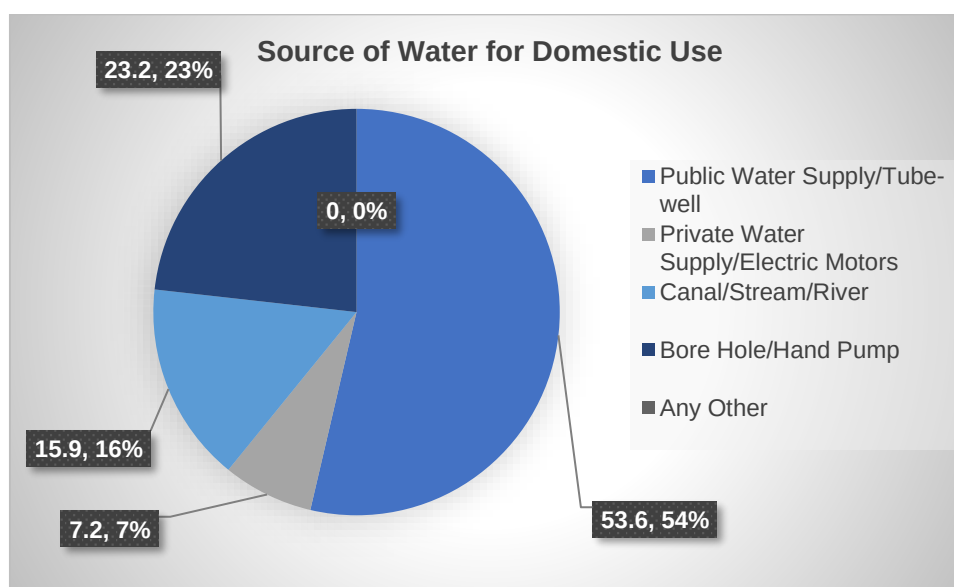


Figure 6-33: Source of Water for Domestic Use

5. Other Ecosystem Services

541. Communities in the AOI benefit from ecosystem services that support their livelihoods and well-being. Fertile soils and Canal irrigation systems enable crop cultivation, ensuring food security and income. Groundwater provide essential water for drinking, farming, and household needs. Grazing lands support livestock farming, contributing to milk, meat, and dairy production. Trees supply fuelwood for cooking and timber for construction. Natural pollinators and nutrient cycling enhance crop yields and soil fertility. The vegetation help manage floods, protecting communities. Cultural and spiritual connections to natural landscapes enrich traditions and foster a sense of community. These services are vital for rural life, emphasizing the need for sustainable management.

6.5.4.15 Migration

542. Migration refers to the movement of people from one place to another, often with the intention of settling in a new location. There are several types of migration, including:

- **Internal Migration:** Movement of people within a country, such as from rural to urban areas in search of better economic opportunities.
- **International Migration:** Movement of people across international borders, either temporarily or permanently, for reasons such as work, family reunification, or seeking asylum.

543. During the survey, it was found that out of 69 respondents, two individuals had moved from Sheikhpura District to foreign countries for employment reasons. Additionally, nine respondents relocated from other districts in Pakistan to Sheikhpura District for employment. This indicates that there is a magnet for local migrants due to job prospects in Sheikhpura District. Hence, based on the survey, migration is limited. Regarding district-level migration, reliable data is not easily available and does not have a significant impact on the project.

6.5.4.16 Traffic Congestion

544. During the survey, respondents were asked about the potential for traffic congestion resulting from the construction and operation of a SAF plant. According to the respondents, they do not anticipate any significant traffic issues, showing confidence in the ability of a main road to handle the expected increase in traffic.

545. It is essential to consider the opinions and experiences of local communities when assessing the safety and condition of the road. Thus, participants were queried about the main road accidents and their awareness or knowledge of them. Hence, the survey indicates that the traffic impact is expected to be minimal, and the existing road network has sufficient capacity to accommodate the fleet used for transportation, causing only minor disruption to road conditions. Any project-specific damage, such as potholes or other road issues resulting from the transportation activities, will be the responsibility of BTE.

6.5.4.17 Awareness Regarding the Proposed Project

546. Awareness about the proposed project is shown in the Table.

Table 6-32: Awareness Regarding the Project

Sr. No.	Category	Frequency	Percentage (%)
1.	Yes	09	13
2.	No	60	87
	Total	69	100

547. The table shows that most of the participants, specifically 87%, have no

prior knowledge of the proposed project, while 13% are informed about it.

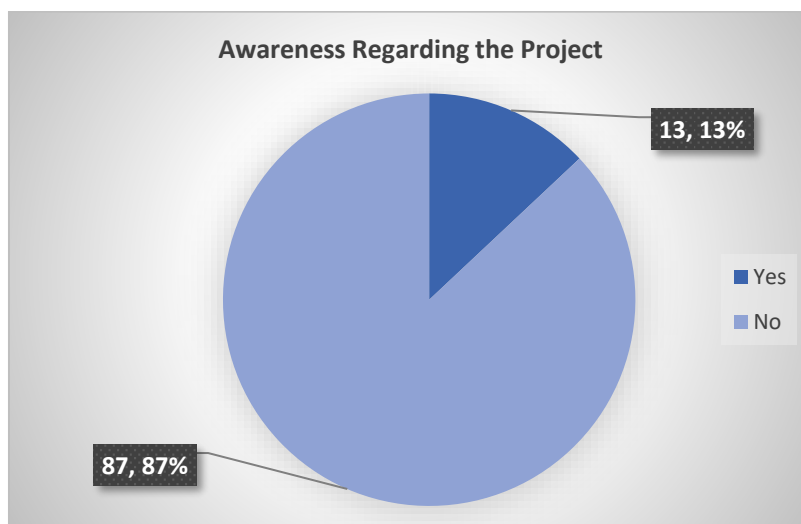


Figure 6-34: Awareness Regarding the Project

6.5.4.18 Protective Measures Suggested by Respondents

548. Protective measures suggested by respondents are shown in the Table.

Table 6-33: Protective Measures Suggested by Respondents

Sr. No.	Protective Measures	Number	Percentage (%)
1.	The project should be completed well in time	69	100
2.	If any private land is acquired, then proper compensation should be paid	N/A	N/A
3.	Harmful effects on residents during construction should be minimized	69	100
4.	Implementation of HSE plan for a safe working environment	69	100
5.	The residents should be given priority for jobs	47	68.1
6.	Provision of basic facilities in the project area (please specify)	33	47.8
7.	Harmful effects on surrounding local communities during operation should be minimized	69	100
8.	Any Other (Please Specify)	0	0
Total			100

549. According to the table, all respondents highlighted that the construction activities should be completed well in time, harmful effects on residents during the construction and operational phase should be minimized and HSE plan for a safe working environment should be implemented. Additionally, the land is BTE owned therefore, no land acquisition is applicable. Furthermore, 68.1% of respondents suggested that the local community should be given priority for jobs while 47.8% suggested that provision of basic facilities in the

project area should be provided.

6.5.4.19 Need Identification

550. Based on the consultations with the respondents, it was identified that:

- The provision of fresh and clean water is the most pressing need of the local community.
- Establishment of vocational training centers for males and females in every locality, and specifically in the AOC for women to equip them with diverse skills.
- Provision of micro-credit loans for females in order to empower them economically and reduce poverty.
- Provision of Sui Gas in rural areas or where gas is not available.
- Implementation of an underground drainage system in the villages.
- Specialized healthcare units for females are one of the most pressing needs in rural areas.

6.5.4.20 Sustainable Aviation Fuel (SAF)

551. SAF is a type of fuel that is derived from renewable sources. This is considered a more environment-friendly alternative to traditional fossil fuels because it produces fewer greenhouse gas emissions, can help reduce dependence on fossil fuels and promote sustainability in the transportation sector.

552. During the survey, respondents were asked about their knowledge SAF, including whether they were aware of its benefits and availability in their area.

Table 6-34: Awareness Regarding SAF

Sr. No.	Category	Frequency	Percentage (%)
1.	Yes	10	14.5
2.	No	59	85.5
	Total	69	100

553. The table indicates that the majority of the respondents, a significant 85.5%, are not familiar with SAF, whereas 14.5% have some awareness of it.

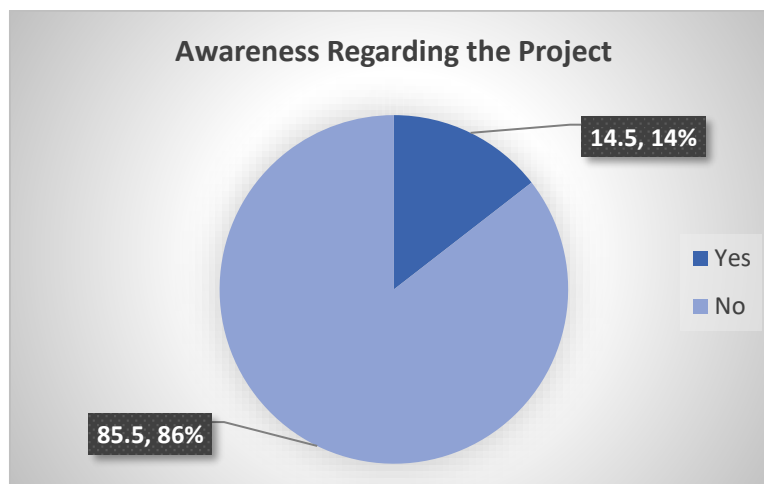


Figure 6-35: Awareness Regarding the Project

1. Advantages of SAF Plant

554. Respondents familiar with SAF expressed a favourable attitude towards using this fuel. The advantages are:

- SAF is used as a viable option for sustainable energy, which could potentially reduce the dependence on imported foreign oil and promote sustainability in the energy sector.
- The conversion of waste into SAF can not only mitigate climate change by reducing greenhouse gas emissions but also contribute to achieving energy security and creating new job opportunities in the energy sector.
- The production of SAF from non-food feedstocks has emerged as a promising solution to address the growing concerns of sustainability, economic viability, and environmental impact associated with traditional fossil fuels.

2. Disadvantages of SAF Plant

555. The respondents who have knowledge of SAF showed some disadvantages of using biofuels. These are:

- The production of SAF can be more expensive than traditional fossil fuels. This is due to the costs associated with growing crops, processing them into fuel, and ensuring compliance with environmental regulations.
- Large-scale production of biofuels can require significant amounts of land. This can lead to deforestation, loss of biodiversity, and competition with food crops for land and water resources.
- The availability of food crops and feedstock for biofuels can be inconsistent, depending on factors such as weather conditions and market demand. This can lead to fluctuations in fuel prices and supply.
- Some vehicles and engines may require modifications to run on biofuels. This can add to the cost of using biofuels and limit their widespread adoption.

6.5.4.21 Project Implementation

556. The implementation status of the proposed project at the proposed location is shown in the Table.

Table 6-35: Project Implementation

Sr. No.	Category	Frequency	Percentage (%)
1.	Yes	61	88.4
2.	No	08	11.6
	Total	69	100

557. The data indicates that the vast majority of participants, constituting 88.4%, support the implementation of the proposed project at the proposed location due to its perceived significance, while a small proportion of respondents, accounting for 11.6%, are against the project.

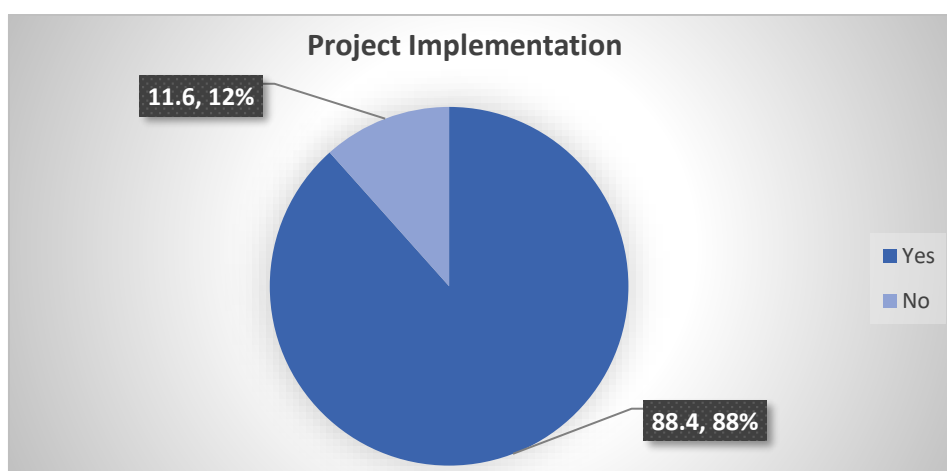


Figure 6-36: Project Implementation

6.5.4.22 Type of Effect

558. The following table displays the impact of the project on the community.

Sr. No.	Effects / Impacts	Yes (%)	No (%)
1.	Employment Opportunities	100	0
2.	Industrial Development Opportunities	100	0
3.	Living standard	100	0
4.	Unemployment	0	100
5.	Loss of Land	0	100
6.	Resettlement	0	100
7.	Income Generating Activities	100	0
8.	Disturbance from Construction/Operation of project	30.4	69.6

559. The table indicated that the project has significant positive impacts on employment opportunities, industrial development, living standards, and

income generation. However, there is no land acquisition and resettlement. Furthermore, there is expected to be a decrease in unemployment but 30.4% of respondents may experience disturbance due to the construction/operation of the proposed project.

6.5.4.23 Occupational Health and Safety of Workers in BTE Existing Unit

560. The interviews and FGDs finding indicated that about 250 employees are currently employed at the Bio-Tech Energy unit. This workforce comprises five senior managers, 35 junior managers, and the rest holding positions as labourers at different levels. Moreover, it was found that 60-65 percent of the labor force is recruited from nearby communities, while the remaining 40-45 percent come from surrounding areas or other districts. Furthermore, most workers have accumulated over seven years of experience in the biodiesel sector, reflecting a steady and experienced workforce within the BTE unit.



561. The labor working in the BTE existing unit has expressed a high level of satisfaction with the implemented safety measures. They felt that the occupational health and safety training, provision of personal protective equipment (PPEs), and regular safety handling of chemicals contributed to a safe working environment. They appreciated the efforts made by the organization to ensure their well-being and minimize risks in the workplace.
562. The BTE establishes a minimum monthly wage of Rs. 32,000, for labor as mandated by the Government of Pakistan.
563. One of the corporate officials expressed his opinion about the welfare programs for the workers. He elaborated, "The organization has taken many steps for the welfare of the workers that include Eid Bonuses, Health Insurance, 13th Salary, Employees' Old-Age Benefits (EOBI) to all employees and Residences with Transportation for those workers who come from far distant areas to ensure that they have a comfortable living situation while working at the industrial site". This serves as an extra incentive for workers to follow safety protocols and uphold a productive work atmosphere.
564. Furthermore, the participants shared their views about the administrative decisions of the factory. One of the participants stated, "Our managers are very supportive and take good care of us". Further, he added, "They give us a break and holidays whenever we need it".
565. Furthermore, the workers expressed their willingness to actively participate in any future safety improvement initiatives for the proposed project and will provide input based on their practical knowledge and experience.

6.5.4.24 Focus Group Discussions with Women

566. Focus Group Discussions (FGDs) were conducted with women from nearby villages within the AOI to gather their perspectives on the proposed project. The participants expressed strong support for the initiative, emphasizing that the project would enhance the value and development of their area.
567. During the discussions, the women highlighted the need for establishing technical skill centers related to BioTech Energy within the AOI. These centers would equip individuals, particularly women, with essential skills to address the local community's needs and create avenues for economic empowerment.
568. Furthermore, the participants emphasized the importance of the project in providing employment opportunities for the local community, with a specific focus on creating roles for women. Their insights underline the community's aspirations for sustainable development, skill enhancement, and inclusive economic growth as key outcomes of the project.

6.5.4.25 Farmers Perceptions

569. Farmers were interviewed to gather their perspectives on the proposed project, with a particular focus on its potential impact on their livelihoods and

the local community. One farmer emphasized the potential economic benefit of the project, stating that “Agricultural residues, non-edible crops, and waste biomass could be sold to BioTech Energy, creating an additional revenue stream for farmers in the area”. Another participant expressed optimism about the project’s capacity to generate employment, stating that, “The proposed project would create employment opportunities for my family.”

570. One farmer highlighted the importance of capacity building, suggesting that training in biomass production farming would enhance the agricultural productivity and enable the farmers to participate more effectively in the project’s supply chain. Another participant acknowledged the broader developmental impact of the project, stating, “The proposed project will provide training in renewable energy as well as other technical skills to the local community, promoting sustainable development and empowering individuals to secure better job opportunities.”

571. These perspectives highlight the farmers’ positive outlook on the project and their willingness to actively participate in its initiatives. They also reflect a clear demand for technical training and employment opportunities that would contribute to both individual empowerment and the sustainable development of the region. The project presents a unique opportunity to integrate local agricultural practices into the renewable energy supply chain while fostering economic growth and skill development within the community.

6.5.4.26 Aesthetics and Visual Effects

572. The proposed project will be situated in an industrial zone, with the Ittefaq Group and Prosperity Weaving Mills flanking it on both sides. The Agosh Foundation and Nagina Kids Campus (non-functional) are located across from it, while other industries and agricultural land are positioned behind it. Additionally, the construction activities are not for a long duration and will not disrupt the surrounding businesses and residential areas. Hence, the construction of the proposed project will not cause any adverse effects on the aesthetic value of the area.

CHAPTER - 7: POTENTIAL ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

7.1 General

573. This section identifies the potential impacts related to the Preconstruction, construction and operation phases of the proposed project on the physical, ecological and socio-economic domains of the environment. Accordingly, mitigation measures have been proposed to mitigate the negative impacts and to enhance the positive impacts.

7.2 Approaches and Methodology

574. This section outlines the screening process undertaken to assess the potential environmental, social, and economic impacts in the proposed area. The screening involved a review of literature, primary and secondary baseline data, and expert judgment to evaluate the potential effects of the proposed project extensions on the physical, biological, and socioeconomic environment.

575. The screening process commenced by identifying the potential environmental aspects associated with siting the project. Subsequently, it assessed the potential environmental impacts at various stages of the project, including site preparedness, construction, and operational phases adhering to the International Finance Corporation (IFC) Performance Standards (PS). Following this, residual impacts were identified post-adoption of mitigation measures that may be necessary at the outset of activities. It is noted that the impacts on environmental resources resulting from the proposed project are anticipated to be short-term and temporary in nature.

576. A systematic strategy was devised to provide a comprehensive assessment of the likely impacts on both the micro- and macro-environment of the project site. This strategy encompassed:

- Reviewing general guidelines of the Punjab Environmental Protection Agency as well as IFC and ADB to ensure adherence to established protocols.
- Identifying potential environmental impacts through a combination of surveys, consultations, and checklists.
- Assessing the intensity and significance of potential impacts by soliciting expert opinion and conducting thorough environmental analyses.
- Defining mitigation measures aimed at minimizing impacts to the lowest practicable level.
- Predicting any residual impacts, encompassing all potential outcomes including long-term and short-term, direct and indirect, beneficial, and adverse impacts.

- Establishing a monitoring framework to effectively track and manage residual impacts over time.
- Integrating an assessment of gender and vulnerability dynamics to ensure that E&S aspects are addressed equitably, recognizing and prioritizing the needs and perspectives of vulnerable groups, including women, marginalized communities, and at-risk populations, throughout the project lifecycle.

577. By following this structured approach, the screening process facilitated a comprehensive understanding of the potential environmental, social, and economic impacts associated with the proposed project extensions. Additionally, it ensured that appropriate mitigation measures were identified and implemented to minimize adverse effects and promote sustainable development practices.

578. The following Checklist in **Table 7-3** provides the screening of potential environmental impact on different components i.e. physical, biological & social of the proposed project.

7.3 Rapid Environmental Assessment (REA) Checklist

	Chemical Based Industrial
Country/Project Title:	Pakistan / Bio-Tech Energy Sustainable Aviation Fuel Project
Sector Division:	Environment Assessment

Table 7-1: Screening Checklist for Potential Environmental Impacts

Screening Questions	Yes	No	Remarks
A. PROJECT SITING Is The Project Area Adjacent to Or Within Any Of The Following Environmentally Sensitive Areas?			
• Cultural Heritage Site		✓	There are no known archaeological, cultural or religious heritage sites located within 500 m of the proposed project area.
• Protected Area		✓	No protected areas have been reported within the project area of influence except the native plantation along the existing road which is managed by the Forest department.
• Wetland		✓	No wetland is present near the proposed project site.
• Mangrove		✓	No mangrove is present near the proposed project site.
• Estuarine		✓	No estuarine near the proposed project site.
• Buffer Zone of Protected Area		✓	No buffer zone of protected area near the

Screening Questions	Yes	No	Remarks
			proposed project site.
Special Area for Protecting Biodiversity		✓	No special areas for biodiversity protection are close to the project site.
POTENTIAL ENVIRONMENTAL IMPACTS			
Will The Project Cause			
Impairment of historical / cultural monuments / areas, and loss/damage to these sites?		✓	No encroachment of historical places.
interference with other utilities and blocking access to buildings; nuisance areas due to noise and odor?		✓	No Interference has been reported for utilities / blocking access to buildings at the proposed project site.
dislocation or involuntary resettlement of people		✓	No involuntary resettlement of people has been reported/involved in the proposed project. As the land belongs to the proponent.
Air pollution resulting from emissions of hydrocarbons from process equipment, accidents, inadequate equipment maintenance, and poor planning?	✓		During the construction phase, there may be a brief increase in air pollution, but using eco-friendly equipment can mitigate this. Since the site is Brownfield and has full existing utilities, temporary generators and extra equipment won't be needed. Once operational, scrubbers will be used to keep emissions within environmental standards. Regular third-party monitoring will ensure compliance. The company's experience with similar operations and existing compliance strategies will effectively manage any environmental impacts.
Social conflicts between construction workers and local community workers?		✓	No such conflict is anticipated as the international engineer's role is to supervise the construction for engineering and best international standards for SAF as well as technology. Where local contractors are available for example civil works, this is being undertaken by local contractors.
Noise and dust from construction activities?	✓		The ambient noise level is anticipated to rise between 80-90 dB (A) due to construction activities, maintenance workshops, and earthmoving equipment. To mitigate this, all stationary noise-producing equipment will be equipped with acoustic enclosures. During construction, there may be a brief increase in dust pollution, which will be addressed through the use of environmentally friendly equipment.

Screening Questions	Yes	No	Remarks
			Regular water sprinkling and adjustments to generators and other mobile machinery will be implemented to minimize impacts. It's important to note that the impact of these factors is significantly lower compared to what would be expected for a greenfield site, given the presence of an existing industrial site.
air pollution resulting from emissions from production processes, accidents, and poor equipment maintenance?	✓		During operations, scrubbers will be installed to regulate emissions within permissible environmental quality standards (PEQS), with regular maintenance to ensure their effectiveness. Third-party EPA-certified monitoring will be conducted routinely. Additionally, BTE possesses extensive experience in biofuels and boasts an engineering team with over 600 years of combined experience. Moreover, a technology licensor and IPC offer a comprehensive 3-year training program covering maintenance. With these measures in place, the risk of inadequate equipment maintenance is highly unlikely, given the support of third-party monitoring and a highly skilled maintenance team.
Pollution of water bodies and aquatic ecosystems resulting from production wastes, utility operations, sanitary sewage, and miscellaneous discharges?	✓		During Production, waste water will be generated from different process activities. A wastewater treatment plant will be installed to ensure compliance with Punjab Environmental Quality Standards (PEQS). Regular O&M plans with third-party wastewater sampling (inlet and outlet of wastewater treatment plant) will help to avoid the risks of pollution which may harm the water bodies. Preventive maintenance measures will be opted for with regular inspection of the production facility to avoid any process-related accident/leakage.
contamination of soil and groundwater from solid wastes from water treatment sludge's, cafeteria or lunchroom wastes, ashes and incineration residues, etc.?	✓		During the construction phase, various activities will generate solid waste, which will be repurposed in cut-and-fill operations. Waste containers will be strategically placed to segregate different types of waste at their source, each properly labeled. Kitchen and domestic waste will be composted. Efforts will be made to minimize packaging waste by using materials with

Screening Questions	Yes	No	Remarks
			minimal packaging and opting for durable, long-lasting materials to reduce waste generation over time. The facility's circular economy concept ensures no solid waste is produced from production activities.
Public health and safety hazards due to air pollution and possible groundwater contamination?	✓		Implementing scheduled water sprinkling and designated timings for heavy equipment movement reduces dust emissions. Structured truck movement schedules and wetting or covering of material stockpiles mitigate dust dispersion. Mandating dust masks and goggles protects workers. Dust pollution occurs only during a 3-month excavation phase, not during production. Wastewater from production will be treated to meet environmental standards, with regular maintenance and third-party sampling. A sour water stripper will enhance wastewater reuse, minimizing environmental impact.

7.3.1 Characteristics of Impacts

579. The predicted impacts have been characterized; various aspects of the impact include:

- Nature (direct/indirect)
- Duration of impact (Short term, medium-term, long-term)
- Geological extend (local, regional)
- Timing (Project phase)
- Reversibility of impact (Reversible/Irreversible)
- Likelihood of the impact (certain, likely, unlikely, rare)
- Impact consequence severity (major, moderate, minor)
- Significance of impact (High, medium, low)

580. The above aspects of environmental characterization are defined in **Table 7-2**.

Table 7-2: Impact Characterization

Nature	Direct: The environmental parameter is directly changed by the project. Indirect: The environmental parameter changes as a result of a change in another parameter
Duration of Impacts	Short-term: lasting only for the duration of the project such as noise from the construction activities. Medium-term: Lasting for a period of a few months to a year after

	the project before naturally reverting to the original condition such as loss of vegetation due to clearing of campsite, contamination of soil or water by fuels or oil. Long-term: lasting for a period much greater than medium-term impact before naturally reverting to the original condition such as loss of soil due to soil erosion.
Geographical Extent	Local, regional (spatial dimension)
Timing	Construction and Operation
Reversibility of Impact	Reversible: when a receptor resumes its pre-project condition. Irreversible: when a receptor does not or cannot resume its pre-project condition.
Likelihood of the Impact	Almost Certain: Impact expected to occur under most circumstances. Likely: Impact will probably occur under most circumstances. Possibly: Impact may possibly occur at some time. Unlikely: Impact could occur at some time. Rare: Impact may occur but only under exceptional circumstances.
Impact Consequences severity	Major: When an activity causes irreversible damage to a unique environmental feature; causes a decline in abundance or change in distribution over more than one generation of an entire population of species of flora and fauna: has long-term effects (period of years) on socioeconomic activities of significance on the regional level. Moderate: When an activity causes long-term (years), reversible damage to a unique environmental feature; causes reversible damage or change in abundance or distribution over one generation of a population of flora or fauna: has short-term effects (years) on socioeconomic activities of significance on the regional level. Minor: When an activity causes short-term (period of a few months), reversible damage to a unique environmental feature; slight reversible damage to a few species of flora or fauna within a population over a short period; has short-term (period of months) effects on socioeconomic activities of local significance. Negligible: when no measurable damage to the physical, socioeconomic, or biological environment above the existing level of impact occurs.
Significance of Impact	Categorized as High, Medium, Low Based on the consequence, likelihood, reversibility, geographical extent, and duration: level of public concern: and conformance with legislative of statutory requirements.

581. The impact characterization due to the Design, Location, Construction and operational phases is given in their respective sections.

7.3.2 Environmental Impacts and Their Mitigation During Pre-Construction Phase

7.3.2.1 Environmental Impacts Regarding Project Location

582. As previously discussed regarding the location alternatives, it has been established that the current site owned by Biotech Energy Pvt Ltd. stands out as the most suitable option. This determination is based on a thorough evaluation of various factors, including drainage capabilities and the availability of required vacant land.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Land Acquisition and Resettlement	PS-1, PS-5	Direct	Long term	Local	Irreversible	Rare	Negligible	Low

Mitigation

583. No mitigation is necessary concerning land acquisition for the proposed project, as the required land is already owned by BTE.

Residual impacts

- There will be no remaining residual impacts from the project site after applying mitigation measures.

7.3.3 Environmental Impact and Their Mitigation during Construction Phase

584. The construction of the Biotech Energy plant encompasses a broad spectrum of activities vital for establishing a state-of-the-art facility focused on energy production. These tasks commence with site preparation, including land clearing and grading to establish a stable foundation. Following this, building construction proceeds, erecting essential structures such as the production plant, boiler room, office facilities, and storage areas. Mechanical tasks entail installing critical components like tanks, piping systems, and HVAC systems, while electrical work involves wiring, lighting, and power distribution. The installation of instrumentation and control systems enables precise monitoring and regulation of plant processes, complemented by setting up and commissioning specialized equipment such as boilers, turbines, and pollution control systems. Prioritizing safety measures and environmental compliance throughout the construction phase, including fire detection systems and waste management protocols, is crucial. Additionally, landscaping efforts are undertaken for both aesthetic enhancement and environmental preservation. The construction phase concludes with thorough testing, operational staff training, and the handover of the completed plant,

ensuring functionality, safety, and preparedness for operational deployment.,

7.3.3.1 Physical Impacts

Soil contamination

585. Construction activities such as excavation, filling, and disposal of materials, both solid and liquid, will inevitably impact the existing soil conditions on the Project Site and its surrounding areas. Instances of spillage from generators or moving vehicles during construction can lead to soil contamination at the construction sites. This contamination poses risks to soil quality and ecosystem health, potentially affecting nearby vegetation.

586. The construction site is expected to produce around 0.45kg/capita/day. Despite its seemingly small quantity, improper waste disposal methods can have significant adverse effects on the project area's physical environment. Inadequate waste management may result in littering, waste accumulation in open areas, and potential contamination of soil and water sources through leachate from decomposing waste. Furthermore, the presence of unsightly waste can diminish the area's aesthetic appeal and attract pests, exacerbating environmental concerns.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Soil Contamination and Erosion (Construction Phase)	PS-1, PS-3	Direct	Short Term	Local	Irreversible	Likely	Moderate	Medium

Mitigation Measures

- **Soil Contamination Prevention:** Set up containment areas for hazardous materials, regularly monitor for leaks, and train personnel in spill response. Implement protocols for immediate cleanup and ensure containment measures are in place before hazardous materials arrive on-site.
- **Training Workforce in Solid Waste Disposal:** Provide comprehensive training to workers on proper waste segregation and disposal through toolbox meetings and workshops. Ensure training begins at project mobilization and continues throughout the construction phase to minimize waste mismanagement.
- **Proper Drainage Facility:** Install drainage systems during site preparation to prevent water accumulation and contamination risks. Ensure adequate drainage coverage across the site and conduct regular maintenance checks to prevent blockages.
- **Ground Leveling:** Level the site during initial preparation to reduce slopes and prevent soil erosion. Conduct inspections to ensure leveling quality and maintain site stability throughout the project.

- **Waste Disposal and Management:** Implement a waste management plan with designated disposal areas, focusing on segregation and recycling. Regularly review and improve waste disposal practices to ensure environmental compliance.
- **Monitoring and Spill Cleanup:** Establish a schedule for monitoring spills and assign trained teams for rapid response. Provide necessary spill cleanup equipment and ensure immediate actions to mitigate environmental impacts and comply with regulations.
- **Waste heaps:** The waste heaps will be removed as part of the site preparation process. A thorough assessment by contractor will be conducted to evaluate the potential for soil contamination, and any necessary testing, including for asbestos within the waste piles, will be carried out to ensure compliance with environmental and safety standards.

Residual impacts

587. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.3.3.2 Contamination of Surface and Groundwater Resources

588. The nearest surface water bodies to the SAF plant are the Mangtawala Feeder Canal, located approximately 2.40 km southwest of the BTE facility. The wastewater generated from the BTE facility is currently being discharged into a nearby seasonal drain known as the Ghazi drain. This is a seasonal drain, with an average flow rate ranging between 8 to 16 cusecs, The construction waste water from site will also discharge in to the Ghazi drain. Construction activities such as concreting, and soil dumping, along with the use of chemicals, oil, lubricants, and detergents, can lead to the deterioration of water quality in Ghazi drain.

7.3.3.3 Wastewater Generation

589. The predominant source of generated wastewater will be municipal and washing water. About 15 to 20 m³/day of waste water will be generated from construction site during construction phase activities.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Surface Water Contamination (Construction Phase)	PS-1, PS-3, PS-4	Indirect	Short Term	Regional	Reversible	Likely	Minor	Medium
Ground Water Contamination (Construction Phase)	PS-1, PS-3, PS-4	Direct	Short Term	Local	Reversible	Unlikely	Minor	Medium

Mitigation Measures

- **Septic Tank Design and Installation:** For the SAF construction phase, septic tanks will be installed to manage wastewater, and disposal will adhere to IFC Performance Standards by utilizing licensed contractors for safe disposal. These measures ensure that the wastewater generated does not adversely affect the surrounding environment or community.
- **Temporary Drainage System:** Install a drainage system with oil and grease interceptors to handle construction runoff and wastewater. Ensure operational readiness before construction activities commence.
- **Prohibition of Waste Disposal:** Enforce strict prohibition on disposal of lubricants or hazardous materials onto the ground or into water bodies. Train workers on protocols and maintain zero incidents throughout construction.
- **Containment Areas for Liquid Materials:** Construct designated liquid storage areas to prevent runoff to surface water. Conduct weekly compliance inspections and train staff on proper storage protocols.
- **Immediate Spill Cleanup:** Implement a protocol for rapid cleanup of oil and fuel spills within one hour. Provide spill kits and ensure trained response teams are on-site throughout construction.
- **Sanitary Latrines Installation:** Install sanitary latrines before construction begins to protect surface waters and ensure worker hygiene.
- **Maintenance of Spill Cleanup Equipment:** Conduct monthly checks and inventory of spill cleanup equipment. Assign dedicated personnel to maintain and restock supplies.
- **Controlled Fueling Operations:** Limit fueling operations to marked containment areas with visible signage. Train staff on proper fueling protocols to prevent leaks and spills.
- **Secure Fuel and Chemical Storage:** Store fuel and chemicals on impervious bases with bunds capable of holding 110% of tank volume. Conduct monthly inspections and ensure repairs are made as needed.
- **Clear Marking of Tanks and Drums:** Label all tanks and drums and monitor them for leaks. Conduct monthly audits and assign a responsible team to ensure safety and compliance.

Residual impacts

590. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.3.3.4 Impact on Ambient Air Quality

591. Due to the construction activities like excavation, clearing, levelling and compaction with the use of machinery like excavators, dump trucks and other transport vehicles etc. Most of these are using diesel engines that generate noise and exhaust emissions. The possibility of exhaust emissions increases when old vehicles/plants are utilized for execution purposes. Generally, the above activity generates particulate- matter (PM10), smoke, dust, CO and NOx in the ambient air, which is deteriorating the air quality and resulting in impacts on human health. The movement of heavy machinery and vehicles on the dirt tracks is also causing dust emissions. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface.

592. Generally, the above activity generates particulate- matter (PM₁₀), smoke, dust, CO and NO_x in the ambient air, which is deteriorating the air quality and resulting in impacts on human health. The movement of heavy machinery and vehicles on the dirt tracks is also causing dust emissions. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Air Quality Deterioration (Construction Phase)	PS-1, PS-3	Direct	Short term	Local	Reversible	Possibly	Minor	Medium

Mitigation Measures

- **Vehicle Tuning to Reduce Emissions:** Tune construction vehicles every three months to reduce NO_x, SO_x, CO, and PM₁₀ emissions. Maintain records of tuning and emissions levels throughout the project.
- **Proper Maintenance of Diesel Equipment:** Implement regular maintenance of diesel-powered machinery to optimize performance, reduce emissions, and extend equipment lifespan. Monitor and log emissions and maintenance frequency throughout the construction phase.
- **Covering of Haul Trucks with Tarpaulin:** Ensure all trucks transporting materials are covered with tarpaulins to minimize dust emissions and prevent material spillage. Conduct random checks to ensure compliance during material transport throughout the project.
- **Water Sprinkling to Control Dust Emissions:** Use water trucks to sprinkle water on paved roads twice daily to reduce dust and particulate matter. Track dust levels weekly and maintain compliance with the watering schedule to ensure air quality throughout the construction period.

Residual impacts

593. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.3.3.5 Impact on Ambient Noise Levels

594. During the construction phase of the SAF, noise will primarily be generated by the operation of heavy machinery and equipment, including bulldozers, excavators, stabilizers, concrete mixing plants, pneumatic drills, stone crushers, and similar equipment. Although construction activities will be limited to building foundations, office structures, and access roads/pathways, these activities are expected to produce significant noise levels within the Core Area. However, as sensitive receptors are located at a considerable distance from the project site, no significant impact from

construction noise is anticipated on these receptors. The distance serves as a natural buffer, mitigating potential noise effects on the surrounding community.

595. The cumulative effects from several machines can be significant and may cause significant nuisances. However, these increased noise levels will prevail only for a short duration during the preconstruction and construction phase. The noise produced by construction equipment is presented in Table below as reference.

Table 7-3: Noise Produced by Construction Equipment

Equipment/Tools	Calculated Baseline Noise Level dB (A)	Noise dB(A) at 15ft from Source
Wheeled loading	62.3	90
Grader		90
Vibration pavement roller		86
2-wheel vibration pavement roller		81
3-wheel pavement roller		81
Tire pavement roller		76
Bulldozer		86
Wheeled pneumatic dredger		84
Sprayer		87
Power generator		98
Impact drill		87
Impact pile driver		112
Truck		92
Concrete mixer		91
Concrete pump		85
Mobile lift		96
Pneumatic hammer and rock crusher		98
Breaker		84
Pneumatic spanner		95

596. Other tools and equipment used for mechanical works and their typical noise levels dB(A) at 15 feet from the source for some common equipment are given below:

Equipment/Tools	Calculated Baseline Noise Level dB (A)	Noise dB(A) at 15ft from Source
Welding		
Welding Machines	62.3	80
Chipping Hammer		95

Equipment/Tools	Calculated Baseline Noise Level dB (A)	Noise dB(A) at 15ft from Source
Drawing		
Drawing Presses	62.3	88
Folding (Bending)		
Press Brakes	62.3	85
Folding Machines		80
Forging		
Forging Presses	62.3	93
Power Hammers		113
Extrusion		
Extrusion Presses	62.3	88
Machining		
Lathe	62.3	85
Milling Machines		90
Drilling Machines		90
Grinding Machines		95
CNC Machines		80
Sawing Machines		90
Shapers and Planers		90
Punching		
Punch Presses	62.3	98
Turret Punch Presses		93
Shearing		
Shearing Machines	62.3	98
Stamping		
Stamping Presses	62.3	98

Source: Quagliata, A., Ahearn, M., Boeker, E., Roof, C., Meister, L., & Singleton, H. (2018). Transit Noise and Vibration Impact Assessment Manual (No. FTA Report No. 0123).

597. The values bold are exceeding existing baseline calculated noise levels. By identifying areas where noise levels are exceeding acceptable limits, targeted mitigation strategies are developed to minimize nuisance and ensure compliance with noise regulations.

598. The likely impacts due to noise are:

- Psychological effects of distraction of attention, irritation and short temperedness in the exposed persons due to persistently higher noise levels;

- Community complaints/grievances due to higher noise levels
- The construction method has not been decided yet, but it is believed that using the proposed mitigation measures will result in reduced noise.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Noise (Construction Phase)	PS-1 PS-3	Direct	Short term	Local	Reversible	Possibly	Minor	Medium

Mitigation Measures

- **Selection of Low-Noise Equipment:** Procure equipment with noise-damping and muffling features, ensuring noise levels are documented before use. Work with vendors to meet noise standards and complete equipment selection before the project begins.
- **Noisy Work Limited to Daytime Hours:** Restrict noisy activities to standard working hours (8 am to 5 pm) and maintain a noise activity log. Enforce this policy from the start of the project and monitor consistently.
- **Provide Hearing Protection to Workers:** Distribute ear protection (earplugs, earmuffs) to all workers exposed to harmful noise levels. Maintain distribution records and ensure ongoing compliance throughout construction.
- **Restrict Nighttime Construction Vehicle Movement:** Limit vehicle movement at night (10 pm to 6 am) and maintain a log of vehicle movements. Implement this restriction immediately and maintain it throughout the project.
- **No Heavy Machinery Use at Night Without Approval:** Prohibit heavy machinery operations (e.g., drills, hammers) at night without prior client approval. Ensure communication with staff and subcontractors and implement this rule throughout the construction phase.
- **Fit Vehicles and Equipment with Silencers/Mufflers:** Equip all vehicles and machinery with appropriate silencers or mufflers, conducting bi-weekly checks to ensure proper noise control. Perform regular checks throughout the project.
- **Install Safety Signs Near Sensitive Receptors:** Install and maintain noise awareness signs in residential, school, or hospital areas. Ensure signs are visible and regularly checked for readability throughout construction.
- **Use Low-Noise or Shielded Machinery:** Prioritize machinery with low-noise or noise-shielding features. Conduct quarterly noise audits and ensure continuous monitoring throughout construction.
- **Adhere to Work Schedule & Noise Control Procedures:** Ensure contractors follow work schedules and minimize noisy operations near sensitive areas. Conduct weekly audits to ensure compliance with noise control procedures throughout the project.

Residual impacts

599. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.3.4 Disposal of Construction Debris & Garbage

600. During the construction phase of the proposed project, a large quantity of construction waste will be produced, the disposal of which, if not managed properly could have negative impacts on the site and surrounding areas. Clearing of shrubs and grass could pose a fire hazard and affect air quality if burned on location. Construction materials including concrete waste, wood, steel, packaging plastics, etc. could be dispersed which may result in the blockage of drainage channels if not disposed of at approved disposal site.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Waste Material (Construction Phase)	PS-1 PS-3	Direct	Short Term	Local	Reversible	Likely	Moderate	Medium

Mitigation Measures

- **Develop and Implement Solid Waste Management Plan:** Create a comprehensive waste management plan that includes storage, collection, and disposal procedures for various waste types (hazardous, recyclable, general). Track activities and review the plan's effectiveness six months after implementation.
- **Dispose of Construction Waste at Approved Sites:** Ensure all construction waste is disposed off at EPA-approved sites with certified vendors. Track disposal receipts and regularly review vendor compliance to meet environmental and regulatory standards.
- **Engage Third-Party Contractor for Organic Waste Management:** Hire a contractor to collect and compost organic waste on-site, promoting sustainability. Maintain logs of waste collection and monitor the contractor's performance throughout construction.
- **Regular Collection of Garbage and Removal of Sewage:** Schedule regular garbage collection and sewage removal to prevent pollution and health hazards. Adjust the collection schedule as needed and maintain records to ensure efficient waste management throughout the project.

Residual impacts

601. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.3.5 Occupational Health and Safety

602. Following health and safety impacts arise during the construction phase of the proposed project

- Workers may face physical hazards like moving machinery, heavy equipment, or falling objects.
- Noise from the machinery during construction may cause hearing loss and noise pollution.
- Lack of awareness and knowledge about OHS issues will lead to near miss, incident and accidents leading to loss of property and resource.
- Excessive heat may result in tiredness, dehydration, and reduced cognitive performance, which raises the likelihood of accidents.
- Working at elevated levels carries a substantial risk of falls, highlighting the importance of implementing adequate safety precautions such as harnesses and guardrails.
- Workers may be inadequately prepared to carry out tasks safely if they lack proper training, which will lead to a higher frequency of accidents and injuries.
- Long working hours or irregular shifts will lead to fatigue-related accidents.
- Poor hygiene, like inadequate sanitation and ventilation, will spread diseases among workers.
- Faulty machinery, slippery floors, and lack of PPEs will cause accidents and injuries.
- Ignoring safety protocols, not using PPEs will increase the risk of accidents.
- High-pressure work environments and job insecurity can lead to stress, anxiety, and depression among workers.

Impact	IFC performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Occupational Safety (Construction Phase)	PS-1, PS-2, PS-3, PS-4	Direct	Medium term	Local	Reversible	Likely	Minor	Medium

Mitigation Measures

- **Provide PPEs to Workers:** Distribute necessary PPE (helmets, gloves, safety boots, masks) to all workers, ensuring regular checks and maintaining stock. Conduct daily checks throughout the construction phase to ensure compliance and safety.
- **First Aid Availability:** Equip all sites with fully stocked first aid kits and train at least 15 personnel in first aid and CPR. Conduct monthly reviews of kits and log all incidents for immediate medical care.

- **Routine Medical Checkups:** Conduct routine medical checkups for all staff, including unskilled labor, every six months. Document health reports and follow-up actions, initiating the first check within the first month of construction.
- **Equipment Operation Training:** Train workers on the safe operation of equipment (excavators, cranes, power tools). Ensure all new workers are trained before operating equipment throughout the construction period.
- **Install Cooling Systems and Frequent Breaks:** Set up cooling systems (fans, AC units, shaded areas) and provide regular breaks to prevent heat-related illnesses. Ensure cooling systems are installed before summer starts.
- **Safety Protocols for Elevated Work:** Provide safety harnesses and install guardrails in elevated work areas to prevent falls. Complete installation before starting elevated work.
- **Regular Safety Meetings:** Organize weekly safety discussions on hazard recognition, PPE usage, and emergency response. Track attendance and meeting effectiveness throughout the construction phase.
- **Obtain Work Permits for Hazardous Tasks:** Implement a work permit system for hazardous tasks (e.g., working at heights, heavy machinery operation). Ensure 100% compliance with the system from the start of construction.
- **Hazard and Risk Assessments:** Conduct regular risk assessments to identify potential hazards and ensure safety. Initiate assessments before construction starts and continue quarterly.
- **Job Hazard Analysis (JHA):** Break down tasks into detailed steps and perform Job Hazard Analysis (JHA) for each. Implement JHA immediately and review quarterly to ensure continued safety.
- **Comprehensive Task Training:** Provide comprehensive training on safe task performance, covering equipment operation, hazard recognition, and emergency response. Ensure all workers complete training before construction begins and offer monthly refreshers.
- **Environmental Awareness and PPE Monitoring:** Distribute PPE (boots, helmets, gloves) and conduct monthly compliance checks to ensure consistent use of protective gear throughout the project.
- **Hygiene Training for Employees:** Educate workers on hygiene practices, including handwashing and waste disposal. Conduct initial training before construction starts and provide quarterly refresher sessions.
- **Regular Machinery Inspections:** Perform routine inspections of machinery to ensure safe operation, minimize downtime, and prevent mechanical failures. Begin inspections immediately after construction starts and review quarterly.
- **Implement Non-Slip Flooring:** Install non-slip flooring in high-risk areas (e.g., entryways, kitchens). Complete installation before construction begins and maintain regularly every six months.

Residual impacts

603. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.4 Ecological Environment

7.4.1 Impact on Flora

604. There are no trees present at the proposed site except a few shrubs.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Impact on trees	PS-1, PS-6	Direct	Short Term	Local	Reversible	Likely	Minor	Low

Mitigation Measures

- **Plantation within BTE Vicinity:** Identify key areas for planting native trees and shrubs that enhance air quality and aesthetics. Begin planting after construction completion, ensuring the allocation of resources for planting and ongoing maintenance.
- **Organized Tree Plantation Campaigns:** Conduct tree planting campaigns involving local communities and staff to improve biodiversity and promote environmental awareness. Arrange at least one campaign within the first year and continue regularly.
- **Maintenance and Care:** Implement a schedule for watering, pruning, and monitoring plant health. Assign dedicated personnel for ongoing care, ensuring the long-term survival and growth of the planted vegetation.

Residual impacts

605. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.4.2 Impacts related to invasive species

606. The sole cross-border effect occurs with invasive species. The seeds of these species could hitch a ride on machinery or equipment being imported and transported across borders, resulting in the introduction of these species into new environments. This introduction of invasive species can have significant impacts on the ecosystems and communities in those new areas, causing disruption to the environment, economic damages, and potential health hazards.

607. Invasive Species Anticipated through Import of Machinery and Equipment" refers to non-native organisms—both plant and animal—that are likely to enter and establish in a new ecosystem as a result of international shipping, particularly via the importation of large machinery, equipment, and shipping containers. These species may hitchhike on or in machinery, containers, or packaging materials, and they often survive long-distance transport due to resilience against varying environmental conditions.

608. These may include but not limited to following:

- **Flora:** Seeds, spores, or fragments of non-native plants. Examples may include invasive grasses, aquatic plants, or hardy weeds like *Parthenium*

or *Cogon grass*, which often arrive as contaminants in soil or adhere to shipping containers.

- **Fauna:** Small animals and insects (e.g., snails, beetles, ants, spiders) that can stow away on or in machinery, along with larvae or eggs hidden in soil, wooden pallets, or packaging.

Transboundary impacts

609. There will be transboundary impacts of invasive species during the transportation of equipment and machinery, as unintended transfer of non-native species can disrupt ecosystems in different regions.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Impacts related to invasive species	PS-6	Direct	Long Term	Local	Reversible	Likely	Minor	Medium

Mitigation Measures

- **Implement Wash Stations:** Establish wash stations at site entrances to pressure wash all vehicles, equipment, and materials entering or exiting the site. Ensure 100% compliance by washing all materials and vehicles, with inspections conducted before permitting entry to document and address any invasive species.
- **Personnel Training:** Train staff on proper washing protocols and invasive species identification to ensure effective operation of wash stations and adherence to standards.
- **Weekly Inspections:** Conduct weekly inspections to monitor for any new invasive plants and promptly address identified risks.
- **Setup Timeline:** Complete the setup of wash stations and staff training prior to the start of construction activities. Continue operations and inspections throughout the project duration to maintain compliance.

Residual impacts

610. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.5 Socio-Economic Environment

7.5.1 Impact on Socio Economy

611. The project is expected to generate around more than 300 number of jobs during its implementation phase. While there is no specific mandate to allocate a fixed percentage of these positions to local workers, it is

reasonable to anticipate that a significant proportion—potentially 30-50% could be filled by suitably qualified individuals from nearby communities. This estimate considers the local population's skill base and the nature of the job roles available.

612. The expectation among the local community is likely to be high regarding access to these opportunities, driven by the perception of the project as a source of economic upliftment. Unrealistic expectations may arise about the number of positions, salary levels, and the types of roles available. If left unmanaged, this could lead to dissatisfaction and strained relationships, particularly if discrepancies emerge between perceived promises and actual recruitment outcomes.

613. Moreover, tensions could arise between individuals or groups within the community, especially if certain groups feel disproportionately favored or excluded. Perceived competition between local workers and any non-local hires may exacerbate these issues.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Impact on Socio Economy	PS-1 PS-2 PS-4	Direct	Short Term	Local	Reversible	Likely	Moderate	Medium

Mitigation Measure

- **Develop a Workforce Profile:** Establish a comprehensive workforce profile tailored to each stage of the project (construction and operations phases). Include a breakdown of skills, qualifications, and job requirements to align with project demands.
- **Preliminary Skills Assessment:** Conduct a detailed assessment of the existing skill levels within local communities to evaluate their readiness to meet project needs. Clearly define which communities are involved, ensuring inclusivity and fair representation.
- **Fair and Transparent Recruitment Procedures:** Collaborate with stakeholders to design a transparent recruitment process that prioritizes local hiring. Actively promote gender equity by ensuring equal opportunities for both men and women.
- Outline specific steps to achieve inclusivity, such as targeted outreach, inclusive language in job postings, and community workshops. Introduce training programs to help individuals lacking current qualifications meet job requirements in the future.
- **Community and Worker Grievance Mechanisms:** Raise awareness of the grievance mechanisms available for both community members and workers. Provide accessible channels for individuals to voice concerns regarding the

recruitment process. Act promptly to address grievances, preventing potential tensions and fostering trust.

- **Addressing Recruitment Gaps:** Use the recruitment process to identify roles that cannot be filled locally. Advertise these roles regionally and nationally while continuing to prioritize local capacity building.
- **Engagement and Communication:** Share quarterly updates on recruitment opportunities, salary levels, and selection criteria to maintain transparency.
- Monitor engagement metrics and adapt strategies to ensure effective communication and accessibility for all applicants.
-
- **Skills Training and Development Programs:** Implement training programs for local residents to develop labor skills.
- **Sustainable Development Goals Integration:** Integrate sustainable development principles into the project by offering long-term employment opportunities and fostering local entrepreneurship. Promote partnerships with local businesses to create secondary employment opportunities and stimulate economic growth.
- **Local Labor Hiring Preference:** Prioritize hiring local labor, ensuring all workers have valid CNICs and police clearance. Conduct behavior briefings and maintain secure employee records. Conduct semi-annual reviews to ensure continued compliance.
- **Promote Social Integration and Community Engagement:** Organize at least two community engagement initiatives per year to promote mutual understanding and reduce tensions between local and non-local employees.
- **Disciplinary Measures Against Anti-Social Activities:** Establish a clear code of conduct for workers, outlining specific anti-social behaviors and corresponding consequences. Ensure all workers acknowledge the code before starting construction.

Residual impacts

614. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.5.2 Community H&S Risks

615. The use of road vehicles during construction activities poses significant community health and safety risks along the identified routes. Increased vehicle traffic is likely to result in air pollution from emissions, dust generation on unpaved roads, and noise pollution, particularly near sensitive receptors such as schools, hospitals, and residential areas. These environmental impacts can lead to reduced air quality, respiratory health issues, and disturbances to daily life. Additionally, social risks include heightened pedestrian safety concerns, increased likelihood of road accidents, disruption of local activities, and traffic congestion, potentially causing conflicts and inconvenience for nearby communities. The proximity of sensitive receptors to the roadways further amplifies these risks, necessitating tailored mitigation measures to minimize adverse impacts on the environment and local populations.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Community H&S risks associated with the use of the public road network	PS-4	Indirect	Short Term	Local	Reversible	Likely	Moderate	Medium

Mitigation Measures

- Transportation Management Plan:** To address community health and safety risks associated with road vehicle use within the 5Km radius of the project site, the EPC contractor shall develop and implement a Transportation Management Plan compliant with the WBG EHS General Guidelines prior to the start of construction. This plan must identify road routes and map environmental and social receptors along road routes (e.g., schools, hospitals, markets) and assess traffic increases after conducting fresh traffic survey on the road. Based on the proximity of receptors, specific road sections with reduced speed limits and traffic restrictions (e.g., during peak community activity hours) must be established and enforced. If an alternative route is required, its use will be permitted only upon obtaining prior authorization. Drivers must be trained on defensive driving and community safety awareness, and vehicles must undergo regular inspections to ensure roadworthiness. The contractor shall engage with communities through awareness campaigns, establish and communicate grievance mechanism for road safety concerns, and maintain an emergency response plan for traffic incidents. Monitoring and reporting of traffic impacts, including near-miss and accident data, must be conducted regularly and included in Environmental and Social Monitoring Reports (ESMRs).
- Risk Assessment and Safety Management for Road Transport Operations:** Address the risks associated with road transport operations, focusing on both drivers and vehicles. Drivers will be assessed for qualifications, training in safe transport, and a clean criminal record. Vehicles will undergo monthly inspections, checking safety-critical devices like brakes and lights. Loads will be securely fastened and properly labeled. A comprehensive assessment and inspection regime will be developed to ensure ongoing safety and compliance. Detailed records of qualifications, inspections, and safety checks will be maintained for audit purposes. This approach ensures safe, efficient, and compliant material transportation
- Noise Mitigation:** To minimize noise impacts, construction machinery will be equipped with high-performance silencers or mufflers to reduce engine noise. A strict "no horn" policy will be enforced, using visual signals instead of horns, except in emergencies. Preference will be given to low-noise machinery designed with quieter engines and vibration-dampening features. Additionally, operators will be trained on noise-reduction practices, including avoiding abrupt acceleration and unnecessary engine revving. Conduct monthly noise assessments near sensitive receptors to ensure compliance and effectiveness.

- **Air Mitigation;** To reduce air emissions, all construction vehicles will undergo regular engine tuning and maintenance to optimize combustion efficiency. Vehicles will comply with national or international emission standards, such as Euro 4 or Euro 6, to minimize environmental impacts. Policies will be enforced to minimize idling time, reducing unnecessary fuel consumption and emissions. Additionally, drivers and operators will be trained in eco-friendly driving practices, including gradual acceleration and maintaining steady speeds, to further decrease fuel consumption and smoke production.
- **Dust Suppression:** Apply dust suppressants monthly to improve road safety and reduce dust emissions.
- **Community Communication:** Develop a stakeholder engagement plan to inform residents about project schedules, road changes, and impacts. Track awareness and address complaints to reduce frustration. Finalize the plan before construction starts.
- **Stakeholder Collaboration:** Ensure coordination with authorities to comply with safety regulations and address community concerns. Implement the stakeholder engagement plan before construction begins and maintain ongoing communication throughout the project.

Residual impacts

616. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.6 Construction Phase Cumulative Impacts

617. The construction phase cumulative impacts involve the combined effects of SAF construction, ongoing BTE operations, and other nearby activities on shared environmental and social receptors. These arise from the interaction of multiple projects over time and space, potentially amplifying impacts. In line with IFC Performance Standard 1, the analysis focuses on valued environmental and social components (VECs), including air quality, noise, wastewater, groundwater consumption, and community health and safety.

Table 7-4: Construction Phase Cumulative Impacts

Sr. No	Aspects	Impacts from BTE operation	Impacts from SAF Construction	Cumulative impacts from BTE operation and BTE operation	Cumulative impacts from nearby Existing Facilities (AOI)	Mitigations
1	Ground Water usage	Total water used in Biodiesel production is 44.9 m ³ /day	Total water used in SAF construction phase is estimated 13 m ³ /day	The cumulative impact would be 58 m ³ /day	Total existing water usage of nearby industries' is 4840 m ³ /day	The estimated water usage for the SAF plant construction phase is 13 m ³ /day, which constitutes a minimal impact compared to the

						total water consumption of 4,086 m³/day by nearby industries and activities in the area. This usage represents less than 0.32% of the total consumption within the AOI, making the impact insignificant, short-term, and one-time during the construction phase. The project has already adopted optimized water consumption measures, including efficient dust suppression methods, such as controlled spraying and water-saving techniques for concrete curing, including curing compounds and targeted application. Therefore, no specific additional mitigation measures are deemed necessary.
2	Wastewater generation	The wastewater generation from the BTE averaging operation is around 24 m ³ /day.	The wastewater generation from SAF construction activities would be around 5.6 m ³ /day.	The cumulative impact would be 30 m ³ /day.	The wastewater generation from nearby existing facilities is around 3872 m ³ /day	The wastewater generation from SAF construction activities is estimated to be 5.6 m³/day, which is minimal compared to the total wastewater generation of 3,872 m³/day by nearby facilities. This accounts for only 0.14% of the total wastewater. Additionally, this wastewater

						impact is short-term, limited to the construction phase, and represents a one-time impact. Similarly, the BTE operations generate 24 m³/day of wastewater, which is effectively managed through its dedicated wastewater treatment plant (WTP), ensuring compliance with environmental standards and minimizing any discharge impact. For the SAF construction phase, septic tanks will be installed to manage wastewater, and disposal will adhere to IFC Performance Standards by utilizing licensed contractors for safe disposal. These measures ensure that the wastewater generated does not adversely affect the surrounding environment or community. Given the negligible contribution of SAF construction activities to the total wastewater load, and the robust management practices in place, the impact is deemed insignificant, controlled, and compliant with international standards. No additional

						mitigation measures are necessary.
3	Noise	The noise level from the center of the BTE boundary towards SAF plant is 59 dB (A).	The estimated noise level from the center of the SAF plant boundary towards existing BTE towards SAF is 69 dB (A).	The average cumulative impact at the boundary wall (BTE and SAF plant) would be 52 dB (A).	The noise level from SAF construction and BTE operation is negligible at the nearest receptor (orphanage at a distance of about 305m).	The cumulative noise impact from BTE operations and SAF construction is minimal and well within acceptable limits. The noise level at the boundary wall of the BTE and SAF plant averages 52 dB(A), while the nearest receptor, an orphanage located 305 meters away, experiences negligible noise levels. This is significantly below thresholds that could adversely affect community health or well-being. The SAF construction and BTE operations will have mitigations in place minimizing noise generation, ensuring that impacts remain localized and temporary. To further mitigate potential noise impacts, strict adherence to measures outlined in Section 7.3.3.4 of the ESIA will be ensured, including limiting noisy activities to daytime hours, maintaining equipment in good working condition to minimize noise emissions, and using erection wall

						between existing BTE operation and SAF construction. Given the low cumulative noise levels, the distance to the nearest receptor, and the effective mitigation measures in place, the overall impact of noise from BTE and SAF activities is negligible and well-managed.
4	Air Emissions	There are 07 existing emission sources those concentrations are in compliance with respect to PEQS.	The emission sources from SAF includes construction machinery and emissions from construction activities.	The cumulative impact is likely to increase.	The cumulative impact will increase.	The detail mitigation measures are present in Chapter 07 Section 7.3.3.3. of the ESIA. After applying this mitigation, measures the impacts would be moderate to minor.
5	Community H&S risks associated with the transport	No. of vehicles used for BTE operation is 15 trucks/ vehicles per day on Sharaqpur Road.	No. of vehicles that would be used for SAF construction would be 25 trucks/vehicles per day (during peak construction activities) on Sharaqpur Road.	The cumulative no. of trucks/vehicles would be 40 trucks/ vehicles per day on Sharaqpur Road.	The existing traffic load at Sharaqpur road is 4097 vehicles per day. The combined impact of BTE operation and SAF construction is negligible compared to the baseline traffic load on the Sharaqpur road.	The addition of vehicles from BTE operations (15 trucks/vehicles per day) and SAF construction activities (25 trucks/vehicles per day during peak construction) will result in a combined total of 40 trucks/vehicles per day on Sharaqpur Road. This represents less than 1% of the baseline traffic load of 4,097 vehicles per day, making the cumulative impact on traffic and Community Health and Safety (H&S) negligible.

						To further mitigate any potential risks, vehicles will operate during off-peak hours. Regular vehicle maintenance, enforcement of speed limits, and community awareness campaigns will ensure safe operations. Additionally, daily traffic monitoring and a grievance redressal mechanism will address any community concerns. With these measures in place, the overall impact of the additional vehicles is controlled, short-term, and aligns with best practices for community and traffic safety.

7.7 Environmental Impact and their Mitigation during Operational Phase

7.7.1 Physical Impact

618. Integrated assessments are crucial during the operational phase to determine the environmental and social impacts, as well as potential risks and opportunities of a project, by IFC Performance Standards 1, 3, 4 and 6 emphasizing the significance of aligning with these physical impacts.

7.7.1.1 Collection of Feedstock

619. A comprehensive risk assessment for collecting used cooking oil (UCO) involves systematically evaluating various factors associated with each type of feedstock. The assessment commences with identifying the diverse sources of UCO, spanning residential households, restaurants, catering services, food processing facilities, and industrial sites. Understanding the characteristics of the waste is paramount, including factors like viscosity, acidity, impurities, and potential contaminants, which may vary based on their origin. Additionally, evaluating the efficiency of collection methods, frequency, route planning, and the personnel and equipment involved is

crucial.

620. Occupational health and safety (OHS) considerations are pivotal in the risk assessment, as workers engaged in UCO collection may encounter hazards such as slips, exposure to harmful chemicals, lifting injuries, and vehicular accidents. It's imperative to assess proper handling and stocking practices to mitigate risks such as spills, leaks, contamination, and adverse environmental exposure. Furthermore, careful attention to transportation risks is essential, encompassing vehicle safety, driver training, traffic hazards, route planning, and adherence to transportation regulations to ensure the safe transportation of collected UCO to processing facilities.
621. Environmental and community impacts are significant focal points in the risk assessment process. Potential risks encompass soil or water contamination, air pollution from vehicle emissions, and disturbances to local communities due to noise, traffic congestion, and visual clutter. Adherence to pertinent regulations and standards governing feedstock collection, transportation, and waste management is imperative. Implementing risk mitigation strategies, including OHS training, spill prevention protocols, vehicle maintenance, and community engagement initiatives, is essential. Continuous monitoring and improvement are vital for evaluating the efficacy of mitigation measures and adapting strategies to evolving risks and regulatory requirements, thereby safeguarding the well-being of workers, communities, and the environment throughout the UCO collection process.

Cumulative impact

622. There will be negligible cumulative impacts due to collection of feedstocks. However, there would be reduction in waste generation and illegal usage of UCO, Poultry Feather Acid Oil (PFAO). Soap Stock Acid Oils and Edible Oil Refinery Wastes (SBE).

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Collection of Feedstock	PS-1, PS-2, PS-3	Direct	Short Term	Local	Reversible	Likely	Moderate	Medium

Mitigation Measures

- **Feedstock Collection Procedure:** BTE will develop and implement a Feedstock Collection Procedure that aligns with the IFC EHS General Guidelines. This procedure will effectively address environmental and safety concerns, ensuring adherence to the highest industry standards. Regular monitoring and audits will be conducted to maintain continuous compliance and drive ongoing improvements.

- **Prevent Spillage During Transportation:** Ensure that during the collection of feedstock containers are not overfilled by limiting fill levels to 90% capacity. Regular inspections will be conducted to verify compliance, with monthly checks to prevent any potential spills. These measures will help mitigate risks associated with transportation, ensuring safe handling and environmental protection.
- **Prevent Contamination of Soil and Water:** Use appropriate containers (polyethylene, polypropylene, or metal) for feedstock collection and transportation. Conduct monthly inspections to ensure no leaks or spills occur, preventing soil and water contamination.
- **Ensure Worker Safety During Handling:** Provide appropriate PPE (gloves, goggles, protective clothing) to all workers handling waste oil. Conduct monthly safety audits to verify PPE use and safe handling practices.
- **Implement Effective Spill Response Procedures:** Develop and implement a spill response plan with clear protocols for containment, cleanup, and communication, ensuring a 15-minute response time. Finalize and train personnel on the plan within the first three months of operations and conduct annual reviews or after each spill incident.
- **Development and Implementation of Supply Chain Management System (SCMS):** A SCMS will be developed and implemented which includes a range of control measures including a Responsible Collection Policy (RCP) to achieve 100% traceability and risk screening across the entire feedstock collection network, and a Supplier Code of Conduct. The Supplier Code of Conduct will require the prohibition of a child or forced labor to be present at the premises and the business to have adequate life and fire safety (L&FS) controls in line with IFC's PS1 and PS2. BTE will also prepare and implement an audit methodology to assess the implementation of SCMS, including monitoring compliance using KPIs and a Remediation Plan for non-compliant businesses.

Residual impacts

623. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.2 Transportation of Feedstock

624. The transportation of feedstock will have a moderate risk to the environment and local communities if not managed properly. Here are some potential impacts:

- Transportation of waste oil feedstock can result in emissions of pollutants such as carbon monoxide, nitrogen oxides, and particulate matter, which can contribute to poor air quality and respiratory health issues.
- Spills and leaks during transportation will lead to the contamination of water sources, land and soil posing a risk to the environment.
- The use of vehicles powered by fossil fuels contributes to greenhouse gas emissions, which will contribute to climate change and have impacts on ecosystems and human health.
- Heavy machinery used for transportation will result in significant noise pollution, which will have negative impacts on local communities or nearby residential areas.

- The total number of vehicles used for feedstock collection for SAF facility will be 300 vehicles per month.

Cumulative impact

625. The total number of vehicles for BTE for feedstock collection currently accounts for 80 vehicles per month. Collectively the total number of vehicles will be approximately 380 vehicles per month. The cumulative impacts of transportation will lead to increase in pollutants such as carbon monoxide, nitrogen oxides, and particulate matter, as well as an increased in GHG emissions. Moreover, the instances of spill and leaks during transportation will also anticipate to increase.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Transportation of Feedstock	PS-1, PS-2, PS-3	Direct	Short Term	Local	Reversible	Likely	Minor	Low

Mitigation Measures

- **Transportation Management Plan** - The company will develop and implement a comprehensive Transportation Management Plan (TMP) to ensure that all transportation activities, from route planning to vehicle and driver management, are fully compliant with the WBG EHS guidelines. This plan will focus on minimizing transportation-related risks, protecting the environment, and ensuring the safety and well-being of workers and local communities. Key components include safe and efficient route selection, driver qualification and training, vehicle inspection and maintenance, load security, and environmental safeguards. Regular monitoring, stakeholder communication, and continuous improvement will be integral to the plan's ongoing success.
- **Ensure Vehicle Safety and Maintenance:** Ensure all transportation vehicles have valid fitness certificates and are regularly maintained. Conduct quarterly inspections to verify compliance and ensure safety during operations.
- **Follow EU Methodology for Collection Tracking:** Implement a system to track feedstock collection using EU standards, recording per-kilometre readings. Complete the tracking system setup within three months and review it quarterly to ensure accuracy.
- **Prevent Spillage During Transport:** Use appropriate containers (polyethylene, polypropylene, or metal) for feedstock transportation. Conduct monthly inspections to ensure containers are in good condition, maintaining 100% compliance during each transport.
- **Ensure Driver Competency:** Ensure all drivers are licensed and complete specialized training for transporting waste oil. Conduct training and competency assessments every six months to maintain high safety standards.

- **Minimize Noise Pollution:** Use noise-reducing equipment and avoid transport during sensitive hours. Measure noise levels monthly to ensure they remain within acceptable limits throughout the operation.
- **Train Personnel on Safe Handling and Transport Procedures:** Ensure all personnel involved in handling and transporting materials are trained on the Spill Management Plan. Complete training within three months of operations and conduct annual reviews to ensure ongoing effectiveness.

Residual impacts

626. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.3 Storage of Feedstock

627. The storage of feedstock in a biotech industry will have several impacts on the environment and the operation of the plant.

- Improper storage and handling of waste oil feedstock will lead to leaks and spills, which can contaminate water sources.
- Improper storage of waste oil feedstocks can contribute to poor air quality, odor and respiratory health issues.
- Spills and leaks from waste oil storage will also result in soil contamination, which will impact the health of plants and animals.
- Improper storage of feedstock will result in degradation of the feedstock quality over time, leading to reduced efficiency and effectiveness of the industry.
- Improper storage of feedstock will result in pest infestations, which can have negative impacts on the operation of the plant and surrounding communities.
- The total capacity of the feedstock storage used for SAF plants will be 7000 metric tons.

Cumulative Impacts

628. The total capacity of storage used for BTE feedstock collection currently accounts for 1000 metric tons. Collectively with BTE and SAF, the total capacity of storage will increase to approximately 8000 metric tons. The cumulative impacts for storage of feedstock will cause increase in leakages and spillages and deterioration of air quality.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Storage of Feedstock	PS-1, PS-2, PS-3	Direct	Short Term	Local	Reversible	Likely	Moderate	Medium

Mitigation Measures

- **Prevent Contamination and Oxidation of Waste Oil:** To prevent contamination, oxidation, and unsafe handling of waste oil, store it in sealed, airtight, and corrosion-resistant containers within a ventilated, temperature-controlled, and covered area equipped with secondary containment systems. Conduct monthly inspections to ensure container integrity, repair any damages, and maintain records of inspections, storage quantities, and disposal activities. Train staff regularly on proper handling, spill management, and emergency response, and ensure all containers are labeled with hazard symbols. Dispose of waste oil through licensed contractors, complying with local and international regulations. Equip storage areas with spill kits, fire extinguishers, and PPE, and implement an Emergency Preparedness and Response Plan (EPRP) for potential incidents
- **Enhance Fire Safety Measures:** Develop and implement an Emergency Preparedness and Response Plan (EPRP) in compliance with WBG EHS General Guidelines with fire suppression systems in key areas including, but not limited to storage areas such as Feedstock storage, Final Product and hazardous material storage. Ensure 100% coverage of fire suppression equipment, conduct quarterly inspections, and provide fire safety training. Complete the EPRP within three months of operation and review it annually or after an incident. A copy of the EPRP will also be shared with the relevant government authorities who has responsibility to provide emergency response services.
- **Implement Effective Pest Control Measures:** Conduct regular inspections, use traps or baits, and maintain sanitation to prevent pest access. Track pest incidents and conduct monthly inspections to ensure pest control measures are effective.

Residual impacts

629. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.4 Supply Chain Risks

630. The supply chain for collecting and transporting used cooking oil involves several risks, particularly related to HSE, contamination, spills and leaks. These risks are described below:-

If the feedstock is contaminated with water, food waste, or other chemicals, it can reduce the quality and therefore production of SAF may be affected.

Feedstock is bulky, heavy, and difficult to transport, especially if it is stored improperly or in unsuitable containers. These factors can lead to delays, transportation accidents, or oil spillage.

Spills, leaks, or improper disposal of feedstock can lead to soil and water contamination, posing a significant environmental threat. This risk is heightened when transporting large volumes of oil over long distances.

Workers handling feedstock may face health and safety hazards, including exposure to contaminants, risk of burns, or physical injuries from improper handling.

Disruptions such as natural disasters, transportation strikes, or fuel shortages can delay the collection or delivery of feedstock, affecting the overall supply chain performance.

Cumulative impacts

631. Cumulatively, the collection points and transportation networks are expected to expand. Simultaneously, the growth of transportation facilities may lead to an increase in child or forced labor, as well as health, safety concerns. However, there is also anticipated to be a positive impact on the informal sector which includes reduction in waste, increased community-health benefits and enhancement in economic activities.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Supply Chain Risks	PS-2, PS-4	indirect	Short Term	Regional	Reversible	Likely	Moderate	Medium

Mitigation Measures

- **Supplier Due Diligence:** BTE will prepare and implement a comprehensive Supply Chain Management System (SCMS), incorporating a Responsible Collection Policy (RCP) to ensure 100% traceability and risk screening across the entire feedstock collection network. A Supplier Code of Conduct will be enforced, which prohibits child or forced labor and mandates adequate life and fire safety (L&FS) controls in compliance with IFC Performance Standards 1 and 2. BTE will also develop an audit methodology to assess SCMS implementation and monitor supplier compliance through Key Performance Indicators (KPIs). A Corrective Action Plan will be established for any non-compliant suppliers to address and correct identified issues, ensuring continuous improvement and adherence to ethical and safety standards.
- **Supplier Code of Conduct:** BTE will develop and enforce a comprehensive Supplier Code of Conduct that explicitly prohibits child and forced labor. All suppliers will be required to sign and adhere to this code. BTE will conduct regular audits of suppliers to verify compliance with the code, ensuring adherence to ethical standards. Any violations will be addressed promptly, with corrective actions taken as necessary to maintain full compliance. Ongoing monitoring will be conducted to ensure continuous compliance and mitigate any risks related to labor practices.
- **Training and Awareness:** BTE will provide regular training on ethical labor practices and incident reporting to both employees and suppliers. The training program will ensure comprehensive participation, with pre- and post-training assessments to gauge effectiveness. To maintain ongoing awareness and compliance, training sessions will be conducted every three months.

- **Monitoring and Auditing:** Conduct internal audits biannually and third-party audits annually for all suppliers, ensuring 100% compliance with national legislation and adherence to IFC-PS-2 standard. Allocate resources for audits and corrective actions, maintaining regular monitoring.
- **Traceability and Transparency:** Implement a tracking system for used cooking oil throughout the supply chain to ensure transparency. Achieve 100% traceability for all batches, integrating the system within three months of operations.
- **Stakeholders Engagement:** Develop the Stakeholder Engagement Plan that will focus on key engagement activities, including regular communication with suppliers on compliance with the Supplier Code of Conduct, ongoing training for employees and suppliers, and updates on internal and third-party audits
- **Recognition for Compliance:** BTE will implement a recognition program to reward suppliers who demonstrate exemplary compliance with IFC- PS2 and national legislation. Suppliers who meet or exceed the established criteria will be eligible for incentives such as prizes, shields, or certificates of recognition. Compliance will be tracked annually, and the program will be reviewed and updated regularly to ensure it continues to encourage and reward ethical practices.
- **Continuous Improvement:** BTE will focus on continuous improvement by regularly reviewing supplier performance and audit results. Identified gaps in compliance with national legislation and IFC PS2 will be addressed through corrective actions. Suppliers will be encouraged to implement these measures and enhance their practices to meet regulatory requirements and industry standards. Ongoing monitoring and feedback will ensure that suppliers consistently improve their operations, fostering long-term compliance and ethical practices.

Residual impacts

632. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.5 Child labour

633. In the existing facility, no child labour has been reported. However, secondary data showed that child labour in the supply chain exists specially in the restaurants sector. The impacts of child labour are given below:

- Child labor stems from poverty, limited education, and cultural norms, pushing children into exploitative work conditions. This deprives them of proper schooling and exposes them to physical hazards and emotional stress. Malnutrition, stunted growth, and mental health issues are common consequences, perpetuating a cycle of disadvantage.
- Labor not only undermines immediate health but also hampers long-term development, hindering social skills and future opportunities. Combating child labor necessitates prioritizing education, healthcare, and safe environments to secure a brighter future for these vulnerable children.

Cumulative impacts

634. Child labour is also cumulatively anticipated to increase by the addition

of SAF facility and increase in supply chain network.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Child labour	PS-1, PS-2,	Direct	Short Term	Regional	Reversible	Likely	Moderate	Medium

Mitigation Measures

As part of the Supply Chain Management System (SCMS), BTE will implement comprehensive measures to address child forced labor, including 100% traceability and risk screening across the supply chain through a Responsible Collection Policy (RCP) that identifies high-risk areas and ensures ethical sourcing practices. A Supplier Code of Conduct will strictly prohibit the presence of child or forced labor at supplier premises and mandate that businesses maintain adequate life and fire safety (L&FS) controls in line with IFC PS1 and PS2. Regular audits and monitoring using Key Performance Indicators (KPIs) will ensure adherence to IFC PS 2 standards, with findings informing a robust Remediation Plan to address and prevent non-compliance. Additionally, training and awareness programs will educate suppliers on the risks and legal implications of child forced labor while promoting ethical practices.

Residual impacts

635. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.6 Health and Hygiene of the Workers

636. Workers engaged in the collection and handling of feedstock, like used cooking oil, face several health and hygiene risks throughout the supply chain.
637. Firstly, exposure to hazardous substances in the material, such as chemicals, contaminants, or pathogens, poses significant health risks, including respiratory issues and skin irritation.
638. Additionally, physical hazards inherent in the collection and handling process, such as heavy lifting and working in confined spaces, increase the likelihood of musculoskeletal injuries and accidents if proper safety measures are not implemented.
639. Moreover, inadequate sanitation facilities and limited access to clean water and hand washing facilities compromise workers' hygiene, heightening the risk of infectious diseases, particularly in environments where direct

contact with feedstock occurs.

640. Furthermore, the absence or lax enforcement of workplace safety standards exacerbates health and hygiene risks for workers. Insufficient training on proper handling techniques, inadequate personal protective equipment (PPE), and poor ventilation in processing or storage areas further contribute to these risks.

Cumulative impacts

641. Expanding of network by addition of SAF facility and increase in supply chain network is also cumulatively anticipated to increase the Health and Hygiene issues of the Workers.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Health and Hygiene of the Workers	PS-2	Direct	Short Term	Local	Reversible	Likely	Moderate	Medium

Mitigation Measures

- **Provide Safety and PPE Training:** BTE will implement training program for all employees and contracted workers engage in supply chain, focusing on safety protocols, proper PPE usage, and hazard awareness.
- **Awareness to Sanitation and Hygiene:** To enhance sanitation and hygiene awareness among workers in the supply chain, a comprehensive program will be implemented, focusing on training and communication. Workers will receive regular training sessions on handwashing techniques, and maintaining clean work environments, supported by multilingual materials such as posters and flyers. This initiative aims to reduce hygiene-related illnesses, promote a healthier workforce, and align practices with occupational health and safety standards.
- **Conduct Regular Safety Inspections and Audits:** Perform monthly safety inspections and address identified hazards within one week. Track and aim for 100% completion of inspections and corrective actions. Implement monthly inspections and audits consistently.
- **Enforce and Monitor Health and Safety Standards:** Conduct quarterly compliance audits to ensure 100% adherence to workplace safety regulations, addressing non-compliance within two weeks. Monitor and track compliance on an ongoing basis with quarterly reviews.

Residual impacts

642. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.7 Storage of Final Product (Renewable diesel and SAF):

643. The environmental impacts of onsite renewable diesel/SAF storage will

include:

- Renewable diesel typically requires storage tanks, which may take up space on-site.
- Storage of renewable diesel, requires adherence to safety regulations to prevent accidents such as spills or fires.
- Proper storage practices are necessary to prevent any leakage or contamination of soil or water sources.
- Storage tanks require regular inspection and maintenance to ensure they remain in good condition and prevent potential leaks or other issues.
- Storage of renewable diesel may be subject to specific regulations and permits, which must be obtained and maintained to ensure legal compliance.
- The total capacity of storage for SAF 3000 metric tons.

Cumulative Impacts

644. The total capacity of storage used for BTE final product currently accounts for 1000 metric tons. Collectively with BTE and SAF, the total capacity of storage will be approximately 4000 metric tons. The cumulative impacts for storage of final product will potential to cause increase in leakages and spillages and deterioration of air quality.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Storage of Final Product	PS-1, PS-2, PS-3	Direct	Short Term	Local	Reversible	Likely	High	Moderate

Mitigation Measures

- **Use Corrosion-Resistant Storage Containers:** Install 100% corrosion-resistant tanks in all storage areas and conduct integrity tests every six months to ensure leak prevention. Regular inspections to maintain tank integrity.
- **Implement Spill Prevention and Response Measures:** Equip all storage areas with secondary containment and spill kits, providing spill response training every six months. Complete installation before operations and ensure ongoing training.
- **Provide Safety Training for Handling/Storage:** Train all personnel on the proper handling and storage of SAF. . Conduct bi-annual safety training sessions to ensure safe handling practices.
- **Develop and Maintain Inspection/Maintenance Schedule:** Conduct quarterly inspections of all SAF storage equipment, ensuring functionality and safety. Address any identified issues within one week and document all inspections and repairs.

- **Seal and Secure SAF Storage Tanks:** Ensure all SAF storage tanks are sealed and secured immediately after each filling operation. Achieve 100% compliance with sealing and securing procedures after every fill.
- **Establish and Implement an Emergency Response Plan:** Develop an emergency response plan for SAF-related incidents, conducting at least two drills per year to test its effectiveness. Finalize the plan before operations start and conduct regular drills thereafter.

Residual impacts

645. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.8 Transportation of Final Product

646. The transportation of renewable diesel/SAF from a production site will have various environmental impacts, including:

- Final product transportation produces greenhouse gas emissions, including carbon dioxide, which contributes to climate change.
- Final product transportation will release pollutants such as nitrogen oxides, particulate matter, and volatile organic compounds (VOCs) that can contribute to air pollution.
- Accidental spills or leaks during transportation will contaminate soil and water, which will have negative impacts on ecosystems and human health. Spill management and response procedure has been prepared and attached as an **Annexure-07A**.
- The transportation of final product will also produce noise pollution, particularly if transportation occurs in residential areas. Detail of Vehicle Safety Instructions for SAF transportation is mentioned in section 5.26.1.
- The total number of vehicles used for transportation of final product for SAF facility will be 10 vehicles per month.

Cumulative impact

647. The total number of vehicles used by BTE for transportation of final product currently accounts for 03 vehicles per month. Collectively the total number of vehicles will be approximately 13 vehicles per month. The cumulative impacts of transportation will lead to increase in pollutants such as carbon monoxide, nitrogen oxides, and particulate matter, as well as an increased in GHG emissions. Moreover, the instances of spill and leaks during transportation will also anticipate to increase.

Transboundary impacts

648. There will be transboundary impacts of transportation of final product because global trade links countries through the movement of goods, resources, and services.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Transportation of Final Product	PS-1, PS-2, PS-3	Direct	Short Term	Local	Reversible	Likely	Minor	Moderate

Mitigation Measures

- **Transportation Management Plan** - The company will develop and implement a comprehensive Transportation Management Plan (TMP) to ensure that all transportation activities, from route planning to vehicle and driver management, are fully compliant with the WBG EHS guidelines. This plan will focus on minimizing transportation-related risks, protecting the environment, and ensuring the safety and well-being of workers and local communities. Key components include safe and efficient route selection, driver qualification and training, vehicle inspection and maintenance, load security, and environmental safeguards. Regular monitoring, stakeholder communication, and continuous improvement will be integral to the plan's ongoing success.
- **GPS Tracking System for Transport:** Implement GPS tracking for 100% of transport vehicles, ensuring real-time tracking capabilities. Complete installation before operations and review system performance annually to ensure optimal functionality.
- **Implement Spill Prevention Measures:** Conduct regular vehicle maintenance and install spill containment systems in all transport vehicles. Ensure 100% of vehicles are inspected every 3 months and are equipped with spill prevention systems.
- **Train Personnel on Spill Response Procedures:** The company will ensure that 100% of drivers and relevant personnel are thoroughly trained in spill response procedures. This will include practical drills and evaluations to enhance their readiness and ability to effectively manage spill incidents. Regular quarterly refresher sessions will be conducted to maintain and improve their knowledge and skills, ensuring that all staff are prepared to handle any spill scenarios promptly and efficiently.
- **Verify Driver Qualifications:** BTE will ensure that 100% of drivers are fully trained and properly licensed before starting operations. The training will cover all necessary safety protocols, vehicle operation procedures, and spill response measures. To maintain high competency levels, quarterly refresher sessions will be conducted, ensuring that drivers remain knowledgeable and prepared for all operational scenarios.
- **Maintain and Communicate Business Partner Policies:** Display BTE's business partner policies in all facilities and provide digital access through the

intranet. Ensure 100% visibility and conduct an annual review for policy compliance.

Residual impacts

649. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.9 Ground Water Resource

650. During the operational phase, groundwater will be used. The SAF require around 104.4-meter cube per day of ground water. The quantities of required water from direct groundwater usage will ultimately impact the level of groundwater resources which may reduce over time. For sustainable water management, a hydrological study has been carried out which states that hydrology analysis concludes that groundwater usage for biodiesel and SAF production is minimal, with a total water consumption of 149.3 m³/day. Comprehensive assessments using water balance and GIS techniques reveal an average groundwater depletion of 0.06 m/year over 17 years, which is considered negligible. The groundwater system benefits from natural recharge through rainfall (705 mm/year) and irrigation systems. Mitigation measures like treated water reuse significantly minimize the impact of the project on groundwater resources, ensuring sustainability in the surrounding agricultural and industrial regions.

651. The full document of the hydrological analysis is attached as **Annexure-12** of the ESIA.

Cumulative impact

652. The SAF along with BTE requires around 149.3 cubic meters of water daily. According to hydrological studies, this water extraction is minimal and has little effect on the depth of the groundwater table. Although other nearby industries, agricultural lands, and farms also draw from the groundwater for their needs, leading to a slight drawdown, the hydrological study found that the groundwater depletion rate is approximately 0.06 meters per year. This depletion rate is considered negligible, implying that groundwater levels remain largely stable. Together, the total water consumption for BTE and SAF production (149.3 cubic meters per day) is minor compared to the water use of surrounding industries, communities, and agricultural operations. Therefore, the overall impact of SAF production on groundwater resources is negligible. The full document of the hydrological analysis is attached as **Annexure-12** of the ESIA.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance

Ground Water Contamination Operational Phase)	PS-1, PS-3, PS-4	Direct	Short Term	Local	Reversible	Unlikely	Minor	Medium

Mitigation Measures

- **Prevent Groundwater Contamination:** Install double-lined engineered containment structures at high-risk storage and waste processing areas. Ensure all containment structures are leak-tested annually. Complete installation before the operational phase to protect local water resources.
- **Adopt Water Conservation Methods:** Install water-saving devices such as low-flow faucets and dual-flush toilets in all washroom facilities. Monitor water usage reduction compared to previous systems, completing installation before operations begin.
- **Recycling of Wastewater:** Install a wastewater treatment and recycling system to recycle 61% of treated wastewater for non-potable uses, reducing fresh water usage by 39%. Complete installation and begin operation alongside SAF operations, tracking progress through monthly water usage monitoring.

Residual impacts

653. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.10 Surface Water Resource

654. The nearest surface water bodies to the SAF plant are the Mangtawala Feeder Canal, located approximately 2.40 km southwest of the BTE facility. The wastewater generated from the BTE facility is currently being discharged into a nearby seasonal drain known as the Ghazi drain. This is a seasonal drain, with an average flow rate ranging between 8 to 16 cusecs, while the contribution of wastewater from the BTE facility is comparatively negligible, averaging around 0.01 cusec. The wastewater released from the SAF plant will be in compliance with PEQs and WB Guidelines, hence the impact would be negligible on the surface water.

655. The anticipated quantity of wastewater disposal to the drain from the SAF plant is estimated to be around 2.4 m³/hr. The total wastewater generated from the SAF plant is 4 m³/hr, of which around 61% is recycled through the reverse osmosis system. The remaining wastewater i.e; 2.4 m³/hr will be the final disposal.

Cumulative impact

656. Currently, the BTE plant is disposing off around 1 m³/hr of waste water, which is being done in accordance with the PEQS limits. The cumulative impact of the waste water disposal from both the SAF and BTE plants will be around 3.4 m³/hr.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Surface Water Contamination Operational Phase)	PS-1, PS -3, PS -4	Indirect	Short Term	Regional	Reversible	Likely	Minor	Moderate

Mitigation Measures

- **Design and Install Wastewater Treatment Plant for SAF:** Design and install a wastewater treatment plant (WWTP) that complies with World Bank Group (WBG) effluent discharge Guidelines. Ensure 100% compliance, verified by monthly water quality sampling. Complete installation before the operational phase.
- **Ensure Disposed Waste Water from BTE is in Compliance with WB Guidelines:** Divert treated water from the BTE facility to the SAF treatment plant, ensuring compliance with WBG and Pakistan Environmental Quality Standards (PEQS). Achieve 100% compliance, with monthly water testing and sampling. Complete diversion before SAF project operations.
- **Monitor and Report Wastewater Volumes:** Regularly measure and report wastewater volumes treated and recycled at both BTE and SAF facilities. Set up a reporting system to track compliance and sustainability. Begin monthly tracking and reporting during operation.

Residual impacts

657. Residual impacts on surface water include slight alterations in water quality due to cumulative discharge, particularly during the dry season when flow rates are lower. Trace contaminants not fully removed by treatment may accumulate over time, posing risks to aquatic ecosystems. These impacts are minimal and manageable with continuous monitoring and strict compliance.

7.7.1.11 Wastewater

658. During the operational phase, wastewater will be generated primarily from flushing and the kitchen and from SAF Production (sour water) as an effluent will be generated at a rate of 4 m³/hr (with 61 % wastewater). This wastewater if not treated will pose a threat to nearby surface water bodies.

Cumulative impact

659. The wastewater generated from the BTE facility accounts for approximately 1 m³/hr, while the wastewater generated from the SAF plant is estimated to be 4 m³/hr. The total wastewater generated from both the SAF and BTE facilities is approximately 5 m³/hr. This represents a cumulative increase in wastewater production, which, if not properly mitigated, could pose a threat to the surrounding surface water bodies.

Impact	IFC Performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Wastewater	PS-1, PS-3	Direct	Short Term	Local	Reversible	Possibly	Minor	Low

Mitigation Measures

- **Design and Install Wastewater Treatment Plant for SAF:** Design and install a wastewater treatment plant (WWTP) to treat wastewater according to WB Guidelines environmental standards. Achieve 100% compliance with effluent discharge standards, with monthly quality assessments. Complete installation before the operational phase.
- **Ensure the Sour Water Treatment System is in Place:** Implement a Sour Water Stripper in conjunction with the WWTP to treat and neutralize sour water. Achieve 100% compliance with WB Guidelines and local effluent standards, verified by monthly water quality assessments. Complete installation and operationalization with the start of SAF operations.
- **Recycling and Maximize Reuse of Treated Water:** Install a Reverse Osmosis (RO) system to reuse 61% of treated wastewater for non-potable applications. Track and report the volume of reused water monthly, reducing freshwater consumption. Complete installation with SAF operations.
- **Manage RO Rejected Water Effectively:** Redirect RO-rejected water for on-site washing applications, ensuring proper disposal of any remaining water in compliance with WB Guidelines. Track the volume of water used for washing and disposed of monthly. Start implementation immediately during operations.
- **Ensure Disposed Wastewater from BTE is in Compliance with WB Guidelines:** Divert treated water from the BTE facility to the SAF treatment plant, ensuring compliance with WB Guidelines standards. Achieve 100% compliance with monthly water sampling and testing. Complete diversion before the start of SAF operations.

Residual impacts

660. Residual impacts of wastewater generation are minimal if treatment systems are effective, with negligible risk to surface water at a cumulative discharge rate of 5 m³/hr. However, seasonal low-flow conditions may cause localized increases in pollutant concentration. Proper monitoring and consistent compliance with mitigation measures are essential to prevent potential risks.



7.7.1.12 Noise

661. The proposed Sustainable Aviation Fuel (SAF) facility is anticipated to generate noise primarily from operational machinery such as pumps, blowers, compressors, road tankers, and generators. Noise modelling has been conducted to provide detailed insights into the noise levels associated with these sources, identifying both high and low-noise areas within the facility.

662. The noise modelling results indicate that the highest noise levels occur in the Gantry Room, where noise levels exceed 70 dB(A). Moderate noise levels, ranging between 66 and 70 dB(A), are observed around the Pump Room and Air Compressor area. These noise levels may pose potential auditory impacts for workers working in and around these areas, given the continuous nature of some operations.

663. The detail of modelling is attached as Annexure-7C.

Cumulative impact

664. The noise modelling indicates that the cumulative impact of the noise levels from both BTE and SAF operations at receiver 1 which is at southern side of the boundry is higher than the PEQS night time standards. Reference to the noise modelling report attached as Annexure-7C.

Impact	IFC Performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Noise (Operational Phase)	PS-1, PS-3	Direct	Short term	Local	Reversible	Possibly	Minor	Medium

Mitigation Measures

- **Noise Barrier:** For the noise barrier, the vertical extension of 2 feet of boundary wall in Brick Masonry will be erected in order to mitigate the cumulative noise level at the southern side of receiver 01.
- **Reduce Noise from Mechanical Equipment through Proper Maintenance:** Implement a regular maintenance schedule for mechanical equipment to minimize noise levels. Monitor noise levels monthly to ensure compliance with WB Guidelines standards throughout the operational phase.
- **Isolate Generators to Minimize Noise:** Place generators in designated isolated zones and equip them with noise-reducing canopies. Ensure monthly noise monitoring to verify compliance with WB Guidelines standards.
- **Implement Regular Noise Monitoring:** Conduct monthly noise monitoring at designated locations around the site to assess noise levels. Use both third-party

laboratory reports and in-house daily monitoring to ensure adherence to WB Guidelines standards.

- **Provide Hearing Protection to Workers:** Distribute suitable hearing protection (e.g., earplugs or noise-canceling earphones) to all workers exposed to noise levels of 70 dB(A) or higher. Ensure 100% compliance through quarterly safety audits.
- **Install Quiet Equipment with Noise Mitigation:** Procure and install the quietest available equipment with manufacturer-supplied noise reduction features. Set a target noise level of 75 dB(A) or lower and implement additional mitigation measures if necessary. Complete installation before operations begins.

Residual impacts

665. Residual noise impacts may include elevated levels in areas like the Gantry Room and potential exceedance of PEQS nighttime standards at the facility boundary. While the impact is minimal, it depends on effective mitigation measures such as regular maintenance, noise isolation, and worker protection. Ongoing monitoring is essential to ensure compliance and minimize risks.

7.7.1.13 Air Emissions

666. There will be no process air emissions from the proposed project and there are only reactors that will be operated under vacuum. The low-pressure off-gases from HDT and HDI sections will be used as fuel. CO₂-rich gas from the Amine Regeneration unit (ARU) will be used as acid gas flare. The predicted increase in ground level concentration of emissions is very low, to have an adverse impact on air quality or alter the existing air quality.

667. The BTE plant's energy demands (electrical and heat energy) are met by sourcing electricity from the national power grid and from the installed utilities, which include: two Heavy Fuel Oil (HFO) fired (2.45 MW combined capacity) generators as backup power source; two diesel-fired (1.76 MW combined capacity) for emergency use; two steam boilers (12 tons/hour combined capacity operating at 12.5 bars); and a thermal oil heater (750 cubic meters/hour capacity). Stack emissions of these sources will produce gasses like NO_x, SO₂, PM and CO. The air emissions produced from these sources will cause air pollution if not properly managed or mitigated. Gaseous emissions from these sources may lead to the deterioration of the air quality of nearby surroundings.

668. Air dispersion modelling was conducted to evaluate pollutant emissions from boilers, thermal oil heaters and standby generators under four scenarios using AERMOD. Four different scenarios are set to perform dispersion modelling, including the normal operation of the BTE plant boiler (Scenario A), operations of the SAF plant boiler (Scenario B), the cumulative impact of both operation plants of both plant boilers BTE and SAF and the thermal oil heater (Scenario C), and Scenario D includes the cumulative impact of both plant boilers BTE and SAF, the thermal oil heater, two backup electricity diesel generators, and two backup source HFO generators. Cumulative impacts of the Biotech Energy Pvt Ltd. facility emissions on the air quality of the area, calculated by combining the modelled contributions

from both existing and proposed facilities with background levels measured in the area, have also been assessed. The detail report and results are Annexed -7B.

Cumulative Impact

669. Under Scenario D, the combined emissions from all project-related stacks and standby generators result in carbon monoxide (CO) concentrations exceeding the Pakistan Environmental Quality Standards (PEQ'S) for both the short-term 1-hour and 8-hour periods at the nearest sensitive receptor locations. For particulate matter (PM2.5 and PM10), the results are non-compliance with IFC standard. However, the surrounding air quality is already categorized as degraded, and the cumulative impact from all stacks is minimal, contributing less than 1% to existing ambient levels. All other parameters remain within the limits set by both the International Finance Corporation (IFC) and PEQ'S standards.
670. Under Scenario C, which excludes standby power generators and considers emissions solely from the SAF, BTE, and thermal oil heater stacks, all parameters are within the PEQ'S and IFC standards at the nearest sensitive receptor locations.
671. Scenario D represents the maximum impact scenario, although the standby generators are operational for only 3% of the total annual time. Considering this, Scenario C is deemed the more practical and appropriate scenario, as it ensures compliance with PEQ'S and IFC standards at sensitive receptor locations.

Impact	IFC performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Air Quality (Operational Phase)	PS-1, PS-3	Direct	Short term	Local	Reversible	Possibly	Minor	Medium

Mitigation Measures

- **Maintain Current Air Quality Levels:** Ensure emissions from existing, emission-compliant boilers remain within WB Guidelines standards. Any deviations will trigger a review and adjustments to boiler efficiency. Monthly air emissions monitoring by a certified third-party laboratory throughout operations.
- **Manage Emissions from Generators:** Adjust the air-fuel ratio in generators to optimize combustion and reduce emissions of NOx, CO, and particulate matter. Maintain adjustment logs and monitor emissions monthly to ensure compliance with WB Guidelines standards.
- **Ensure Generator Maintenance:** Conduct regular maintenance and tuning of generators to ensure emissions stay within permissible limits. Document and

track all maintenance activities, with ongoing checks and monthly emissions monitoring.

- **Integrate Emissions in GHG Assessments:** Include emissions from feedstock transportation and boilers in GHG savings calculations. Perform annual lifecycle assessments to quantify GHG emissions and support sustainability goals.
- **Control Odors from Feedstock Storage:** Keep containers closed at all times, except during loading, to minimize odors. Conduct bi-annual audits and provide training to staff to ensure containers remain covered.
- **Provide PPE for Workers:** Ensure 100% of workers are equipped with appropriate PPE before starting work, and conduct quarterly audits to ensure ongoing compliance. Allocate resources for procurement and timely distribution of PPE.
- **Monitor Ambient Air Quality:** Conduct monthly ambient air quality monitoring for key pollutants (CO, NOx, SOx, PM) to assess project impact and ensure compliance with WB Guidelines and PEQS standards.
- **Perform Regular O&M Checks:** Schedule monthly operations and maintenance (O&M) checks for all critical equipment, ensuring 100% compliance with maintenance protocols. Track and document all checks to prevent equipment failure and ensure operational efficiency.

Residual impacts

672. Residual impacts may include localized increases in pollutant concentrations, particularly within a 5 km radius, and transient effects during simultaneous operation of boilers and generators. Secondary pollutants like ozone may form from compliant NOx emissions, and residual GHG emissions contribute cumulatively to climate change. Robust monitoring and maintenance help minimize, but not fully eliminate, these impacts.

7.7.1.14 Occupational Health and Safety

673. Following health and safety impacts arise during the operational phase of the proposed project:

- Fire
- Fuel Spillage
- Gas Leaks
- Explosions Injury from Machinery and Equipment
- Fall, Climbing Accident
- Riots, Strikes
- Emergency As a Result of Environmental Conditions (E.G., Heat, Cold, Wet, Snow, Wind, Lightning, Bushfires, Floods) Emergencies Requiring Evacuation
- Hazardous Substances and Chemical Spills
- Internal Emergencies Such as Loss of Power or Water Supply and Structural Collapse Serious Injury Events or Medical Emergencies
- Bomb Threats

674. Health and safety issues will arise if gases or noise exceed the

permissible limits of PEQS, and improper practice of work during the storage, handling and transportation of fuel.

675. Potential health and safety impacts during the project's operational phase will include fire, fuel spillage, gas leaks, explosions, machinery injuries, falls, environmental and internal emergencies, serious injuries, and bomb threats. Mitigation measures, training, and emergency response plans are essential to ensure a safe working environment.

Cumulative Impact

676. The addition of the SAF facility will lead to an increase in the number of workers, physical structures and operational resources at the site. This expansion of workforce and infrastructure may potentially result in a higher risk of various safety and environmental incidents, such as fire, fuel spillage, gas leaks, explosions, machinery-related injuries, falls, environmental and internal emergencies, serious injuries, and even bomb threats. Cumulatively, the overall occupational health and safety concerns will likely increase with the addition of the new SAF facility.

Impact	IFC performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Occupational Safety (Operational Phase)	PS-1, PS-2, PS-3, PS-4	Direct	Medium term	Local	Reversible	Likely	Minor	Low

Mitigation Measures

- **Establish HSE Team and Protocols:** Designate a dedicated Health, Safety, and Environment (HSE) team to conduct monthly safety audits and ensure emergency equipment is inspected and maintained. Recruit and train the team, ensuring ongoing audits throughout operations.
- **Provide First Aid Resources:** Install first aid boxes at key workstations throughout the plant. Conduct monthly inspections to ensure boxes are stocked and maintained, ensuring quick response during emergencies.
- **Train Staff in First Aid:** Provide comprehensive first aid training to all supervisors and relevant staff, aiming for 100% completion for supervisors and for relevant staff. Conduct quarterly training sessions to ensure preparedness for medical emergencies.
- **Conduct Operation and Maintenance Training:** Train all the employees involved in plant operations and maintenance activities. Provide the necessary resources and facilities for effective training, with quarterly training sessions to enhance operational safety and efficiency.
- **Maintain Emergency Contact Information:** Compile and update contact details for local hospitals and emergency organizations, ensuring it is readily accessible. Regularly update this list for easy access during emergencies.

- **Develop and Implement an Emergency Response Plan:** Complete the emergency response plan before operations start, covering fire, chemical spills, and medical emergencies. Conduct at least two drills per year to test its effectiveness.
- **Restrict Access to Sensitive Areas:** Implement access control measures for production and chemical storage areas, ensuring only authorized personnel enter. Conduct monthly audits to ensure compliance with the access policy.
- **Distribute Code of Ethics and Business Conduct:** Make the Code of Ethics available in at least three key locations within the facility and on the company website. Ensure ongoing distribution and staff training on ethical conduct.

Residual impacts

677. The expansion of the SAF facility increases occupational safety risks, including fire, gas leaks, and machinery injuries, despite mitigation measures. Ongoing training, emergency planning, and strict safety protocols are essential to manage these residual risks.

7.7.1.15 Biofuel Transport: Community H&S Risks

678. The transportation of biofuels for SAF operations will contribute to the existing traffic load on Sharaqpur Road. Currently, the road experiences a baseline traffic volume of 500 trucks per day, consisting primarily of goods transportation for various industries. The addition of 10 biofuel transport trucks from the SAF project will increase the total daily truck traffic to 510 trucks, representing a 3.5% increase. While this increment appears minor in percentage terms, it will impact on health, safety, and community life as given below:

Health and Safety Risks

679. The additional truck movements could elevate the risk of traffic accidents, especially on Sharaqpur Road, which may already experience congestion and potential bottlenecks in populated areas. Larger biofuel transport vehicles navigating rural sections of the road may increase risks of collisions, especially for smaller vehicles, pedestrians and livestock. In addition, poor visibility during night transport or adverse weather conditions could exacerbate these hazards.
680. Another key health and safety risk involves exposure to hazardous substances in case of accidental spills during transport. While biofuel is considered less toxic than traditional petroleum products, certain components (e.g., methanol residues) can pose health risks to nearby communities, particularly children or other vulnerable groups, if spills are not managed promptly. Furthermore, emissions from the additional transport vehicles, especially if they are not well-maintained, could contribute to air pollution, aggravating respiratory and cardiovascular issues in local populations. This is particularly concerning for individuals already suffering from conditions such as asthma or bronchitis.

Social and Community Impacts

681. The increased truck traffic could cause significant disruption to daily life for residents living along or near Sharaqpur Road. Heavy vehicle traffic often

results in congestion, making commuting more challenging and time-consuming for locals. Delays in school transport, emergency response vehicles, or public transportation systems could further inconvenience the community. Additionally, the noise from passing trucks, especially during nighttime operations, may disturb the peace and affect the quality of life for nearby residents.

682. Increased wear and tear on local infrastructure is another notable impact. With an additional 10 trucks daily, the already substantial truckload on Sharaqpur Road may accelerate the deterioration of roads and bridges. This could lead to more frequent maintenance requirements, causing further disruptions to traffic flow and increasing costs for local governments. Over time, the added pressure on infrastructure might necessitate capacity upgrades or repairs, impacting both public budgets and community mobility.

Cumulative Impact

683. The addition of the SAF facility will increase the number of vehicles from the existing 03 vehicles to 10 vehicles per day. Due to the increase in the number of vehicles, there will also be an increase in the community's health and safety concerns. Cumulatively, the health and safety of the community is expected to increase due to the addition of the SAF facility, as the increased vehicular traffic and associated emissions may pose risks to the local population.

684. Also, there will be no increase in process air emissions and noise emissions as depicted in the air and noise modelling so no risk to community related to air and noise emissions from combined processes.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Biofuel Transport: Community H&S Risks	PS-4	Direct	Short Term	Regional	Reversible	Likely	Moderate	Moderate

Mitigation Measures

- **Transportation Management Plan:** The company will develop and implement a comprehensive Transportation Management Plan (TMP) to ensure that all transportation activities, from route planning to vehicle and driver management, are fully compliant with the WBG EHS guidelines. This plan will focus on minimizing transportation-related risks, protecting the environment, and ensuring the safety and well-being of workers and local communities. Key components include safe and efficient route selection, driver qualification and training, vehicle inspection and maintenance, load security, and environmental safeguards. Regular monitoring, stakeholder communication, and continuous improvement will be integral to the plan's ongoing success.

- **Community Health and Safety:** To mitigate community health and safety risks associated with the increased transportation of biofuels, the SAF project will implement strict traffic management and safety measures. These include scheduling truck movements during off-peak hours to minimize congestion, enhancing road safety through driver training programs focused on defensive driving and spill management, and ensuring that all transport vehicles are well-maintained to reduce emissions and the risk of accidents. In addition, clear signage and speed restrictions will be placed along Sharaqpur Road, particularly in high-risk areas such as populated zones and school crossings. Emergency response protocols will be established in collaboration with local authorities to address potential spills promptly, including equipping transport vehicles with spill containment kits and training drivers on their use. Regular engagement with local communities will also be conducted to address concerns, share safety information, and improve public awareness of biofuel transport operations.

Residual impacts

685. There will still be residual impact but it remains minimum after applying the mitigation measures.

7.7.1.16 Solid Waste

686. During the operational phase the BTE WMP existing plan will be updated and will be followed during the operational phase of SAF. During the operational phase following waste will be generated

- Oil and Lubricants contaminated clothes from workshop and spill cleanups
- Chemical waste from laboratory
- Plastics
- Paper and Cardboard
- General Domestic waste
- Sludge from WWTP
- Spent Catalyst from Process.
- The SAF is anticipated to produce around 150 kg per month of this solid waste.

Cumulative Impact

687. The current BTE facility generates approximately 100 kg per month of total solid waste that includes plastics, chemicals, paints, sewage sludge and paper and cardboard. The upcoming SAF operations is anticipated to generate an additional 150 kg per month of solid waste. Cumulatively, the operation of both the BTE and SAF facilities will result in an increase in the total waste generation of about 250 kg per month. If this increased waste is not managed and disposed of properly, it could pose a significant threat to the environment as well as the health and safety of the workers involved in the operations.

Impact	IFC performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Solid Waste	PS-1, PS-3, PS -4	Direct	Short term	Local	Reversible	Likely	Minor	Low

Mitigation Measures

- **Establish Waste Collection System:** Develop a comprehensive waste collection system with processes for waste segregation, collection, and disposal for different types of waste (hazardous, non-hazardous, recyclable). Achieve 95% proper segregation with monthly audits to ensure compliance. Complete implementation within 6 months of operation and evaluate effectiveness every 3 months.
- **Strategically Place Waste Containers:** Install clearly labeled waste containers for specific waste types (e.g., general waste, recyclables, hazardous materials) at key locations on-site. Ensure containers are emptied regularly and maintained in good condition. Complete installation within 1 month and conduct a review of usage and effectiveness every 6 months.
- **Recycle Spent Catalysts:** Establish a recycling process to recycle 100% of spent catalysts produced during SAF production. Track and measure progress monthly, partnering with qualified recycling facilities for proper processing. Complete the implementation of the recycling process within 1 month of operation.

Residual impacts

688. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.17 Fire Explosion and Process Safety

689. In SAF Plant the fire and explosion can happen due to:-

- **Chemical Reaction:** There are different chemical reactions involved in production of SAF. These chemical reactions potential to catch fire and explosion risk.
- **Flammable Liquids and Gases:** Similary some of flammable materials like methanol and H₂ gas is used in production of SAF. The accidental spills or leaks of flammable liquids or gases can have potential to catch fire and explosion especially in confined spaces.
- **Equipment's:** Boilers and heaters used for process heat carry risks of overheating, fires, or explosions. Failure of mechanical systems can result in spills, leaks, or equipment malfunction.

- **Storage Tanks:** Fire and explosion related to the rupture, leakage, or structural failure of SAF, methanol, and byproduct storage tanks.
- **Human Error and Incompetencies:** Operator error during chemical handling, start-up, or shut-down procedures can lead to accidents. Similarly, the Lack of training on equipment use, emergency response, or chemical safety protocols increases the likelihood of accidents.

690. The potential for fire and explosion poses a serious risk to nearby communities, workers, equipment, and the plant itself. However, the fire, explosion, and process safety impacts associated with the Sustainable Aviation Fuel facility are not expected to be significant. This is because the SAF plant is designed and will be constructed in accordance with the applicable National Fire Protection Association standards,

Cumulative Impact

691. The fire explosion and process safety impacts for both the Biodiesel and the Sustainable Aviation Fuel plants are not expected to be significant. Both facilities have been designed and constructed in accordance with the applicable NFPA standards, ensuring compliance and even exceeding the required limits for inter-tank and inter-building distance requirements. The specific details regarding the fire, explosion and process safety measures implemented are provided in Section 5.5.2 of the ESIA report.

Impact	IFC Performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Fire Safety (Operational Phase)	PS-1, PS-2, PS-3, PS-4	Direct	Medium term	Local	Reversible	unlikely	Minor	Medium

Mitigation Measures

- **Ensure Compliance with NFPA Standards:** Design and construct facilities in full compliance with National Fire Protection Association (NFPA) standards. Conduct a compliance assessment to ensure 100% adherence to applicable standards, reviewed by a qualified fire safety engineer. This will be completed during the facility design phase.
- **Conduct Regular Safety Inspections:** Implement a schedule for quarterly safety inspections of fire and emergency systems. Ensure that 100% of systems are inspected and documented, with corrective actions tracked. Conduct these inspections quarterly throughout the operational phase.
- **Provide Employee Fire Safety Training:** Develop and implement comprehensive fire safety training programs for all employees, ensuring 100% completion. Provide hands-on drills and simulations. Begin training within the first month of operations, with quarterly refresher sessions thereafter.

- **Implement Emergency Response Plans:** Develop and implement an emergency response plan, detailing roles, responsibilities, and procedures for fire and related incidents. Complete the plan within 3 months of operations and conduct at least two drills per year to test the plan's effectiveness.
- **Maintain Fire Safety Equipment:** Schedule biannual maintenance for all fire safety equipment (extinguishers, alarms, sprinklers) to ensure they remain operational and compliant with safety regulations. Assign teams for regular inspections and repairs, with biannual checks throughout operations.

Residual impacts

692. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.18 Chemical Hazard

693. Exposure to chemicals such as H₂ and other chemicals used in process and laboratory may occur during the handling and storage of chemicals in SAF production. Avoid unnecessary chemical exposure to the workers who are working in the process area or related to the process. A long term and direct chemical exposure may impact the health of the workers and the risk of spillage may increase. Additionally, procedures for identifying, assessing, and mitigating human rights risks, including emergency response protocols (as annexed 8), have been developed and will be enacted to minimize chemical hazards.

Cumulative Impact

694. The activity for handling and storage facility of chemicals will increase with the addition of the SAF operations, along with the existing BTE operations. This increase in chemical handling activities and storage facility is expected to correspondingly increase the risk of potential chemical exposure to workers and the surrounding environment.

Impact	IFC performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Chemical Hazard (Operational Phase)	PS-1, PS-3, PS-4	Direct	Long term	Local	Reversible	Likely	Minor	Low

Mitigation Measures

- **Provide Personal Protective Equipment (PPE):** Ensure the distribution of high-quality PPE, including helmets, gloves, safety boots, and masks, to all workers. Conduct daily PPE checks to maintain records and ensure consistent availability throughout operations, preventing injuries and hazardous exposures.

- **Regulate PPE Usage:** Enforce strict compliance with PPE regulations through monthly audits conducted by designated safety authorities. Achieve 100% adherence by providing training on proper PPE usage and the critical importance of compliance.
- **Use Appropriate Containers for Storage:** Employ corrosion-resistant and leak-proof containers and storage tanks for all chemicals to prevent leaks and contamination. Conduct quarterly inspections to verify container integrity, implementing this measure immediately upon commencement of operations.
- **Implement Fire Safety Measures:** Enforce comprehensive fire safety protocols, including proper handling and storage of flammable materials. Achieve full compliance through quarterly audits and employee training, ensuring all employees are trained within two months of operations. Review and update fire safety measures annually.
- **Ensure Proper Ventilation:** Install effective ventilation systems in chemical storage areas to minimize vapor accumulation and maintain air quality. Engage professional expertise for installation, ensuring completion before the initiation of chemical processing.
- **Proper Storage of Chemicals:** Develop and enforce protocols for the safe storage of chemicals, including labeling, segregation of incompatible materials, and temperature control. Conduct quarterly audits to achieve full compliance and provide training for all employees involved in handling and storing chemicals.

Residual impacts

695. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.7.1.19 Gender-based violence (GBV) risks

696. The risk of Gender-Based Violence (GBV) within the direct and contracted workforce, particularly where female workers are present, can lead to significant challenges such as increased vulnerability to harassment and discrimination, negatively impacting their well-being, productivity, and job satisfaction. This can also harm the organization's reputation, lead to legal and compliance risks, and hinder efforts towards gender equality and empowerment. Unaddressed GBV may cause operational disruptions, with potential consequences such as absenteeism, high turnover, and delays in production output.

Cumulative impact

697. Cumulatively, as the size of the staff, workers, and contracted workforce increases, there may be a corresponding rise in the risk of Gender-Based Violence (GBV).

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Gender-based violence (GBV) risks	PS-1, PS-2, PS-4	Direct	Short Term	Regional	Reversible	Likely	Moderate	Medium

Mitigation Measures

- **Establish Gender-Sensitive Workplace Policies:** BTE will develop and enforce comprehensive gender-sensitive policies to prevent Gender-Based Violence (GBV), discrimination, and harassment, specifically within its direct workforce and contracted employees. These policies will be formulated at the planning stage and reviewed annually to ensure they remain effective and compliant with best practices. BTE will focus on ensuring that all employees directly engaged by the company, as well as workers contracted for specific tasks, are fully covered by these policies. Conduct GBV Awareness and
- **Response Training:** BTE will conduct mandatory training on GBV awareness and response for its direct workforce and contracted employees. The training will ensure that employees understand how to identify, prevent, and respond to instances of GBV in the workplace. The first session will be conducted within four months of operations, with subsequent training sessions held every six months. The effectiveness of the training will be evaluated using pre- and post-training assessments to measure knowledge improvement and retention.
- **Engage with Community Stakeholders:** While the focus of GBV measures will be on the direct and contracted workforce, BTE will also engage with local community stakeholders, particularly women's groups, to gather insights and incorporate their perspectives into the project's broader decision-making process. These engagements will ensure that the community's views on GBV and gender equality are considered, and they will be conducted initially before operations commence and quarterly thereafter.

7.8 Ecological Environment

7.8.1 Impact on Flora & Fauna

698. There are negligible impacts on flora and fauna during the operation phase of the project. However, mitigation has been provided to enhance the biodiversity of the area.

Cumulative Impact

699. No cumulative impact is anticipated on flora and fauna.

Impact	IFC Performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Impact on Flora & Fauna (Operational Phase)	PS-1, PS-6	Direct	Short Term	Local	Reversible	Likely	Minor	Low

Mitigation Measures

- **Enhance Green Cover:** Initiate a planting project with at least 500 new trees and plants, focusing on native and environmentally beneficial species. Complete the plantation within one year after project completion, collaborating with local nurseries for plant sourcing.
- **Regular Maintenance of Green Areas:** Develop a maintenance plan to ensure the health and growth of new and existing plantations. Conduct quarterly checks, with 100% of plants receiving regular maintenance, and document health assessments and interventions.
- **Community Engagement in Plantation:** Organize an annual community event to engage participants in activities promoting environmental sustainability, such as tree planting, encouraging community involvement and raising awareness about environmental conservation.
- **Biodiversity Improvement:** Plant at least 300 native tree species to promote local biodiversity and wildlife habitats. Complete planting within one year of project completion, with oversight by environmental specialists to ensure proper species selection and planting practices.
- **Monitoring and Reporting on Green Initiatives:** Establish a monitoring system to track plantation growth and health, preparing biannual reports to inform and improve future planting efforts. Use simple tools to streamline monitoring processes.

Residual impacts

700. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.9 Socio-Economic Environment

7.9.1 Impact on Socio Economy

701. In the proposed project area, minimal changes are anticipated in the traditional lifestyle and occupations of local communities, with benefits expected from job opportunities provided by the project. By prioritizing local recruitment, offering specialized training, and ensuring transparency in hiring can minimize, though not entirely eliminate, the influx of external workers.

702. . Additionally, the project aims to improve community lifestyle by

converting unhygienic waste into sustainable products. While minor social and health-related issues may arise during operations, adopting best management practices can mitigate these impacts significantly.

703. Outside workers may pose risks to the local community if outsiders are given priority over the local people in employment, inappropriate behavior of the outsider staff towards the culture and traditions of the locals and especially women. Introduction of security personnel can also raise concerns of the community. Transportation related impacts are also foreseen.

Cumulative Impact

704. The addition of the SAF operations with existing BTE operations is expected to have a positive socioeconomic impact. This integration will likely generate more direct and indirect employment opportunities, leading to increased incomes and improved livelihoods for the surrounding community. The creation of new jobs, both skilled and unskilled, as well as the indirect economic activities supported by the expanded operations, will contribute to the overall economic development and prosperity of the local area.

Impact	IFC performance Standards	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Impact on Socio Economy	PS-1 PS-2 PS-4, PS-7	Direct	Short Term	Local	Reversible	Likely	Minor	Low

Mitigation Measures

- **Promote Local Employment Opportunities:** Prioritizing hiring of workforce from the local community, providing on-the-job training to build skills. Begin hiring and training within 3 months of project start, with quarterly tracking of progress in hiring and training participation.
- **Implement Hiring Standards:** Verify that 100% of new hires have valid CNICs and police clearance before employment. Implement the verification process immediately before operations, with monthly reviews to ensure compliance and build community trust.
- **Establish First Aid and Health Monitoring Systems:** Ensure first aid kits are available at key workstations and conduct biannual medical check-ups for all staff. Assign teams to manage supplies and schedules, maintaining records of inspections and health assessments.
- **Conduct Safety Training for Workers:** Provide safety training on machinery operation, safety protocols, and environmental awareness for all workers, ensuring 100% participation within 3 months. Launch the program within 1 month of operations and conduct quarterly refreshers.

- **Monitor and Enforce Safety Gear Usage:** Equip all workers with necessary PPE (e.g., helmets, boots, gloves, masks) and conduct quarterly audits to ensure 100% compliance. Maintain a reliable supply chain to support timely distribution of PPE.
- **Foster Cultural Sensitivity:** Conduct quarterly cultural awareness training for all staff to promote understanding and respect for local customs and traditions. Use practical sessions to minimize conflicts and build positive community relations throughout operations.

Residual impacts

705. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.9.2 Community H&S risks associated with the use of security personnel

The security impacts of the project may include theft, vandalism, and unauthorized access, particularly with valuable materials on site. Armed security guards could lead to conflicts with the local community over restricted access. There may also be risks to the environment and delays in emergency responses if security is not properly managed.

Cumulative impact

706. The addition of the SAF operations with existing BTE operations will lead to an increase in the number of security personnel to oversee operations. This influx of armed guards may conflict among local rural communities, where the presence of firearms is not a common occurrence. The increased security presence could create potential conflicts between the facility workers and the surrounding residents, who may feel their sense of security and privacy is being compromised.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Community H&S risks associated with the use of security personnel	PS-4	Direct	Short Term	Local	Reversible	Possibly	Minor	Low

Mitigation Measures

- **Security Management Plan:** a comprehensive security management plan outlining protocols, responsibilities, and actions to mitigate risks and foster positive interactions with the community will be developed and implemented.
- **Cultural Sensitivity Training for Security Personnel:** Provide quarterly cultural sensitivity training for all security personnel, ensuring 100% participation. Develop practical sessions and demonstrations to foster positive community interactions.

- **Establish Communication Channels:** Create effective communication channels between security personnel and local residents to enhance transparency and trust.
- **Foster Community Engagement Programs:** Organize bi-annual participatory programs local residents and all security personnel to strengthen ties and improve security perception.
- **Develop Conflict Resolution Mechanisms:** Establish accessible mechanisms to address conflicts between security personnel and the community.
- **Monitor and Evaluate Security Measures:** Conduct security evaluations every 6 months, focusing on incident response times, compliance rates, and community feedback. Use findings to implement improvements and ensure effectiveness.
- **Ensure Transparency and Accountability:** Publish annual reports detailing hiring practices, training, incident responses, and community engagement. Achieve 100% transparency and ensure local residents are aware of these efforts through community meetings and updates
- **Develop and Implement Grievance Mechanism:** Establish a grievance mechanism from the planning stage, providing a formal channel for complaints. Ensure all staff and community members are aware of its availability and review its effectiveness regularly.

Residual impacts

707. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.9.3 Impacts related to the risk of breeding of pests/rodents

708. The storage of used cooking oil feedstock at a SAF facility poses various risks associated with pest and wildlife infestation. These risks include contamination and spoilage of the stored oil, resulting in compromised quality and safety for biofuel production. Additionally, infestation by pests and rodents can lead to feedstock losses and reduced production efficiency, impacting overall biofuel production processes. Moreover, the presence of pests and wildlife such as crows and eagles can pose health and safety risks, environmental contamination concerns, infrastructure damage, and regulatory compliance issues for the facility. These risks can be effectively managed through the implementation of standard pest control procedures and best practices. Detailed mitigation measures are outlines in the section mentioned below.

Cumulative Impact

709. Cumulative impact is anticipated to increase the risk of breeding of pests/rodents with addition of SAF and existing BTE operations.

Impact	IFC Performance Standard	Nature	Duration	Geo Extend	Reversibility	Likelihood	Consequence	Impact Significance
Impacts related to the risk of breeding of pests/rodents	PS-1, PS-6	Direct	Short Term	Local	Reversible	Likely	Moderate	Medium

Mitigation Measures

- **Regular Monitoring of Storage Areas:** Conduct monthly inspections of storage areas to detect pests early, with a target to address issues within 48 hours of detection. Assign a dedicated team to inspect, document findings, and coordinate pest management actions.
- **Sanitation Practices Implementation:** Implement regular cleaning schedules and proper waste management to eliminate pest attractants. Ensure 100% compliance through weekly audits, disposing of waste within 24 hours of generation. Assign a sanitation team for maintenance and training.
- **Utilization of Control Methods:** Deploy trapping or chemical/biological control methods within 48 hours of detecting a pest issue. Engage trained pest management professionals to evaluate the situation, apply effective solutions, and ensure adherence to safety and regulatory guidelines.

Residual impacts

710. There will be no remaining residual impacts from the project site after applying mitigation measures.

7.10 Positive Impacts of the Proposed Project

711. The establishment of a Sustainable Aviation Fuel (SAF) Facility can have several positive environmental and social impacts.

712. The project aims to pioneer environmentally friendly technology, positioning Pakistan as a leader in:

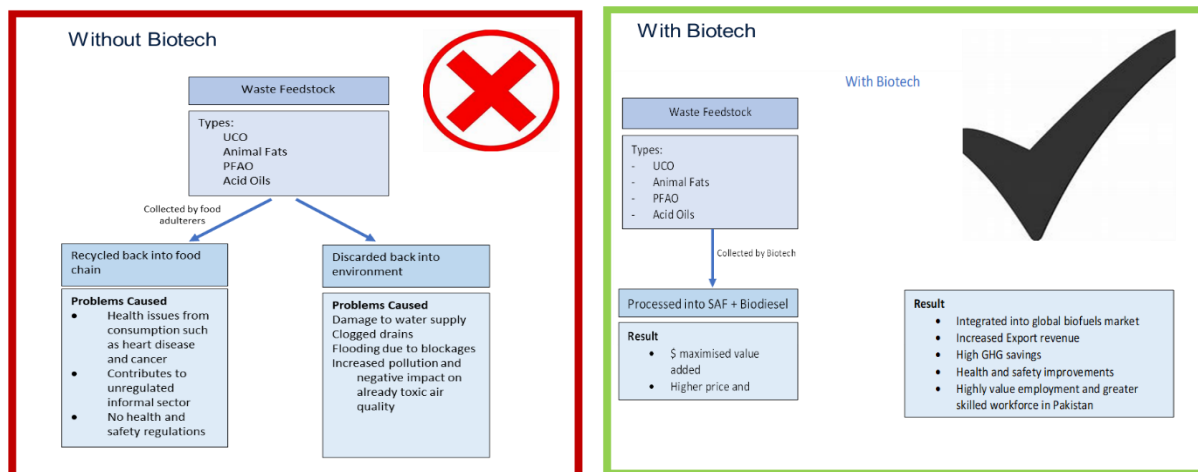
- Circular collection
- Renewable energy production
- Global greenhouse gas (GHG) reduction efforts.

713. The expansion of feedstock collection poses no adverse environmental, social, or safety impacts and predominantly yields positive outcomes. It contributes to the circular economy by:

- Preventing waste from re-entering the food chain.
- Preventing waste from clogging drains and contaminating Pakistan's water resources.

- c) Preventing growing waste concern of the country and large cities
- d) Organic waste if disposed of creates several bacterial and fungal outbursts and highly affect the aesthetics and hygiene of the area.

714. Below is a sectoral overview comparing the collection component with and without the project's involvement.



7.10.1 Environmental impacts

715. **Renewable Energy Generation:** Sustainable Aviation Fuel or renewable diesel is produced from renewable sources such as vegetable oils, animal fats, or recycled cooking oil. By producing Sustainable Aviation Fuel or renewable diesel, the plant contributes to the generation of renewable energy. This reduces dependence on finite fossil fuel resources and helps combat climate change by reducing greenhouse gas emissions.

716. **Reduced Carbon Footprint:** Biodiesel has lower carbon emissions compared to conventional fuel. It produces fewer particulate matter, sulfur dioxide, and carbon monoxide emissions when combusted. By replacing fossil fuel-based diesel with biodiesel, the plant helps reduce the overall carbon footprint of transportation and other industries.

717. SAF GHG savings calculation has been made and attached as an **Annexure-03**. The project is projected to contribute to the reduction of nearly 1,000,000,000 kg of CO₂ emissions annually at maximum production. This equates precisely to 704,500,766 kg of CO₂ per year, which is equivalent to:

- i. Planting 41,342,807 trees annually.
- ii. Offsetting the carbon footprint of 130,000 EU citizens (based on World Bank average carbon footprint data).
- iii. Taking 312,000 full-size passenger vehicles off the road each year.

718. The emissions resulting from the transportation of UCO or any other feedstock, along with the expansion of collection points, are accounted for by the approved methodology of the EU Renewable Energy Council. This methodology allocates emissions on a per kilometre or ton basis.

719. **Reduction in Greenhouse Gas Emissions:** One of the most significant advantages of SAF or renewable diesel is their potential to significantly reduce greenhouse gas emissions. These fuels will be typically

produced from renewable feedstocks such as vegetable oils, animal fats, or recycled cooking oil which results in lower carbon emissions compared to traditional fossil fuels. Bio-Tech Energy ensures that biofuels make a positive contribution to the overall health and sustainability of the food chain, while also delivering greenhouse gas savings of 704,500,766 CO₂ per year .

720. **Improved Air Quality:** Using SAF or renewable diesel in aviation and transportation can lead to reduced emissions of pollutants such as sulfur dioxide (SO₂), nitrogen oxides (NOx), and particulate matter. This can contribute to improved air quality in urban areas, reducing health risks associated with air pollution.
721. **Global Climate Goals:** The adoption of SAF or renewable diesel aligns with international climate goals, such as those outlined in the Paris Agreement, by reducing the carbon footprint of aviation and transportation.
722. **Waste Utilization and Reduction:** SAF or renewable diesel production often utilizes waste materials such as used cooking oil. By utilizing these waste streams as feedstock, the plant/facility promotes waste management. It reduces the amount of waste that would otherwise be disposed of or potentially contribute to environmental pollution.
723. Converting waste into SAF or renewable diesel provides a sustainable waste management solution, reducing the amount of waste sent to landfills. By converting waste into a useful energy product, it promotes a circular economy approach and reduces the burden on landfills. Moreover, the project is anticipated to have a substantial economic impact on Pakistan's development by transforming local waste resources into a valuable export-oriented product.
724. **Waste Management:** the SAF Project positively impacts the waste value chain by influencing job markets, creating income generation channels, encouraging entrepreneurship, boosting overall economic development, and delivering significant environmental benefits. BTE collaborates with local communities to transform waste into SAF through efficient collection systems and environmentally friendly processes. By engaging with communities, BTE aims to establish sustainable practices, turning waste into valuable assets and creating economic opportunities while reducing environmental impact. The project aims to collect 203,600 MT of feedstock annually, all sourced locally within Pakistan. This collection generates an estimated revenue of \$203,000,000 per year for local communities. By monetizing waste through legal channels and producing SAF, the project maximizes the economic value derived from waste, creating a high-value product of global standard.

7.10.2 Social & Economic Impacts

725. **Job Creation and Economic Benefits:** The establishment of a SAF production plant can create employment opportunities in various stages of the production process, including feedstock collection, processing, transportation, and storage. Employment opportunities will be communicated to local communities through brochures and via CLOs. This can contribute to local economic development and provide income opportunities for the community.

726. In rural Punjab, Pakistan, addressing community concerns and promoting harmony between newcomers and locals involves several key strategies:

- Holding four inclusive forums annually with at least 50 participants from both groups to address resource access and cultural differences.
- Provide skills training to individuals annually, leading to an increase in job opportunities.
- Hosting cultural exchange programs biannually with 50 participants to reduce tensions by 20% within a year.
- Establishing mechanisms to resolve 80% of disputes within six months to promote community cohesion.

727. **Export of SAF:** Renewable diesel/SAF produced by the plant can be exported to other countries. By exporting, the production plant can generate revenue from international markets, contributing to export earnings.

728. **Technological Innovation:** Investment in the development and production of alternative fuels drives innovation in the biofuel and renewable energy sectors. This can lead to advancements in sustainable fuel production processes and feedstock cultivation techniques. The technology transfer facilitated by the project enables Pakistan to contribute significantly to achieving net zero carbon emissions in the aviation industry by 2050. Sustainable aviation fuel (SAF) will play a crucial role, with IATA estimating it to account for over 65% of the industry's reduction target. By leveraging waste feedstock, the project not only establishes a new industry in Pakistan but also generates exports, jobs, and innovative technologies. Ultimately, this initiative will have a global impact by utilizing Pakistan's abundant waste resources to help meet global carbon targets for SAF production.

729. **Long-Term Fuel Security:** SAF or renewable diesel can provide long-term fuel security as they can be produced sustainably from various sources, including non-food crops and waste materials. This reduces the vulnerability of the aviation and transportation sectors to fluctuations in fossil fuel markets.

730. Overall, the establishment of a Sustainable Aviation Fuel (SAF) or renewable diesel facility will have positive impacts such as renewable energy generation, reduced carbon emissions, waste utilization, job creation, and export revenue. These benefits contribute to a more sustainable and environmentally friendly energy system.

7.10.3 Steps to ensure equal opportunities for women and vulnerable individuals in the workforce

731. To ensure fairness and inclusivity within the workforce, the project will focus on creating an environment where all individuals, regardless of gender or other characteristics, have equal access to employment opportunities. Recruitment and hiring processes will be designed to uphold non-discrimination, ensuring that no individual is treated unfairly or excluded based on personal attributes. The project will strictly adhere to PS2 IFC requirements to maintain a transparent, equitable approach to workforce participation.

CHAPTER - 8: ENVIRONMENTAL & SOCIAL MANAGEMENT AND MONITORING PROGRAM

8.1 General

732. This chapter outlines the management strategies for addressing the identified impacts and risks highlighted in previous Chapters. It includes mitigation and control measures, as well as monitoring protocols. The Environmental and Social Management and Monitoring Plan (ESMMP) is structured around management plans, institutional arrangements, capacity building, and training initiatives. It also features key indicators for monitoring and assessing performance.

8.2 Objectives

733. The primary objectives of the ESMMP are to:

- 1) Facilitate the implementation of the mitigation measures identified in the ESIA.
- 2) Define the responsibilities of the project proponent.
- 3) Define a monitoring mechanism and identify monitoring parameters in order to:
 - a. Ensure the complete implementation of all mitigation measures.
 - b. Ensure the effectiveness of the mitigation measures.
 - c. Provide a mechanism for taking timely action in the face of unanticipated environmental situations.
 - d. Identify training requirements at various levels.

8.3 Review of EHS Management System

734. BTE has formulated and implemented an Environmental and Social Management System (ESMS) that includes various policies, plans, and procedures related to Environmental, Health, and Safety (EHS). Same plans/policies/procedures will be utilized for SAF construction and operational phase with necessary updation. Moreover, the plans which are currently not available are recommended in the EMP (table 8-5). A dedicated ESG and Sustainability department oversees these efforts, led by a Departmental Head, an Environmental Engineer, and a Head of HSE, reporting directly to the department. Supporting the Head of HSE are four HSE Officers responsible for ensuring compliance with EHS regulations at the plant. Additionally, BTE has employed two Community Liaison Officers (CLOs) from nearby communities, who report to the Head of Admin and HR while also maintaining a parallel reporting line to the Head of ESG and Sustainability. Below is an organogram illustrating the current EHS staff structure, along with details of the existing policies, plans, and procedures in place.

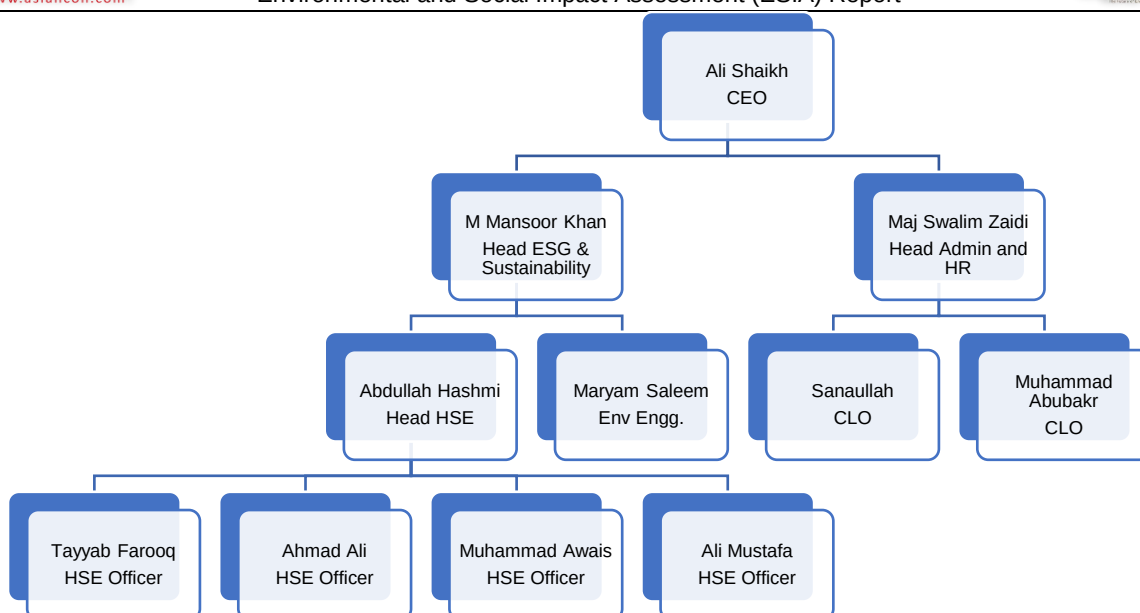


Figure 8-1: BTE Organogram

Table 8-1: List of Existing Environmental and Social Management System (ESMS) policies, plans, and procedures

Sr. No.	Name of Document	Reference No.	Date Issued
Related to Environment			
Policies			
1	BTE ESG Policy	BTE.HSE.ESG. PR. 01	-
2	BTE Corporate Social Responsibility (CSR) Policy	BTE.HSE.PR.015	17/3/2023
3	BTE Grievance Policy	BTE.HSE.PR.014	17/3/2023
Management Plans			
1	BTE Environmental Management Plan	BTE.HSE.MS.03	20/5/2023
2	BTE Solid Waste Management Plan	BTE.HSE.PR.21 Issue No:01 Rev:0	-
3	BTE Water Resource and Conservation Plan	-	-
4	BTE Wastewater Management Plan	BTE.HSE.PR.023 Issue No:01 Rev:0	-
5	Air Emissions Management Plan	-	08/2023
Forms			
1	Community Grievance Form	BTE.HSE.FRM.09 Rev:0	-
2	Employee Grievance Report Form	BTE.HSE.FRM.08 Rev:0	-

Sr. No.	Name of Document	Reference No.	Date Issued
Procedures/SOP			
1	BTE Spill Management and Response Procedure	BTE.HSE.PR.022 Issued No:01 Rev 0	-
Related to Health and Safety			
Policies			
1	BTE HSE Policy	BTE.HSE.MS.02	04/03/2022
Management Plans			
1	Fire Fighting Plan	BTE.HSE.PR.019	02/3/2021
Forms			
1	Training Form	BTE.HSE.FRM.1	10/8/2022
2	Evacuation Plan	BTE.HSE.FRM.2	-
3	Incident Investigation Report	BTE.HSE.FRM.3	02/05/2022
4	MOC Form	BTE.HSE.FRM.4	26/8/2023
5	Incident/Near Miss/Spillage Report Form	BTE.HSE.FRM.5	05/04/2022
6	Cold Work Permit	BTE.HSE.FRM.6	07/2022
7	Risk Register	BTE.HSE.FRM.12	-
8	Warning Letter	BTE.HSE.FRM.13	24/08/2022
9	Internal HSE Audit (Monthly)	BTE.HSE.FRM.14	-
10	Emergency Evacuation Instructions	BTE.HSE.FRM.15	-
11	Document Change Request Form	BTE.HSE.FRM.17	02/1/2022
12	Pre-Start-Up Safety Review Check list	BTE.HSE.FRM.19	06/05/2023
*13	Application Form for Training Under the Scheme for "Skill Development Training Program"	BTE.HSE.FRM.20	01/01/2024
Procedures/SOP			
1	HSE Manual	BTE.HSE.MS.01	17/3/2023
2	Permit To Work Procedure	BTE.HSE.PR.002	24/07/2022
3	Accident/Incident Reporting Procedure	BTE.HSE.PR.002	17/3/2023
4	Emergency Fire Action Plan	BTE.HSE.PR.003	20/09/2022
5	Emergency Response Plan	BTE.HSE.PR.004	21/09/2022
6	HSE Training Procedure	BTE.HSE.PR.005	10/04/2023
7	Management Of Change Procedure	BTE.HSE.PR.006	26/8/2023

Sr. No.	Name of Document	Reference No.	Date Issued
8	Pre-Start-Up Safety Review Procedure	BTE.HSE.PR.007	06/05/2023
9	HSE Induction (English)	BTE.HSE.PR.008	10/05/2023
10	HSE Induction (Urdu)	BTE.HSE.PR.009	10/05/2023
11	LAB Safe Working procedure	BTE.HSE.PR.010	02/05/2023
12	Personal Protective Equipment Procedure	BTE.HSE.PR.011	12/01/2022
13	Uniform Issuance Procedure	BTE.HSE.PR.012	12/01/2022
14	Raw Material Collection & Safe handling procedure	BTE.HSE.PR.013	21/09/2023
15	Documented Information Control Procedure	BTE-HSE-PR-016	01/01/2022
16	Risk Management Procedure	BTE.HSE.PR.017	21/02/2023
17	SOP for Bio Diesel Transportation	BTE.HSE.PR.018	11/10/2023
18	Fire Alarm System for Bio-Diesel Plant	BTE.E/I.PR.011	1/1/2021

8.4 Institutional Arrangements

735. The institutional requirements for the Construction and Operational Phase of the Proposed Project are provided below:

8.4.1 Institutional Arrangements for Implementation of ESMMP During Construction Phase

736. The key players involved during the construction phase of the proposed Project are Biotech Energy Pvt Ltd. as employer/proponent, ESSU, Lenders, Govt Departments, the Supervisory Consultant (SC) and the Contractor/EPCM. The roles and responsibilities of this organization setup are outlined below.

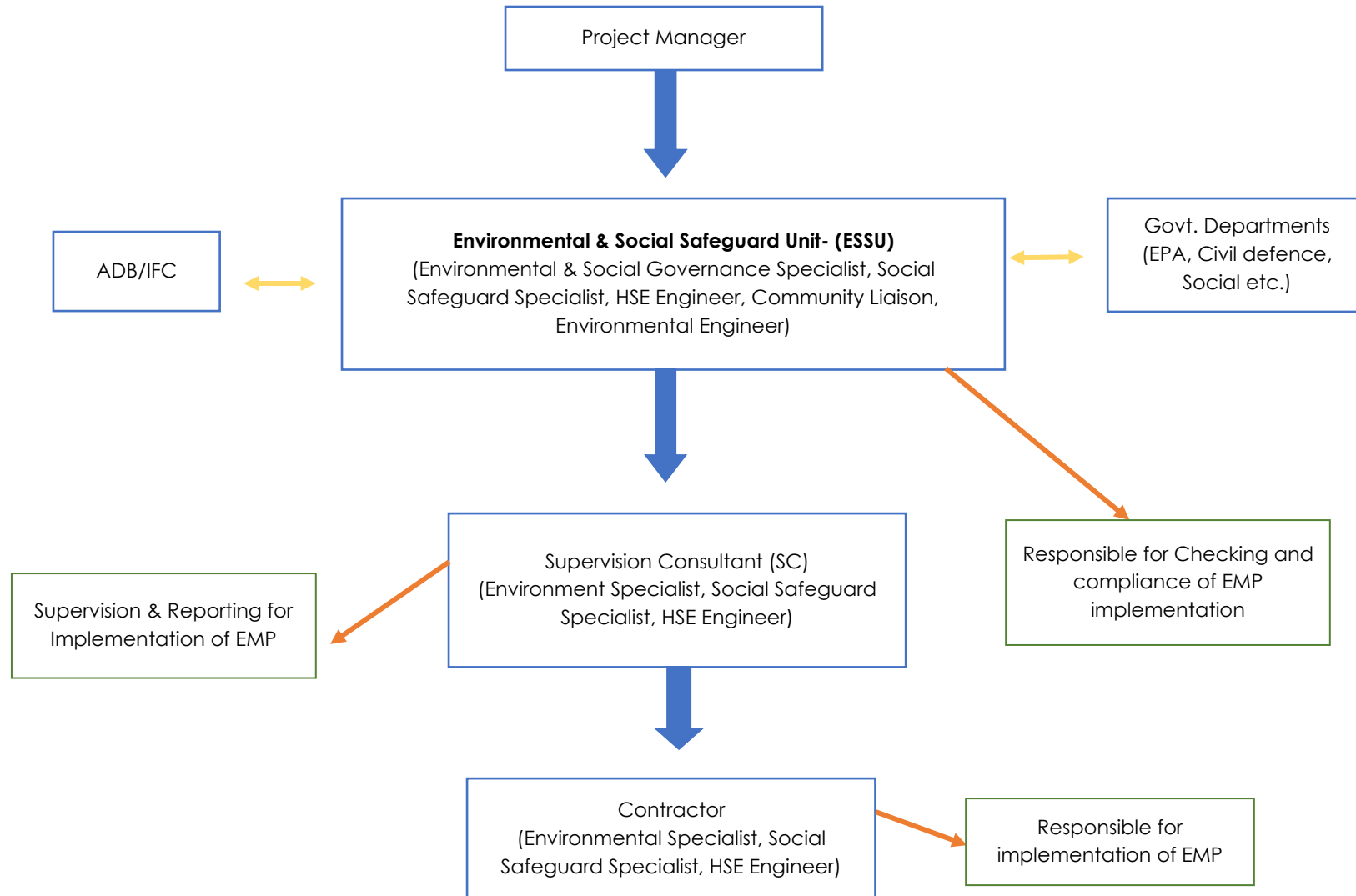


Figure 8-2: Organizational Setup for Implementation of ESMMP at the Construction Phase

8.4.2 Institutional Arrangement for Implementation of ESMMP During Operational Phase

737. The key players involved during the operational phase of the proposed Project are the BTE, ESSU, Lenders and Govt. Departments. The ESSU have Environmental Social Governance (ESG) Specialist, GHG Specialist Community Liaison Officer (CLO), Head of Safety, Compliance Officers, Safety Officers and Supply Chain Compliance Officers. The organogram for structure of ESSU and their roles and responsibilities are outlined below.

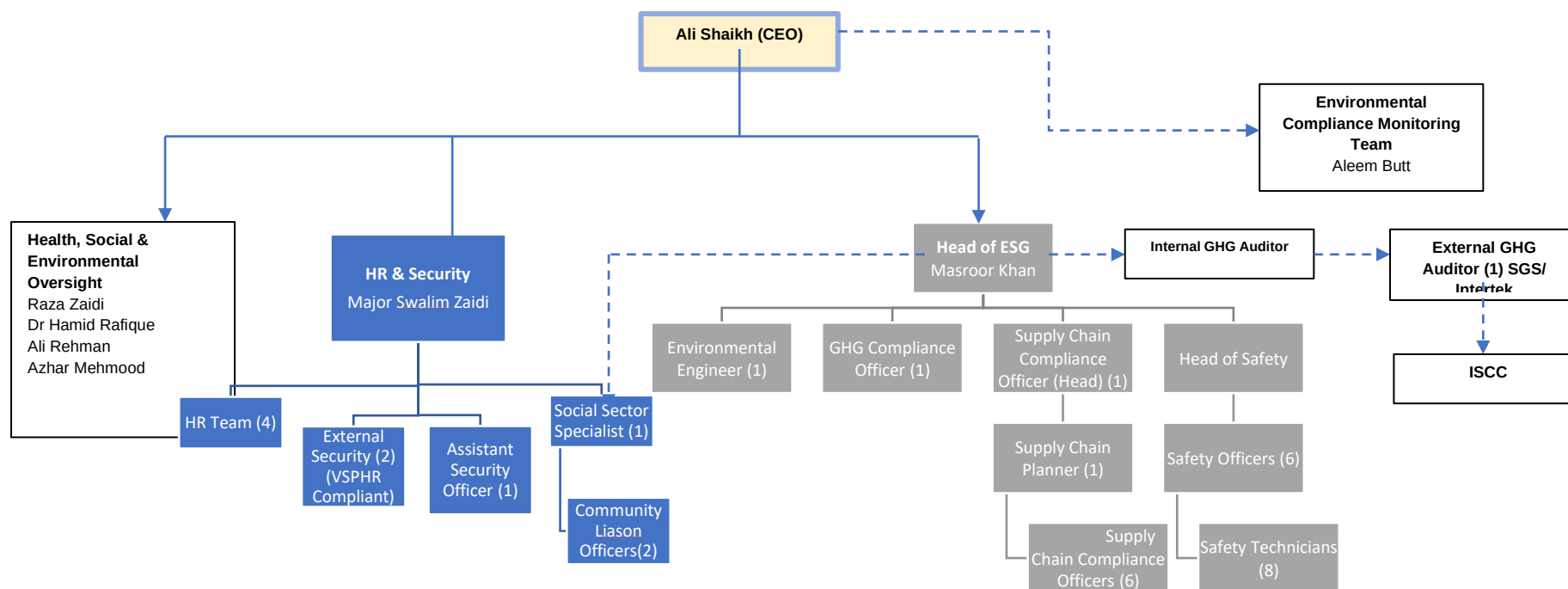


Figure 8-3: Organizational Setup for Implementation of ESMMP at Operation Phase

8.4.3 Roles and Responsibilities

8.4.3.1 Biotech Management

738. Biotech Management is directly in charge of the financial and technical matters of the project. An Environmental & Social Safeguard Unit-ESSU will be established under Biotech management to look after environmental and social activities.

8.4.3.2 Environmental & Social Safe Guard Unit (ESSU)

739. The ESSU will be supported by Environmental & Social Governance Specialist, Social Safe guard specialist, Community Liaison Officer, GHG Specialist, Head of Safety, Compliance Officers, Safety Officers and Supply Chain Compliance Officers. The responsibilities of ESSU include:-

- Submission of Semi-Annual Report to ADB/IFC;
- Coordinate implementation and monitoring of environmental and social protection measures;
- Work with ADB/IFC to keep track of ESMMP implementation;
- Coordinate with SC and ADB/IFC to address issues in the course of ESMMP delivery if needed;
- Ensuring that the required environmental training is provided to the concerned staff;
- To carry out random site visits to the construction sites to review the environmental performance of the Contractor;
- Review monitoring reports for the progress of environment-related activities;
- Make sure that the Contractor is implementing the additional measures suggested by the SC in environmental monitoring reports;
- Maintaining interface with the other lined departments/stakeholders;
- Reporting to the Punjab EPA on the status of ESMMP implementation;
- Monitor the Implementation of ESMMP and other management plans developed under ESMMP. Oversee the compliance of all the monitoring programs as given in ESMMP;
- Check randomly whether monitoring of the environmental aspects of the Project during the construction phase is being properly carried out;
- Document and disclose monitoring results and identify necessary corrective and preventive actions in the periodic monitoring reports (quarterly reporting), and make follow-up on these actions to ensure progress toward the desired outcomes; and
- Make sure that the Contractor is implementing the additional measures suggested by the Supervision Consultant.

- Perform stakeholder engagement in accordance with stakeholder engagement plan and ensure effective communication with stakeholders throughout the project lifecycle.
- Ensure that all contractors and subcontractors follow the E&S guidelines and regulations during construction and operation of the project.
- Ensure the Implementation GRM to address any concerns or grievances raised by stakeholders.
- Oversee compliance within the supply chain specific to SAF material sourcing.
- Monitor suppliers for compliance with company and legal standards.
- Prepare audit reports for GHG emissions and reporting of findings of GHG to stakeholders and regulatory agencies.

8.4.3.3 Supervisory Consultant

740. The Supervision Consultant will be assisted by an Environmental Specialist, Social Specialist and HSE Engineer. The roles and responsibilities of SC will be:

- Prepare environmental screening checklists;
- Review the C-ESMP or other management plans prepared by the contractor; and
- Grant approval for the establishment of all facilities; camp batching plants and, borrow areas, etc (if required) in light of the ESMMP requirements.
- Ensure that the C-ESMPs and other plans including all proposed mitigation measures and monitoring programs, are properly implemented by the contractor.
- Share information and disclosure of environmental safeguard documents (including any Corrective Action Plans prepared in cases of change to the original project design) as required.
- Carry out visits to construction sites and borrow pits to review the environmental performance of the contractors;
- To oversee the performance of the Contractor to make sure that the Contractor is complying with C-ESMP and other management plans
- Monitor the construction activities and ensure compliance with the ESMMP, local and international regulations.
- Report the E&S compliance and noncompliance issues to the project stakeholders and take necessary actions to address any deficiencies.
- Advise BTE for E&S improvement as and when required
- Issue Permit to Work to the contractor after reviewing and approving their proposed mitigation measures.
- Perform E&S Risk Assessment and OHS Risk Assessment of the site and provide recommendations for mitigation measures to ensure the safety and well-being of workers and the surrounding environment.

- Present E&S progress and update to the BTE regularly
- Maintain an action plan for necessary compliance as per the ESMMP and CESMP
- To supervise and monitor environmental activities being performed at the site;
- To organize periodic environmental training programs and workshops for the consultant's and contractor's staff;
- Periodic reporting as mentioned in CESMP; and
- Suggest any additional mitigation measures (if required).

8.4.3.4 Construction Contractor/EPCM

741. The contractor has developed several plans. The Contractor has developed the Emergency Response Plan, HSE plan and Construction Plan. These plans are placed from **Annexure 8-10**. However, BTE and SC will review these plans and propose any addition/deletion (if required). A formal approval will also be required from BTE and SC before start of construction. The contractor will be bound to appoint a site site-based Environmental & Social officer along with HSE personnel with relevant educational background and experience for the implementation of these plans. The contractors' E&S staff will carry out the following activities:

- Developing site-specific or contractor's ESMP according to the ESMMP provided in ESIA report.
- Monitoring and reporting on progress monthly.
- Conducting site visits to review environmental status and address non-compliance.
- Prepare all work program and pre-approved project plans required for implementing the ESMMP during construction phase and ensure their effective implementation.
- Prepare the additional plans as and when required by supervision consultant and Project Manager BTE
- Conducting environmental monitoring as per ESMMP frequencies.
- Generating monthly environmental monitoring reports.
- Implementing mitigation measures on-site.
- Ensuring contractor compliance with contract provisions and ESMMP recommendations.
- Providing proper Personal Protective Equipment (PPEs) to workers and training them.
- Conducting environmental and health & safety training for workers/labor.

8.5 Job Hazard Analysis

742. Job hazard analysis (JHA) will be conducted by Contractor and subsequently approved by Supervision Consultant for each construction

component focusing on job tasks as a way to identify hazards before they occur. It will focus on the relationship between the worker, the task, the tools, and the work environment. Ideally, after identifying uncontrolled hazards, steps will be taken to utilize the hierarchy of control: elimination, substitution, engineering controls, administrative controls and personal protective equipment, to minimize them to an acceptable risk level. Many workers are injured and killed at the worksite every day. The JHA will be one of the major components of the larger commitment of the Contractor's health and safety management system. The JHA will be conducted on many jobs in the worksite. Priority will be given to the following types of jobs:

- Jobs with the highest injury or illness rates;
- Jobs with the potential to cause severe or disabling injuries or illness, even if there is no history of previous accidents;
- Jobs in which one simple human error could lead to a severe accident or injury;
- Jobs that are new or complex to the construction or have undergone changes in construction processes and procedures; and
- Jobs complex enough to require written instructions.

8.6 Contractor Environmental & Social Management Plan (CESMP)

743. BTE has signed an agreement with the EPCM named as PT Istana Karang laut, for the construction of SAF project. The EPCM has developed several plans as listed below.

- Labour/Workforce Management Plan;
- Pollution Control Plan;
- Waste Management Plan;
- Traffic Management Plan;
- Occupational Health and Safety Plan; and
- Environmental and Social Awareness Training Plan.

744. The Contractor has developed and shared all these plans with the proponent i.e.; BTE. These plans are placed from **Annexure 8-10**. However, BTE and SC will review these plans and propose any addition/deletion (if required). A formal approval will also be required from BTE and SC before start of construction.

8.6.1 Labour/Workforce Management Plan

745. The contractor has prepared the labour/workforce management plan which is part of **Annexure-09** (HSE Plan) of the ESIA. The labour/workforce management plan will adhere to Labour/workforce Management Procedures, as per the IFC -PS2. The labour/workforce management plan will set out the project's approach consistent with national requirements as well as the objectives of the relevant IFC & ADB's Environmental and Social Standards/policies on Labor and Working Conditions.

8.6.2 Camp Management Plan

746. There will be no Camp Management Plan because there will be no construction camp within the BTE premises. This is because all the workforce will be hired from Sheikhpura and transported back through the project vehicles after working hours. The Contractor shall prioritize hiring of local skilled and un-skilled workforce during construction phase of the project. Although a specific target could not be set at the moment depending on the availability of relevant staff within the area and if required, EPC will arrange rented accommodation outside the BTE premises adhering to the IFC Performance Standards (labor and working conditions IFC PS 2). EPC shall establish a labour office in which EPC shall depute one or two staff members to publish vacancies, receive applications from the locals and also record grievances related to workforce and communities.

8.6.3 Pollution (air, land, and water) Control Plan

747. The contractor has prepared the pollution control plan which is the part of **Annexure-09** (HSE Plan) of the ESIA. The plan outlines the details of the principal pollution control facilities proposed and of contingency plans in the event of failure of these facilities.

8.6.4 Waste Management Plan (WMP)

748. The contractor has prepared waste management plan which is the part of **Annexure-09** (HSE Plan) of the ESIA. The plan includes the details of the procedures for the collection and disposal of wastes. The Plan deals with each waste stream separately. WMP is prepared as the mitigation plans given in the report.

8.6.5 Traffic Management Plan (TMP)

749. The contractor has prepared traffic management plan which is the part of **Annexure-10** (Construction Plan) of the ESIA. The Traffic Management Plan includes the details of the proposed access routes to the project area as well as haulage/ access routes throughout the project area.

750. The contractor has identified control measures to ensure no environmental or health impacts from the handling of hazardous materials and the collection and safe disposal of hazardous materials.

8.6.6 Occupational Health and Safety Plan

751. The contractor has prepared Occupational Health and Safety Plan which is the part of **Annexure -09** (HSE Plan) of the ESIA. This plan details the following:

- Health and safety management structure, responsibilities, supervision and reporting scheme
- Health and safety goals for the project
- Identification of potential hazards (health risks, safety risks)

- Proposed measures to reduce the risk of identified hazards
- Arrangements to implement such measures
- A system for reporting and investigating accidents, incidents and near misses
- A plan for emergency transfer of staff or public from the site to medical facilities
- Fire and emergency procedures
- Site security.

8.6.7 Environmental and Social Awareness Training Plan

752. The contractor has prepared Environmental and Social Awareness Training Plan which is the part of **Annexure -09** (HSE Plan) of the ESIA. This plan includes the details of the Contractor's environmental and social awareness training program proposed for the workforce. Details are given in Table 8.1 given below. The training will be conducted by the contractor with the collaboration of a supervisory consultant under the guidelines of the IFC/ADB. These pieces of training will be conducted before the project/physical works commencement, during construction and after construction.

8.6.8 Emergency Preparedness and Response Plan

753. The contractor has prepared Emergency Preparedness and Response Plan which is the part of **Annexure 8B** (Emergency Response Plan) of the ESIA. The plan is prepared to address emergencies/events such as fire, floods, earthquakes, accidents, and death/injury. The Plan includes the following details:

- Contacting the relevant agency (e.g., Fire Brigade)
- Procedure for the shutdown of the site;
- Indicators on-site that shall prompt the shutdown of areas of work (linked to natural events)
- Shutdown procedure and Emergency evacuation procedure of staff and members of the public within range of likely impact.)

754. Following is the list of key plans and trainings required but not lied to, during the Construction and Operational phases of SAF in order to address the protentional impacts of the proposed project.

Table 8-2: List of Plans and Trainings Required during the Construction and Operational phases of SAF

Construction Phase

Type	Description	Time Period
Plans	Soil Contamination Prevention Plan	Before Start of Construction Phase
	Influx management plan	Before Start of Construction Phase

Type	Description	Time Period
	Waste Management Plan	Before Start of Construction Phase
	Transport Management Plan	Before Start of Construction Phase
	Air Quality Management Plan	Before Start of Construction Phase
	Stakeholders Engagement plan	Before Start of Construction Phase
	Spill Prevention and control plan	Before Start of Construction Phase
	Occupational Safety & Health Management Plan	Before Start of Construction Phase
	Invasive Species Management Plan	Before Start of Construction Phase
Training	Safety training for handling of hazardous materials	Throughout Construction Phase
	Fire Fighting Training	Throughout Construction Phase
	First aid and CPR training for construction personnel	Throughout Construction Phase
	Machinery operation and environmental awareness training	Throughout Construction Phase
	Skills training programs for local residents	Throughout Construction Phase
	Cultural awareness training for all workers	Throughout Construction Phase
	Hygiene and waste management best practices for workers	Throughout Construction Phase
	OHS Trainings	Throughout Construction Phase
	Emergency Response Training	Throughout Construction Phase
	Worker's Grievance Mechanism Training	Throughout Construction Phase

Operational Phase

Type	Description	Status
Plans	Spill Prevention and Control Plan	Before start of Operations
	Emergency Response Plan	Before start of Operations
	Transport Management Plan (TMP)	Before start of Operations
	Stakeholder and Community Engagement Plan	Before start of Operations
	Air Quality Management Plan	Before start of Operations
	Noise Management Plan	Before start of Operations
	SAF Storage Integrity and Inspection Plan	Before start of Operations
	Plantation and Maintenance Plan	Before start of Operations
	Conflict Resolution Mechanism	Before start of Operations
	Supply Chain Management plan	Before start of Operations
Trainings	Spill response and handling/storage safety training for SAF	Throughout Operation Phase
	Fire Safety Training of Employees	Throughout Operation Phase
	Operation and maintenance training for safety and compliance	Throughout Operation Phase

	GBV awareness and response training for employees and suppliers	Throughout Operation Phase
	Safety training for SAF handling and Storage	Throughout Operation Phase
	Health and safety training including PPE usage and emergency response	Throughout Operation Phase
	Community Grievance Mechanism Training to Local Communities	Throughout Operation Phase
	Cultural Sensitivity Training	Throughout Operation Phase

Table 8-3: Environmental and Social Awareness Training Plan

Sr. No.	Topics/Courses Required	To be Attended By			Duration	Schedule	Status		Remarks
		BTE	Skilled Crafts	Labors			Completed	Outstanding	
1.	Initial Orientation	✓	✓	✓	2 hrs	Once upon joining			
2.	Specific Orientation (on job)	✓			2 hrs	On job assignment			
3.	Training to Staff Working within Active Process Area	✓	✓	✓	2 hrs	As & when required			
4.	Daily Tool Box Talk		✓	✓		Daily			
5.	Safety Talks			✓	15 min	Weekly			
6.	Communicable disease	✓	✓	✓	10 min	Daily			
7.	Task-Specific Training Course	✓	✓	✓	2 hours as & when required				
8.	Environmental Issues	2 hours as & when required							
9.	PPEs on Site	✓	✓	✓	2 hour	Weekly			
10.	Driving Rules and Driver's Training	For Any Category	✓	✓	2 hour	- Do -			
11.	Risk Assessment			✓	1/2 day	- Do -			
12.	Accident/Incident Reporting			✓	1/2 day	- Do -			
13.	Emergency and Evacuation Drills & Exercises			✓	1/2 day	- Do -			
14.	Labour Management		✓	✓	1/2 day	- Do -			
15.	Fire Fighting			✓	1/2 day	- Do -			
16.	Solid Waste Management				✓	1/2 day	- Do -		

Sr. No.	Topics/Courses Required	To be Attended By			Duration	Schedule	Status		Remarks
		BTE	Skilled Crafts	Labors			Completed	Outstanding	
17.	First Aid		✓	✓	1/2 day	- Do -			
18.	OHS			✓	1/2 day	As & when required			
19.	Wastes and Spills			✓	3 hours	- Do -			
20.	Air/Water Emissions			✓	3 hours	- Do -			
21.	Grievance Redressal Mechanism		✓	✓	½ hour	As & when required			
22.	Community Mobilization/Consultation		✓	✓	½ hour	Once in month			
23.	Social and Cultural Dynamic		✓	✓	½ hour	Once in month			
24.	Gender Issues		✓	✓	½ hour	Once in month			

8.7 Compliance and Effects Monitoring

755. BTE shall carry out monitoring within the sub-project area using the monitoring checklists to be prepared based on this mitigation and monitoring plan to aid the monitoring process; the Contractor will complete the following:

- The construction staff will be trained for the implementation of the ESMMP and safety measures.
- Periodic progress reports will be submitted to the ESSU of BTE.
- Progress Reports will include the various issues related to the HSE, including but not limited to the following:
 - OHS Measures adopted (as OHS statistics)
 - Fuel and hazardous material consumption
 - Workforce statistics (employment/deployment etc.)
 - Compliance monitoring to check whether the actions proposed in the ESMMP are being carried out.
 - Effects monitoring to record the impacts of mitigation measures.

756. The effects monitoring shall be the responsibility of Contractor. The Examples of compliance and effects monitoring parameters have been presented in Box 1 below. The list presented in Box 1 shall not be considered exhaustive. Other areas of compliance, and environmental and social effects monitoring can be added to this list. The monitoring can be conducted by visual observation as presented in Table 22, photographic documentation, and measurement through laboratory sampling and testing where necessary. All the data shall be made part of the records.

8.8 Environmental Non-compliances and Corrective Measures

757. The Contractor will be notified of any violations of the ESMMP, as well as any corrective actions required by SC and BTE- ESSU. Outlined below are some steps relating to the increasing severity of environmental problems, which will be implemented. The principle is to keep as many issues within the first few steps as possible.

- **Step 1.** BTE and Contractor to work out mitigations together and record the facts and the decision implemented.
- **Step 2.** A more serious infringement will be observed and BTE will be notified the Contractor of the issues in writing, with a deadline by which the problem must be rectified. All costs will be borne by the Contractor.
- **Step 3.** The suspension will be enforced until the offending parties, procedure, or equipment is corrected and/or remedial measures put in place if required. No extension of time will be granted for such delays and all costs will be borne by the Contractor.
- **Step 4.** Breach of contract - One of the possible consequences of this is the removal of a Contractor and/or equipment and/or the termination of the

contract. Such measures will not be replaced by any legal proceedings that BTE may institute against the Contractor.

8.9 Tree Plantation / Reforestation

758. The basic purpose of the plantation of suitable species in the Project Area is to reduce the risk made to enhance green cover and improve the overall environment of the area. Plantation/Reforestation will not only reduce the risk being made but will also increase the carrying capacity of the area regarding many positive aspects.

759. Based on the estimation, a total of approximately 500-600 numbers of trees/plants will be planted. The total cost is approx. 1,000,000 (PKR 01 million).

8.10 Communication Reporting and Documentation

760. ESSU-BTE and its Contractors will prepare periodic monitoring reports on the status of the implementation of ESMMP and will be submitted to IFC and ADB for their review and feedback. Details of these reports and their content are given in **Table 8-4**.

Table 8-4: ESMMP Monitoring and Compliance Reports

Sr. No.	Title of the Report	Contents of the Report	Frequency of Report Preparation	Report to be prepared by
1.	OHS and ESMMP Monitoring Report	The compliance status of the Project with environmental and social mitigation and monitoring measures. Besides, the report also covers: • ESMMP/CESMP implementation progress report • Environmental incidents; • Leading indicators (inspections, walk-throughs by supervisors, OHS Officer and management, work observation, training, tool-box talk, meetings, reward and recognition.) • Lagging indicators (fatalities, lost-time injuries, medical treatment cases, first-aid cases and near-misses); • Health and safety supervision: • Usage of PPE by workers • Worker accommodations • Worker' s grievances • Community grievances Chance Finds (if any)	Monthly	Contractor
2.	OHS and ESMMP Monitoring Report	The ESMMP & OHS/CHS implementation progress reports	Quarterly	SCand ESSU-BTE
3.	Ecological monitoring	Status of biodiversity in AOC as compared to baseline. All new plantation to monitor and ensure that no invasive species	Quarterly	SCand ESSU-BTE
4.	Incident Reports	Incident flash reports, Incident investigation reports for all major incidents covering details of the incident, root cause analysis, and actions taken to address the future recurrence of this event	Initial investigation report within 24 hours Detailed Investigation Report within seven days	Contractor
5.	Project Completion Monitoring Report	Soon after the completion of construction, the BTE with the support of SC will submit a Project Completion Environmental Monitoring Report which will summarize the overall environmental and social impacts and risks from the project as well as lessons learned.	After physical work completion	SC/ESSU-BTE

Sr. No.	Title of the Report	Contents of the Report	Frequency of Report Preparation	Report to be prepared by
6	Environmental Audit Report	After one year project completion done by the 3 rd party consultant. The Environmental Audit report will highlight the overall compliance status of the project during construction phase.	After one Year	3 rd Party Consultant

Box 1

(i) Compliance Monitoring:

- Frequency of anti-dust water sprays during construction period;
- Installation of signage regarding community health and safety
- Safety at workplaces and working hours during construction;
- Incidence of liquid/solid waste in the vicinity of construction site (type and amount of waste, amount, interference with local residents, fauna, flora and crops);
- Plantation of saplings of new trees & Survival rate of saplings of new trees
- Arrangements made at construction sites for protection of floral and faunal resources
- Assurance of installation of signage regarding community health and safety
- Traffic Management during construction activities

(ii) Environmental Effects Monitoring

- Ambient air quality (Particulate matter) during construction phase;
- Stack Emissions from Generators
- Construction Machinery Vehicular Emissions
- Surface water quality during the construction phase.
- Ground water quality at construction site;
- Ground water table monitoring at construction sites;
- Noise levels (in dBA), monitored at fixed locations and planned schedule during construction
- Extent and degree of functionality of diversion channels to ensure un-interrupted water supply;

(iii) Social Effects Monitoring

- Number of skilled and un-skilled employment especially from the adjacent communities.
- Incidence of child labour and disproportionate wages
- Conflict at the community level
- Chance finds the archaeological site
- A grievance redressal mechanism is in place
- Health screening of labour at the site
- Contractor's staff at construction site sensitized on Gender base violence (GBV)
- Number of workers suffering from malaria, cholera, diarrhea, and respiratory ailments during construction phase

761. A photographic record of the project area shall be kept. The contractor, SC, will be required to take photographs at key locations using a digital camera of the sub-project areas in a walkthrough survey. The following data will be recorded for each photograph:

- Shot number
- All the photographs will be referenced with GPS Coordinates
- Title of photograph
- Date and Time, and
- Photographic features.

762. The photographic record shall be incorporated into the monthly reports.

8.11 Complaints Register

763. The complaint register will be ultimately part of overall GRM mechanism develop for this project. The Contractor will be required to maintain a

complaint register at the construction site and workplaces to document all complaints received from the local communities. The register will also record the measures taken to mitigate the reported concerns. The final report will be communicated to the ESSU of BTE. All complaints/issues of the community will be reported in the monthly progress report of the following month, along with the status of the last month's complaints and will be reviewed by the ESSU of BTE.

764. Moreover, telephone numbers and addresses of all concerned tiers within the GRM will be displayed in Punjabi and Urdu at all sites, and the same will be distributed in community training/meetings.

8.12 Change Record Register

765. A review of this ESIA will be triggered in two scenarios:

- A change to the designs deviates from the parameters that are safeguarded in this document.
- A change which is un-anticipated which is not recognized or covered by this ESIA.

766. In the event of either scenario, the report will be updated and reissued accordingly. The Contractor and BTE to document any change in the project design/operation shall maintain the design change record.

Table 8-5: Environmental & Social Management Plan

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
A. DESIGN PHASE											
A.1. Design / pre-construction considerations											
A.1.1	Pre-construction considerations	PEPA 1997 (Amended 2012), IFC PS-1 & PS-5, ADB Safeguard Policy Appendix 1 Point D	- Biotech Energy Pvt. Ltd. (BTE) proposes to expand its existing biodiesel production plant in Sheikhpura, Pakistan, by constructing a new SAF facility. - As discussed in location alternatives, Biotech Energy Pvt Ltd. already owns the current site since 2014, which is deemed optimal due to the presence of available land	Low	No mitigation is necessary concerning land acquisition for the proposed project, as the required land is already owned by BTE. The total area of the existing facility is 23,644 square meters (5.84 acres), and the planned expansion for the SAF facility will encompass an additional 12,870 square meters (3.18 acres).	Negligible	BTE	SC	Comply with the approved design	Once at the end of the design stage	BTE project office
B. CONSTRUCTION PHASE											
B.1. Physical Impacts											
B1.1	Soil Erosion and Contamination	IFC PS-1 & PS-3, ADB Safeguard Policy Appendix 1 Point D Subpoint 09	Construction activities have the potential to cause soil erosion and contamination through various processes such as excavation, disposal, and accidental spillage. Additionally, construction site generates solid waste and debris, necessitating appropriate disposal methods to avoid environmental harm. Soil contamination can also occur due to the use of chemicals and fuel during construction.	Medium	The impact could be mitigated as: - Set up containment areas for hazardous materials, monitor regularly for leaks, and train personnel on safe handling and cleanup to protect soil quality. - Provide training for construction workers on waste handling, segregation, and disposal, ensuring ongoing sessions for safety compliance and reduced mismanagement. - Install drainage systems to prevent water accumulation, minimizing soil contamination risks and delays, with regular maintenance throughout the project. - Level the site during preparation to prevent soil erosion and promote site stability, ensuring routine inspections for quality maintenance. - Designate waste disposal and recycling areas to promote regulatory compliance and	low	CC	SC and BTE	- Construction of containment areas - Training records - Inspection records - Installation of drainage system - Implementation of Soil Contamination Prevention Plan.	Daily /Regularly	At the active construction site..

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					environmental protection, with a waste management plan implemented from project start. - Conduct regular monitoring to detect spills and initiate immediate cleanup to limit environmental impact, with response teams trained for effective action. - Development and implementation of Soil Contamination Prevention Plan. - The waste heaps will be removed as part of the site preparation process. A thorough assessment by contractor will be conducted to evaluate the potential for soil contamination, and any necessary testing, including for asbestos within the waste piles, will be carried out to ensure compliance with environmental and safety standards.						
B.1.2	Ambient Air Quality Deterioration Due to Construction Activities:	PEQS 2016, IFC PS-1 & PS-3, ADB Safeguard Policy Appendix 1 Point D Subpoint 6&9	Construction activities involving machinery such as batching plants, excavators, and dump trucks emit noise and exhaust emissions (particulate matter (PM10), smoke, dust, carbon monoxide (CO), and nitrogen oxides (NOx).), leading to air pollution.	Medium	The impact could be mitigated as: - Tune all construction vehicles every three months to reduce NOx, SOx, CO, and PM10 emissions, maintaining records of emissions and tuning frequency throughout the project. - Perform regular maintenance on all diesel-powered equipment to optimize performance and reduce emissions, with logs of maintenance frequency and emission levels kept for the project duration. - Ensure all trucks transporting materials are covered with tarpaulins to control dust emissions, with random compliance checks conducted consistently during material transport. - Use water trucks to sprinkle paved roads twice daily to control dust, with weekly	Low	CC	SC and BTE	- Compliance with PEQS and WHO/IFC - Maintenance and inspection records - Water Sprinkling Log - Implementation of Air Quality Management Plan	Daily/ Monthly/Quarterly/Regularly	At the active construction site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					monitoring of dust levels and maintenance logs to ensure adherence to the schedule throughout construction. Development and implementation of Air Quality Management Plan						
B.1.3	Surface and Ground Water Contamination:	PEQS 2016 IFC PS-1, PS-3, PS-4 ADB Safeguard Policy Appendix 1 Point D; Sub-point 6&9	It is anticipated that around 15-20 m3/day of waste water generated from construction site with mostly washing and municipal in nature and it can lead to the deterioration of water quality that will final discharge into Ghazi drain.	Medium	The impact could be mitigated as: - Design and install a septic tank based on soil and groundwater data to handle sewage discharge, with design approval required before construction begins. - Install a temporary drainage system with oil and grease interceptors to manage construction runoff and wastewater, operational before construction starts. - Prohibit disposal of lubricating oil or other materials into soil or water, aiming for zero incidents of illegal disposal during construction. - Set up designated containment areas for liquid materials with weekly compliance inspections to prevent runoff to surface water, maintained throughout the construction phase. - Establish a protocol for immediate spill cleanup, aiming to respond within one hour, with spill kits and trained personnel on-site throughout construction. - Equip work sites with sanitary latrines to protect water sources and support hygiene, installed before on-site construction begins. - Maintain spill cleanup equipment with monthly checks to ensure it is ready for rapid response, minimizing environmental impact and ensuring compliance. - Conduct all fueling within designated containment areas, with zero incidents of	Low	CC	SC and BTE	- Installation of Septic tanks and drainage system with oil and grease traps - Provision of Spill kits - Inspection and training Records - Compliance with PEQS and WHO/IFC - Implementation of Spill Prevention and Control Plan as well as Water Quality Management plan	Weekly /Monthly	At the active construction site.

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					- spills, and train staff on fueling protocols throughout construction. - Store fuel and chemicals on an impervious base with bunds to contain 110% of tank volume, inspected monthly to prevent contamination of groundwater and surface water. - Mark and monitor all tanks and drums for leaks, with monthly audits to ensure labeling accuracy and safety, protecting ecosystems throughout the construction phase. - Conduct monthly Surface and ground water quality testing in compliance with PEQS and WHO/IFC. - Development and implementation of Spill Prevention and Control Plan as well as Water Quality Management plan						
B.1.4	Disposal of Construction Debris & Garbage	PEPA 1997 (Amended 2012), IFC PS-1 & PS-3 ADB Safeguard Policy Appendix 1 Point D Subpoint 9	Improper disposal could lead to adverse impacts on the site and surrounding areas. Additionally, construction materials like concrete, wood, steel, and plastics may block drainage channels if not disposed of properly at approved sites.	Medium	The impact could be mitigated as: - Develop a waste management plan with designated storage, collection schedules, and disposal methods for different waste types, implementing it at construction start with effectiveness reviews after six months. - Dispose of all construction waste at EPA-approved sites using certified vendors, tracking compliance with EPA standards and vendor approvals throughout the project. - Arrange regular garbage collection and sewage removal to prevent pollution and health hazards, maintaining records of collection frequencies and adjusting as needed during construction. - Train all relevant staff dealing with waste handling on hygiene and safety on	Low	CC	SC and BTE	- Designated waste storage area - Effectiveness Review Report - Hiring of an EPA approved vendor - Waste lifting records - Training Records - Implementation of Waste Management Plan	Regularly/Quarterly	At approved disposal sites

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					monthly basis						
B.1.8	Occupational Health & Safety	Punjab OHS act 2019, PEPA 1997 (Amended 2012), IFC PS-2 & PS-3/ ADB Safeguard Policy Appendix 1 Point D; subpoint 10	Health and safety impacts during the construction phase of the proposed project include physical hazards such as moving machinery, falling objects, heat stress, hygienic conditions, un-safe working condition and un-safe acts, leading to potential injuries for workers. Noise pollution from construction machinery may cause hearing loss. If concerns of workers are not resolved then grievances of workers may lead to unrest and potential incidents at workplace.	High	The impact could be mitigated as: - Distribute essential personal protective equipment (PPE) like helmets, gloves, and masks to all workers and conduct daily checks to ensure compliance throughout the construction period. - Equip construction sites with fully stocked first aid kits and ensure at least 15 personnel are trained in first aid and CPR, with monthly inventory checks on kit contents. - Conduct mandatory routine medical check-ups for all field staff every six months to monitor health and ensure follow-up actions for any identified issues. - Provide training sessions on safe equipment usage for all workers, ensuring completion before operating machinery during the construction phase. - Set up cooling systems and schedule regular breaks to prevent heat-related illnesses, monitoring adherence to breaks and system functionality. - Equip workers with safety harnesses and install guardrails in elevated areas to enhance safety and prevent falls before elevated work begins. - Organize weekly safety discussions covering hazard recognition and emergency response procedures to reinforce safety protocols among all workers. - Implement a work permit system for dangerous tasks, ensuring compliance and effective management of permit issuance before construction starts. - Conduct regular risk assessments to identify and	Low	CC	SC and BTE	- Training and Inspection Records - Implementation of Worker's Grievance Mechanism - Implementation of OHS Management Plan - Monthly HSE Progress Reports	Weekly/Monthly/Quarterly/Annually	At the project area

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					evaluate potential hazards on-site, with quarterly evaluations continuing throughout construction. • Perform a Job Hazard Analysis for specific tasks to identify potential hazards and review findings quarterly to ensure ongoing safety compliance. • Ensure 100% of workers complete safety training on critical areas such as equipment operation and emergency procedures before construction begins. • Educate workers on hygiene best practices and conduct quarterly refresher training to maintain a healthy work environment. • Perform routine inspections and maintenance on machinery to prevent failures and ensure safety, with quarterly reviews of inspection records. • Install non-slip flooring in high-risk areas to reduce slip incidents, ensuring installation before construction starts and conducting semi-annual maintenance checks. • Perform Tool Box Talks (TBTs) daily before start of activities at relevant work sites • Record incidents and accidents and maintain a log on regular basis • Develop monthly HSE Progress Reports and present to the management for review. Take necessary corrective measures and ensure tracking of all these activities. • Develop and implement workers grievance mechanism and install grievance boxes at various work fronts including any safety related suggestions or						

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					complaints. Review the grievances received on monthly basis. Develop and implement Occupational Health and Safety Management Plan encompassing all mitigations measures listed and any additional as required.						
B.1.9	Noise	IFC PS-1 & PS 3, ADB Safeguard Policy Appendix 1 Point D Subpoint 6 & 9	Construction activities for the SAF facility, such as operating heavy machinery like bulldozers, excavators, and concrete mixers, will generate significant noise. While these impacts will be temporary and limited to the preconstruction and construction phases, they may still cause nuisances due to the cumulative effects of multiple machines operating simultaneously	Medium	The impact could be mitigated as: - Procure low-noise equipment with noise-damping features, measuring and documenting decibel ratings before use, with selection completed prior to project initiation. - Limit excessively noisy work to daytime hours from 8 am to 5 pm, maintaining a noise activity log to ensure compliance and reinforcing the policy with signage from the project's start. - Distribute hearing protection equipment to all workers exposed to hazardous noise levels, ensuring 100% distribution and maintaining records throughout the construction period. - Restrict nighttime movement of construction vehicles from 10 pm to 6 am, logging vehicle movements and conducting inspections to reduce disturbances in nearby communities. - Prohibit the use of heavy machinery at night without client approval, logging machinery use and ensuring personnel understand the approval process throughout the construction period. - Fit all vehicles and machinery with appropriate silencers or mufflers, conducting bi-weekly noise checks and inspections to control operational noise levels. - Install and maintain safety signs near sensitive areas, checking their visibility monthly to raise noise	Low	CC	SC and BTE	- Construction Work Schedule and Vehicle Movement Log - Compliance status with PEQs and IFC WHO - PPE's Inspection Log - Implementation of Noise Management Plan	Weekly/ Monthly/Quarterly	At the Project Area

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					awareness among workers and the public throughout construction. - Prioritize low-noise or shielded machinery in construction activities, conducting quarterly noise assessments to document decibel levels and enhance community relations. - Ensure adherence to work schedules and noise control procedures, conducting weekly audits of operations near sensitive receptors and overseeing compliance with noise control measures throughout the project. - Internal noise level monitoring of all work areas on weekly basis and external noise monitoring from an EPA approved laboratory on monthly basis against PEQS and WHO/IFC - Development and Implementation of Noise Management Plan						
B.1.11	Invasive Species	IFC PS-1 & PS 6 ADB Safeguard Policy Appendix 1 Point D; subpoint 6 & 9	Invasive species (flora or fauna) can be introduced across borders when hitchhike, grow or enter on imported machinery or equipment, leading to significant environmental, economic, and health impacts in the new areas.	Medium	The impact could be mitigated as: - Ensure all machinery and parts are disinfected before site entry to remove seeds, soil, and organic residues, starting immediately and monitored monthly. - Assign trained personnel to inspect machinery for visible soil, plant material, or small animals prior to entry. - Set up an area at the industry site for cleaning and inspection of incoming machinery to control contamination risks. - Incinerate any soil, plant material, or biological residues collected during cleaning to prevent the spread of invasive species. - Identify, remove, and dispose of invasive plant species in an ecologically responsible manner, establishing procedures within 30 days	Low	CC	SC and BTE	- Washing and disinfection records - Inspection records - Disposal records (if any)	Daily/ Monthly/ Quarterly	Construction Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					and monitoring compliance quarterly. - Install wash stations at all site entrances to pressure wash vehicles and equipment upon entry and exit, reducing the risk of contamination spread, with setup to be completed within 30 days and ongoing daily maintenance thereafter. - Development and implementation of Invasive Species Management Plan						
B 2. Ecological Environment											
B.2.1	Impact on Flora	PEPA 1997 (Amended 2012), IFC PS-6	The project area does not fall inside or in the vicinity of any wildlife-protected area. There are no trees present at the proposed site except a few shrubs. In the micro-environment and immediate vicinity, no forest is located which might be affected due to project implementation.	Low	The impact could be mitigated as: - Identify key areas on-site for planting native trees and shrubs to improve air quality and enhance the natural landscape, measuring the number of trees and shrubs planted, with area identification completed before construction ends and planting initiated afterward. - Organize tree plantation campaigns as part of corporate social responsibility (CSR) or community goodwill efforts, actively involving local communities and employees to promote biodiversity and environmental stewardship - Implement a maintenance schedule for watering, pruning, and monitoring plants to ensure their long-term survival, measuring the frequency and effectiveness of these activities while maintaining records of plant health throughout the project's duration.	Negligible	CC	SC and BTE	Progress Reports	Regularly	At the Project Area
B 3 Social Environment											
B.3.1	Impact on Socio Economy	IFC PS-4, ADB Safeguard Policy Appendix 1-point subpoint 1 & 2	The proposed project will create employment opportunities during the construction phase. This job creation will contribute to a more robust local economy.	Medium	The impact could be mitigated as: - Develop a workforce profile for construction and operations phases, outlining required skills, qualifications, and job requirements. - Conduct a skills assessment to evaluate local community readiness, ensuring	High	CC	SC and BTE	Comply with: - Labour Management Plan - Influx management plan - Stakeholders' management	Regularly/ Quarterly/ Annual	At the Project Area

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					inclusivity and fair representation. - Design transparent recruitment procedures in collaboration with stakeholders, prioritizing local hiring and gender equity. - Ensure inclusivity through targeted outreach, inclusive language in job postings, community workshops, and training programs. - Establish grievance mechanisms with accessible channels for concerns, addressing issues promptly to foster trust. - Identify recruitment gaps and advertise unfilled roles regionally and nationally while building local capacity. - Share quarterly updates on job opportunities, salaries, and selection criteria to maintain transparency. - Monitor engagement metrics and adapt communication strategies to ensure accessibility for all applicants. - Implement training programs to develop labor skills among local residents. - Integrate sustainable development by offering long-term employment opportunities, fostering local entrepreneurship, and promoting partnerships with local businesses to create secondary employment opportunities and stimulate economic growth. - Prioritize hiring local labor, ensuring workers have valid CNICs, police clearance, behavior briefings, and secure employee records. Conduct semi-annual compliance reviews. - Organize at least two community engagement initiatives annually to promote social integration and reduce tensions between local and			plan			

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					- non-local employees. - Establish a clear code of conduct outlining anti-social behaviors and consequences, ensuring all workers acknowledge the code before construction begins.						
B.3.2	Community H&S Risks	IFC PS-4, ADB Safeguard Policy Appendix 1 Point D Subpoint 1 & 2	The use of road vehicles during construction poses significant risks, including air pollution, dust, noise, and traffic congestion, particularly near sensitive areas like schools, hospitals, and homes. These impacts can harm air quality, cause respiratory issues, disrupt daily life, and increase road safety concerns. Tailored mitigation measures are essential to minimize these effects on the environment and local communities.	High	- Develop a transportation Management plan to map routes, assess traffic impacts, enforce speed limits, train drivers, and engage communities on road safety. Regular monitoring and reporting will be conducted. - Assess driver qualifications, inspect vehicles monthly, secure loads, and maintain safety records. - Use low-noise machinery, enforce a "no horn" policy, train operators, and conduct monthly noise assessments near sensitive areas. - Maintain vehicles to meet emission standards, reduce idling, and train drivers on eco-friendly practices. - Apply dust suppressants monthly. - Inform residents of schedules, road changes, and impacts while addressing concerns. - Coordinate with authorities and maintain engagement to address safety and community issues.	Low	CC	SC and BTE	Number of complaints to ensure compliance with PS4 – Community Health and Safety	Regularly/ Monthly	At the Project Area
C. OPERATION PHASE											
C.1. Physical Impacts											
C 1.1	Collection of Feedstock	IFC PS-1, PS-2, & PS-3 ADB Safeguard Policy Appendix 1 Point D Subpoint 9	A thorough risk assessment for collecting used cooking oil (UCO) involves identifying sources such as households, restaurants, and industrial sites, considering factors like viscosity and acidity. Occupational health and	Medium	- The impact could be mitigated as: - Develop and implement a Feedstock Collection Procedure in line with IFC EHS General Guidelines, addressing environmental and safety concerns with regular monitoring and audits	Low	BTE	Labour Department/Industry Department/PFA/EP A Punjab	Adherence to BTE/SAF Policies for Vendors/Third party/suppliers and Transport Management Plan	Monthly/ Annually	At collection points

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							Execution	Monitoring			
		&10	safety (OHS) concerns include slips, chemical exposure, and transportation hazards, requiring proper handling and training. Environmental impacts like pollution and community disturbances must be addressed through adherence to regulations and mitigation strategies, including spill prevention and community engagement. Continuous monitoring and improvement are essential to ensure worker safety and environmental protection throughout the UCO collection process.		for compliance and improvement. - Prevent spillage during transportation by limiting feedstock container fill levels to 90% capacity, conducting regular inspections, and performing monthly checks to ensure safe handling and environmental protection. - Use appropriate containers made of polyethylene, polypropylene, or metals for the collection and transportation of feedstock to prevent leakage, conducting regular inspections to verify the absence of spills, with inspections scheduled monthly. - Ensure containers are filled to no more than 90% capacity during loading to prevent spills, implementing guidelines and conducting inspections for 100% compliance on a monthly basis. - Equip all workers handling waste oil with the required personal protective equipment (PPE) and safe handling practices, aiming for 100% PPE compliance while conducting monthly safety audits. - Develop and implement a Spill Prevention and Control Plan with clear procedures for hazardous material spills, ensuring a response time of 15 minutes and conducting annual reviews or immediate reviews after spill incidents. - Development and Implementation of Transport Management Plan (TMP). - Develop and implement a Supply Chain Management System (SCMS) with a Responsible Collection Policy (RCP) for 100% traceability and risk screening, along with a Supplier Code of Conduct						

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					prohibiting child or forced labor and requiring adequate life and fire safety (L&FS) controls per IFC PS1 and PS2. Prepare and implement an audit methodology to monitor SCMS compliance using KPIs, with a Remediation Plan for non-compliant businesses.						
C 1.2	Transportation of Feedstock	IFC PS-3, ADB Safeguard Policy Appendix 1 Point D Subpoint 9 &10	Improper management of feedstock transportation poses significant environmental and community risks. Air pollution from emissions like carbon monoxide, nitrogen oxides, and particulate matter deteriorates air quality, leading to respiratory health issues. Spills during transportation can contaminate water sources, threatening ecosystems and human health. Greenhouse gas emissions from fossil fuel-powered vehicles worsen climate change, impacting ecosystems and human well-being. Additionally, noise pollution generated by heavy machinery disrupts nearby communities and residential areas.	Medium	The impact could be mitigated as: - Implement a Transportation Management Plan (TMP) aligned with WBG EHS guidelines to ensure safe routes, qualified drivers, vehicle maintenance, load security, and environmental protection, with regular monitoring and continuous improvement. - Ensure that all vehicles used for transportation have valid fitness certificates and are regularly maintained, conducting quarterly inspections to verify 100% compliance. - Implement EU methodology for tracking feedstock collection by developing a system to record collection volumes and distances travelled, aiming for completion within three months and conducting quarterly reviews. - Use appropriate containers for transporting feedstock to prevent spillage, ensuring 100% compliance through inspections scheduled monthly. - Reduce vehicle speed limits to 30 km/h and restrict horn usage near sensitive areas, monitoring compliance through speed checks and aiming for a 90% compliance rate with quarterly assessments. - Require all drivers to have valid licenses and complete	Low	BTE	Punjab EPA/Transport Department	Adherence to the Code of Conduct for Suppliers/ Vendors/ third Party and Trasport Management Plan (TMP)	Monthly/Annually	Transportation route

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					specialized training for transporting waste oil, with training and competency assessments conducted every six months. - Use noise-reducing equipment and avoid transportation during sensitive hours, measuring noise levels monthly to protect community well-being. - Train all personnel involved in handling and transport on safe procedures outlined in the Spill Prevention and Control Plan, ensuring 100% completion of training before the start of operations and conducting annual reviews. - Development and Implementation of Transport Management Plan (TMP)						
C 1.3	Storage of Feedstock	IFC PS-2, ADB Safeguard Policy Appendix D Subpoint 9 & 10	- The storage of waste oil feedstock in a biotech industry can have significant environmental and operational impacts. - Improper handling may lead to leaks and spills, contaminating water sources and causing soil contamination, which can harm plants and animals. - Additionally, the release of volatile organic compounds and pollutants from storage can degrade air quality, leading to odor and respiratory health issues. The flammability of waste oil poses a fire risk if not stored correctly, while improper storage can also degrade feedstock quality over time, reducing industry efficiency. - Pest infestations resulting from improper	Medium	The impact could be mitigated as: - Store waste oil in sealed, airtight, and corrosion-resistant containers in ventilated, temperature-controlled areas with secondary containment systems. Conduct monthly inspections, train staff on handling and spill management, and dispose of waste oil via licensed contractors in compliance with regulations. Equip storage areas with spill kits, fire extinguishers, and PPE, and implement an Emergency Preparedness and Response Plan (EPRP). - Develop and implement an Emergency Preparedness and Response Plan (EPRP) with fire suppression systems for key storage areas, ensuring 100% equipment coverage, quarterly inspections, and fire safety training. Finalize the EPRP within three months of operation, review it annually, and share with relevant	Low	BTE	Punjab EPA	Comply with Policies for Vendors/ Suppliers/ third Party and Emergency Response Plan (ERP)	Regularly/ Monthly/ Quarterly	Storage areas

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
			storage further disrupt plant operations and affect surrounding communities. Therefore, proper storage practices are crucial to mitigate these environmental and operational risks.		- government authorities. - Conduct monthly pest control inspections, use traps or baits, maintain sanitation, and track pest incidents to ensure effective prevention measures.						
C 1.4	Supply Chain Risks	IFC PS-2, ADB Safeguard Policy Appendix 1 Point D Subpoint 9 &10	- The supply chain for collecting and transporting used cooking oil involves several risks, particularly related to HSE, contamination, spills and leaks. These risks are described below:- - If the feedstock is contaminated with water, food waste, or other chemicals, it can reduce the quality and therefore production of SAF may be affected. - Feedstock is bulky, heavy, and difficult to transport, especially if it is stored improperly or in unsuitable containers. These factors can lead to delays, transportation accidents, or oil spillage. - Spills, leaks, or improper disposal of feedstock can lead to soil and water contamination, posing a significant environmental threat. This risk is heightened when transporting large volumes of oil over long distances. - Workers handling feedstock may face health and safety hazards, including exposure to contaminants, risk of burns, or physical injuries from improper handling.		The impact could be mitigated as: - Implement a Supply Chain Management System (SCMS) with 100% traceability and risk screening, including background checks and site inspections for all suppliers. - Enforce a Supplier Code of Conduct prohibiting child and forced labor, with regular audits for compliance. - Provide training on ethical labor practices and incident reporting to employees and suppliers every three months, ensuring full participation. - Conduct biannual internal audits and annual third-party audits to ensure compliance with national laws and IFC standards. - Implement a tracking system for used cooking oil to ensure full traceability, integrated within three months of operations. - Develop a Stakeholder Engagement Plan for communication and collaboration with suppliers, industry associations, and NGOs. - Offer recognition and incentives to suppliers demonstrating exemplary compliance, tracking compliance annually. - Regularly review supplier performance and address compliance gaps through corrective actions, promoting continuous improvement.	Low	BTE	Labour Department	- Development of Code of Conduct (COC) - Implementation of Supply Chain Management Plan	Monthly/ Annually Quarterly/ Bi-annually/	Entire supply chain

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
			- Disruptions such as natural disasters, transportation strikes, or fuel shortages can delay the collection or delivery of feedstock, affecting the overall supply chain performance.								
C 1.6	Storage of Final Product (SAF)	IFC PS-1 & PS-3 ADB Safeguard Policy Appendix 1-point subpoint 9 & 10	- SAF typically requires storage tanks, which may take up space on-site. - Storage of SAF requires adherence to safety regulations to prevent accidents such as spills or fires. - Proper storage practices are necessary to prevent any leakage or contamination of soil or water sources. - Storage tanks require regular inspection and maintenance to ensure they remain in good condition and prevent potential leaks or other issues. - Storage of SAF may be subject to specific regulations and permits, which must be obtained and maintained to ensure legal compliance.	High	The impact could be mitigated as: - Install 100% corrosion-resistant tanks and conduct integrity tests every six months. - Implement spill prevention measures with secondary containment and spill kits in all storage areas, conducting spill response training biannually. - Provide safety training for 100% of personnel on proper SAF handling and storage. . Conduct training biannually. - Develop a maintenance schedule for quarterly inspections of SAF storage equipment and address issues within one week. Document all maintenance activities. - Ensure all SAF storage tanks are sealed and secured after filling, achieving 100% compliance through a checklist. Inspect for proper sealing after each fill. - Establish an emergency response plan for oil spills, completing it within 3 months before operations and conducting two drills annually to test effectiveness.	Low	BTE	Punjab EPA	- Integrity Test records - Implementation of Spill Prevention and Control Plan - Training records - Implementation of ERP	Weekly/ Quarterly/ Bi-annually	Project Site (storage Areas)
C 1.7	Transportation of Final Product (SAF)	IFC PS-1, ADB Safeguard Policy Appendix 1 Point Subpoint 9&10	Final product transportation produces greenhouse gas emissions, including carbon dioxide, which contributes to climate change. Final product transportation will release pollutants such as nitrogen oxides,	Medium	The impact could be mitigated as: Develop and implement a Transportation Management Plan (TMP) in line with WBG EHS guidelines, focusing on safe route selection, driver training, vehicle maintenance, load security,	Low	BTE	Punjab EPA/Transport Department	- Performance and Compliance Review - Vehicle maintenance log - Training record - Implementation of TMP	Biweekly/ Quarterly/ Bi-annually/ Annually	Entire Transport Routes

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
			particulate matter, and volatile organic compounds (VOCs) that can contribute to air pollution. Accidental spills or leaks during transportation will contaminate soil and water, which will have negative impacts on ecosystems and human health. Spill management and response procedure has been prepared and attached as an Annexure 7A. The transportation of final product will also produce noise pollution, particularly if transportation occurs in residential areas. Detail of Vehicle Safety Instructions for SAF transportation is mentioned in section 5.26.1.		and environmental safeguards, with ongoing monitoring and continuous improvement to ensure safety and compliance. - Implement a GPS tracking system in all transport vehicles before operations, with annual performance reviews. - Conduct vehicle maintenance every three months and equip all vehicles with spill containment systems before operations. - Ensure that drivers and relevant personnel are trained in spill response procedures, with practical drills and quarterly refresher sessions to maintain readiness and improve spill management skills. Enforce a 30 km/h speed limit and reduce horn use near sensitive areas, monitoring compliance biweekly. - Verify that all the drivers are fully trained and properly licensed, with ongoing quarterly refresher sessions to ensure continued knowledge of safety protocols, vehicle operation, and spill response measures. Ensure BTE's business partner policies are visible and accessible, with annual compliance reviews						
C 1.8	Biofuel Transport: Community H&S Risks	IFC PS-1 & PS-3 ADB Safeguard Policy Appendix 1-point subpoint 9 & 10	The addition of 10 biofuel trucks to Sharaqpur Road could increase traffic risks, including accidents, spills, and air pollution, impacting health and safety. It may also disrupt daily life with longer commutes, noise, and delays for residents and emergency vehicles. Additionally, the extra traffic could accelerate road wear, leading to higher maintenance costs and	Medium	The company will develop a comprehensive Transportation Management Plan (TMP) to ensure compliance with WBG EHS guidelines, focusing on minimizing risks, protecting the environment, and ensuring the safety of workers and local communities. Key elements include route planning, driver training, vehicle inspections, load security, and	Low	BTE	Punjab EPA	- Performance and Compliance Review - Vehicle maintenance log - Training record - Implementation of TMP	Biweekly/ Quarterly/ Bi-annually/ Annually	At the Project Area

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
			further disruptions.		environmental safeguards, with ongoing monitoring and improvement. To mitigate community health and safety risks from increased biofuel transportation, the SAF project will implement measures such as off-peak truck scheduling, defensive driving training, vehicle maintenance to reduce emissions, and clear signage. Emergency response protocols for spills and regular community engagement will also be established to address concerns and improve safety awareness.						
C 1.9	Air Emissions	IFC PS-1 & PS-3, ADB Safeguard Policy Appendix 1 Point D Sub point 6 & 9	- There will be no process air emissions from the proposed project and there are only reactors that will be operated under vacuum. - The BTE plant meets its energy demands through electricity from the national grid and on-site utilities, including 02 HFO and 02 diesel-fired generators, 02 steam boilers, and 01 thermal oil heater, which emit pollutants such as NOx, SO2, PM, and CO that may degrade local air quality if not mitigated.	High	The impact could be mitigated as: - Maintain air quality levels using emission-compliant boilers, with monthly monitoring to ensure compliance with WHO/IFC standards. - Optimize generator emissions by adjusting the air-fuel ratio, tracking adjustments through logs, and monitoring monthly for WHO/IFC compliance. - Conduct regular maintenance on generators to keep emissions within limits, with monthly documentation of maintenance activities. - Include emissions from feedstock transport and boilers in GHG assessments, conducting annual calculations for accurate reporting. - Manage odors from feedstock storage by keeping containers covered and conducting bi-annual compliance audits. - Equip all workers with necessary PPE before work begins, with quarterly audits to ensure ongoing compliance.	Low	BTE	Punjab EPA	- Comply with PEQS, WHO/IFC - Implementation of Air Quality Management Plan - Annual Compliance Audit	Monthly/Quarterly	Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					- Monitor ambient air quality monthly, ensuring compliance with WHO/IFC and PEQS through collaboration with EPA certified labs. - Schedule monthly operations and maintenance checks on critical equipment to ensure optimal functioning and 100% compliance with protocols. - Development and Implementation of Air Quality Management Plan.						
C 1.10	Noise	IFC PS-1 & PS 3, ADB Safeguard Policy Appendix 1 Point D Subpoint 6 & 9	The proposed SAF project is expected to generate noise from various mechanical equipment such as product pumps, blowers, compressors, and road tankers. While this noise may have an unpleasant impact on workers and nearby communities, it is anticipated that the levels will be kept within permissible limits, be transient, reversible, and not significant.	Low	The impact could be mitigated as: - For the noise barrier, the vertical extension of 2 feet of boundary wall in Brick Masonry will be erected in order to mitigate the cumulative noise level at the southern side of receiver 01. - Implement a regular maintenance schedule for mechanical equipment to ensure optimal performance and reduce noise, with monthly monitoring to meet WHO/IFC standards. - Place generators in isolated zones and equip them with canopies to minimize noise, ensuring compliance with WHO/IFC standards through monthly monitoring. - Conduct monthly noise monitoring around the project site, ensuring levels meet WHO/IFC standards and documenting results in reports from a third-party EPA-certified lab. - Distribute appropriate PPE, like earplugs or noise-canceling headphones, to 100% of workers in high-noise areas, verified through quarterly safety audits. - Procure and install quiet equipment with noise reduction features, targeting a sound level of 75 dB(A) or lower, with additional measures if exceeded,	Negligible	BTE	Punjab EPA	Comply with PEQS, WHO/IFC	Monthly/Quarterly	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					completed before operations start. - Extend the existing boundary wall by 2 feet using brick masonry to reduce noise pollution, improving the environment for residents and meeting regulatory standards. Complete within three months using a qualified contractor. - Development and Implementation of Noise Management Plan.						
C 1.11	Ground Water Resource	IFC PS-1, PS -3 & PS -4/ ADB Safeguard Policy Appendix 1Point D subpoint 6 & 9	The SAF production process requires approximately 104.4 m3 of water per day. According to the hydrological analysis, the groundwater extraction for SAF production is minimal and does not significantly affect the groundwater table depth.	Low	The impact could be mitigated as: - Install engineered containment structures with proper lining in storage and waste processing areas to prevent groundwater contamination, ensuring 100% compliance with leak-testing annually. - Implement water-saving devices (like low-flow faucets and dual-flush toilets) in all washroom facilities to reduce consumption, aiming for measurable reductions in water usage. - Quarterly third-party analysis of Groundwater Quality from an EPA Certified Laboratory. - Install a wastewater treatment and recycling system to recycle 61% of treated wastewater for non-potable uses, targeting a 40% reduction in fresh water usage, monitored quarterly. - Complete the installation of all systems before the operational phase to protect local water resources and support sustainability goals. - Development and implementation of a Water Quality Management Plan (WQMP)	Low	BTE	Punjab EPA	- Compliance with PEQS and WHO Limits - Annual Leak Testing Record - Quarterly Monitoring Reports for GW recycling system - Implementation of Water Quality Management Plan (WQMP)	Monthly/Annually	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
C 1.12	Surface Water Resource	IFC PS-1, PS -3 & PS -4 ADB Safeguard Policy Appendix Point Subpoint 6 &9	The nearest surface water bodies to the SAF plant are the Mangtawala Feeder Canal, located approximately 2.40 km southwest of the BTE facility. The wastewater generated from the BTE facility is currently being discharged into a nearby seasonal drain known as the ghazi drain. This is a seasonal drain, with an average flow rate ranging between 8 to 16 cusecs, while the contribution of wastewater from the BTE facility is comparatively negligible, averaging around 0.02 cusec. The wastewater released from the SAF plant will be in compliance with PEQS limits, hence there would be no impact on the surface water.	Low	The impact could be mitigated as: - Design and install a wastewater treatment plant (WWTP) at the SAF facility to meet World Bank Group (WBG) environmental standards, ensuring 100% compliance confirmed through quarterly surface water quality sampling. - Divert treated water from the BTE facility to the SAF treatment plant to ensure it meets Pakistan Environmental Quality Standards (PEQS) and WB Guidelines, achieving 100% compliance. - Regularly measure and report wastewater volumes generated and treated at both BTE and SAF facilities, establishing tracking systems for quarterly compliance reporting. - Complete the design and installation of the WWTP and diversion pipelines before the operational phase to ensure sustainability and regulatory compliance. - Development and Implementation of a Water Quality Management Plan (WQMP)	Negligible	BTE	Punjab EPA/ Irrigation Department	- Quarterly Surface Water Testing - Implementation of a Water Quality Management Plan (WQMP) - Quarterly Monitoring Reports	Quarterly	At SWTP
C 1.13	Wastewater	IFC PS-1 & PS -3, ADB Safeguard Policy Appendix 1 Point D subpoint 6 &9	During the operational phase, wastewater will be generated primarily from flushing and the kitchen and from SAF Production, as an effluent (2.4 m3/hr wastewater). This wastewater if not treated will pose a threat to nearby surface water bodies. The wastewater of BTE will be connected with SAF facility which will be then disposed off to the nearby ghazi drain. The anticipated quantity of wastewater disposal to the drain from the SAF plant is estimated to be around 2.4	High	The impact could be mitigated as: - Design and install a WWTP at the SAF facility to meet PEQS and WB Guidelines standards, ensuring 100% compliance via quarterly sampling. - Implement a sour water treatment system with a Sour Water Stripper and WWTP for 100% compliance with WB Guidelines and local standards, verified quarterly. - Install a Reverse Osmosis (RO) system to reuse 61% of treated wastewater for production and non-potable uses, tracked quarterly. - Redirect RO-rejected water	Low	BTE	Punjab EPA	- Installation & operation of a wastewater treatment Plant. - Quarterly Monitoring Reports - Implementation of Waste Management Plan (WMP)	Quarterly	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
			m3/hr. The total wastewater generated from the SAF plant is 4 m3/hr, of which around 61% is recycled through the reverse osmosis system. The remaining wastewater i.e; 2.4 m3/hr will be the final disposal.		for on-site washing and ensure proper disposal meets PEQS and WB Guidelines standards, achieving full utilization for washing. - Divert treated water from BTE to the SAF treatment plant - Complete installations of the WWTP, sour water treatment system, and RO system before operations for sustainability and compliance. - Development and implementation of Waste Management Plan						
C 1.14	Solid Waste	IFC PS-1 &PS -3, ADB Safeguard Policy Appendix 1 Point D subpoint 9	During the operational phase following hazardous and non-hazardous waste will be generated - Oil and Lubricants contaminated clothes from workshop and spill cleanups - Chemical waste from laboratory - Plastics - Paper and Cardboard - General Domestic waste - Sludge from WWTP - Spent Catalyst from Process The above solid waste is not handled properly would contaminate soil, groundwater posing risks to the environment and also pose health and hygiene risks to workers.	Low	The impact could be mitigated as: - Develop a waste collection system for segregating, collecting, and disposing of various types of waste (through an EPA approved third party), achieving 95% segregation at the source, tracked with quarterly audits. - Assign a waste management team to implement and maintain the system, with staff trained in waste disposal processes. - Complete the waste collection system within 6 months, with a review every 3 months to assess and improve effectiveness. - Place waste containers strategically on-site, designated for specific waste types, and ensure clear labeling for proper disposal. - Facilities management team to oversee container placement, regular emptying, and maintenance. - Hazardous waste to be handled, stored and disposed off separately. An EPA approved vendor shall be hired for safe hazardous waste disposal and records of which to be maintained. - Conduct quarterly trainings of the waste management team on segregation, collection	Negligible	BTE	Punjab EPA	- Quarterly Audit Reports - Training Records - Waste lifting Records - Implementation of Waste Management Plan (WMP)	Monthly Quarterly/ Bi-annually	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					and disposal methods. • Install containers within 1 month, with usage reviewed every 6 months. • Implement a recycling process for spent catalysts from SAF production, targeting 100% recycling. • Development and Implementation of Waste Management Plan (WMP)						
C 1.15	Fire safety	IFC PS-1, PS-2, PS- 3 & PS -4, ADB Safeguard Policy Appendix 1 Point D Subpoint 10	In SAF Plant the fire and explosion can happen due to-: • Chemical Reaction: There are different chemical reactions involved in production of SAF. These chemical reactions potential to catch fire and explosion risk. • Flammable Liquids and Gases: Similarly, some of flammable materials like methanol and H2 gas is used in production of SAF. The accidental spills or leaks of flammable liquids or gases can have potential to catch fire and explosion especially in confined spaces. • Equipment's: Boilers and heaters used for process heat carry risks of overheating, fires, or explosions. Failure of mechanical systems can result in spills, leaks, or equipment malfunction. • Storage Tanks: Fire and explosion related to the rupture, leakage, or structural failure of SAF, methanol, and byproduct storage tanks. • Human Error and Incompetencies: Operator error during chemical handling, start-	High	The impact could be mitigated as: • Design and construct facilities to meet 100% NFPA standards for fire and process safety, verified by a compliance assessment before the operational phase. • Schedule quarterly inspections of fire and emergency systems, ensuring 100% compliance, with records of findings and corrective actions. • Implement fire safety training for all employees, ensuring complete participation and quarterly refresher drills for emergency preparedness. • Develop and finalize an emergency response plan for fire incidents three months before operations, with biannual drills to ensure readiness. • Schedule biannual maintenance of all fire safety equipment to guarantee functionality and compliance, with documented inspections and servicing.	Low	BTE	Civil Defense	• Quarterly Inspection Reports • Training Records • Biannual Maintenance Records • Implementation of Emergency Response Plan (ERP)	Quarterly/Bi-annually	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
			up, or shut-down procedures can lead to accidents. Similarly, the Lack of training on equipment use, emergency response, or chemical safety protocols increases the likelihood of accidents.								
C 1.16	Child labour	IFC PS-1, PS-2, ADB Safeguard Policy Appendix 1 Point D Subpoint 10	In the existing facility, no child labour has been reported. However, secondary data showed that child labour in the supply chain exists. The impacts of child labour are given below: - Child labor stems from poverty, limited education, and cultural norms, pushing children into exploitative work conditions. This deprives them of proper schooling and exposes them to physical hazards and emotional stress. Malnutrition, stunted growth, and mental health issues are common consequences, perpetuating a cycle of disadvantage. - Labor not only undermines immediate health but also hampers long-term development, hindering social skills and future opportunities. Combating child labor necessitates prioritizing education, healthcare, and safe environments to secure a brighter future for these vulnerable children.	High	The impact could be mitigated as: - As part of the Supply Chain Management System (SCMS), BTE will implement comprehensive measures to address child forced labor, including 100% traceability and risk screening across the supply chain through a Responsible Collection Policy (RCP) that identifies high-risk areas and ensures ethical sourcing practices. - A Supplier Code of Conduct will strictly prohibit the presence of child or forced labor at supplier premises and mandate that businesses maintain adequate life and fire safety (L&FS) controls in line with IFC PS1 and PS2. - Regular audits and monitoring using Key Performance Indicators (KPIs) will ensure adherence to IFC PS 2 standards, with findings informing a robust Remediation Plan to address and prevent non-compliance. - Additionally, training and awareness programs will educate suppliers on the risks and legal implications of child forced labor while promoting ethical practices.	Low	BTE	Provincial Government: Department of Labor and Human Resource (DLHR)	- Implementation of SOP in company and supply chain - Quarterly Compliance Reports - Awareness Training Records - Audit Reports	Quarterly/ Bi-annually	At Project Area
C 1.17	Health and Hygiene of the Workers	Punjab OHS act 2019, PEPA 1997 (Amended 2012), IFC PS-2 & PS-3/ ADB Safeguard Policy	- Workers engaged in the collection and handling of feedstock, like used cooking oil, face several health and hygiene risks throughout the supply chain. - Firstly, exposure to	Low	The impact could be mitigated as: BTE will implement training program for all employees and contracted workers engage in supply chain, focusing on safety protocols, proper PPE usage, and hazard awareness.	Negligible	BTE	Provincial Government: Department of Labor and Human Resource (DLHR)	- Training Records - Inspection Records - Medical Checkup Records - Quarterly Audit Reports	Monthly / Quarterly	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
		Appendix 1 Point D; subpoint 10	hazardous substances in the material, such as chemicals, contaminants, or pathogens, poses significant health risks, including respiratory issues and skin irritation. - Additionally, physical hazards inherent in the collection and handling process, such as heavy lifting and working in confined spaces, increase the likelihood of musculoskeletal injuries and accidents if proper safety measures are not implemented. - Moreover, inadequate sanitation facilities and limited access to clean water and hand washing facilities compromise workers' hygiene, heightening the risk of infectious diseases, particularly in environments where direct contact with feedstock occurs. - Furthermore, the absence or lax enforcement of workplace safety standards exacerbates health and hygiene risks for workers. Insufficient training on proper handling techniques, inadequate personal protective equipment (PPE), and poor ventilation in processing or storage areas further contribute to these risks.		- To enhance sanitation and hygiene awareness among workers in the supply chain, a comprehensive program will be implemented, focusing on training and communication. Workers will receive regular training sessions on handwashing techniques, and maintaining clean work environments, supported by multilingual materials such as posters and flyers. This initiative aims to reduce hygiene-related illnesses, promote a healthier workforce, and align practices with occupational health and safety standards. - Perform monthly safety inspections and address identified hazards within one week. Track and aim for 100% completion of inspections and corrective actions. Implement monthly inspections and audits consistently. - Conduct quarterly compliance audits to ensure 100% adherence to workplace safety regulations, addressing non-compliance within two weeks. Monitor and track compliance on an ongoing basis with quarterly reviews.				Implementation of Grievance Mechanism		
C 1.18	Occupational Health and Safety	Punjab OHS act 2019, PEPA 1997 (Amended 2012), IFC PS-2 & PS-3/ ADB	Following health and safety impacts arise during the operational phase of the proposed project: - Fire - Fuel Spillage	Low	Form an HSE team to conduct monthly safety audits and maintain emergency equipment. Recruit and train qualified personnel to ensure workplace safety and	Negligible	BTE	Provincial Government: Department of Labor and Human Resource (DLHR	- Monthly Audit Reports - Inspection Records - Emergency Contact List	Monthly/ Quarterly/ Bi-Annually	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
		Safeguard Policy Appendix 1 Point D; subpoint 10	- Gas Leaks - Explosions Injury from Machinery and Equipment - Fall, Climbing Accident - Riots, Strikes - Emergency As a Result of Environmental Conditions (E.G., Heat, Cold, Wet, Snow, Wind, Lightning, Bushfires, Floods) Emergencies Requiring Evacuation - Hazardous Substances and Chemical Spills - Internal Emergencies Such as Loss of Power or Water Supply and Structural Collapse Serious Injury Events or Medical Emergencies - Bomb Threats Health and safety issues will arise if gases or noise exceed the permissible limits of PEQS, and improper practice of work during the storage, handling and transportation activities. Handling of equipment or machinery, working at height or confined spaces etc etc. Potential health and safety impacts during the project's operational phase will include fire, fuel spillage, gas leaks, explosions, machinery injuries, falls, environmental and internal emergencies, serious injuries, and bomb threats. Mitigation measures, training, and emergency response plans are essential to ensure a safe working environment.		- compliance. - Install first aid boxes at key locations throughout the plant, ensuring they are stocked and maintained. Conduct monthly inspections for supplies. - Record HSE Statistics and report on monthly basis such as incidents, accidents, lost time injuries, safe man hours, TRIR etc etc - Provide first aid training to all supervisors and relevant staff, aiming for 100% completion for supervisors and 80% for other staff, with quarterly training sessions. - Train at least 90% of employees involved in plant operation and maintenance, with ongoing quarterly sessions using qualified trainers and adequate resources. - Compile and regularly update contact information for local hospitals and emergency services, ensuring accessibility for all staff. - Create a comprehensive emergency response plan and conduct at least two drills per year to test its effectiveness, finalizing the plan before operations start. - Implement access control measures to restrict entry to authorized personnel only, with monthly audits to ensure compliance. Ensure the Code of Ethics is accessible in at least three locations in the facility and on the company website, with ongoing training for staff on its importance - Develop and implement Worker's Grievance Mechanism and train employees on quarterly basis. - Develop and implement OHS Management Plan.				- Training Records - Implementation of Emergency Response Plan, Worker's Grievance Mechanism and OHS Management Plan		
C	Chemical	IFC PS-2 &	Exposure to chemicals such	High	The impact could be mitigated as:	Low	BTE	Punjab EPA	Implementation	Monthly/Quarterly	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
1.19	Hazard	PS-3/ ADB Safeguard Policy Appendix 1 Point D; subpoint 10	as H2 and other chemicals used in process and laboratory etc., may occur during the handling and storage of chemicals. Avoid unnecessary chemical exposure to the workers who are working in the process area or related to the process. A long term and direct chemical exposure may impact the health of the workers and the risk of spillage may increase. Additionally, procedures for identifying, assessing, and mitigating human rights risks, including emergency response protocols (as Annexed 8A), have been developed and will be enacted to minimize chemical hazards.		- Distribute PPE including helmets, gloves, safety boots, and masks to all workers, with daily checks and records to monitor availability and compliance throughout operations. - Establish regulations for PPE usage, aiming for 100% compliance through monthly audits and designated safety authorities trained on proper PPE usage and enforcement. - Utilize corrosion-resistant and leak-proof containers for all chemicals, documenting specifications and assigning the facilities management team to oversee proper storage practices. Implement immediately upon operation with quarterly inspections. - Develop and implement SOPs for chemical handling, and transportation - Enforce fire safety procedures, ensuring 100% compliance through quarterly audits and training for all employees within the first two months of operation, managed by a designated safety officer. - Install effective ventilation systems in chemical storage areas, monitoring air quality and ventilation effectiveness before commencing chemical processing. - Disposal of chemical waste to be conducted through an EPA approved vendor. Separate specialized containers to be used for chemical waste storage and trained personnel to handle the waste only. Disposal records to be maintained. - Develop and implement clear protocols for chemical storage, aiming for 100% compliance through quarterly audits, with a safety officer responsible for training and			of SOPs - Monthly Audit Reports - Training Records - Disposal Records - Air Quality Monitoring for Storage Areas - Implement Hazardous Materials Management Plan			

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					- regular reviews of the protocols - Develop and implement Hazardous Materials Management Plan						
C 1. 20	Gender-based violence (GBV) risks	IFC PS-2 & PS-4, ADB Safeguard Policy Appendix 1 Point D subpoint 9 & 10	The risk of Gender-Based Violence (GBV) within the direct and contracted workforce, particularly where female workers are present, can lead to significant challenges such as increased vulnerability to harassment and discrimination, negatively impacting their well-being, productivity, and job satisfaction. This can also harm the organization's reputation, lead to legal and compliance risks, and hinder efforts towards gender equality and empowerment. Unaddressed GBV may cause operational disruptions, with potential consequences such as absenteeism, high turnover, and delays in production output.	Medium	- Establish Gender-Sensitive Workplace Policies: BTE will develop and enforce comprehensive gender-sensitive policies to prevent Gender-Based Violence (GBV), discrimination, and harassment, specifically within its direct workforce and contracted employees. These policies will be formulated at the planning stage and reviewed annually to ensure they remain effective and compliant with best practices. BTE will focus on ensuring that all employees directly engaged by the company, as well as workers contracted for specific tasks, are fully covered by these policies. - Conduct GBV Awareness and Response Training: BTE will conduct mandatory training on GBV awareness and response for its direct workforce and contracted employees. The training will ensure that employees understand how to identify, prevent, and respond to instances of GBV in the workplace. The first session will be conducted within four months of operations, with subsequent training sessions held every six	Low	BTE	IFC/ADB	- Adherence to the GBV Policy and integration - Maintaining training log	Quarterly/Bi-annually and annually	At Project Area

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
					months. The effectiveness of the training will be evaluated using pre- and post-training assessments to measure knowledge improvement and retention. Engage with Community Stakeholders: While the focus of GBV measures will be on the direct and contracted workforce, BTE will also engage with local community stakeholders, particularly women's groups, to gather insights and incorporate their perspectives into the project's broader decision-making process. These engagements will ensure that the community's views on GBV and gender equality are considered, and they will be conducted initially before operations commence and quarterly thereafter.						
C.2. Ecological Environment											
C 2.1	Impacts related to the risk of breeding of pests/rodents	IFC PS-1 & PS-6, ADB Safeguard Policy Appendix Point D Subpoint 8	The storage of used cooking oil feedstock at a biofuel facility in rural Punjab, Pakistan, presents risks of pest and wildlife infestation. These risks include contamination and spoilage of stored oil, leading to compromised quality and safety for biofuel production. Infestation by pests and rodents can result in feedstock losses and reduced production efficiency. Furthermore, the presence of pests and wildlife poses health and safety risks, environmental concerns, infrastructure damage, and regulatory compliance issues for the	Low	The impact could be mitigated as: - Inspect storage areas monthly to detect and address any pest issues, with reports generated after each inspection. - Implement sanitation practices with weekly audits to ensure full compliance and prompt waste disposal within 24 hours to minimize pest attractants. - Apply trapping or chemical/biological control methods within 48 hours of pest detection, using trained professionals to ensure safety and regulatory compliance. - Develop and implement Pest Control Management Plan	Negligible	BTE	Punjab EPA	- Nos of pest encounter incidents - Implementation of Pest Control Management Plan - Weekly Audits of Sanitation Practices	Weekly/Monthly/Quarterly	At Project Site

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
			facility.								
C 2.2	Impact on Flora& Fauna	PEPA 1997 (Amended 2012), IFC PS-6	There are negligible impacts on flora and fauna during the operation phase of the project. However, mitigation has been provided to enhance the biodiversity of the area.	Negligible	The impact could be mitigated as: - Initiate a planting project to enhance green cover by planting at least 500 native trees and plants within the first year after project completion, collaborating with local EPA and nurseries for sourcing. - Develop and Implement the Plantation and Maintenance Plan - Implement a maintenance plan for existing and new plantations, ensuring 100% of plants receive monthly maintenance checks with documented health assessments and interventions, assigned to a dedicated team trained in best care practices. - Organize an annual community event to engage participants in activities promoting environmental sustainability, such as tree planting, encouraging community involvement and raising awareness about environmental conservation. - Identify and plant at least 300 native tree species that support local biodiversity within the first year of the planting project, with a team of environmental specialists overseeing the selection and planting process. - Establish a monitoring system to evaluate plantation growth and health, using simple tools to track growth rates and prepare biannual health reports to inform future planting efforts.	Positive	BTE	Punjab EPA	Implementation of Plantation and Maintenance Plan Biannual Health Reports of Plants	Quarterly/Bi-Annually	At Project Area
C-3 Socio-Economic Environment											
C 3.1	Impact on Socio Economy	IFC PS-4, ADB Safeguard Policy Appendix 1	In the proposed project area, minimal changes are anticipated in the traditional lifestyle	Low	The impact could be mitigated as: Encourage SAF to prioritize local community members in employment, providing job training to build local skills,	High Positive	BTE	Social Welfare Department	- Employment Records - Training Records - Implementation of Transport	Monthly/Quarterly	At Project Area

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
		point D subpoint 1 & 2	and occupations of local communities, with benefits expected from job opportunities provided by the project. By prioritizing local recruitment, offering specialized training, and ensuring transparency in hiring can minimize, though not entirely eliminate, the influx of external workers. . Additionally, the project aims to improve community lifestyle by converting unhygienic waste into sustainable products. While minor social and health-related issues may arise during operations, adopting best management practices can mitigate these impacts significantly. - Outside workers may pose risks to the local community if outsiders are given priority over the local people in employment, inappropriate behavior of the outsider staff towards the culture and traditions of the locals and especially women. Introduction of security personnel can also raise concerns of the community. Transportation related impacts are also foreseen.		with progress tracked quarterly. - Verify that all new hires have a valid CNIC and police clearance before employment, with records reviewed monthly. - Provide cultural sensitivity training quarterly to foster local understanding and respect among all staff, enhancing community relations. - Provide training to the outsider labor/staff and security personnel involved in the operations to maintain healthy relations with the community and avoid unnecessary contacts, respect privacy and cultural norms. - Transportation Management Plan to be developed and implemented to avoid HSE and community incidents. - Develop and implement Community Grievance Mechanism and provide necessary information to the communities on regular basis.				Management Plan Implementation of Community Grievance Mechanism		
C 3.2	Community H&S risks associated with the use of security personnel	IFC PS-4, ADB Safeguard Policy Appendix 1 Point subpoint1 & 2	The security impacts of the project may include theft, vandalism, and unauthorized access, particularly with valuable materials on site. Armed security guards could lead to	Medium	The impact could be mitigated as: A comprehensive security management plan outlining protocols, responsibilities, and actions to mitigate risks and foster positive interactions with the community will be developed	low	BTE	Punjab EPA	- Implementation of Grievance Mechanism - Biannual Community Engagement Programs - Conflict	Monthly/ Quarterly/ Bi-annually	At Project Area

Sr. No.	Anticipated Impacts	Legislative / IFC PS/ ADB Relevance	Description of Impact	Significance before Mitigation	Detail of actions needed	Significance after Mitigation	Responsibility		Key Performance Indicators	Monitoring Frequency	Location
							Execution	Monitoring			
			conflicts with the local community over restricted access. There may also be risks to the environment and delays in emergency responses if security is not properly managed. To reduce these risks, clear security measures and good communication with the community will be preferred to prevent problems and ensure everything runs smoothly.		and implemented. • Conduct quarterly cultural sensitivity training for all security staff to enhance positive interactions with local residents. • Establish communication channels between security personnel and residents. • Hold biannual community engagement programs to strengthen ties, aiming for at resident and all on-duty security personnel. • Set up conflict resolution mechanisms to address community-security issues. • Evaluate security measures every 6 months, reviewing response times, compliance, and community feedback for ongoing improvements. • Ensure transparency in security operations, publishing annual reports on hiring, training, and incident responses. • Develop and maintain a grievance mechanism from the planning phase, providing a structured way for community and worker concerns to be addressed and reviewed regularly.			Resolution Mechanism • Annual Reports on Hiring, Trainings and Incident Responses • Community feedback on Security Measures			

Table 8-6: Environmental & Social Monitoring Plan

Point	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in the project budget)	Who (Is responsible for monitoring?)
Environmental Parameters							
Soil contamination due to Accidental spills of hazardous materials, such as fuel, chemicals, or sewage, can contaminate soil if not properly cleaned up and managed.	Fuel spill	Construction vehicle parking area, UOC collection & transfer area	Visually Through checklists Field observations and visual inspections of soil properties, such as color, texture, odor, and vegetation health, can provide preliminary indications of soil contamination and guide further investigation and sampling efforts	Quarterly	To avoid soil contamination	Included in project cost	BTE and Contractor

Point	What (Is the parameter to be monitored?)	Where (Is the parameter to be monitored?)	How (Is the parameter to be monitored?)	When (Define the frequency / or continuous?)	Why (Is the parameter being monitored?)	Cost (if not included in the project budget)	Who (Is responsible for monitoring?)
Excavation at the sub-project site.	shallow excavation	Worksite and borrow area	Visually Through checklists	Quarterly	To prevent labor from fall hazards	Included in project cost	BTE and Contractor
Impacts on flora/clearing of trees due to project interventions.	Tree cutting and vegetation clearing	Near the construction boundaries	Visually Through checklists, avoid tree cutting and vegetation clearing at all costs.	During the execution of the project	To avoid tree cutting and compensation for tree cut	Included in ESMMP Cost	BTE and Contractor
Solid waste management during construction.	Solid Waste Management. Collection, Segregation, Handling, Transportation.	Active construction site	Provision of Colored Dustbins, Municipality Agreement, Recycling	Monthly	To avoid solid waste accumulation	Included in ESMMP Cost	Contractor
Air quality deterioration due to dust and exhaust emissions. (Construction Equipment)	Air Quality	Active construction site	Air Quality Monitoring Necessary PPE to be provided	Monthly	To maintain ambient air quality as per PEQS	Included in ESMMP Cost	Contractor through third-party monitoring company
Water Quality Monitoring	Drinking and surface water	Water bodies near construction site	Through Third-party Lab	Monthly	Monitor Water Quality as per PEQS	Included in ESMMP Cost	Contractor through third-party monitoring company
Noise emissions from running of construction machinery and works.	Noise levels	Worksite	Noise Emission Monitoring	Monthly	To maintain ambient noise levels of 65dB during the day and 55 dB at night Noise activities are to be carried out between 7 am to 5 pm	Included in ESMMP Cost	Contractor through third-party monitoring company
Social Parameters							
Community Health and Safety.	Health and Safety of the community	Community-dwelling areas	Close consultations with the communities	Weekly	To ensure community integrity and social links	Included in ESMMP Cost	BTE and Contractor
Occupational Health and Safety.	Health and safety of labor	Worksite	TBT, PPE, Fire Safety, Safety Signage, Clean drinking water	Frequently	To ensure that no HSE-related hazards take place at the worksite	Included in ESMMP Cost	Contractor
Project resources and materials protection from theft.	Protection from theft	Worksite	Robust inventory management, security	Daily	Safety of labor and equipment	Included in ESMMP Cost	Contractor
Grievances of the local communities	Complain, suggestion, recommendation	Construction sites and transportation route	GRC log book	As or when required	Nos of complains	Included in ESMMP Cost	Contractor

8.13 Environmental and Social Management Plan Cost

767. The cost that is required to effectively implement the mitigation measures is important for the sustainability of the proposed project in the construction and operation stage. Cost related to the mitigation measures of environmental parameters associated with the location of the construction site and activities, borrowing materials, etc. will be the sole responsibility of the Contractor and he will take care of cost implications. Tentative ESMMP annual based costs for the construction and operational phases are given below. The contractor ESMMP will be adjusted within this cost.

Table 8-7: ESMMP Cost for Construction Phase

Sr. No.	Description	Cost Estimated (PKR)
1	ESSU Staff Cost	14,400,000
2	HSE & Environmental Staff Contractor	6,000,000
2	Plantation Campaign Cost	1,000,000
3	HSE Equipment/PPE cost Contractor	1,500,000
	Safety Signs and Boards Contractor	1,000,000
4	External Training to the staff contractor	1,000,000
5	Third-Party Environmental Monitoring	2,000,000
8	GRM Implementation cost	1,000,000
9	Labor Management cost (Septic Tank, Water Supply, Sanitation, Washrooms etc) Contractor	8,000,000
Total Cost		3,590,000
Contingences 10% of total Cost		3,590,000
Grand Total		39,490,000 (39.49 million)

Table 8-8: ESMMP Cost for Operational Phase

Sr. No.	Description	Cost Estimated (PKR)
1	ESSU Staff Cost	14,400,000
2	HSE Equipment/PPE cost	1,000,000
3	Training National International to staff to ESSU	2,000,000
4	Third-Party Environmental Monitoring	2,000,000
5	Air Scrubbers Operational Phase Construction	8,000,000
6	WWTP Operational Phase Construction	40,000,000
7	Air Scrubber and WWTP Operation Maintenance Cost	2,000,000

Sr. No.	Description	Cost Estimated (PKR)
8	Environmental Audit Cost	5,000,000
9	CSR Cost	2,000,000
10	Noise Mitigation Cost	6,230,000
Total Cost		82,630,000
Contingences 10% of total Cost		8,263,000
Grand Total		90,893,000 (90.893 million)

Note: The staffing cost in both construction and operational phase will have 10% increment each year.

CHAPTER - 9: STAKEHOLDERS AND PUBLIC CONSULTATION

9.1 Introduction

768. Under the IFC and ADB financed projects, a Stakeholder Engagement Plan (SEP), and project level Grievance Redress Mechanism (GRM) need to be developed in accordance with Environmental and Social Standard 10 (ESS10) “Stakeholder Engagement and Information Disclosure” of the World Bank’s Environmental and Social Framework (ESF) and any corresponding national legislation. ESS10 requires Biotech Energy (BTE) Pvt. Ltd. to engage with stakeholders throughout the project lifecycle, commencing such engagement as early as possible in the project development process and in a timeframe that enables meaningful consultations with stakeholders on project planning, development and implementation. The nature, scope and frequency of stakeholder engagement have to be proportionate to the nature and scale of the project and its potential risks and impacts.

769. This Stakeholder Engagement Procedure (SEP) has been prepared for the Project to provide information on the process of stakeholder and analysis and engagement, Categorization, Methodology of Engagement and future consultation matrix.

9.2 Stakeholder Analysis and Engagement

770. The Project is committed to proactively engage with main stakeholders before and during construction and operations. Stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for successful management of the project. It is an ongoing process that involves varying degrees of the following:

- Stakeholder analysis (influence and interest) and planning;
- Disclosure and dissemination of information;
- Consultation and participation;
- Grievance management; and
- On going reporting to and engagement with affected stakeholders.

771. The nature, frequency, and level of effort of stakeholder engagement for the Project are scaled and commensurate with the limited social and environmental risks and impacts of the Project (Figure 9-1). The Project is committed to disclosing appropriate information about the Project to enable relevant take holders to understand the risks, impacts, and opportunities of the Project by providing above mentioned information.

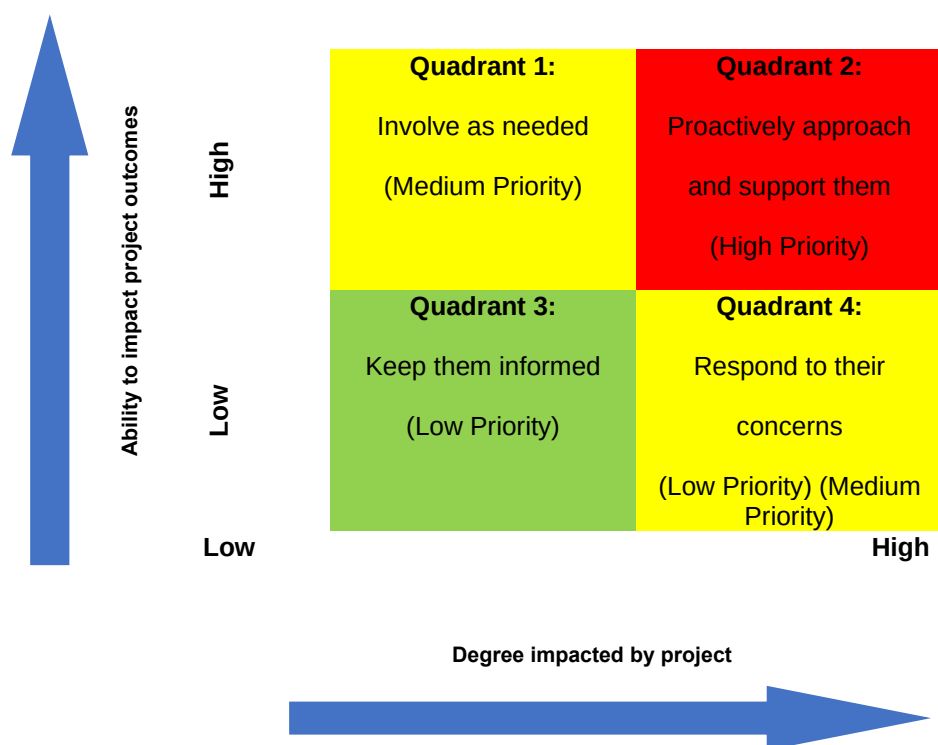


Figure 9-1: Stakeholders Categorization

Table 9-1: Stakeholders Group Categorization

Stakeholder Groups	Stakeholders
Internal Stakeholders	• Lenders: IFC & ADB • Employees of BioTech • Security Personnel • Suppliers and Transport Vendors • Collectors and Sub-collectors • Contractors and Sub-contractors • O and M Operations SAF Plant
Raw Material Management Stakeholders	• UCO/Feedstock Collectors • Brokers • Port Qasim Authority (PQA Karachi Port Trust (KPT)
Final Product Management Stakeholders	• Buyers • Transporters • Waste Management Companies • Third-Party Monitoring Labs
Utility Departments	• Lahore Electric Supply Company (LESCO) • Tehsil Municipal Administration (TMA)
Regulatory Institutions	• Environment Protection Department (EPD) Lahore • Punjab Food Authority, Sheikhpura

Stakeholder Groups	Stakeholders
	Punjab Irrigation Department
Government Institutions	- Resue 1122 Sheikhpura - District Heath Authority, Office CEO, Health Sheikhpura - Assistant Commissioner (AC), Local Government of Sheikhpura District - Sheikhpura Chamber of Commerce & Industry - National Highway Authority (NHA) - DSP, Police Station, Sharaqpur Sheikhpura - Traffic Department Sheikhpura
Institutional Stakeholders	- Nagina Kids Campus Sheikhpura (Neighbor) (Non-Functional) - MFTC Research Farm, Sheikhpura (in AOC) - Muhammadan Educational Complex, Sheikhpura (Nearby Educational Institute)
Community	- Local Community (Residents, Farm Houses, Farmers, and Businesses) - Local Laborers
Nearby Industries	- Ittefaq Group (Neighbor) - Prosperity Weaving Mills (Neighbor) - Etihad solvent plant pvt Ltd, Sheikhpura (nearby industry) - Polity Form - Kaboota machinery engineering company
Non-Government Organizations (NGOs) and other Groups	- Aghosh Al-Khidmat Sheikhpura (Neighbor) - Nearby Local Shops, Sheikhpura

9.3 Methodology

772. This section presents the program for engaging stakeholders by describing the activities that will be undertaken throughout the project cycle and will be an on-going process. The stakeholder engagement program serves the purpose of disclosing appropriate information about the project progress and the implementation of EIA, ESMP, and GAP. The project would adopt the following methodologies / approaches to engage the stakeholders and disclose the information to achieve the objectives of the stakeholder's engagement plan. The details are provided Stakeholder Engagement Plan (SEP) attached as Annexure-11.

9.3.1 Formal Meetings

773. Formal meetings are more targeted ways to engage with stakeholders. They permit more in-depth discussions about project plans and allow the opportunity to go into more detail about technical aspects of the project or address specific concerns raised by one or a group of stakeholders. These meetings or workshops are likely to involve interest-based stakeholders who have most influence over the project such as government regulatory bodies and NGOs.

9.3.2 Correspondences (Phone / Emails / Letters)

774. This process is adopted to distribute information to Government

officials, NGOs, Local Government, and organizations / agencies, and to invite stakeholders to meetings and follow-up.

9.3.3 One-on-One Meetings

775. This process is to seek views and opinions, enables stakeholders to speak freely about sensitive issues, build personal relationships and for record meetings.

9.3.4 Public Meetings and Interviews

776. Public meetings are conducted with the community people and impact-based stakeholders. These meetings will be conducted at different villages/settlements falling in the AOC. Most of these meetings are based on questioning and answering. The concerns of the people are noted and addressed in through corrective course of action and respective plans.

9.3.5 Focus Group Discussions (FGDs)

777. In-depth engagement with community groups will require fewer formal methods of engagement to disclose information, project plans and timescales that would need to be explained in non-technical local language. Communication should also be verbal to overcome any issues with illiteracy. This type of engagement is best delivered in locations which are familiar to local communities. Familiar surroundings are more conducive for productive and interactive consultation for the following reasons;

- It lends transparency to the process: community members can witness the process and stay informed about what is being discussed on their behalf, and what has been agreed at the closure of consultation or negotiations.
- It contributes to community members' empowerment and feeling of ownership over the engagement process: community members say that the opportunity to have input into the public meetings give them a sense of having a role in the outcome of decisions.
- Finally, it allows community members to identify their own representatives, preventing illegitimate representation from claiming that they speak for communities.

778. The requirement for engagement through focus groups will be determined throughout the project implementation process.

9.3.6 Consultation with women or another vulnerable group

779. Consultations targeting women and other vulnerable groups are designed to ensure specific needs and concerns. Focus group discussions (FGDs) and separate consultation sessions conducted in culturally sensitive and familiar settings to encourage active participation.

9.3.7 Field Visits

780. Stakeholders are also engaged with the help of frequent field visits. For this project, the concerned members of BTE, will visit the site and interact with the people, both formally and informally. This also develops a sense of

security among the community people and helps in rapport building. These visits are a regular feature of the project and will continue throughout the project cycle.

9.3.8 Project Website

781. IFC, ADB and BTE websites presents the project information and progress updates; disclose ESIA, ESAP and other relevant project related documents.

9.3.9 Virtual Meetings

782. Stakeholders are also engaged through virtual meetings.
783. The SEP will also highlight methods to involve citizens' voices and feedback and will suggest differentiated measures of engagement across the project area.

9.4 Summary of the engagement

784. The stakeholder engagement process employed diverse methods to ensure inclusivity, including formal meetings with regulatory bodies, public consultations, focus group discussions, one-on-one meetings, and field visits.
785. The primary data collection methods included surveys, focus group discussions, and interviews. A survey was conducted with 69 participants from the general population of the Area of Interest (AOI). Focus group discussions included one session with 8 Biotech Energy workers and laborers, as well as two sessions with women—one with 14 participants and the other with 20 participants. In-depth interviews were conducted with 6 senior officials and 4 junior managers at the Biotech Energy Unit, totalling 18 participants, and with 8 farmers. Additionally, 8 interviews were conducted with local community members and project employees. These methods provided a comprehensive understanding of the perspectives and concerns of various stakeholder groups, ensuring a diverse range of insights from both primary and secondary stakeholders.

9.5 Proposed Structure and Engagement MATRIX for future stakeholder consultation

786. The proposed institutional structure for future stakeholder consultations and long-term stakeholder engagement is outlined as follows:
- Consultations as part of the ESIA process will be conducted by trained ASIAN staff with attendance of the BTE's representative.
 - After the ESIA Process is completed, the following will assist BTE with continuous engagement and implementation of the SEP throughout the various phases of the Project:
 - Community liaison officers / Admin officer will oversee continued consultations and grievance mechanism implementation and redress;

- CLO which will include people from each community, with a certain level of education, that can be approached by the community liaison officers / Admin officer to help in engagement and disseminate information and can be approached by the community members to assist in providing feedback and communicating their grievances to the Project.
- A Stakeholder Engagement Matrix is provided in this section which details engagement activities to be carried out, frequency of engagement, responsibilities, and data to be collected or shared. Table 9.2 provides the detailed stakeholder engagement matrix

Table 9-2: Stakeholder Engagement Matrix for Future Consultations

Stakeholder Groups	Stakeholders	Stakeholder Category	Frequency	Applicable Phase
Internal Stakeholders	- Investors/Lenders: IFC & ADB - Employees of BioTech - Security Personnel - Suppliers and Transport Vendors - Sub-collectors - Contractors and Sub-contractors - O and M Operations - Any third party hired by contractors	High Priority	Periodic/ As and When needed	Construction and operation
Raw Material Management Stakeholders	- UCO/Feedstock Collectors - Brokers - Port Qasim Authority (PQA)/ Kamari Port Authority (KPA)	High Priority	Monthly/ As and When needed	Construction and operation
Final Product Management Stakeholders	- Buyers - Transporters - Waste Management Companies - Third-Party Monitoring Labs	High Priority	Monthly/ As and When needed	Construction and operation
Utility Departments	- Lahore Electric Supply Company (LESCO) - Tehsil Municipal Administration (TMA)	High Priority	Monthly/ As and When needed	Construction and operation
Regulatory Institutions	- Environment Protection Department (EPD) Lahore - Punjab Food Authority, Sheikhpura - Punjab Irrigation Department - Civil Defence	High Priority	Monthly/ As and When needed	Construction and operation

Stakeholder Groups	Stakeholders	Stakeholder Category	Frequency	Applicable Phase
Government Institutions	- Resue 1122 Sheikhpura - District Heath Authority, Office CEO, Health Sheikhpura - Assistant Commissioner (AC), Local Government of Sheikhpura District - Sheikhpura Chamber of Commerce & Industry - National Highway Authority (NHA) - DSP, Police Station, Sharaqpur Sheikhpura - Traffic Department Sheikhpura	Medium Priority	Monthly/ As and When needed	Construction and operation
Institutional Stakeholders	- Nagina Kids Campus Sheikhpura (Neighbor) (Non-Functional) - MFTC Research Farm, Sheikhpura (in AOC) - Muhammadan Educational Complex, Sheikhpura (Nearby Educational Institute)	Medium Priority	Quarterly/As and When needed	Construction and operation
Community	- Local Community (Residents, Farm Houses, Farmers, and Businesses) - Local Laborers	High Priority	Quarterly/As and When needed	Construction and operation
Nearby Industries/company	- Ittefaq Group (Neighbor) - Prosperity Weaving Mills (Neighbor) - Etihad solvent plant pvt Ltd, Sheikhpura (nearby industry) - Kaboota machinery engineering Company - Polity Form (back Side)	High Priority	Quarterly/As and When needed	Construction and operation
Non-Government Organizations (NGOs) and other Groups	- Aghosh Al-Khidmat Sheikhpura (Neighbor) - Nearby Local Shops, Sheikhpura	Medium Priority	Quarterly/As and When needed	Construction and operation

9.6 Ongoing Community Feedback

787. The Project will commit to ongoing community feedback during both the phases i.e., construction and operational phase.

9.7 Grievance Mechanism

788. The Project maintains a straight-forward Grievance Mechanism that will be communicated to adjacent villages as soon as the Project enters the construction phase which is attached as (Appendix 14).

CHAPTER - 10: CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

789. The project will be located in a brownfield area owned by the project proponent, which has already reduced significant environmental impacts. The ESIA finds that the project is expected to yield significant environmental advantages, particularly in terms of improving waste oil management and converting it into renewable resources. Additionally, substantial reductions in greenhouse gas emissions are anticipated as a result of the project. Furthermore, the initiative is projected to bring about health benefits and address the issue of waste oil disposal, which if left unmanaged could negatively impact both aquatic and human life through its eventual entry into sewerage systems. The environmental impacts related to the construction of the project will be concentrated within the core zone (500 m) of the proposed project site. These impacts are short-term, site-specific, reversible and manageable. The operational impacts are relative long term however The Environmental and Social Management Monitoring Plan (ESMMP) has been provided to mitigate both construction and operational phase impacts and bring these impacts to an acceptable level. The implementation of the ESMMP will be closely monitored and reported on by the relevant stakeholders in the project.

790. Meaningful consultations have been conducted during the pre-construction phase and all concerns of the affected persons and stakeholders have been incorporated in the ESIA. These consultations were represented by key stakeholders. An integrated social and environmental Grievance Redress Mechanism has been formed to continue receiving feedback and complaints, if any, from affected parties and addressing them during the construction stage and operation stage. A non-technical summary in English and Urdu will be distributed to the stakeholders. Additionally, the ESIA report and other project-related documents will be accessible on ADB, BTE, and IFC websites.

10.2 Recommendations

791. Based on findings of ESIA study, following is recommended:

- I. A hazard and operability study are a methodical and organized analysis of a complicated system, typically a processing facility, with the goal of recognizing risks to staff, equipment, or the environment. It also aims to identify any potential operational issues that could impact efficiency. Usually carried out post-detailed design phase, a HAZOP and QRA study is recommended to be conducted after detail design which aims in identifying and resolving potential hazards and operational challenges before implementation.
- II. The CSR plan will be developed following a survey of community needs and discussions with stakeholders. This is to ensure that the project addresses the unique needs and priorities of the local community. The CSR

plan will aim to support and uplift the community by implementing initiatives that align with their needs and aspirations.

- III. The ESMMP will be included in the bid document of the contractor along with its budget and eventually become part of the civil works contract (s).

ANNEXURES

ANNEXURE – 1: ISCC

ANNEXURE – 2: BTE COLLECTION NETWORK OF FEEDSTOCKS

ANNEXURE – 3: GHG EMISSION CALCULATION SHEET

ANNEXURE – 4: BIOTECH ENERGY HUMAN RESOURCE REFERENCE DOCUMENT

ANNEXURE – 5: SOCIO-ECONOMIC PERFORMA

ANNEXURE – 6: BTE CHILD LABOR POLICY

ANNEXURE – 7A: BIOTECH- SPILL MANAGEMENT AND RESPONSE PROCEDURE

ANNEXURE – 7B: AIR DISPERSION MODELLING REPORT

ANNEXURE – 7C: NOISE MODELING REPORT

ANNEXURE – 8A: BTE EMERGENCY RESPONSE PLAN

ANNEXURE – 8B: EMERGENCY RESPONSE PLAN FOR PROJECT (SAF) BY CONTRACTOR

ANNEXURE – 8C: BTE WASTE MANAGEMENT PLAN

ANNEXURE – 9: CONTRACTOR HSE PLAN

ANNEXURE – 10: CONSTRUCTION PLAN (DRAFT BIOTECH)

ANNEXURE – 11: GRM PROCURE

ANNEXURE – 12: HYDROLOGICAL ANALYSIS FOR WATER AVAILABILITY ASSESSMENT AND IMPACT ON GROUNDWATER

ANNEXURE – 13: ENVIRONMENTAL MONITORING REPORTS

ANNEXURE – 14: PROJECT IMPACT MATRIX

ANNEXURE – 15: SPECIFICATION FOR FLARE TIP AND IGNITION

ANNEXURE – 16: EQUIPMENT AND PIPING DESIGN LIFE

ANNEXURE – 17: FINAL PRODUCT STORAGE CHECKILST FINAL

ANNEXURE – 18: PRELIMINARY HAZID STUDY

ANNEXURE – 19: PRELIMINARY QUANTITATIVE RISK ASSESSMENT
