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Environmental and Social Impact Assessment
Fecal Sludge Treatment Plant Subproject for Bishoftu
Town
Oromia Region

Second Urban Water Supply and Sanitation Project



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List of Acronyms

BT	Bishoftu Town
BTWSSE	Bishoftu Town Water Supply Sewerage Enterprise
CDMP	Community Disease Management Plan
CEC	Code of Ethical Conduct
CWIS	City-Wide Inclusive Sanitation
EHSP	Environmental Health and Safety Plan
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ETB	Ethiopian Birr
FDRE	Federal Democratic Republic Of Ethiopia
FEPA	Federal Environmental Protection Authority
FGDs	Focus Group Discussions
FS	Fecal Sludge
FSM	Fecal Sludge Management
FSTP	Fecal Sludge Treatment Plant
GBV	Gender-based violence
GSEMC	Green Sober Environmental Management Consultants
HW	Hazardous Waste
HWMP	Hazards Waste management Plan
MASL	Meter above Sea Level
MSDA	Material Safety Data Sheets
MoWE	Ministry of Water and Energy
OSHA	Occupational Safety and Health Administration,
PAHS	Project affected Household
PAPS	Project affected persons
SWMS	Solid Waste Management System
TMP	Traffic Management Plan
ToR	Terms Of Reference
UWSSR II	Ssecond Urban Water Supply and Sanitation Program.

Executive Summary

Incremental growth in the number and size of Ethiopian towns has been observed in the last two decades. Such trends will result in enormous pressure on the existing urban infrastructure and the need for more basic urban services and infrastructure in the years to come. As a result, people in many towns lack access to adequate sanitation systems, consequently causing environmental and social problems (ESMF, 2017).

The government of Ethiopia has set out to transform the country from a rural to an urban one with economy-led industrialization. Meeting this goal is dependable on the town's ability to meet basic urban standards of living. One of these urban living standards is access to improved urban sanitation facilities. Thus, the government of Ethiopia and the World Bank have launched the second Urban Water Supply and Sanitation Program (UWSSP II).

The UWSSP-II is a five-year program that aims to increase access to enhanced water supply and sanitation services in cities and towns of Ethiopia. The project is intended to aid in the government's efforts to eliminate open defecation, raise the proportion of the population using a "safely managed" sanitation service, and improve current water supply services through increased operational effectiveness and expansion of water supply service to underserved areas of urban centers. The project is financed by the World Bank and has three key components:-i) Addis Ababa Sanitation and Water Supply Services Improvement, (ii) Secondary Cities and Towns Sanitation and Water Supply Services Improvement, and (iii) Project management and institutional strengthening. Thus, as part of the objective of UWSSP-II, this project aims to build fecal sludge treatment plants in Bishoftu town (BT), using current state-of-the-art technology.

As part of the contract, the Federal Democratic Republic of Ethiopia's (FDRE) Ministry of Water and Energy (MoWE) hired Green Sober Environmental Consultant (GSEMC) Pvt. Ltd. Co. to conduct full Environmental and Social Impact Assessment (ESIA) for the proposed fecal sludge treatment plant (FSTP) construction subproject under UWSSP-II in BT in Ethiopia. As an objective, the GSEMC identified major environmental and social impacts during the life cycle of the project and its management and recommended appropriate mitigation measures. Furthermore, to minimize the possible adverse impact and enhance the positive one, GSEMC prepared environmental and social management and monitoring plans.

Proposed Project Scope of Works: The proposed project scope is limited to the UWSSP-II - sub-project that is going to be implemented in BT. Following the components of the project, specifically, the scope of the work is demarcated by seven interrelated tasks. These include a review of pertinent policy, legal instruments, standards and guidelines, and institutional regulatory frameworks, public participation and consultations, assessment of the baseline condition of the project, impact identification, characterization, and evaluation, analysis of alternatives, impacts mitigations and management plan development, institutional arrangement, human resources, and capacity building plan development, Grievance Redress mechanism.

Methodology: GSEMC used a mixed methodological approach. Based on the EIA guideline of Ethiopia, the GSEMC utilized both quantitative and qualitative data types from primary and secondary sources. The ESIA was conducted by collecting and analyzing the socioeconomic and environmental data through surveys, focus group discussions and experimental methods. Moreover, through structured questionnaires, observational checklists, and key informant interviews data were collected related to socioeconomic, and environmental issues of the town. The GSEMC was involved in the stakeholder consultation process, social and environmental surveys using structured questionnaires accordingly analyzed, and key informant interviews with institutions, lead organizations, and surrounding community consultations. In general, this ESIA typically used a range of methods including scoping, baseline studies, stakeholder engagement, impact prediction, impact assessment, risk assessment, mitigation measures, monitoring, and evaluation.

Policies, Legislations, and Institutional Framework: Relevant national policies and Strategies, proclamations, regulations, regulatory frameworks, and the World Bank safeguard policies, World Bank Group (WBG), and Environmental health and safety (EHS) guidelines related to the proposed project have been reviewed. The Constitution of the FDRE provides the overriding principles and legal provisions for all legislative frameworks in the country. The Environmental Policy of Ethiopia (EPE), issued in 1997, has the overall policy goal to improve and enhance the health and quality of life of all Ethiopians, to promote sustainable social and economic development through sound management and use of natural, human-made and cultural resources and their environment as a whole. Cross-sectorial environmental policies emphasize the early recognition of environmental issues in project planning, public participation, mitigation and environmental management, and capacity building at all levels of administration. These include the Ethiopian Water Resources Management Policy, the Health Policy, the National Policy on Women, and others.

Applicable strategies and programs include the Conservation Strategy of Ethiopia (CSE), and the Second Urban Water Supply and Sanitation Program (2017 to 2022). Moreover, the country's legislations related to the Expropriation of Land, Payments of Compensation and Resettlement proclamation (No. 1161/2019), Environmental Impact Assessment Proclamation No. 299/2002, Environmental Impact Assessment Guidelines (2002), Proclamation on Environmental Pollution Control (NO 300/2002), Labor Legislation (Proclamation No.1156/2019) Health Proclamation No 200/2000, Proclamation on Environmental Pollution Control (NO 300/2002), Expropriation of Land, Payments of Compensation and Resettlement proclamation (No. 1161/2019), Resettlement Regulation No 472/2020 and others reviewed.

Physical Environment: Bishoftu town is located in Oromia Regional State in the eastern direction of the capital, Addis Ababa, at 47 km away on the lifeline road of Addis Ababa-Djibouti. The geographical/astronomical/ location of Bishoftu town is at 8044'40''N latitude and 38059'9''E longitude and according to the new structural plan the city's total area is increased to

63,158.56 hectares in 2023 (Bishoftu town, 2024). Bishoftu is situated in the East African Rift Valley and is known for its numerous freshwater lakes. The topography and landform of Bishoftu town and its environment are characterized by gentle slopes, plain areas, and smooth topography which is often interrupted by undulating rocky hills that comprise several ups and downs, rivers and streams (both perennial and permanent), swampy and crater lakes.

The maximum average monthly temperature ranges between 23.8°C in August to 28.3°C in March. The overall average temperature is 18.68°C. The monthly precipitation pattern of Bishoftu town is almost mono-modal with peak rainfalls of 230 mm on average in August (maximum) with more than 150mm monthly rainfall between July to September.

Biological Environment: Long time Human intervention for agricultural purposes changed the natural diversity in to agricultural crop area (Ada'a Teff (*Eragrostis tef*). In the hills and valleys of the surrounding area, there are drought-tolerant shrubs, and scramblers like *Lantana camara*, *Solanium incanum*, and *Eragrostis spp.* (*Lovegrass*). A few scattered trees like *Acacia tortilis* (Umbrella Thorn), *Acacia seyal* (White-Barked Acacia) *Faidherbia albida* also available. The presence of some wild mammals like Abyssinian hare (*Lepus habessinicus*), and hyena were confirmed. Similarly, a few species of aquatic birds (flamingo's pelicans, Marabou stork) Egyptian vultures, and pied crow are reported.

Socio-Economic Environment: Data on population of Bishoftu town collected starting from the third National Population and Housing Census (2007) revealed the total population size of Bishoftu town 99,928 while as of CSA population projection CSA (2020) result, the total population size of the town estimated to be 188219 of which 47.4% were Males and 52.6% were females. It has been indicated that the town has been growing by 5% per annum since 2017. Based on the CSA 2007 data, the age Structure shows that the proportion of the total population under 15 years of age was 27.6 percent while the proportion of the working age group was 68.4 percent. The proportion of those aged above 65 years and over increased from 3.3 percent in 1994 to 4 percent in 2007. The current sex ratio of the town is 89% which indicates that there are only 89 men for every 100 women in the city whereas the proposed normal sex structure is 90 to 105 men for every 100 women. The overall dependency ratio is 46.3 implies that roughly about 100 persons in the economically productive ages have to support 46.3 dependents in terms of food, clothing, health, education, and the like. By considering specific socioeconomic factors, the population size of Bishoftu town is expected to grow at 5.5, 6.0, and 6.5 percent annually based on low, medium, and high growth rate variants respectively. As per the low Population projection, this figure is estimated to reach 534,600 in 2039 and 1,097,337 in 2059 after twenty and forty years respectively. Similarly, the population is estimated to be 583,200 in 2039 and 1,197,095 in 2059 by the medium variant growth rate projection. As per the high growth rate projection result, the current base year population is estimated to reach 631,800 in 2039 and 1,296,853 in 2059.

Description of the Proposed Subprojects

Construction of new Fecal sludge treatment plant (FSTP): By using primary data the estimated total sludge volume is 281m³/d. Fecal Sludge generation volume (m³/d) based on Primary data for the Short term (Up to 2025) Medium term (2026- 2035), Long term (2036-2045) is 281, 798, 2359 m³ respectively. The Bishoftu fecal sludge is categorized under medium-strength municipal fecal sludge. It is treatable with the natural conventional treatment method. The proposed full FSTP will be comprised of interconnected working units of seepage receiving and screening units, Settling – thickening tanks, Sludge drying beds, a Flow equalization tank and pumping station, an Anaerobic baffled reactor, a Wetlands feeding pumping station, Constructed Wetland. The proposed project is to be built in Bishoftu at Udde Kebele which was recently incorporated under the town boundary which has an elevation of 1769m. The new FSTP requires a maximum of 22 hectares and a minimum of 14 hectares of land for the year 2045 design period.

The environmental and social evaluation of a project must be carried out following the World Bank's requirements to guarantee that all project activities are socially acceptable, sustainable, and of a sound environmental nature. The MoWE assigned GSEMC to evaluate and create an ESIA for the suggested project to achieve this.

Public and Stakeholder Consultation: Participants of the PC were communities at the proposed FSTP, project sites. The PC meeting was held among 56 participants from local community members like youth, women, vulnerable community group sector experts, and institution leaders. Moreover, stakeholder meetings were also conducted at the BT water supply and sewerage enterprise office with representatives from offices like the Environmental Protection Authority, Agriculture and Natural Resources Department, Health Department, Education Department, Culture and Tourism Department, municipality, town urban development, and construction.

Consensus on the proposed site and technology alternatives was reached through tripartite consultation meetings between the clients (MoWE), Design, and ESIA consultants.

The outcomes of the consultations conducted with the aforementioned actors reveal that all the stakeholders have concerns about the implementation of the project. The main issues/concerns raised by the stakeholders and recommendations provided include the following:

- Loss of property and livelihood especially at the FSTP site construction site
- Low level of public consultation related to the coming project;
- Farming is the only skill they have for their livelihood, losing agricultural land means a lot to them;
- How are PAHs, compensated? Will it be reasonable? How it will be done appropriately following rules and regulations?

Project, site, and technology alternatives:

The do-nothing alternative of the project: The option of doing nothing increases the risk of epidemics in populations who are already vulnerable by allowing human waste to contaminate the surrounding ground and drinking water sources, as well as the environment. Urbanization

and human population growth is expected to increase and hence the town needs fecal sludge treatment facilities. As such, the choice of doing nothing is not a practical one. The design and construction of sanitation facilities is crucial.

The FSTP site was proposed by the design consultant using the various socioeconomic, and environmental criteria.

For the implementation of the project, three alternative sites namely Golba, Abusera, and Udde Dinkaka sites were considered. Among these sites, the optimal location was chosen after the project site alternatives' suitability compared to each other through various assigned criterion parameters with a score for each indicator parameter ranging from 1 to 5, where 1 is the worst (low) and 5 is the best(excellent). Scoring (weighting) of indicators was given based on legislative directions and best practices and was defined through expert judgment, stakeholders 'analysis, and knowledge considering the characteristics of the area. The score for each parameter was multiplied by the weighting factor. From the assessment of environmental and social factors, the most suitable site against other sites with a site score of 62% is Site III Udde Dinkaka village and the next options are Abusera (site II) 56% and 33% Golba (Site I). The design consultant, ESIA team, and stakeholder consultation meetings revealed that the Udde Dinkaka site is the ideal project site location for FSTP. In this particular location, the main social issue is land loss (economic displacement) of the 35 PAHs and 188 PAPs from the project site. The site necessitates the relocating of farmers who are currently owned for farming purposes which should be managed through due implementation of country laws, RPF, and RAP guidelines.

The project's technological alternatives have been analyzed to the groundwater level in the project area, capital costs (CAPEX), operating costs (OPEX), energy requirements, skill requirements, and land requirements. Moreover, the technology selected based on the region's priorities and local characteristics, including population density, health, and environmental benefits, and the eradication of open defecation, all influence the choice of FS treatment method for BT. In general, sludge drying beds are simpler, more adaptable, easier to use, and use less energy to operate than mechanical systems, making them the better dewatering solution for BT.

The prioritized technology alternative design for treating the fecal sludge in BT comprises and is sequentially arranged as a receiving settling–thickening chamber, coarse screen, anaerobic pond, sludge drying bed, facultative pond, and maturation pond. These technological possibilities offered the possibility of successfully treating fecal sludge to generate leachate effluent that could be safely disposed of without damaging the environment or providing health risks to people. Sludge and leachate that would fulfill the minimal or indicative wastewater quality standard values described in the UWSSP II, ESMF/WBG EHS can also be treated using the suggested fecal sludge treatment approach.

Potential Impacts and Mitigation Measures: Though the construction and operation of the planned subprojects is a well-recognized solution to overwhelm the current environmental pollution and allied health impacts, some impacts are anticipated to occur during the construction, operation, and decommissioning phases of the project.

Positive impacts at construction and operation phases: The development and operation of the proposed project will have substantial positive environmental on the local people, city, and region at large. The main positive impact during the construction phases is job creation for skilled and unskilled workers, improved Income to material/ equipment suppliers, skill, and technology transfer, and others. The operational phase of the project will have beneficial impacts, such as enhanced water quality, improved public health status hygiene and household health status, urban service infrastructure improvement (sanitation facilities), skill and technology transfer, and creation of employment opportunities, fertilizer, biogas production, and others.

Project phases	Adverse impacts	Mitigation measures
Pre-construction phase	Involuntary economic displacement of 35 PAHs from their lands	<ul style="list-style-type: none"> • RAP has to be conducted before any civil work of the project and PAP needs to be properly compensated in cash and kind for the losses. • Compensate those affected according to the laid down laws such as Ethiopian Proclamation No. 1161-2019 and the World Bank safeguard policy on involuntary resettlement.
Construction phase	Loss of grasses and some acacia trees (5-7 trees) coverage in the project site	<ul style="list-style-type: none"> • Re-vegetation of ¼ of the area delineated and perimeters of the FSTP with Indigenous tree species (Acacia trees) • Work on greenery structures outside of the project site and plant 10 times more trees to replace lost Acacia trees during site clearance as much as practical once;
	Soil degradation, flooding, erosion, and loss of Topsoil	<ul style="list-style-type: none"> • Store topsoil and subsoil removed from the site during site preparation properly for backfilling and reinstatement. • Contour temporary and permanent access roads / lay down areas to minimize surface water runoff and erosion. • Develop a stable landform that mirrors the pre-disturbed condition to minimize the risk of preferential erosion and therefore facilitate natural grass and bushes recovery. • Excess soil must be removed from the site timely (in an hourly or daily basis as applicable) manner and deposited at an approved site;
	Air quality loss and noise pollution	<ul style="list-style-type: none"> • Construction workers will be made aware of the Ethiopian Ambient Environment Standard Guideline (2003); • The contractor has to ensure that all construction equipment is properly maintained and fully functional. • Workers be provided with the necessary personal protective equipment (PPE) such as earmuffs, and masks whenever needed and as found appropriate; and
	Alteration of natural drainage pattern	<ul style="list-style-type: none"> • Proper drainage channels shall be constructed within the construction site. • Drainage channels shall be installed in all areas that generate or receive surface water and channels shall be designed about

Project phases	Adverse impacts	Mitigation measures
		maximum expected volumes.
	Traffic congestion	<ul style="list-style-type: none"> • The Contractor should provide temporary road signs or notices to indicate ongoing works; • The Consultant and Contractor should choose traffic routes to reduce the impact in the neighborhood and any sensitive areas.
	Water pollution due	<ul style="list-style-type: none"> • All construction equipment will be kept in good operating condition to avoid oil, grease or fuel leakages; • All routine maintenance of construction machinery and vehicles shall be carried out in a designated workshop or maintenance area with a concrete hard-standing surface and drainage to an oil interceptor. • All hazardous wastes and empty containers of hazardous materials shall be stored in a designated area on site and regularly;
	OHS and safety risks and risk of accidents	<ul style="list-style-type: none"> • The contractor shall prepare site site-specific health and safety management plan. • A qualified health and occupational safety officer will be recruited by the contractor to oversee OHS matters daily. • All construction workers will be oriented on safe work practices and guidelines (OHS) first and ensure that they adhere to them.
	Risk of impacts on Physical Cultural resources (PCRs)	<ul style="list-style-type: none"> • Chance Finds Procedure (CFP) has to be followed when an event of buried PCRs being unexpectedly encountered or “chance find” during the construction phase of the project and duly reported to respected bodies.
	Impact on Landscape and Aesthetic Value	<ul style="list-style-type: none"> • Planting more than 10 indigenous seedlings to replace the cut tree during construction time. • Reinstate borrow and quarry sites used for construction purposes.
	Impact on Vulnerable Groups	<ul style="list-style-type: none"> • Ensure women-headed HHs and elderly are treated during land acquisition & compensation. • Ensure that women and girls equally get job opportunities during the project construction processes and the benefits of the Project implementation.
	(GBV) Gender and Gender Based Violence Risks	<ul style="list-style-type: none"> • Provide and avail a separate sanitation facility for women at construction camp, • Provide women-friendly safety equipment and materials, • Ensure that women construction workers do not face GBV and sexual harassment,
Operation phase	Air emission and dust pollution	<ul style="list-style-type: none"> • Watering dusty roads during operation. • Using new vehicles and giving proper service to the trucks regularly to improve their fuel performance and reduce emissions; and • Turn on generators only during power cut-off periods,

Project phases	Adverse impacts	Mitigation measures
	Occupational health and safety adverse impacts	<ul style="list-style-type: none"> • Hire qualified and trained OHS and environmental health crew for regular monitoring and management of FSTP. • Develop and work on EHS Plan including health and safety measures to avoid accidents and injuries during work at the FSTP. • The FSTP should be fenced, and signals put in place
Decommissioning phases	Pollution of soil and water bodies	<ul style="list-style-type: none"> • Develop a decommissioning plan that outlines the steps and working procedures. • Engage local stakeholders including nearby residents, businesses, and community organizations in the decommissioning process to ensure their concerns are addressed. • Restore the project site to its original or to a condition that is acceptable to local stakeholders and regulatory authorities. • Monitor the decommissioned site to ensure that there are no potential environmental or health risks associated with the decommissioned plant.
	Occupational health, safety, and Air pollution	<ul style="list-style-type: none"> • Recruiting a qualified health and occupational safety officer who will oversee OHS matters on site. • Providing training and education to workers on the proper use of equipment, PPE, and hygiene practices. • Provide appropriate, adequate PPE, such as gloves, masks, and protective clothing, OHS personnel protective gear to the employees.
	Socio-economic adverse impacts on employees and dependents	<ul style="list-style-type: none"> • Based on their skill, knowledge, experience, and interest, vulnerable community groups must be transferred to another secured job opportunity. • Providing adequate provident fund or pension for those who want to retire. • Providing retraining programs in new industries or skills opportunities for workers. • Supporting workers to start their businesses.

Environmental and Social Management Plan (ESMP): ESMP is a plan of action and a key to certifying that the environmental and social quality of the project influence area does not deteriorate due to the implementation of the proposed development project covering all aspects of project implementation in its different phases. The ESMP for the proposed project consists of a set of feasible and cost-effective mitigation and official measures to be assumed during the different phases of the project to remove or reduce to tolerable levels for the recognized adverse environmental and social impacts. Therefore, the ESMP is focused on mitigating, minimizing, or controlling negative impacts rising all over the different phases of the project. This ESMP outlines the roles and responsibilities of various stakeholders for guaranteeing well-integrated implementation and monitoring of the project operations.

Environmental and Social Monitoring Plan: Environmental monitoring is an important component of environmental management as it provides the basis for rational management decisions regarding impact control. Monitoring should be performed during all stages of the project development to ensure that the impacts are no greater than predicted, and to verify the impact predictions. The monitoring program will indicate where changes to procedures or operations are required, to reduce impacts on the environment or local population.

Implementation measures and capacity building: The responsibility for implementing the ESMP of the supplement ESIA during construction will be of the contractor, BTWSSE. During the operation and maintenance of the development works, the responsibility will be mainly under the BTWSSE. Thus, BTWSSE already allocated environmental and social development specialists for the overall environmental and social safeguard issues, training, and capacity-building activities. The environmental sustainability of the sub-projects is dependent on the capacity of institutions at all levels (i.e., recruitment of Environmental Safeguard staff, training, and other essential support services) to carry out the associated ESMP implementation work. Thus, BTWSSE must allocate sufficient resources for training and capacity building.

Conclusion: BT requires modern advanced suitable sanitary facilities. So inadequate facilities for disposal of human excreta, and refuse material is observed. The implementation of the proposed FSTP at BT will bring major solutions to improving the prevailing poor sanitation conditions and associated factors in the town and downstream areas. The positive impacts of the project are enhanced through the implementation of enhancement measures outlined in each project phase. The identified adverse impacts of -sub-projects are of low to moderate significance and can be easily mitigated to an acceptable level by properly applying the mitigation measures of each impact stated in this report.

Therefore, it is suggested that the enhancement and mitigation measures for the identified positive and negative impacts correspondingly have to be implemented. The benefits of implementing these measures by far are more important than the costs to be incurred. Moreover, saving life supports environmental resources and ecosystems from further pollution and deterioration would be of utmost significance. Monitoring of identified mitigation measures and operational parameters are key to sound environmental and social safeguard management. So it is advisable to use both compliance and effects monitoring plans during the project lifecycle. The compliance monitoring mechanism will ensure that the various project-concerned institutions are implementing the provisions of the ESMP effectively, whereas the effects monitoring part will check on the impacts that the project is having on the receiving physical, biological, and social environment by regular measuring of indicators. Excluding the RAP, the estimated Environmental and social safeguard management and monitoring plan budget for the Bishoftu town FSTP project is **150,859.2 (One hundred Fifty Thousand Eight Hundred Fifty Nine) USD.**

1. Introduction

1.1 Background

Fecal Sludge Management (FSM) in urban area is a global challenge generating significant negative public health, socioeconomic wellbeing, and environmental risks particularly in low-income countries. Urban sanitation facilities required for the ecosystem health, environmental well-being and socio economic development. Improved sanitation facilities (flush toilets, fecal sludge treatment technologies) are vital to prevent the spread of contagious diseases and environmental pollution.

Ethiopia is one of the Sub-Saharan African countries with poor sanitation services, and rapid urbanization is exacerbating the situation (Oliver, 2015). In Ethiopia, the annual urbanization (GOE, 1995) growth rate is (5.4 per cent) which is resulting towns to expand in size and number over the past 20 years. Such urban growth requires basic urban infrastructures and services but people in many towns and cities of Ethiopia lack access to sanitation infrastructure services, adequate sanitation systems at the required level (ESMF, 2017).

The government of Ethiopia has set out to transform the country from a rural to an urban one with economy-led industrialization. Meeting this goal is dependable on the cities' and towns' ability to meet urban standards of living. And one of these urban living standards is access to improved urban sanitation facilities. Thus, the government of Ethiopia (GOE) and the World Bank have launched the second Urban Water Supply and Sanitation Program (UWSSP II).

The UWSSP-II is intended to aid in the government's efforts to eliminate open defecation, raise the proportion of the population using a "safely managed" sanitation services, and improve water supply services through increased operational effectiveness and expansion of water supply service to underserved areas of cities and towns of Ethiopia.

Specifically, the UWSSP-II project has three key components: i) Addis Ababa Sanitation and Water Supply Services Improvement, (ii) Secondary Cities and Towns Sanitation and Water Supply Services Improvement for 22 towns, and (iii) Project management and institutional strengthening. However, components one and two of the UESSP-II projects do have some adverse environmental and social impacts which needs adequate mitigation actions. Implementation of the project components will have environmental and socioeconomic impacts like soil erosion, soil and water pollution, loss of vegetation, traffic accidents, air pollution, the health and safety of people near construction sites, and the taking of privately owned land and others.

To assess the environmental and social impacts of the UWSSP-II project components that will be implemented in Bishoftu town, the Federal Democratic Republic of Ethiopia's (FDRE) Ministry of Water and Energy (MoWE) hired Green Sober Environmental Consultant Pvt. Ltd. Co. Hence this is ESIA report for the implementation of fecal sludge treatment plant (FSTP) construction project that will be developed in Bishoftu town.

1.2 Objective of the ESIA

1.2.1 General Objective

The main objective of the consultancy service is to carry out an environmental and social impact assessment on FSTP construction, operation and decommissioning phases. The general objective is to identify, predict, and evaluate environmental and social impacts of the proposed project through the analysis of project lifecycle and recommend appropriate mitigation measures for the adverse impacts and enhancement measures for the positive. Further, the objective includes preparation of environmental and social management and monitoring plans (ESMP). Additionally, conducting indicative socio-economic survey for the preparation of resettlement action plans (RAPs) for potentially affected individuals.

1.2.2 Specific Objectives

The specific objectives are:

- ◆ Examination of the National and the World Bank environmental safeguard policies and regulations that will be triggered by the subproject activities at any development phase of the sub project and these shall include but not be limited to the project ESMF, Gender Action Plan (GAP), World Bank's Gender strategy and GBV requirements.
- ◆ Describe the views and concerns of the public and stakeholders towards the implementation of the subproject.
- ◆ Establish baseline features of the biophysical, socio-economic, and cultural attributes in the subproject influence area.
- ◆ Identification and evaluation of significant impacts (both beneficial and adverse) due to the subproject implementation that requires appropriate mitigation measures.
- ◆ Propose specific mitigation for inclusion in the subproject detail design and management plan to reduce or avoid significant adverse environmental and social impact including gender and potential Gender Based Violence (GBV) risks.
- ◆ Conduct an analysis of alternatives to the proposed sub-projects in terms of technology, design, and operation, including the "without project" situation.
- ◆ Assessment and identification of capacity gap and propose training and capacity building requirements for implementation of environmental mitigation and monitoring plans.
- ◆ Preparation of Environmental and Social Management Plan.
- ◆ Cost estimate for each proposed mitigation measure and monitoring program.
- ◆ Develop a monitoring program that will be followed during the project implementation.
- ◆ Recommend environmental and social compliance requirements, design measures, and staffing that should be included in the works contract documents.

1.3 Scope of the ESIA Study

The scope generally include collection primary and secondary environmental and socioeconomic data and analysis of the information for the desired objectives. Specifically embrace desk review of pertinent policy, legal instruments, environmental social standards, guidelines, and institutional arrangement and frameworks. Besides this, the scope encompasses, field assessments like collection of city/town biophysical, socioeconomic, and cultural baseline data like soil mapping land use and cover, water and hydrology, landscape and visual, archaeological and cultural heritage, air quality and noise, flora, fauna and ecology, and socio-economic environment. Moreover, the stakeholder consultation and indicative household survey for the likely project-affected households were also made as part of the scope. The scope of the study also covers identification of project adverse impacts and development of possible mitigation measures for the identified significant impacts. Development of proposal for human resources, capacity building, and monitoring plan with time and with their cost implications addressed as part of the scope.

Generally, scope of works undertaken by the consultant includes the following tasks:

Task 1: Description of the Proposed Sub-Project

Task 2: Review of Regulatory and Policy Framework

Task 3: Public Participation and Consultations

Task 4: Biological, physical, social, cultural and economic Baseline Conditions assessment

Task 5: Impact Identification, Characterization and Evaluation

Task 6: Setting of alternatives/options for comparison

Task 7: Impacts Mitigations and Management plan development

Task 8: Environmental and Social Monitoring Plan

Task 9: Institutional arrangement, human resources, and BT building plan development

Task 10: Grievance Redress mechanism.

1.4 Organization of the ESIA Report

This report is organized into 11 chapters. The contents of this ESIA report are as follows the executive Summary, **Chapter One** is an introduction and indicates the purpose of the ESIA; presents an overview of the proposed project, as well as the project's purpose and needs. **Chapter Two** discusses related policy, legal, institutional, and administrative frameworks. It presents the relevant environmental and social policies of the World Bank, as well as the relevant national legal requirements for the project. **Chapter Three** deals with the ESIA study approaches and methods. **Chapter Four** outlines the description of the project and its justification. This chapter discussed the project components and their area of influence including a map showing the project's location. **Chapter five** presents a description of the baseline environment like the project's physical, biological, and socio-economic environments within the proposed project-affected area. **Chapter six** addresses the procedural aspect of public

consultations aims objectives and identifications of the project. The views and concerns of the affected communities and other key stakeholders on the project have also been presented. **Chapter Seven** focuses on the baseline socioeconomic background of project-affected households. **Chapter Eight:** addresses an analysis of the project alternatives including the "without project" option. **Chapter Nine** discussed the potential project impacts on the physical, biological, and socio-economic environments. The unit also presented mitigation /enhancement measures and complementary initiatives to prevent, minimize, mitigate, or compensate for adverse environmental and/or social impacts. **Chapter ten** summarizes the environmental social management and monitoring activities and the proposed monitoring indicators derived from the baseline survey. Also, it identifies the roles and responsibilities of stakeholders in the implementation as well as the estimated cost of the activities. **Chapter 11** in this chapter summary of the conclusion. The last section reference and annex are contained within the ESIA report.

1.5 Team in charge of the ESIA

Ten experts from different disciplines have been involved in this ESIA study. Most hold second degrees (MSc, MA) two of them have PhD, and others are near to finishing their PhD. All of them have experience in research, and conducting ESIA studies including base line data collection, analysis of project alternatives, public consultations, and others. The participants of this ESIA study their role, educational background is annexed

2. ESIA Approach and Methods

2.1 Approach/Design

The ESIA study requires the collection and evaluation of comprehensive socioeconomic and environmental data. Since the type and nature of data collected analyzed are different, applying mixed assessment method was selected as the best preferred approach. The EIA guideline of Ethiopia utilized to collect both quantitative and qualitative data from primary and secondary sources.

The collected socioeconomic and environmental data described and explained at the required scale. The impact of the project on receiving biophysical, socio-cultural, and economic environment as they are on the ground described based on the available primary and secondary data sources. It looks at individuals, groups, institutions, methods, and materials to describe, compare, classify, analyze, and interpret the entities and events that constitute the various fields of inquiry. Moreover, explanations given by professionals as supplement when elaboration and enrichment of socioeconomic, cultural, and environmental issues on the ground.

2.2 Period of Field Data Collection and Site Visits

The required ESIA field data was collected from Dec 25-30/2023, June 4 /2023 and August 2024. A team of experts participated in the collection of information from the public, stakeholders, project owners, experts, sample analysis, and proposed project sites.

2.3 Assessment Method

The ESIA method comprises a wide variety of methods. Information related to the biophysical, socio-cultural, and economic environment of the proposed project was collected exclusively on environmental safety, social acceptance, and economic viability as key points of project implementation. Moreover, data related to vulnerable groups' management, land acquisition, access to job opportunities, compensation, relocation, and infrastructure facilities were also collected and examined. ESIA typically involves a range of methods including scoping, baseline studies, stakeholder engagement, impact prediction, impact assessment, risk assessment, mitigation measures, monitoring, and evaluation.

Scoping: Scoping is used for identifying potentially significant environmental impacts of the proposed project. This involves detecting the environmental components that might be affected by the project, such as air, water, soil, ecology, human health, and cultural heritage.

Baseline studies: Baseline data collection is one source of information that involves collecting data on the current environmental and social conditions like data on the physical, biological, and social environment, as well as information on the existing land use, infrastructure, and other activities in the project area. This method is used to establish a baseline against which the potential impacts of the project can be compared.

Impact and risk assessment: Impact assessment covers identifying and assessing the potential environmental, and social impacts of the project. Impact and risk assessments

are conducted using various methods, such as Screening, Checklists, Matrix methods, and Expert judgment.

- Checklists are used as a method to list potential environmental impacts that may be caused by the proposed project. The checklist is used to identify impacts and their scopes.
- The matrix assessment method also applied for assessing the potential environmental impacts of the project and to evaluate the significance of the impacts.
- Expert judgment was also utilized to obtain opinions of experts in relevant fields, such as ecologists, hydrologists, environmentalists, sociologists and others.
- Geographic Information System (GIS) mapping was used to visualize and analyze spatial data.

Stakeholder engagement: individuals or groups who may be affected by the proposed project or who have an interest in the project have been consulted. This method is applied to assess the stakeholder's interests and obtain their values, concerns, and perspectives on the proposed project and its potential environmental impacts.

Mitigation measures are employed methods to reduce or avoid the potential environmental impacts of the project done by mitigation measures. Project alternatives change to the project design modifications, use of alternative technologies, or operational measures.

2.4 Data Sources

Project-linked data obtained from both primary and secondary data sources. The primary data sources used were structured surveys, Laboratory experiments, and observation while secondary data sources were obtained from government statistics, institution reports, academic research, public records, and others.

There are two types of data that are gathered: qualitative and quantitative. Gathering non-numerical data via Key Informant Interviews (KII), observations, or open-ended survey responses is a step in the qualitative evaluation process. When gathering the necessary data, focus group discussions (FGD) are commonly employed to learn about people's experiences, viewpoints, and attitudes regarding FSTP. The quantitative technique uses experimental (environmental sample) and survey (questionnaire) approaches to obtain data.

2.4.1 Field Surveys

To gather fresh data on the surrounding environment, baseline circumstances, and prospective effects of the project under consideration, a field study was carried out. Direct observation, stakeholder interaction, and GPS data collecting were used to gather physical, social, and biological data from the project site and its environs.

2.4.2 Documents, Policies and Guidelines review

Secondary data sources can offer important details about the project's possible effects, baseline circumstances, and environmental context. A thorough examination of pertinent papers, regulations, and guidelines was carried out to guarantee that the proposed project complies with the legal and regulatory frameworks of both the country and the World Bank. The feasibility and design study of the proposed project, national laws and policies, WB safeguard policies and guidelines, reports, and other materials are among the documents that have been analyzed.

2.5 Data Collection Tools

Data collection tools are instruments or methods used to collect data from primary or secondary data sources. Collecting physical, chemical, and biological data from the project site and surrounding areas was done by using direct observation, environmental sampling, Stakeholder engagement, and Geographical Information Systems (GIS) remote sensing. The data collection instruments are presented as follows.

2.5.1 Survey

Surveys are questionnaires or interviews designed to collect large amounts of data at a particular point in time. To acquire appropriate information about the existing situation of the physical, social, and cultural environment, and institutional-level survey was done by using a questionnaire. The office data collection questionnaire dealt with demographic characteristics, human resources and capital, natural resources, and settings, infrastructural facilities of the city, and cultural and economic resources within and around the project site as a receiving environment.

2.5.2 Public Consultation Checklist

Public consultation was one form of data collection tool. Representatives of local government (Kebele), community members composed of elders, the youth, women, religious leaders, and vulnerable community groups which are found nearby of the project site were engaged in this event. Consultation was held by using a checklist and data related to public views, concerns, questions, and comments of local communities documented through minutes. The consultation was freely carried out without any persuasion or interference to push the interests of the consultant.

2.5.3 Focus Group Discussion (FGD)

FGD was another data collection tool which included participants between 8 and 12 individuals. The moderator was responsible for asking open-ended questions and guiding the discussion. Focus group discussions can be particularly useful for gaining insights into complex or sensitive topics, where individual perspectives and interactions among participants can provide a deeper understanding of the issues at hand. Discussions were made on particular issues and information documents though Minutes and FGD conducted at FSTP and stakeholders.

2.5.4 Key Informant Interview (KII)

The KII method is used to collect in-depth data on a particular topic or issue by interviewing an individual who has specialized knowledge or experience relevant to the project. Project-related semi-structured question items were prepared for the interviewee. Data was collected by a semi-structured interview guide, which includes a list of open-ended questions designed to elicit detailed information on the topic of interest. Semi-structured interview items have flexibility advantages in which new questions could be forwarded during the interview based on the responses of the interviewee.

2.5.5 Informal Interview

Another data collection tool used in this study was a spontaneous and on-site informal interview using a guideline during field visits. Though this tool, informative and suggestive data about individuals, local communities, households, Kebele, and city officials was collected.

2.5.6 Observation

Observations are typically conducted in a natural environmental setting, such as project sites workplaces, or communities. Direct observation involves visually inspecting the project site and surrounding areas to identify potential environmental impacts. This may involve documenting the presence of sensitive ecosystems, wildlife habitats, or cultural heritage sites. By using experts' deep observation, GSEMC assessed the social settings, physical characteristics, economic activities, environmental features, plants, and crops found in and around the proposed project sites. The observation activities were also supported by taking photographs and video recordings.

2.5.7 Hand-Held GPS

A global positioning system (GPS) (Model: GPS Map 76 CSx) Hand, GPS is used to collect (X, Y) coordinate points of the study site and development of GIS-based maps. GPS coordinates are collected at site-level investigation points for the identification of location features and to ensure accurate mapping, analysis, and visualization of environmental parameter data. Remote sensing is also applied by using satellite imagery technologies to gather information on the project site and surrounding areas. This method is utilized for identifying land use patterns, vegetation cover, or other environmental features. The collected data was analyzed using various software tools, including ArcGIS for preparing different maps.

2.5.8 Water Physico-chemical Quality Testing

Sampling involves collecting water samples to assess the baseline environmental conditions or potential impacts associated with the proposed project. A sterilized sample bottle was used to collect water samples from rivers in and around the proposed project sites. Before sampling, sample collection containers were properly cleansed with distilled water and rinsed with the sample water. After a brief flow of about two–three minutes, groundwater samples were taken. Before water sample analysis, testing instruments were calibrated by using calibrating solutions supplied by the company. In

situ (on-site) physicochemical analysis for temperature, pH, Total dissolved solids (TDS), and Electrical Conductivity (EC) done by using portable TechPro II™ Series Model THP1 (MYRON L® COMPANY USA) per the guidelines of the instrument manual.

Furthermore, other physicochemical parameters like Nitrite, Sulphate, Potassium, Iron, Phosphate, Ammonia and Total alkalinity were measured Ex situ (in the laboratory) by using Wagtech WTD Palin test Photometer 7100 at Dilla University research laboratory.

2.6 Impact Identification and Analysis

The type and sources of collected data greatly vary according to the analysis. Analysis was done through the evaluation of the baseline conditions, risk assessment, and stakeholder analysis, and information was triangulated to see their associations.

Stakeholder analysis comprises identifying and analyzing the interests, values, and concerns of stakeholders who may be affected by the project. For each identified impact risk assessment was done through quantifying the likelihood and severity of potential environmental, social, and health impacts of the project. The significance of the predicted or identified impacts has been quantified and evaluated by considering the magnitude of the effect and the sensitivity, value, and importance of the affected resource or receptor. For the quantification and evaluation of impacts checklists and interaction matrices were applied. Each major impact is evaluated using the criteria assigned by experts' professional judgment based on the impact intensity, extent, duration, and sensitivity of the receiving biophysical and socio-cultural environment. After the evaluation of impacts, appropriate and justified mitigation measures for the negative impacts and enhancement measures for the positive impacts are forwarded.

Descriptive data analysis were done after the collected baseline data was encoded in Microsoft excel. Descriptive analysis was done as mean, maximum, minimum, frequency, and percentage which are presented in tables, figures, pictures, and charts.

2.7 Data quality

High-quality data is fundamental to the effectiveness of Environmental Impact Assessments. Ensuring accuracy, completeness, consistency, and relevance in data collection helps to create reliable assessments that inform environmental management and decision-making. To ensure data quality we have utilized ,Established working Protocols (WB and Ethiopian ESIA guideline), Quality Control Procedures(Implement checks and audits throughout the data collection and analysis process), Stakeholder Involvement (in data collection to enhance relevance and accuracy), Use of Technology(remote sensing, GIS, and tools to enhance data collection and analysis efficiency).

3. Policy Legal Frameworks and Institutional Arrangement

The implementation of the BT FSTP subproject has the potential to cause environmental and/or social impacts that shall be addressed by relevant Ethiopian legislation as well as the requirements of the World Bank Environmental and Social safeguards and standards. The subsections below provide more details on the applicable legislative framework for the ESIA.

3.1 Policy and legal Frameworks

3.1.1 Constitution of the Federal Democratic Republic of Ethiopia

The Constitution is the supreme law of the country, whose provisions must be complied with by all other policies, regulations, and institutional frameworks. The Constitution of the FDRE (Proclamation No. 1/1995 as amended) is the foundation for human rights, natural resources, and environmental management. The concepts of sustainable development and environmental rights are enshrined in the constitution of the FDRE through articles 43 and 44, which state among others the right to development and the right to live in a clean and healthy environment.

Article 44(2) of the Constitution states that all persons who have been displaced, or whose livelihood has been adversely affected as a result of state programs have the right to commensurate monetary or alternative means of compensation including relocation with adequate State assistance. The government shall pay fair compensation for property found on the land but the amount of compensation shall not take into account the value of land. Moreover, the Constitution states that, without prejudice to the right to private property, the government may expropriate private property for public purposes subject to payment in advance of compensation commensurate to the value of the property (Article 40(8)). Moreover, Article 43 (2) dealing with the rights to development states that nationals have the right to participate in national development and, in particular, to be consulted concerning policies and projects affecting their community.

3.1.2 Environmental Policy and Strategies

To further amplify the Constitutional provisions on environmental protection, the Environmental Policy of Ethiopia was approved in 1997 (EPA, 1997). The policy goal is to improve the health and quality of life of the people of Ethiopia and to promote sustainable social and economic development through sound management and use of natural, human-made, and cultural resources and the environment.

The policy seeks to:

Ensure that essential ecological processes and life support systems are sustained, biological diversity is preserved and renewable natural resources are used in such a way that their regenerative and productive capabilities are maintained and where possible enhanced so that the satisfaction of the needs of future generations is not compromised; where this capability is already impaired.

3.1.3 Land Tenure Policy

The Constitution of the Federal Democratic Republic of Ethiopia (FDRE) states that the right to ownership of rural and urban land, as well as all the natural resources, is exclusively vested in the State and People of Ethiopia. Article 40 of the Constitution

indicates that land is a common property of the Nations, Nationalities, and the People of Ethiopia, and shall not be subjected to sale or other means of transfer. The constitution of FDRE retained land under the control of the people and government of Ethiopia thus, prohibiting its buying and selling. Article 4(5) of the proclamation 94/1994 also deals with the provision of land for the conservation, development, and utilization of state forests or protected areas. However, this can be effective only after the consultation and consent of the peasantry and subject to the assurance of their benefits.

3.1.4 National and Regional Conservation Strategy

Since the early 1990s, the Federal Government of Ethiopia has undertaken many initiatives that aim to develop regional, national, and sectorial strategies to conserve and protect the environment. Paramount among these was the conservation strategy of Ethiopia (CSE, 1996). This document provides a strategic framework for integrating the environment into new and existing policies, programs, and projects. It is also an important policy document, which views environmental management as an important component of development. It recognizes the importance of incorporating environmental factors into development activities from the outset.

The major environmental and natural resources management issues facing Ethiopia are well documented in the CSE (FDRE, 1997). The CSE sets out detailed strategies and action plans as well as the institutional arrangements required for the implementation of sectoral as well as cross-sectorial interventions for the management of Ethiopia's natural, man-made, and cultural resources.

3.1.5 National Biodiversity Policy

The National Biodiversity Policy (NBP) was established in 1998 based on a holistic ecosystem approach to conserve, develop, and utilize the country's biodiversity resources. The policy guides effective conservation, rational development, and sustainable utilization of the country's biodiversity, and contains comprehensive policy provisions for the conservation and sustainable utilization of biodiversity. Integration of biodiversity conservation and development in federal and regional sectoral development initiatives, and mobilization of international cooperation and assistance, have been identified as the principal strategies for implementation of the policy.

This policy framework provides direction and regulatory tools for the overall conservation and sustainable development of the country. In line with this, the proposed project will have and be expected to support the conservation of nature including the forest resource as has been required.

3.1.6 Ethiopia's Climate Resilient Green Economy Strategy

To cope with the prevailing environmental problems such as land degradation and climatic hazards (rainfall fluctuation, increasing temperature, flooding), and speed up its socioeconomic development, the Government of Ethiopia has planned a climate-resilient green economy as a development strategy. This development direction promotes environmental protection, reducing fossil fuel consumption which releases greenhouse gases into the atmosphere. With the demand for energy growing with the

increasing population, industrialization, and urbanization, the government realized that harnessing clean and renewable energy sources such as wind, solar, hydro, and geothermal energy sources was critical. It has indicated that these natural resources would deliver electricity at virtually zero GHG emissions. The generated electricity is a fundamental enabler of modern economic development, from powering cities and fueling industrial activity to pumping water for irrigation purposes in agriculture. The government also decided to increase its income through exporting electric power generated from clean sources to neighboring countries.

3.1.7 Ethiopian Water Resources Management Policy

The overall goal of water resources policy is to enhance and promote all national efforts towards the efficient, equitable, and optimum utilization of the available water resources of Ethiopia for significant socioeconomic development on a sustainable basis. The policy has three sub-policies: water supply and sanitation policy, irrigation policy, and hydropower policy. For this particular ESIA study Water Supply and Sanitation Policy objectives are summarized here as follows:

The Water Supply and Sanitation policy objectives are the provision of, as much as conditions permit, sustainable and sufficient water supply services to all the peoples of Ethiopia; satisfying water supply requirements for livestock, industries, and other users as much as conditions permit; carrying out operation and maintenance of all water supply and sanitation services sustainably and efficiently; promoting sustainable conservation and utilization of the water resources through protection of water sources, efficiency in the use of water as well as control of wastage and pollution; creating sustainable capacity building in terms of the enabling environment, including institutions, human resources development, legislation and regulatory framework for water supply and sanitation; and enhancing the wellbeing and productivity of the people by creating conducive environment for the promotion of appropriate sanitation services (FDRE, 2010).

3.1.8 National Policy of Women

The national Policy of Women (NPW) was issued in March 1993. In this policy it is indicated that government policies, laws, regulations, plans, programs, and projects should be based on the following objectives: to ensure the participation of women in the formulation of government policies, laws, regulations, programs, and projects that directly or indirectly benefit and concerns of women; to insure participation and involvement of women in implementation and decision-making processes; and to ensure equal access of men and women to the country's resources.

3.1.9 National Health Policy

Ethiopia had a low level of health coverage even in comparison with other Sub-Saharan countries. This is largely related to low levels of income and widespread poverty, low levels of education, nutritional deficiencies, poor environmental conditions, and inadequate access to health services.

Health Sector Development Plans and Strategies have been designed to implement the stated health principles within a defined period. The strategies include raising awareness of personal and environmental health care and sanitation through

Information, Education, and Communication; control of disease; and promotion of primary health care through community participation.

3.1.10 National Policy on HIV/AIDS

The 1998 Policy on HIV/AIDS of the Federal Democratic Republic of Ethiopia urges communities at large, including government ministries, local governments, and civil society to feel responsibility for carrying out HIV/AIDS awareness and prevention campaigns “to provide an enabling environment for the prevention and control of HIV/AIDS in the country”. So it is expected that sufficient awareness exists within the community. In addition, all the workers and contractors working in the proposed sub-projects shall be treated fairly per the policy.

3.1.11 Urban Wastewater Management Strategy

MoWIE issued this strategy in 2017. The purpose of this strategy is to provide a common understanding of the strategic vision to guide wastewater management partners towards an effective and coordinated response through prioritized interventions and targeted programs, whilst encouraging efficient and sustainable use of resources. The objectives of the strategy are geared toward the development of strong wastewater management institutions, master plan preparation, implementation methods, protecting of the environment from wastewater discharge, social and cultural sustainability, wastewater collection and treatment, wastewater collection transportation, and treatment and reuse of treated effluent and sludge.

3.1.12 Urban Development Policy

Ethiopia has enacted urban development policy in 2005. The policy has directed to solve the major routine problems of urban centers of Ethiopia such as: Infrastructure development, Social service development, Housing development, Recreation facilities, Solid and liquid waste disposal system, Maintaining proper urbanization processes and strengthening of urban rural linkage, Maintaining balanced development among urban centers. Maintaining proper solid and liquid waste disposal system is one of the issues which have special consideration in the urban policy of Ethiopia. The policy paper has classified urban centers of Ethiopia in to four major categories. These are metropolitans (more than one million population), cities (100,001-1 million population), large City’s (50,001-100,000), medium City’s (20,001-50,000), and small City’s (2,001-20,000 population). Thus, Bishoftu is consisting of 188,035(CSA, 2020) total population size and falling under City category of Ethiopia. The above specified objectives of the urban policy of Ethiopia comply with one of the key principles of City-Wide Inclusive Sanitation- i.e., is thriving cities which asserts sanitation contributes to thriving urban economy.

3.1.13 Integrated Urban Sanitation and Hygiene Strategy

The Ministry of Health (MoH) issued the strategy in 2016. The goal of the strategy is to mitigate the negative impacts of poor urban sanitation and hygiene on health, the environment, society, education, and the economy by promoting full sanitation and hygiene systems. The basic premise for the MoH to formulate this strategy was issues around urban sanitation and hygiene, which are complicated due to cross-sectorial

interventions and differences between towns. The implementation of the strategy is expected to have a positive impact on the economy of the country, the natural environment, health and wellbeing of all urban dwellers, including the most vulnerable ones. The strategy encourages all sanitation-related interventions to be based on town and town development plans, taking advantage of economies of scale, sharing of best practices within the country, and involvement of the private sector and Community Based Enterprises (CBEs).

3.2 Proclamations

3.2.1 Environmental Impact Assessment (Proclamation No, 299/2002)

Proclamation (No 299/2002) aims primarily at making the ESIA mandatory for schedule I and schedule II category projects and programs. The proclamation specifies the projects and activities that will require an ESIA. The proponent of the project must prepare the ESIA following the format specified in the legislation. The proclamation requires, among other things:

- ✓ Licensing agencies to ensure that the requisite authorization has been duly received before issuing an investment permit, a trade or operating license, or a work permit to a business organization;
- ✓ Specified categories of projects to be subjected to an ESIA and receive authorization from the competent or the relevant regional environmental agency before commencing implementation of the project;
- ✓ The authority or the relevant regional environmental agencies may issue an exemption from carrying out an ESIA in projects supposed to have an insignificant environmental impact;
- ✓ A licensing agency may suspend or cancel a license that has already been issued where the institution responsible for the environment at the federal level or the relevant regional environmental agency suspends or cancels environmental authorization;
- ✓ Procedures that need to be followed in the process of conducting an environmental impact assessment are described in the Proclamation. Thus, a project developer is expected to act as follows: - undertake a timely environmental impact assessment; identify the likely adverse impacts, incorporating the means of their prevention, and submit the environmental impact study report accompanied by the necessary documents to the institution responsible for environment at the federal level or the relevant regional environmental agency for review and approval.

Based on the proclamation the EPA Guideline (2003) developed, proposed projects are assessed and classified as one of the following schedules:

- ✓ **Schedule 1:** Projects which may have adverse and significant environmental impacts, and may, therefore, require full ESIA;
- ✓ **Schedule 2:** Projects whose; type, scale, or other relevant characteristics have the potential to cause some significant environmental impacts but are not likely to warrant a full EIA study.

- ✓ **Schedule 3:** Projects that have negligible direct environmental impacts and hence do not require environmental impact assessment.

Therefore, BC FSTP construction activities fall under category B (schedule II) which can cause some environmental and social impacts but are not likely to warrant a full ESIA.

3.2.2 Environmental Pollution Control proclamation (No.300/2002)

Ethiopian environmental pollution control proclamations No-300/2002 prove that some social and economic development activities may cause environmental harm that could jeopardize production. Article 3/1 of the proclamation explains environmental standards and simultaneously prohibits any person shall polluting or causing any other person to pollute the environment by violating the relevant environmental standard. Article 4 of this same proclamation elucidates the management of wastes, chemicals, and radioactive substances by the producer.

3.2.3 Solid Waste Management Proclamation (No.513/2007)

The main objective of the solid waste management proclamation (No 513/2007) is to enhance all stakeholders' capacity to manage the possible adverse impacts while creating environmentally, economically, and socially beneficial resources out of solid waste.

In article 17(1), it is depicted that without obtaining authorization, a person who implements a solid waste management project that requires a special permit before its implementation as determined in a directive issued by the relevant environmental agency commits an offense and shall be liable according to the relevant provision of the Criminal Code. Article 17(3) states that any manufacturer, importer, or seller who violates the provision of this Proclamation commits an offense and shall be liable according to the relevant provision of the Criminal Code.

3.2.4 Hazardous Waste Management and Disposal Control Proclamation

The objectives of the Hazardous Waste Management, Disposal Control Proclamation (Proc. No.1090/2018) are to create a system for the environmentally sound management and disposal of hazardous waste and to prevent damage to human or animal health, the environment, biodiversity, and property due to the mismanagement of hazardous waste. The law addresses the management of hazardous waste including the application of cleaner production principles to minimize hazardous waste, the responsibilities of hazardous waste generators, transportation of hazardous waste, precautionary measures to be taken during transportation and storage of hazardous wastes, and reuse, recycling, and disposal of hazardous wastes. In this proclamation wastewater in general terms has been categorized as hazardous waste in Annex One of this Proclamation and any waste that has substances or wastes containing viable microorganisms or toxins that are known or suspected to cause disease in animals or humans is also considered to be hazardous.

Under the proclamation the hazardous waste generator shall have the responsibilities to collect, segregate, and dispose or cause to be collected, recycled, or disposed of

hazardous waste by an authorized body; ensure that the containers of hazardous waste are properly packed and conspicuously labeled with Amharic and English languages or other languages of the country as may be necessary; keep record on the type and quantity of hazardous waste that exist at the temporary hazardous waste storage facility; and show the record at any time when requested by inspector, and not to store hazardous waste at a temporary storage facility for a period exceeding one month. The relevance of this proclamation for the subproject is that it is a legal base regarding the way wastewater and sludge are handled managed, and discharged to the environment as well as workers' welfare.

3.2.5 Expropriation of Land, Payments of Compensation and Resettlement Proclamation

The Expropriation of Land holdings for Public Purposes, Payments of Compensation and Resettlement Proclamation (No. 1161/2019) has revoked proclamation No. 455/2005 and is applicable throughout the country in rural and urban centers on matters relating to land expropriation, payment of compensation and resettlement of landholders whose land is expropriated for public purpose. The Proclamation defines public purpose as a decision that is made by the cabinet of a regional state or city administration or the appropriate federal authority based on an approved land use plan/development plan / structural plan under the belief that the land use will directly or indirectly bring better economic and social development to the public.

3.2.6 Labour Legislation (Proclamation No.1156/2019)

The labor proclamation obliges that an employer shall take the necessary measures to adequately safeguard the health and safety of the workers. To ensure workers' safety and job security the need to respect this proclamation has been clearly stated in this document. Under this proclamation, the following specific issues have been found relevant and important to be recognized and implemented accordingly during the operation of the plants under process. Freedom of association and collective bargaining: the right of all workers to form and join trade unions and bargain collectively. Representatives should not be subjected to discrimination and shall have access to all workplaces necessary to enable them to carry out their representation section.

Living wages: wages and benefits paid for a standard working week should meet at least legal or industry minimum standards and always be sufficient to meet the basic needs of workers and their families and to provide some discretionary income. Pay should be in cash, direct to the workers, promptly and in full. Information on wages should be available to the workers in an understandable and detailed form.

Equal handling: workers should have access to jobs and training on equal terms, irrespective of gender, age, ethnic origin, color, marital status, sexual orientation, political opinion, religion, and social origin. Physical harassment or psychological oppression, particularly of women workers must not be tolerated.

2.2.7 Cultural Heritage Conservation

The objectives of the Research and Conservation of Cultural Heritage Proclamation No. 209 /2000 are among others to carry out registration and supervision of cultural

heritage, to protect cultural heritage against man-made and natural disasters. There is an Authority for the Research and Conservation of Cultural Heritage accountable to the Minister of Culture.

3.3 The World Bank Group Environmental, Health, and Safety

Guidelines

The general approach to the management of Environmental, Health, and Safety (EHS) issues at the facility or project level is for the effective inclusion of EHS considerations into corporate and facility-level business processes in an organized, hierarchical approach that includes the following steps:

- ✓ Identifying EHS project hazards (threats to human health and what they value) and associated risks as early as possible in the facility development or project cycle, including the incorporation of EHS considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans;
- ✓ Involving EHS professionals, who have the experience, competence, and training necessary to assess and manage EHS impacts and risks, and carry out specialized environmental management functions including the preparation of project or activity-specific plans and procedures that incorporate the technical recommendations
- ✓ Understanding the likelihood and magnitude of EHS risks, based on:
 - ❖ The nature of the project activities, such as whether the project will generate significant quantities of emissions or effluents, or involve hazardous materials or processes;
 - ❖ The potential consequences to workers, communities, or the environment if hazards are not adequately managed, may depend on the proximity of project activities to people or to the environmental resources on which they depend.
 - ❖ Prioritizing risk management strategies achieves an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and/or significant impacts.
 - ❖ Favoring strategies that eliminate the cause of the hazard at its source, for example, by selecting less hazardous materials or processes that avoid the need for EHS controls. When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences, for example, with the application of pollution controls to reduce the levels of emitted contaminants to workers or environments.
 - ❖ Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.

The WBGEHS guideline of wastewater and ambient water quality set a standard for basic parameters for sanitary discharge limit (Table 1).

Table 1 Indicative value for treated sanitary sewage discharges

Pollutant	Unit	Maximum value
pH	pH	6-9
BOD	mg/l	30
COD	mg/l	125
Total Nitrogen	mg/l	10
Total Phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50

Source: WBG EHS (2007) standard of Wastewater and ambient air quality

Thus, it is important to comply with the required discharge limit for all effluent parameters during the entire operation period which implies that it is possible to use the treated fecal sludge for different purposes.

3.4 World Bank Safeguard Policies

WB has several Operational Policies (OP) to ensure that the environment and human populations are protected during the development process. Five of the ten WB safeguards Policies are triggered as part of the implementation of the UWSSP II (Environmental Assessment (OP/BP 4.01), Safety of Dams (OP/BP 4.37), Physical Cultural Resources (OP/BP 4.11), Involuntary Resettlement (OP/BP 4.12) and Projects on International Waterways OP/BP 7.50). Besides, the World Bank Group (WBG) Environment, Health and Safety Guideline (EHSG) shall be applicable as deemed necessary. However, the following safeguards policies are more relevant and applicable as part of the implementation of the proposed FSTP subproject activities; Environmental Assessment (OP/BP 4.01); Involuntary Resettlement (OP/BP 4.12); and Physical Cultural Resources (OP/BP 4.11).

Environmental and Social Assessment (OP 4.01): This policy requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. According to the WB OP 4.01, Environmental Assessment (EA), and the National EIA guideline (2003) the proposed project falls under category B and schedule II, respectively. The proposed UWSSP II triggers the WB OP 4.01, Environmental Assessment Policy. Thus, according to the WB categorization of ESIA study reports BC FSTP was grouped under category ‘B’ which was again endorsed by the WB as a financier.

Natural Habitats (OP 4.04): This policy is triggered for environmentally sustainable development through protecting, conserving, maintaining, and rehabilitating natural habitats and functions. Moreover, when there is a potential for significant degradation of natural habitats, directly through construction or indirectly through human activities induced by the project. However, OP 4.04 will not be triggered due to the absence of any natural habitat in BC FSTP or other components of the project.

Projects on International Waterways (OP 7.50): This policy is relevant if a project activity adversely impacts the quality and quantity of international waterways shared with one or more countries. This project triggers OP 7.50 given that it is located within the Ethiopian Rift Valley water Basin, which is shared with the Kenyan ground water sources.

Indigenous Peoples (OP 4.10): The objective of this policy is to (i) ensure that the development process fosters full respect for the dignity, human rights, and cultural uniqueness of vulnerable and historically under-served communities and peoples; (ii) ensure that they do not suffer adverse effects during the development process; and (iii) ensure that such communities and peoples receive culturally compatible economic benefits. In BC FSTP, No indigenous people will be affected, so it does not trigger OP 4.10.

Physical Cultural Resources (OP 4.11): The objective of this policy is to assist countries in avoiding or mitigating the adverse impacts of development projects on physical cultural resources (PCR). For purposes of this policy, “physical cultural resources” are defined as movable or immovable objects, sites, structures, groups of structures, natural features, and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. The chance finds procedure, under OP 4.11, shall at least be applicable as part of the excavation activities of the FSTP.

Involuntary Resettlement (OP/BP 4.12): The WB Involuntary Resettlement Policy OP 4.12 requires that all projects with land acquisition implications are guided by a Resettlement Policy Framework (RPF), which outlines processes and procedures to be followed for the preparation of site-specific RAPs during project implementation. The UWSSP-II project will apply both WB requirements and the Ethiopian government’s guidelines regarding compensation and resettlement of PAP and where there are gaps between these two, the most stringent policy will prevail.

3.5 Comparison of the World Bank Safeguard and National Policies

The summary of the Ethiopian and the World Bank safeguard policy comparison is indicated in Table (2).

Table 2 Ethiopian and the World Bank policy comparison

Theme	The Ethiopian legislations	WB safeguard OP	Comparison	Measures
Social issues in ESIA	EIA proclamation 299/2002 overlooked social issues. That is the proclamation title itself was written as “Environmental Impact Assessment (EIA)” not as Environmental and Social Impact Assessment (ESIA) and the public disclosure of the ESIA is not mandatory. Preliminary social screening was not stated.	The Bank’s operational policy OP 4.01 emphasizes both environmental and social impact assessment of programs or subprojects. It also made the public disclosure of category A & B ESIA mandatory.	The EIA proclamation 299/2002 overlooked social assessment of subprojects and programs and public disclosure of the ESIA whereas OP 4.01 gives a special focus on them	When the government legislation is found less stringent in addressing issues compared to the WB procedures, the safeguard policies of the WB will be applied
Eligibility for compensation	Proclamation No1161/2019, Article 8(1) allows landholders to be eligible for compensation when the landholders or their agents whose landholdings are to be expropriated shall submit landholding certificates or other proofs that show their landholding rights over the lands that are decided to be expropriated to the urban or rural land administration office on the schedule of the office. This gives entitlement only to those who have formal legal rights over their land holdings	World Bank OP4.12 gives eligibility to: those who have formal legal rights to the land; those who do not have formal legal rights to land, but have a claim to such land; and those who do not have recognizable legal rights or claims to the land.	According to World Bank OP4.12 eligibility for compensation is granted to all affected parties but the Ethiopian Legislation only grants compensation to those with lawful possession of the land that is expropriated. It does not recognize those without a legal right or claim as eligible for compensation.	Eligibility criteria for compensation and assistance shall be in line with the WB eligibility for benefits

<p>Concern for the indigenous people's right</p>	<p>The Expropriation of Land holdings for Public Purposes, Payments of Compensation and Resettlement Proclamation No. 1161/2019 does not clearly articulate the rights of indigenous people. Moreover, it is not importance for separate social assessments to address how indigenous people are closely tied to land, forests, water, wildlife, and other natural resources,</p>	<p>The World bank BP 4.10- gives separate social assessment and the need for indigenous people plan (IPP) preparation to manage their wisdom sustainably.</p>	<p>The World bank BP 4.10- necessitates the need for separate social assessment and also gives special consideration to land and related natural resources to address how Indigenous Peoples are closely tied to them but the Proclamation No. 1161/2019 overlooked it.</p>	<p>When the livelihood of the indigenous might be affected social assessment and preparation of IPP should be in line with the world bank BP 4.10.</p>
<p>Actions for livelihood restoration and assistance to vulnerable groups</p>	<p>There are no specific laws or regulations specifying support for livelihood restoration and transition& and moving allowances. Ethiopian law makes no specific accommodations for potentially vulnerable groups such as women, children, the elderly, ethnic minorities, indigenous people, the landless, and those living under the poverty line.</p>	<p>Livelihoods and living standards are to be restored in real terms to pre-displacement levels or better. OP 4.12 further requires attention to be given to the needs of vulnerable groups like people with disabilities below the poverty line, landless, elderly, women and children, indigenous groups, ethnic minorities, and other disadvantaged persons</p>	<p>Ethiopian policy and legislation would need to be aligned with the Bank's policy to effectively guarantee the rights of all affected persons by involuntary resettlement. Vulnerable groups are at the highest risk or prone to experience negative effects due to resettlement and should receive special consideration during the preparation of a resettlement policy framework.</p>	<p>The treatment of the vulnerable and historically under-served community groups should be per <i>OP 4.10</i></p>

3.6 UWSSP II Specific Legal Frameworks

3.6.1 Environmental and Social Management Framework (ESMF)

The overall objectives and purposes of the ESMF of UWSSP II can be summarized as follows:

- Review Ethiopia's environmental policies, legislation, regulatory and administrative frameworks in conjunction with the World Bank's ten safeguard policies. Where there are gaps between these policies make recommendations as to how to bridge these gaps in the context of the proposed project as appropriate;
- Develop a stakeholder consultation process that ensures that all key stakeholders, including potentially affected persons, are aware of the objectives and potential environmental and social impacts of the proposed project;
- Assess the current ability at the regional and/or city level to implement the recommendations of the ESMF, and make appropriate recommendations;
- Assess the potential environmental and social impacts of planned sector investments and rehabilitation activities in the urban areas;
- In light of the available information, develop an environmental and social screening process for the future rehabilitation and construction activities referred to above; and,
- Prepare an Environmental and Social Management / Monitoring Plan (ESMP), including monitoring indicators, for the UWSSP.

3.6.2 Resettlement Policy Framework (RPF)

The main objective of this RPF is to ensure adequate management of the land acquisition process the World Bank Operational Policy as well as the country's legal requirements and provide guidance for the preparation and implementation of Resettlement Action Plans (RAP) for the subprojects of the UWSS-II Project. This RPF aims to ensure that any possible adverse impacts of proposed project activities are addressed through appropriate mitigation measures. It addresses issues of land acquisition, loss of property or access, or more of livelihoods resulting from the implementation of waste water treatment plant, public and communal toilets, trunk line and a pipe line and in some cases access roads under the proposed project.

3.7 Administrative and Institutional Framework

The FDRE Environmental Protection Authority (FEPA) is an autonomous public institution of the Federal Government of Ethiopia entrusted with the protection and conservation of natural resources in Ethiopia. The general role of the FEPA is to provide for the protection and conservation of the broad environment, through the formulation of policies, strategies, laws, and standards, which foster social and economic development in a manner that enhances the welfare of humans and the safety of the environment. following the principles of government decentralization, each national regional state shall establish an independent Regional Environmental Agency or designate an existing agency that shall, based on the Ethiopian Environmental Policy and Conservation Strategy and ensuring public participation in the decision-making process, be responsible for Coordinating the formulation, implementation, review, and revision of regional Environmental monitoring, protection, and regulation.

3.8 Oromia region Environmental Protection Authority

Oromia region Environmental Protection Authority (OREPA) is responsible for environmental protection matters in the region. The office has the mandate of enacting regional environmental proclamations, regulations, standards, and guidelines. The OREPA is responsible for the review and approval of ESIA of development proposals under the mandate of the Regional Government. It is also mandated to follow up construction and execution of the project at least on a semiannual basis. The office is responsible to conduct environmental and social safeguard audits every two years and give technical assistance and guidance to the zone and city administration environmental regulatory agencies.

3.9 East Shewa Zone Environmental Protection Office (ESZEPO)

ESZEPO is mandated to ensure concerned stakeholder involvement in the FSTP planning, construction, and operation. Community follow-up of the implementation of ESIA recommendations of such proposals becomes a joint responsibility of regional and Zone EPA. Zone EPA should follow up every quarter and compile progress reports to the regional EPA. The regional EPA at least should visit twice per year and give written feedback to the developer. Therefore, project proponents in the Region should operate in close cooperation with both the regional and Zone EPA to ensure that the adverse environmental and social effects of development proposals are properly identified and their mitigation or management actions incorporated in the project design, planning, and implemented at the right time.

4. Description of the Proposed Development Subproject

In this section the overall description of proposed development of fecal sludge treatment plant (FSTP) is presented.

4.1. Project area description

The project is implemented in Bishoftu town. Bishoftu town is located in Oromia Regional State in the eastern direction of the capital, Addis Ababa, at 47 km away on the lifeline road of Addis Ababa-Djibouti. The geographical/astronomical/ location of Bishoftu town is at 8044'40''N latitude and 38059'9''E longitude and according to the new structural plan the city's total area is increased to 63,158.56 hectares in 2023 (Bishoftu town, 2024). Bishoftu is situated in the East African Rift Valley and is known for its numerous freshwater lakes. The proposed project includes the rehabilitation of public toilets, and development of a fecal sludge treatment plant. The location map of FSTP and public and communal toilets is presented in (Figure 1).

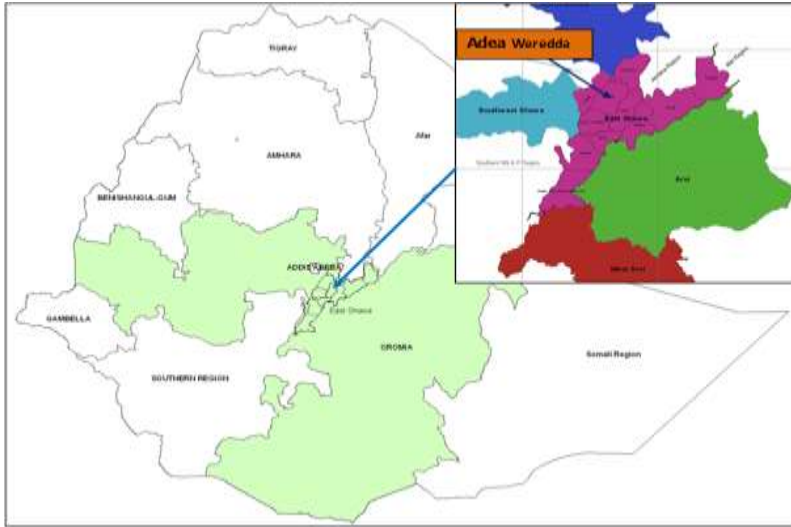


Figure 1 Location Map of Bishoftu town

Source (Ms Conculancy, 2010)

The proposed site for FSTP is located at Udde Kebele which was recently incorporated under the town boundary. Geographically the proposed project site is located between 06°47'01.37" N and 37°44'33.06" E and has an elevation of 1769m. The area is situated east of the BT center, almost 12 kilometers south of main Bishoftu to Mojo Asphalt road.

The slope of the project area is almost 0 (flat) and surrounded by hills in one side. The proposed area is an agricultural land of "Teff". Some part of the area is used by communities as grazing land for their cattle. The area is suitable for investment the proposed site is located at the periphery of the town, far from residential areas and suitable for investment. The proposed FSTP construction site is found nearby of electricity transmission line infrastructure. Access Road infrastructure: The proposed site do not require access road. The existing Bishoftu Gafat armament road can be used.

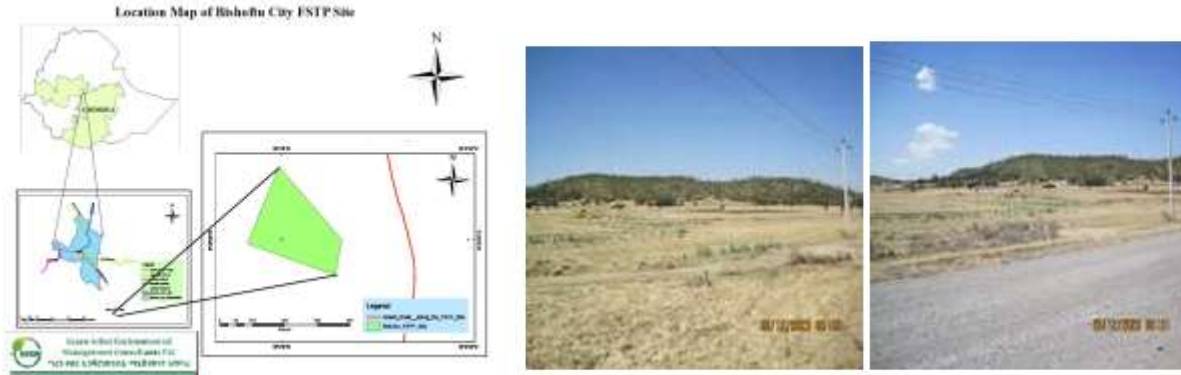


Figure 2 Location and pictures of the proposed site at Bishoftu town

4.2 Overview of UWSSP-II project and Its Components

4.2.1 Components of the Project

The project's UWSSP-II development goal is to increase access to better sanitation and water supply services in Addis Ababa and 22 other secondary cities while preserving operational effectiveness. The three project elements listed below will help to accomplish this objective:

- Sanitation and water supply services improvements in Addis Ababa will finance the construction of sanitation facilities in various settlements and socio economic situations;
- Sanitation and water supply services improvement in selected 22 secondary cities from all the regional states and Dire Dawa city administration; and
- Project management and institutional strengthening component will help manage the project and strengthen their institutional capacity.

The sanitation improvement plan of the town is considered to be implemented at phased approach. Phase one: immediate/ short term solution phase which will serve the city up to 2025 Phase two: middle phase which will serve the city up to 2035 Phase three: long term phase which will serve the city up to 2045.

4.2.2 Short term intervention period (2023-2025)

As an immediate /short term solutions includes construction of additional public/communal toilet; purchase of additional municipal vacuum trucks, standby truck; supplying two portable suction pumps. Setup an independent wastewater management within the utility.

Almost 50% of the existing communal toilets, 30 of the existing communal and 12 public toilets are in poor condition needs rehabilitation and improvement work. Currently seven additional toilets are under construction and the total number of communal toilets is limited to 69. The total area required for the newly constructed 28 public toilet ranges from 96-151m² while for the 22 communal toilets the area required ranges from 80-140m². Locations of the public toilets

to be selected based on the available land for critical areas such as and the need in the dense areas and to be coordinated with the relevant authorities.

The existing situation of the transportation system is depending on a number of wastewater transportation trucks, which are limited in number and is not in a good condition, operated by both the private and the public government sectors. Doing the necessary maintenance to the current wastewater trucks and adding some new trucks spicily to serve the densely populated areas and the areas of greatest need. The additional vacuum trucks with holding capacity that ranges from 6-12m² to be introduced in the city fecal sludge collection service is in the range of 10 more (5 trucks for dry pit latrine and 5 trucks for wet holding tank desludging). All additional vacuum trucks to be special type which can handle dry pit latrine sludge.

4.2.3 Medium phase (2025-2035)

Bishoftu lacks both a recognized liquid waste treatment infrastructure such as FSTP. Provision of a standard fecal sludge treatment unit; Encourage the involvement of private vacuum truck operators; provision of special small hand driven desludging units; training and capacity building of the utility staffs are main activities that will be implemented in the medium term.

In this period, fecal sludge treatment plant with drying bed plus waste stabilization pond need to be constructed in appropriate location. Currently the private vacuum truck operators take 5/7 share of the fecal sludge collection and disposal activities. If they are encouraged they can cover all the wet: holding tank fecal sludge contribution. Most of the pit latrines located in densely populated areas are located at the back side of the residential blocks and are inaccessible to the conventional vacuum trucks so provision of special small hand driven desludging units is important. Training and capacity building in both water and sanitation sector will greatly contribute to the improvement of service delivery, which in turn will have its effects on public health.

4.2.4 Existing fecal sludge dump site

The existing fecal sludge disposal site at Golba area is functioning as lagoon and the surrounding surface drainage is also challenging it carrying capacity during the wet season. The surrounding communities are not in favor of it due to its miss management. Along the water supply, the BTWSSE utility is working to institutionalize the fecal service. Two vacuum trucks are currently operating alongside the five vacuum vehicles owned by private operators. The management of the fecal dumping site falls under the purview of the utility. The locals have expressed grave concerns about the dumping site's past poor management and anticipate that the service will be moved to a different location (figure 3).



Figure 3 Golba existing fecal sludge dump site at Bishoftu town

4.3 Treatment System Components of FSTP

Fecal sludge treatment plant has different components that works together in treating fecal sludge material that is suitable for reuse or environmental disposal. Fecal sludge and septage treatment plants need to include a number of treatment units that provide the following functions:

The proposed system includes:

- Inlet, Receiving Tank, screening equalization.
- Influent solids-liquid separation: Drying beds.
- Liquid treatment: 2 Anaerobic ponds.
- Liquid stabilization: 2 Facultative ponds.
- Pathogen reduction: 6 Maturation ponds.
- Drainage to storm drainage.

Fecal sludge/septage reception: Fecal sludge arriving at the treatment plant will usually first be discharged into a receiving tank. This tank should be equipped with a grid for removing the coarse objects. Coarse screens remove large solids, rags, and debris from wastewater, and typically have openings of 6 mm or larger. Additionally the receiving tanks can function as buffering tank, receiving the sludge in a strong flush and passing then in a lower continuous flow on the primary treatment facility.

Solids–liquid separation/Sludge drying beds: Sludge drying beds: consist of a gravel sand filter, equipped with a drainage system. Raw or pre settled FS is loaded on the bed and the water is evacuated mainly by percolation through the filter and to a minor part by evaporation. This structure separate solids and liquid through evaporation, settling, and filtration. Solids–liquid separation is an essential aspect of fecal sludge and septage treatment. This allows the size of subsequent treatment units in septage treatment plants to be reduced. To allow sunshine to reach the sludge storage while keeping out rain, the proposed drying beds were built to be

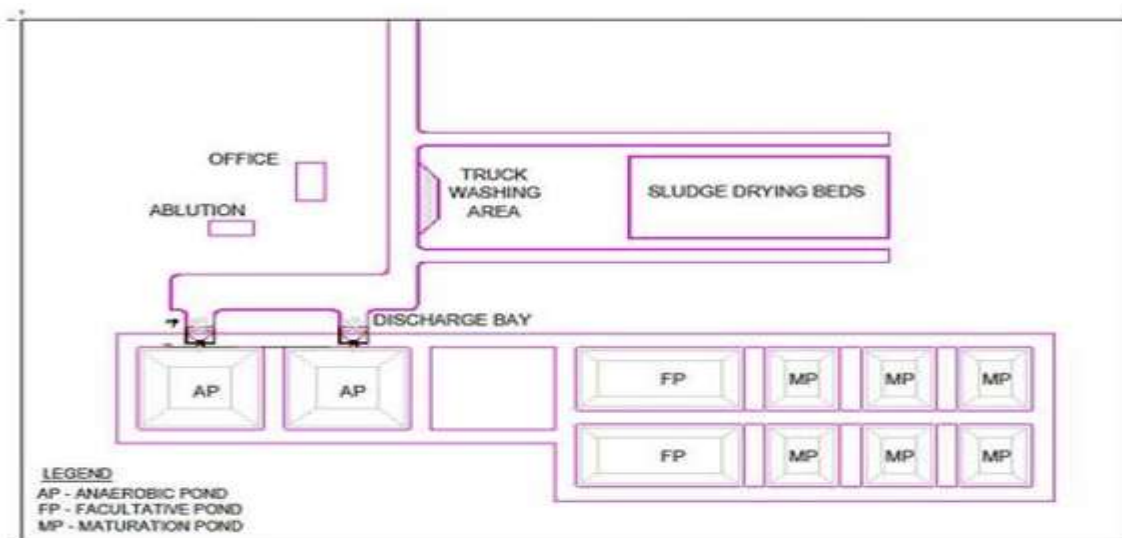
covered with translucent or semi-transparent roofs. A total height of 1.0 m was intended for each bed.

Liquid treatment/Anaerobic ponds (AP): Anaerobic ponds are ponds that are loaded sufficiently heavily for them to operate in purely anaerobic mode. Like sludge drying beds, anaerobic ponds are simple, requiring few specialist operational skills. Solids settle in anaerobic ponds, reducing the pond volume and creating a need for periodic sludge removal.

Liquid stabilization/ Facultative ponds (FP): FP are generally aerobic, however, these ponds do operate in a facultative manner and have an anaerobic zone. Treatment in a facultative pond is provided by settling of solids and reduction of organic oxygen demanding material by bacterial activity. Dissolved oxygen is supplied by algae living within the pond and atmospheric transfer through wind action. Facultative ponds are usually 4 - 8 feet in depth and can be viewed as having three layers. The main function of anaerobic, facultative and aerated ponds is the removal of carbon-containing organic matter.

Pathogen reduction/ Maturation ponds: Maturation ponds (low-cost polishing ponds), which generally follow either the primary or secondary facultative pond, are primarily designed for tertiary treatment, i.e., the removal of pathogens, nutrients and possibly algae. The maturation ponds, usually 1-1.5 m deep, receive the effluent from the facultative ponds. Their primary function is to remove excreted pathogens. The FSTP is designed based for the short term and can accommodate the long term and the following schematic shows the proposed system.

FSTP conceptual site arrangement: The proposed conceptual arrangement of FSTP includes the site work required for efficient operation of the main treatment units which includes fencing, gate and gate house, access roads, office, Washing platform and treatment infrastructures like AP,FP and MP.



Source: (CATS and United CE, 2022)

Figure 4 FSTP conceptual site arrangement for BT

Outline of the discharge outfall pipeline: Waste stabilization Pond (WSP) systems are simple, low maintenance systems requiring large footprint areas. Waste stabilization ponds (WSPs) are open basins enclosed by earthen embankments, and sometimes fully or partially lined with concrete or synthetic geo-fabrics. In general, anaerobic ponds are deepest (≥ 3.0 m) and are used first in series; facultative ponds are shallower (1.5 – 3.0 m) and may be used first or second in series (after anaerobic ponds); maturation ponds are shallowest (≤ 1.5 m), and are used last in series. The WSP layout is presented in figure (5).

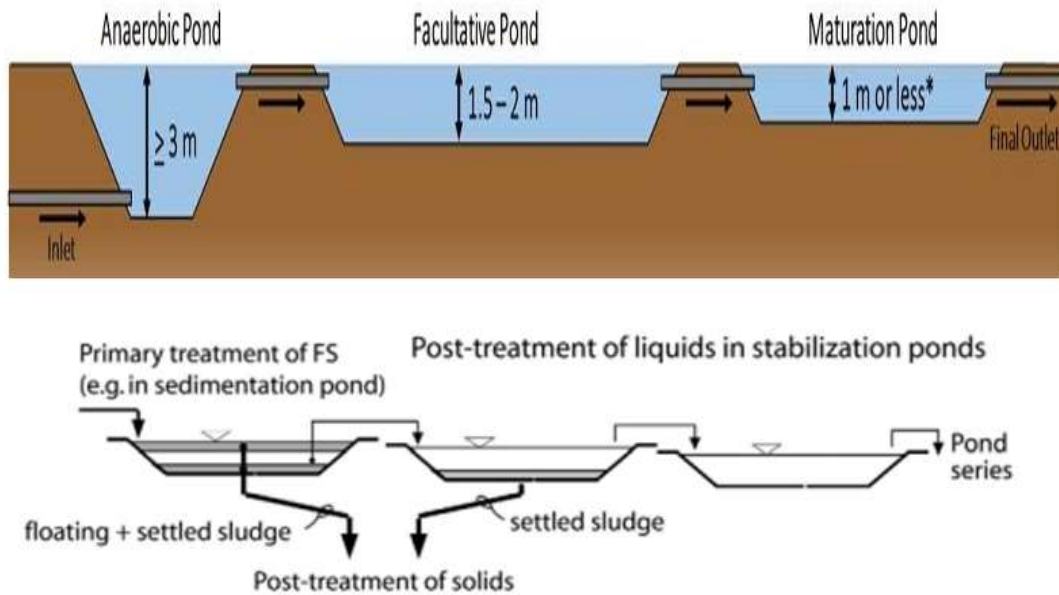


Figure 5 WSPs layout for BT FSTP

4.3.1 Fecal Sludge Treatment Plant capacity

To determine the capacity of fecal sludge treatment plant, estimation of fecal sludge seepage generation rates is important which may vary widely from place to place depending on practices of septic tank use, number of users, water used for flushing, and the frequency of cleaning the seepage. In any cases accurate estimation is crucially important to determine the complete management mechanism right from desludging intervals, collection system, treatment modules, size of treatment unit and area required for treatment to the end-use of the treatment by-products.

Estimations based on FS generation rate of the population: The size of a septic tank in individual houses that has been considered in Bishoftu town ranges from 5 to 10 cubic meter, whereas the size of a septic tank in office or apartment buildings may vary from 10 to 20 cubic meter. Adopting the (U.S. EPA, 1984) estimate of septage generation of 230 liters/year and taking 20 Household equivalent for institutional use. Hence, the current FS estimation based on generation rate is about $655.1\text{m}^3/\text{d}$ Table (3).

Table 3 FS estimation based on Fs generation rate for BT

	Criteria	Up to 2025
1	population	254070
2	No of residents Per HH	7
3	No HH (Homes)	36296
4	No of commercial/ institutional establishments in the coverage area	1462
5	FS Generation from HH (m ³ /d)	486.97
6	FS Generation Institutions (m ³ /d)	168.13
	Total FS(m ³ /d)	655.1

Source: (CATS and United CE, 2022)

4.3.2 Estimations using demand for fecal sludge collection

The fecal sludge to be received at the treatment plant is estimated based on the current fecal sludge collection volumes. The current estimates of fecal sludge desludging demand in volume is equal to the number of vehicles servicing the town multiplied by the volumes hauled by the truck x number of trips per day.

There are seven vehicles of which two of them have 10m³ capacity while the rest 12 m³, then total volume of fecal sludge that can be desludged per day is equal to Capacity of Vehicle * No of trips per day * No of vehicles. Based on this assessment the estimated volume of fecal sludge currently collected as per demand in BT is 320 m³/d table (4).

Table 4 Estimations using demand for fecal sludge collection

Vehicle type	Capacity M ³	No of trips/day	No of Vehicles	Total volume collected /day
Municipality	10m ³	2	1	20m ³
Private	12m ³	5	5	300m ³
Total			7	320m ³
S/No	Method of Estimations			Estimated FS generation (m ³ /d)
1	Estimation based on population based FS generation rate			655.1
2	Estimation using demand for FS collection			320
3	Estimation using primary data-Volumetric			281

Source: (CATS and United CE, 2022)

Estimation of FS by using primary data - volumetric involves, collected informations from households in terms of containment sizes and desludging frequencies were used for estimating the fecal sludge collected at the own level. Fecal sludge generation volume is done by considering different assumptions and by taking the relevant data from the conducted house hold survey done by CATS and United CE, (2022). By using primary data the estimated total sludge volume is 281m³/d and 52% is from Holding tank and rest from pit latrine (Table 4). Fecal sludge generation volume (m³/d) based on Primary data for the Medium term (2026-2035), and Long term (2036- 2045) is 798 and 2359 m³/d respectively.

4.3.3 Expected effluent quality standards

The treatment technology and processes are selected according to influent– effluent parameters and technical and economic considerations in which ultimately efficient in treating the fecal sludge at the required level. Waste stabilization ponds can treat the majority of wastewater types and function well in almost any setting. Because temperature and sunlight intensity are crucial for the effectiveness of the removal processes, they are especially well-suited for tropical and subtropical nations. Around the world, ponds are used. Ponds are the most popular method of treatment in many nations and areas. Maturation ponds are needed if the effluent is to be used for unrestricted irrigation or if there are special requirements in terms of microbiological quality for the receiving water body (bathing waters, for example). Maturation ponds play a crucial role in enhancing the treatment of fecal sludge, improving environmental sustainability, and ensuring public health safety.

For treated wastewater, the disposal standards of the effluent quality parameters have to follow Ethiopian WHO/EPA discharge limit guidelines as indicated in Table(5).

Table 5 Treated Wastewater (effluent) Quality Requirements

S/N	Parameters	Unit	Concentration
1	pH		6-9
2	COD	Mg/L	125.00
3	Biochemical oxygen demand (BOD ₅) at 20°C	Mg/L	80.00
4	TSS	Mg/L	50.00
5	TN	Mg/L	15.00
6	TP	Mg/L	2.00
7	Nitrate (NO ₃ -N)	Mg/L	10.00
8	Ammonia(NH ₄ -N)	Mg/L	2.00
9	Oil and grease	Mg/L	10
10	Fecal Coliforms	FCU/100ml	<1000

To reuse the dried fecal sludge, further treatment (mixing with lime) is necessary to eliminate pathogens in the dried sludge. Leachate that has been collected from drying beds and drained through them has to undergo further treatment, waste stabilization ponds, or wetlands before it can be disposed of or utilized properly.

Cost of the FSTP: The overall cost estimate for the selected FSTP components and site clearance is about 116,723,022.00 for which 6,965,000.0 for site work cost and the remaining is for construction of FSTP infrastructure. The cost breakdown is presented in table (6) below

Table 6 The estimated capital expenditure for the FSTP project

Item No	Description	Units	Quantity	Rate	Amount ETB
1	Fencing, Gate & Site office				
	Chain Link	m	2000	500	1,000,000.00
	Concrete posts (at 2m interval)	no	1000	2500	2,500,000.00
	Gate Including Pillars	no	1	150,000.00	150,000.00
	Gate House (watch tower)	m ²	15	25,000.00	375,000.00
2	Office Building	m ²	35	25000	875,000.00
3	Ablution Block	m ²	20	25000	500,000.00
4	Clean water tank And Tower (25000 L)	item	1	75000	75,000.00
5	Access road	km	1.2	950000	1,140,000.00
6	Vehicle Washing Area	m ²	70	5000	350,000.00
	Total				6,965,000.00

S.no	Item Description	Unit	Qty	Unit Rate	Amount
1	Sand Drying Bed (12m*32m)				
	Earth Work	m ³	43200	200	8,640,000.00
	Sand Supply and installation	m ³	6480	750	4,860,000.00
	Clay Layer supply spreading	m ³	1312.5	125	164,062.50
	Gravel packing	m ³	4320	750	3,240,000.00
	Piping (315mm HDPE pipe)	m	2400	600	1,440,000.00
	Total				18,344,062.50
2	Anaerobic pond				
	Earth Work	m ³	98280	200	19,656,000.00
	Piping	m	500	600	300,000.00
	Distribution Box/ transfer	m ³	86.4	8000	691,200.00
	Reinforcement bar	kg	67824	90	6,104,160.00
	Total				26,751,360.00
3	Facilitative Pond				
	Earth Work	m ³	39648	200	7,929,600.00
	Piping	m	500	600	300,000.00
	Distribution Box/ transfer	m ³	86.4	8100	699,840.00
	Reinforcement bar	kg	67824	90	6,104,160.00
	Total				15,033,600.00
4	Maturation				
	Earth Work	m ³	212625	200	42,525,000.00
	Piping	m	500	600	300,000.00
	Distribution Box	m ³	86.4	8100	699,840.00
	Reinforcement bar	kg	67824	90	6,104,160.00
	Total				49,629,000.00
	Option 1 Total Cost estimate				100,738,022.50

4.4 Implementation Arrangements

The proposed city wide inclusive sanitation (CWIS) project in BT calls for the building of communal and public toilets and fecal sludge treatment infrastructure over the course of the next 20 years. It will be carried out in three phases. The components of the short-term and mid-term interventions are as follows:

Short term interventions (2023-2025): it strives to increase containment, collection, and a secure discharge site by offering adequate public and community toilets. It also involves construction of drying bed for fecal sludge treatment facility. Since it is a temporary solution, immediate, cheap actions are put into effect immediately.

Medium term interventions (2025-2030): rehabilitate existing sanitation infrastructure in short term to improve containment and collection. It also comprises upgrading the fecal sludge treatment units, which has been improved to be managed more effectively and efficiently.

5 Description of Biophysical and Socio-Economic Conditions

This section gives baseline information on the physical, biological, socioeconomic, and cultural environments present in the area of BT.

5.1 Climate

Bishoftu has wet and dry season. The wet season brings lush greenery and vibrant landscapes, while the dry season is characterized by dry, sunny weather. However, BT enjoys a relatively mild and moderate climate throughout the year.

5.1.1 Rainfall and Evapotranspiration

The rainy season generally occurs from June to September, with July and August being the peak months. During this time, the town receives significant rainfall. The monthly precipitation pattern of the Bishoftu town is almost mono-modal with peak rainfalls of 230 mm in average in August (maximum) with more than 150mm monthly rainfall between Julys to September. Regarding potential evapotranspiration of the area, it is almost lower than the actual precipitation from June to September that indicates the presence of surplus moisture for nearly 4 consecutive month's figure (6).

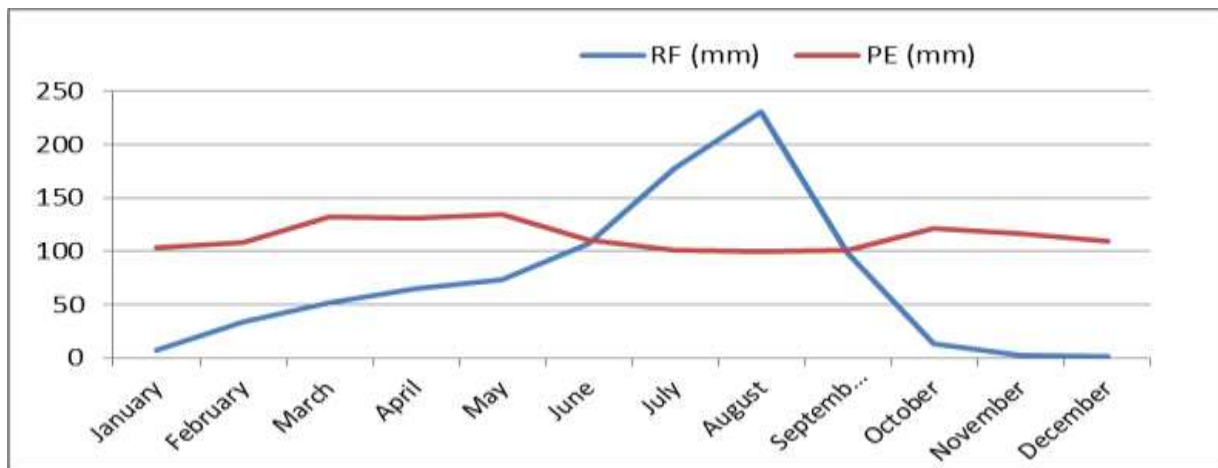


Figure 6 Bishoftu town Monthly rainfall and potential evapotranspiration in mm

5.1.2 Temperature

The maximum average monthly temperature of BT ranges between 23.8°C in August to 28.3°C in March. Similarly, the minimum and mean temperatures range respectively between 8.3°C to 13.3°C and 16.8°C to 20.5°C. The overall average temperature is 18.68°C. The hottest months are typically March, April, May and June with mean temperatures greater than 19.6°C. The coolest months are December (16.8°C) and January (17.6°C), with average temperatures less than 17.6°C figure (7).

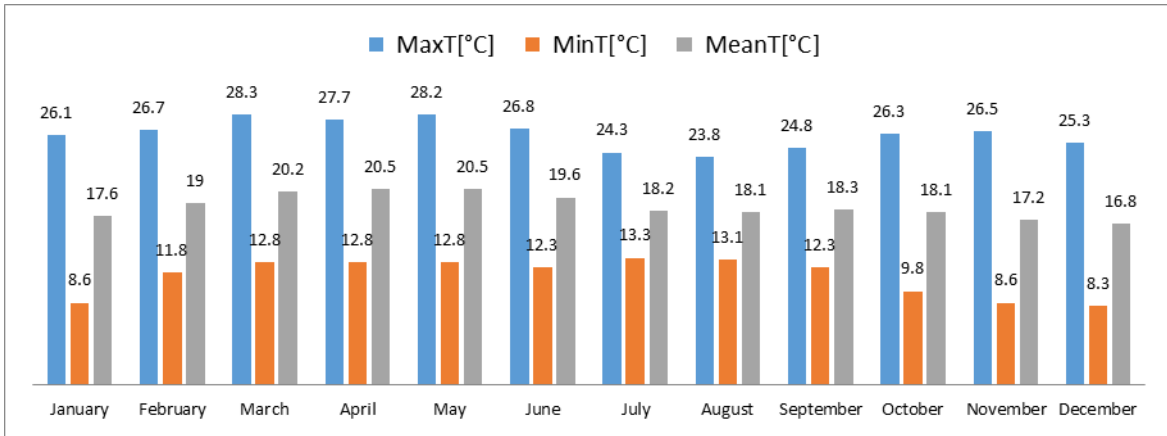


Figure 7 Max, Min, Mean monthly average temperature of Bishofitu town

5.1.3 Humidity

Humidity is the presence of water vapor in the atmosphere. The more water evaporates in a given area mean that the more water vapor rises into the air, and the higher the humidity of that area is. Hot places tend to be more humid than cool places because heat causes water to evaporate faster. The humidity level in Bishoftu, varies throughout the year. Bishoftu generally experiences moderate humidity levels. According to the CLIMWAT2.0 tool of FAO (2006), the annual average humidity of Bishofitu town is 56%. The maximum humidity is recorded about 72% in August and the minimum is recorded 43% in December Figure (8).

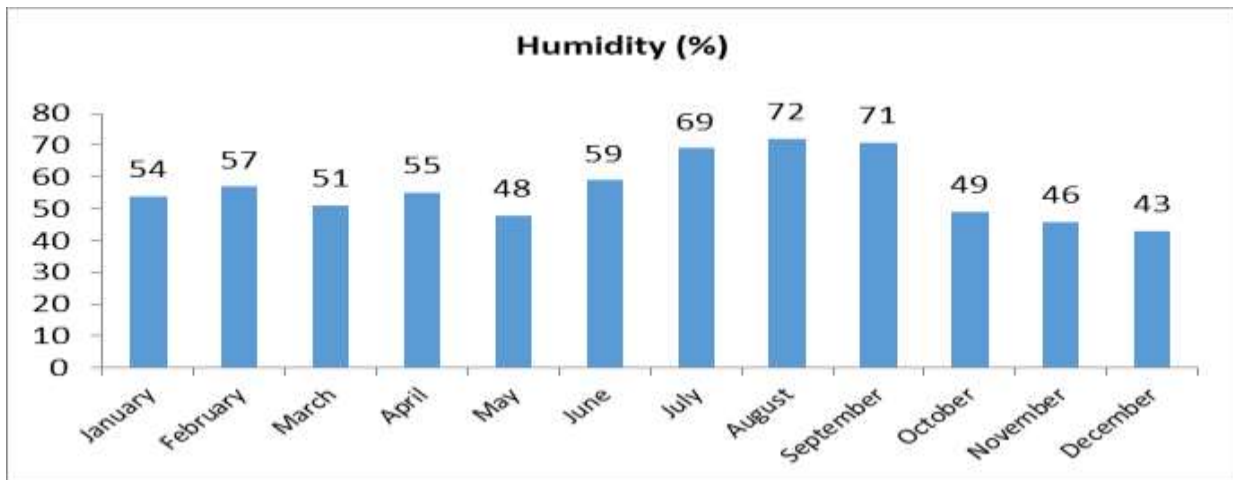


Figure 8 Monthly humidity data of Bishofitu town

Source: CLIMWAT2.0 tool of FAO (2006)

5.1.4 Water vapor Pressure

Water vapor pressure and wind speed: Water vapor pressure is the pressure at which the liquid water and its vapor are in equilibrium at a given temperature. When the vapor pressure reaches the atmospheric pressure, the liquid starts evaporating. At Bishoftu area the water vapor

pressure is high between July and mid-September. However, the wind speeds in these months are lower hindering vapor to scape to move away that limits the spaces to consume more water vapor in these months figure (9).

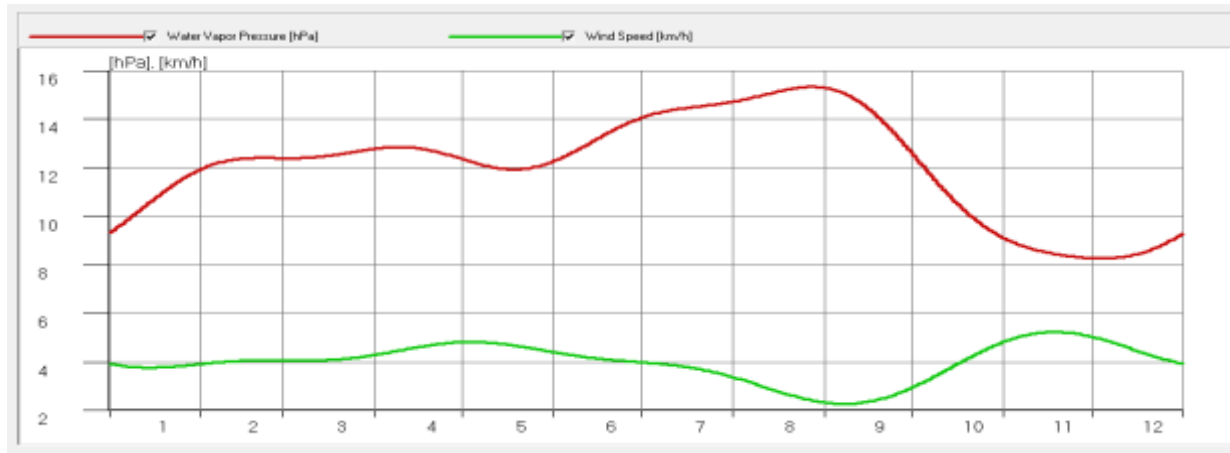


Figure 9 Water vapor and wind speed of Bishoftu area

Source: FAO NewLocClim_10

5.1.5 Sunshine and fractions

Sunshine duration is a climatological indicator and measure of cloudiness of an area representing duration of sunshine in given period. Solar fraction is the ratio of solar energy consumed by a system against solar energy provided by the solar system. Due to high cloud cover for more hours of the day, in Bishoftu town the sunshine is less than 6 hours per day between August and September. Similarly, the solar fraction is below 50% in the same months of the year figure (10).

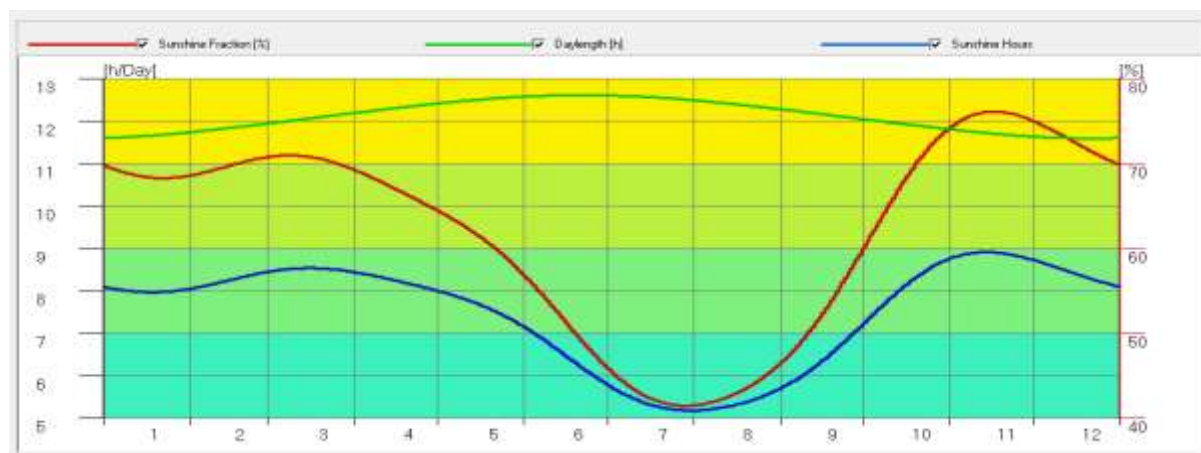


Figure 10 Sunshine hours and solar fraction of Bishoftu town

Source: FAO NewLocClim_10

5.1.6 Wind Speed and Direction

Wind speed and direction are detrimental factors for selecting and deciding several planning issues including waste treatment sites, tree planting pattern and building orientation to avoid or mitigate unwanted impacts affecting the dwellers. The average wind speed in Bishoftu can vary depending on the time of year and specific weather conditions. However, in general, Bishoftu does not experience extremely high wind speeds compared to some other regions. As data obtained from FAO NewLocClim_10 databases the average annual wind speed of the town ranges between 2.16km/h in September and 5.4 km/h in November; but on average reaches 19km/hr. for 22 hours in a year. The dominant wind direction of BT as indicated in the figure (11) is from East to West. The wind rose for the town shows how many hours per year the wind blows from the indicated direction. Example E: Wind is blowing from East (E) to West (W).

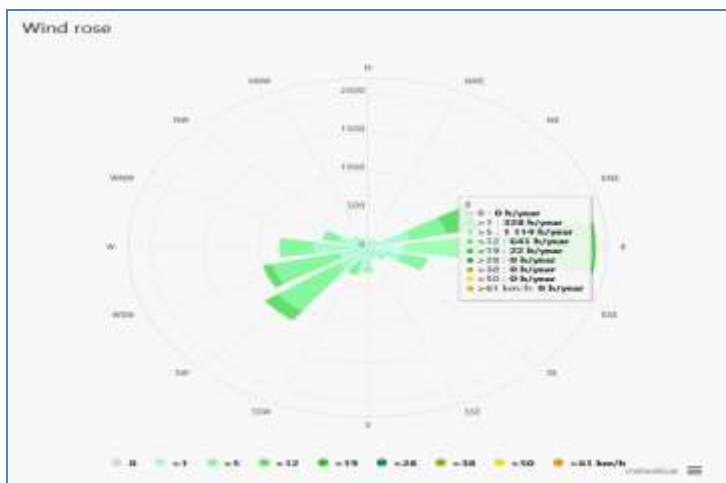


Figure 11 Wind rose diagram of BT with dominant wind direction from East to West

Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/bishoftu_ethiopia_339666

5.2 Topography

The topography and landform of BT and its environ is characterized by gentle slopes, plain areas and smooth topography which is often interrupted by undulating rocky hills that comprises several ups and downs, rivers and streams (both perennial and permanent), swampy and crater lakes. The southern portion of the town is largely associated and characterized by undulating and rugged terrains whereas the eastern is to a large extent plain area. The elevation of the town ranging from 1800 and 1995 meters above sea level which decreases from northern and south-western peaks towards the East. BT and its environ comprising vast plain areas, swampy and water bodies, soft, rounded hips and hilly mountains, steep and rounded hills and associated undulating dissected areas Figure (12).

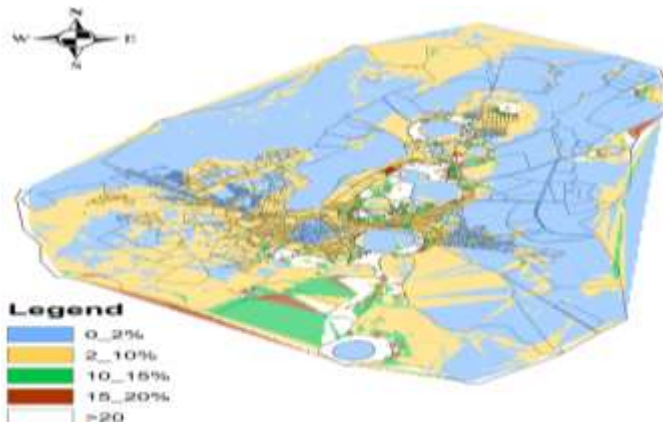


Figure 12 Topographic Features of Bishoftu town

Source: (Ms Concultancy, 2010)

5.2.1 Geomorphology

The Bishoftu area is mainly covered by volcanic rocks and the sedimentary rocks consist of alluvial cover and lacustrine sequences.

5.2.2 Slope of the Study Area

Bishoftu has water bodies (Lakes), hills, maintains, plain plateau and others. Majority of the Bishoftu area is covered with undulating plateau (23.2%), rolling (14.7%), and plateau (13.6%) Table (7).

Table 7 Bishoftu Soil cover

Landforms	Area	%
Lakes and others	708.19	3.99
Escarpment	172.13	0.97
Foot slope	771.46	4.34
Hilly	1957.04	11.02
Alluvial Plain	342.75	1.93
Piedmont Plain	115.40	0.65
Plain	1376.81	7.75
Plateau	2419.24	13.62
Mountainous	866.76	4.88
Rolling	2614.63	14.72
Undulating Alluvial Plain	174.06	0.98
Undulating Plain	2121.25	11.94
Undulating Plateau	4124.65	23.22

Source: (CATS and United CE, 2022)

5.3 Soil Characteristics

The present land configuration of the Bishoftu influence region is the result of past tectonic and denudation activities. The soil of the city generally classified in to Colluvial deposit, lacustrine sediment, and residual soil. Colluvial soil is characterized by high variability in grain size distribution and thickness which is mostly found on topographically rugged part of the city. This type of soil do have higher permeability in order of 10-5cm/s with low depth in thickness.

Lacustrine soils are found in flat area of the city. The thickness of this group is high, and their permeability is low because of dominance of fine-grained soil. The disadvantage of the areas covered by this soil is the presence of ground water at shallow depth in those areas and presence of sand sandwiched between the impervious soil layers. Residual soils are soils formed from weathering of surface volcanic rocks. These are found in the hilly parts of the city (CATS and United CE, 2022).

The soil color around the town is primarily gray to very dark gray, or black clays or clay loams. In some areas there are also brown to reddish brown clay soils. The slopes of the hills are often reddish brown and in the lower areas the soils are dark colored clays. The dark gray to black clay soil has high swelling and shrinkage properties and hence, not good for engineering construction activities. Thus recommended this soil layer to be removed to the required depth during the construction of huge engineering structures (Ms Conculancy, 2010).

5.4 Water Resources of BT

Major surface water source is the Wadecha River and its tributaries coming from the steep flanks of Mt. Sokoru and Mt. Yerer. Other major surface water source is the crater lakes and seasonal ponds surrounding the city. These include; Bishoftu Lake, Babo Gay Lake, Arsedil Lake and Hidha Lake. Seasonal ponds like Cheleleka, Chafe Anan and small surface water storages are also considered as water source potential of the area. Most of these surface sources fall within the city catchments and receive runoff from the surrounding hills and from the urban centers as well. Hence, they are prone for pollution impacts generating from the urban areas.

5.4.1 Existing Water Supply BT

The sources of water supply in the city administration; is bore holes available around different areas In the city there are 46 deep wells of which only 36 are giving services in the city as a whole. According to the information obtained from the office, currently there are 65,319 households are accessed with clean water. On the other hand there are 9 concrete reservoirs with different water holding capacities in m³ ranging from 200 to 1000. The water supply services coverage of the city is 59.4% (Bishoftu town, 2024).

5.4.4 Water Quality Analysis

As a baseline data some selected physicochemical water quality analysis was done by taking two boreholes found nearby of the FSTP site. The analyzed water parameters their quantity and comparison with WHO and Ethiopian standards is presented in Table (8).

Table 8 Physical-chemical analysis borehole water sample from Bishoftu town

Parameters	Sampled water sources			
	BHB1	BHB2	WHO	Ethiopian
pH	8.6	8.3	6.5-8.5	6.5-8.5
Temp (°C)	22.7	23.2		
TDS (PPM)	447.6	375.8	1000	1000
Electrical Conductivity $\mu\text{s}/\text{cm}$	672	567.8	1500	
Nitrite NaNO_2 (mg/l)	5.0	0	45	50
Sulfate SO_4 (mg/l)	7.3	6.3	400	250
Potassium (mg/l)	10.1	9.8		1.5
Iron (mg/l)	0.51	0.41	0.3	0.3
Phosphate PO_4 (mg/l)	57.8	16.8		
Ammonia NH_4 (mg/l)	0.52	0.58		1.5
Alkalinity CaCO_3 (mg/l)	310	253	500	300

NB. BHB1: Bishoftu household Borehole 1; BHB2: Bishoftu Household Borehole 2

Most of the assessed parameters from sampled shallow wells like TDS, Electrical conductivity, Nitrate, Sulfate, Potassium and Alkalinity are within the required standard level of WHO.

But the level of Iron, Phosphate per ml is higher than the required standard. These chemicals can be found in various forms in natural water sources, including borehole water but a little bit higher in Bishoftu. The presence of higher level of Iron Phosphate in borehole water can be attributed to factors, like as geological formations, agricultural runoff, and human activities in the surrounding areas. Since the boreholes are located nearby of agricultural area, the use of fertilizers containing Phosphorus and Nitrogen compounds can contribute to the presence of phosphate and ammonia in the water. When fertilizers are applied to fields, rain or irrigation water can carry the excess nutrients into the groundwater, eventually reaching the borehole.

The presence of higher levels of Iron, Phosphate in nearby ground water can have mixed effects for the fecal sludge treatment plants if utilized it. It offers potential benefits in terms of nutrient recovery and improved treatment efficiency, it also poses challenges related to toxicity, sludge management, and costs. Careful monitoring and management of Iron Phosphate levels are essential to maximize benefits while minimizing negative impacts. Phosphates are not toxic to people or animals unless they are present in very high levels, i.e., > 1000 mg/L. Digestive problems could occur from extremely high levels of phosphate, leading to Hyperphosphatemia.

5.9 Noise Emission

The ambient noise level in the project area is low. The project site is found in the rural outskirts of BT away from main transportation route and industrial area. Noise levels in traditional agricultural fields can vary widely depending on several factors, such as the type of farming practices, equipment used, and surrounding environments. The area are characterized by a more

serene, natural soundscape with natural background noise, wind through crops, bird songs and insects cattle vocalizations from 40 to 70 dB (A) with minimal human-generated noise. It is unlikely that noise levels will exceed legal limits.

5.10 Biological Environment

The proposed project site is located in agricultural land used for cultivating Ada'a Teff (*Eragrostis tef*). Long time human intervention for agricultural purposes changed the natural diversity in to agricultural crop area. In the hills and valleys of the project area, there are drought-tolerant shrubs, scramblers like *Lantana camara*, *Solanium incanum*, and *Eragrostis spp.* (Lovegrass). Moreover, few scattered trees like *Acacia tortilis* (Umbrella Thorn), *Acacia seyal* (White-Barked Acacia) *Faidherbia albida* are also observed.

During the field visit period, mainly domestic animals were observed in the project site. The presence of some wild mammals like Abyssinian hare (*Lepus habessinicus*), and hyena were confirmed by their fecal matter. Similarly, few species of aquatic birds (flamingo's pelicans, Marabou stork) and Egyptian vulture, and pied crow were detected. The proposed project site is found away from ecologically sensitive, area the impact of construction and operation of the plant could have lower adverse impact on the flora and fauna of the area. Hence, the fecal sludge treatment plant is not expected to cause major adverse impact on fauna and flora of the area.



Figure 13 Partial view of the plants and animals in the project site

5.11 Socio-economic Environment

5.11.1 Demographic Characteristics

BT has 62158.56 hectare of land and the human population is distributed in three sub cities. In view of this as CSA population projection result, the total population size of the town estimated to be 140039 in 2013 and 161,354 in 2017. The city population growth is rapidly increasing by more than 4% annually. Based on administration data currently population size of the city is projected to be 522,894 of which 272,565 male (52.1%) and 250,304 (47.9%) female Table (9). By considering specific socioeconomic factors, the population size of BT is expected to grow at

5.5, 6.0 and 6.5 percent annually based on low, medium and high growth rate variants respectively. As per the low population projection, this figure is estimated to reach 534,600 in 2039 and 1,097,337 in 2059 after twenty and forty years respectively. Similarly, the population is estimated to be 583,200 in 2039 and 1,197,095 in 2059 in accordance with the medium variant growth rate projection. As per the high growth rate projection result, the current base year population is estimated to reach 631,800 in 2039 and 1,296,853 in 2059 (Table 9).

Table 9 Demographic characteristics of Bishoftu town

Sub cities	Area in Hectare	Household			Number of population		
		Male	Female	Total	Male	Female	Total
Dukem	20,123.22	22450	20231	42682	112,247	102,963	215,210
Dibayu	23,808.9	18045	16439	34484	90,227	82,193	172,420
Celeleka	19,226.44	14018	13030	27048	70,091	65,148	135,239
Total	62,158.56	54513	49700	104214	272,565	250,304	522,869
%		52.3	47.7	100	52.1	47.9	100

Source : Bishoftu town , (2024)

Population density: The observation survey attested that, the oldest section of the city is characterized by high density from 40-80 capita per hectare (Filtu kebele) whereas mid-level density observed between 12-40 capita per hectar at Kebeles of Dire Jitu, B/Foka, Chaleleka, Kudada, H/Bishoftu, Kurkura and Dembi. The rest of kebeles do have low population density which is less than 12 capita per hectare.

Sex ratio: The current sex ratio of the City is 89% which indicates that there are only 89 men for every 100 women in the city.

Age Structure: On the other hand, the age composition of a population revealed that large percentage of the population is concentrated at ages 15-19 (14.5 %), 20-24 (12.8 %); 25-29 (11.7 %) and 10-14 (10.2 %). According to CSA 2007 data. The proportion of the total population under 15 years of age was 27.6 percent. The proportion of the working age group on was 68.4%. The proportion of aged 65 years was 4 percent.

Dependency Ratio: For every 100 persons of working age, the youth dependency ratio is 40.4 dependents in 2007 while the old age dependency is 5.9 dependents in 2007. The overall dependency ratio is 46.3 implies that roughly about 100 persons in the economically productive ages have to support 46.3 dependents in terms of food, clothing, health, education, and the like.

Land Use: Master plan of Bishoftu town has considered environmental land use which includes green areas, parks, playground, river buffers, water bodies, etc.

5.11.2 Education Facility

Based on 2021 data obtained from BT Education Office, there are 80 kindergartens 83 primary schools and 16 secondary schools, 1 TVET, 4 colleges and 1 University. Educational facilities

owned by government, private and NGO. Some of the higher institutions include Addis Ababa University of Veterinary Science, Defense Engineering and Health College, Rift Valley University College, Ethiopian management Institute. During this period the primary school students Net Enrollment Ratio (NER) was 93.4% of this men accounts 94.4 percent while females 92.5 percent. Similarly, secondary school students NER was 104.5 percent for total and 107 and 102 for male and female respectively (CATS and United CE, 2022; Bishoftu town , 2024).

In all of primary schools toilet is available for students but drinking water and electricity supply was not available in eight and nine schools respectively. Contrary all of high schools do have toilets and water supply facilities Table (10).

Table 10 Availability of educational facilities in Bishoftu town 2024

Primary Schools 1-8										
Primary Schools			Drinking Water		Electricity		Library		Toilet	
Gov	Private	Total	Available	NA	Available	NA	Available	NA	Available	NA
29 (34.9%)	54 (65.1%)	83	75 (90.4%)	8 (9.6%)	74 (89.2%)	9 (10.8%)	53 (63.9%)	30 (36.1%)	83	0
Secondary Schools 9-12										
Secondary Schools			Drinking Water		Electricity		Library		Toilet	
Gov	Private	Total	Available	NA	Available	NA	Available	NA	Available	NA
7	9	16	16	0	14	2	16	0	16	0

NB: NA= Not available; Gov= Government Source: (Bishoftu town, 2024)

5.11.3 Health Facility

There are 81 health institutions in the town. Among these number of health institutions, there are two general hospitals, seven health centers, 39 clinics, 20 drug stores and eight pharmacies. The current health service coverage of the town is 100 % and sanitation coverage 86%. The health facilities is presented in table (11).

Table 11 Distribution of Health Institution by Ownership, 2024

Year	Hospital		H/ Center		Clinics		H/ Post		Pharmacy		Drugstore	
	Gov	Pri.	Gov	Pri.	Gov.	Pri.	Gov	Pri.	Gov	Pri.	Gov.	Pri.
2020	2	0	5	1	1	50	5	0	0	18	0	21
2021	2	1	6	1	1	53	5	0	0	22	0	26
2022	2	1	6	1	1	53	5	0	1	20	1	26

Source: (Bishoftu town 2024)

The number of health professionals working in government, private and others owned health services. Thus, there are 43 medical doctor, 58 health officers, 249 nurses of all type at degree and diploma level, 33 pharmacists, 34 druggist, 62 laboratory technicians, 51 health extension workers, 5 X-Ray technicians, 7 environmental health, 9 dentist and 39 other professionals in both governmental and private health institution. As data obtained from Bishoftu town Health Office, the current health service coverage of the city is 100 %and sanitation coverage 86%.

5.11.4 Economic activities (Trade, Industry, and Other Services)

BT is found nearby of the Capital Addis Ababa (Finfinne), and strategic location on main high way road to Eastern and Southern part of the county, and on main high way to the Port of Djibouti. Due to its strategic location, Bishoftu is one of the few towns in Oromia region which has relatively good number of manufacturing industries concentration. Most of privately owned manufacturing industries in the town are engaged in agro-processing, steel rolling, plastic (packaging and shoe), textile and garment, and in the production of different chemicals (Ms Conculancy, 2010).

The industrial sector has a very decisive role in many ways for the development of the country in general and our city in particular. In our city, around **18%** of population relies on industry. Bishoftu has much advantage that makes it suitable for industrial development Table (12).

Table 12 Existing Number of industries and job opportunity in Bishoftu town 2024

No	By Sector	Quantity	Capital(Br.)	Land Area (hec.)	Job opportunities created		
					Permanent	Temporary	Total
1	Manufacturing	892	200,633,009,009	1161	47424	6,065	53489
2	Agro processing	193	68,251,869,590	162.7	6883	3068	9951
3	Service	656	4,928,342,233	233	12,490	1,153	13,643
4	Agriculture	82	436816260	500	3747	777	4524
	Total	1823	274,250,037,092	2056.7	70,544	11,063	81,607

Source: (Bishoftu town , 2024)

5.11.5 Agriculture

Urban agriculture is playing an imperative role in enhancing urban food security, local economic development, poverty alleviation and social inclusion of the urban poor and Women in particular. In the year 2015 about 28211.75 hectare of land was cultivated with 1,103049 quintals of production and yield obtained (Quintals/hectare) was 39.1%.

5.11.6 Tourism

Lakes: Bishoftu is naturally prosperous by 7 creator lakes which have beautiful scenery for tourism. These beautiful lakes are suitable for recreational investments and fishing. Hotels and resorts that are constructed near these lakes create exciting feeling for tourists.

Parks and Play grounds: in the city there are a total of 7 parks were inventoried in the city with 14.3 hectares of coverage and 23 playgrounds with a total area of 8.8 hectares. All of the 23 playgrounds which included main stadium football field and play areas found in youth centers are developed. + City Park.

Irrech / thank giving ceremony/: Among the cultures of Oromo “Irecha” is the great cultural festival where Oromo people and others celebrate on the next week of Meskel Holiday.

Palace of Atse Haile Silassie: The palace is founded in 1939 by the reign of Emperor Haile Silassie I, located at the pinnacle of Hora Arsadi Lake, beside Ethiopian Air Force Hospital. It contains different heritages which is important for research and arty facts.

5.11.7 Energy and Power Supply

Bishoftu town is accessed to 81,200Kw of hydropower from five substations that gives services for 24 hours, Around 44,074 households are using electric power and the electricity coverage of city is about 59.8%. The surrounding industries are using 36,300Kw and the street light coverage at is 62.1Km and more over 2,484 poles are stretching in the city (Bishoftu town , 2024).

5.11.8 Existing Municipal Infrastructure

Road Network: The BT administration has been working on upgrading and constructing new and existing road networks within the city. The total length of the road within the city is 583 Km/asphalt, red ash coble and concrete. In addition to this it has constructed 36.13Km walkway (Bishoftu town, 2024).

5.11.9 Waste Management

Solid waste treatment: In Bishoftu town administration identifies six major sources of solid waste with their share namely households (75%), commercial institutes (12%), industries (5%), hotels (4%), street sweepings (3%) and hospitals (1%). All municipal waste collection is handled in three ways i.e. door to door collection, block collection and container collection systems are the major. Based on the assessment conducted the city daily waste generation rate is 342m³ while the total annual solid waste generation is reached 123,248m³ by volume. The city average solid waste generation rate is 0.48 kg per capita per person/day. The city experiences 4% increase in urban waste generation per year (Bishoftu town , 2024).

6. Stakeholder Consultation and Public Participation

This ESIA study has undertaken public consultation with two categories of people: persons directly affected by the project and relevant government stakeholders from BT administration. The aims of the consultations are to present information about the nature and scope of the proposed FSTP construction in Udde Kebele; to identify people adversely affected by the project; to seek their views and concerns about the proposed project and to take their feedbacks into account in project implementation and monitoring activities.

6.1. Community Consultation

Community consultation was carried out with members of the community that would be directly or indirectly affected by the proposed FSTP project in Udde Kebele. The major aim of the consultations was to incorporate the community's views, opinions, concerns and questions regarding to the proposed project in the study. The consultation was held on 21 April 2016 E.C. at the Udde Kebele. In the consultation a total of 56 participants including project affected persons, Kebele official, elders, women and youths were participated.

The consultation was facilitated by Kebele Official and BTWSSE and led by the consultant team. The procedures followed by the consultation were that the consultant team has:

- Informed participants of consultation that Bishoftu town water supply and sanitation services Enterprise is planning to build a FSTP in Udde Kebele;
- Described both potential benefits and adverse environmental and social impacts associated with proposed project such as employment opportunities and displacement of people; and
- Described that this community consultation was organized to provide opportunity for local community to participate in; and express their views and concerns on the proposed project.

Community consultation was focused on the following core issues. Whether or not:

- they have prior information and awareness about the proposed FSTP project development in their locality;
- they have ownership claim over the land allocated to the project;
- there are historical, cultural, religious or archeological heritages over the land identified for FSTP development; and
- their expectation from the proposed FSTP project

The community consultation was held in a form of group discussion through the method of question and answer. Participants of the consultation were invited to freely express their opinions and questions using local language. Questions and answers discussed during the consultation were written and documented as a minute. Major concerns raised during consultation were (1) Insufficiency of cash compensation and (2) Health risks posed by disposal

of sewer in the project area. Both consultant team and focal person from BTWSSSE clarified that the town admiration will explore land replacement alternative as far as possible; if land replacement is not feasible, development assistance and employment opportunities will be facilitated to support the livelihoods of PAPs.



Figure 14 Partial view of community consultation for FSTP at BT

Results of Consultation with Displaced Persons by FSTP Project and Their Community

On undertaking prior community participation on the proposed FSTP project in the area

The first question forwarded by the consultant team for consultation was whether or not a prior community consultation was held during project design and site selection for the proposed FSTP project construction? Participants reported that

- “Nobody came to here and had a discussion with us about the project.
- “We have seen personnel from the Municipality roaming over the farm and measuring land. Except this, there was nobody who came to us to discuss about the issue.”
- “Even though we do not know the type of project planned to be constructed in the area, we have been watching people from the government were surveying the area and burying boundary stone in the area. They simply told us that the area is needed for a project. This is what we know.”
- Lack of prior consultation or limited information on awareness campaign observed. These refers to prior community consultation and project sensitization the BTWSSSE supposed to do during project screening, design and site selection. This ESIA study has undertaken prior consultation with PAHs and Public stakeholders and has created awareness about the nature of the proposed project including key potential negative and positive environmental and social impacts associated with FSTP project.

On Undertaking of community mobilization and awareness creation programs on UWSSP-II FSTP project

Participants response on whether community mobilization and awareness creation on UWSSP-II FSTP project undertaken or not. Their response for this question was a resounding “No”

On community representatives’ participation during project planning and site selection

Participants of consultation replied that no one from their village has participated during project planning and site selection. One of the participants informed that; “Before today, no consultation was held with the community and none of us have participated during site selection for the project.”

On owners of the land earmarked for FSTP construction

At first participants have described that they are not certain which tract of land is required for expropriation, as a result they have demanded information about the exact boundary of the proposed project site so that they can affirm whose plot of land is included inside the proposed project site or not. In this regard, representatives of the BTWSSE and the Kebele have described the relative boundary of the land identified for the project. Then participants of consultation have identified thirty five individuals as owners of the land selected for the proposed project.

On the presence of historical, cultural, religious or tourist heritages and artifacts on the land proposed for the project

One of the participants has described that “as you can see for yourself the area is an agricultural land; there are some eucalyptus trees near the area. Except that there is neither a worship nor burial place in the area”. He interrogated that “isn’t it visible that the area is a farm land?”

Participants views, concerns, opinions and reflections on the proposed project

Participants of the consultation have described that:

- “We did not have any prior information about the nature of the said project; as we heard from you now it is described that the project is about sewer disposal. When the community learned about this there were complaints and uneasiness over the matter. What will happen to us? There are children, elders and others living in the area? Does not it pose health risks to the community?”
- “The project will take the land away from farmers; agriculture is our only source of livelihood; we do not have any other trade than agriculture. Earlier you said that cash compensation will be given to displaced persons. But money is disposable and it perishes. We are farmers; we consume what we produce. Once this land is taken away what will be our fate?”
- “You have said that the government will pay cash compensation but the land I am cultivating now is the land which I have inherited it from my forefathers and I will also bequeathed it to my children likewise. I am administrating my family based on this land. If it is taken away from us, what will happen to me and my family?”
- “The place is a farm land; as a farmer agriculture is our only source livelihoods. Firstly, the amount of compensation money is not enough; secondly we do not have any experiences of buying from markets. Money could be lost within a year but land extends to generations to come.”

The summary of issues raised during community consultation and responses given to participants by the consultant team and representative of BTWSSE is outlined in the Table 13 below.

Table 13 Summary of issues raised during community consultation

No	Issues raised	Responses given
1	Health risks posed by disposal of sewer in the project area	Both consultant team and focal person from BTWSSE described that: <ul style="list-style-type: none"> • The facility will adopt state of the art technology to treat the liquid wastes to avoid smell and other health risks; • After the treatment the water can be used for drinking, irrigation, car wash and other purposes
2	Kinds project benefits to local community	The consultant team described that: <ul style="list-style-type: none"> • Temporary construction job opportunities will be created during project construction phase During project operation phase <ul style="list-style-type: none"> • Permanent job opportunities will be created in the plant; • Provides easy access to compost fertilizer; and • Provide water source for irrigation works and car wash services
3	The importance of designing sustainable resettlement strategies for persons displaced by the project	Both consultant team and focal person from BTWSSE described that: <p>Interested and qualified persons will be</p> <ul style="list-style-type: none"> • offered job opportunities during project construction and implementation phases; • organized in small and medium enterprises; • provided with trainings and working spaces; and • Engaged in urban agriculture and car wash services around project area.
4	Inadequacy of cash compensation	Both consultant team and focal person from BTWSSE described that: <ul style="list-style-type: none"> • Attempt will be made to prepare a replacement land in the area as far as possible; • Resettlement assistance will be offered; and • Self-employment opportunities will be facilitated
5	The fate of displaced persons once land is expropriated	Consultant team described that; <ul style="list-style-type: none"> • Displaced persons will participate in planning, implementing and monitoring of resettlement activities; and • Appropriate and accessible grievance mechanism will be prepared

Conflict resolution methods: To smooth project-host community relations, to avoid potential conflict and community opposition to the proposed FSTP project, the following measures should be taken by BTWSSE and the Contractor:

- The BTWSSE should engage project affected community including project hosting community.

- Decision-making processes related to compensation and livelihood restoration should include options and alternatives from which affected persons may choose.
- Giving priority of job opportunities for unemployed youths and people in the project area as far as they are qualified and fulfilled all job requirements.
- A public grievance mechanism should be established to receive and complaints from project affected people and local community and to ensure that all grievances related to the project are addressed through a transparent and impartial manner. Mechanisms such as face-to-face meetings, letter and grievances boxes should be prepared for PAPs and stakeholders to share their opinions and grievances.

6.2. Stakeholder Engagement

This ESIA study has undertaken open, transparent and inclusive engagement with relevant stakeholders on the nature, scope, and potential environmental and social risks and impacts of the proposed FSTP project in Bishoftu town. The following section presents and describes stakeholders identified by this study; provide a summary of issues raised by stakeholders and how their feedback is taken into account under this ESIA study.

The consultation was conducted on 17 December at office of deputy mayor of BT administration. Thirteen stakeholders have participated in this consultation. They are from Mayor, Biftu Woreda administration, Education, Health, EPA, Culture and Tourism, WSSE, Land Administration, Construction, Women and Children and Housing and Urban Development offices and BTUWSSP-II representatives. Issues, views and suggestions raised by stakeholders and discussed during consultation are presented as below.



Figure 15 Partial view of stakholders meeting at Bishoftu town

A stakeholder from Biftu Woreda Administration has requested information and explanation about:

- exact location of land selected for the proposed project;
- mechanisms how questions raised by displaced persons will be addressed;
- proliferation of bad odors, garbage, waste materials, pollution and other potential negative impacts in the area associated with the proposed FSTP project; and
- Ways in which children and other members of households will be treated in compensation process if compensation is provided only to heads of households.

EPA office representative stated that she finds it difficult to give her opinions since she does not know the specific location of the proposed project site. Nevertheless, she recommends paying attention to following points:

- ensuring the proposed project site's alignment with the new structural plan of the town;
- informing and creating awareness to local community in advance about the benefits and opportunities the project will brought in the area; and
- providing appropriate compensation measures such as land replacement and cash payment and their immediate implementation

The other stakeholder from Health office raised a question that how far the proposed project will be located from residential areas and water sources.

One of the participants of stakeholder consultation was from Ethiopian Electric Utility Bishoftu Branch and he informed that there are electric power transmission grids in the area and he requested to leave from 20 to 30 meter buffer zone between the electric grids and any structures that will be constructed by the proposed FSTP facility.

To ensure effectiveness and outcomes of stakeholder engagement method effectiveness, appropriate and convenient timing and place of consultation were employed. The consultations were undertaken during office hours with government sectors and non-farming hours with PAPs and community. They were taken place at the meeting hall of the city administration with the presence of deputy mayor and at the vicinity of their village with PAHs and members of local community. The form of the consultation was prior, free and open meetings and participants as well as participants were expressed their opinions through Affan Oromo and Amharic languages. The engagement was also representatives since all of PAHs as well as members of local community and relevant government sectors were selected and participated in the consultation process.

The outcome of the consultation is also successful because the consultation was both meaningful and informed: key potential project risks and impacts as well as their mitigation measures were presented to participants. Moreover, they were briefed how their concerns and questions will be incorporated under the ESIA study. Finally, the consent given by stakeholders to project activities is also another indicator of the stakeholders engagement methods effectiveness adopted by this study.

Summary of issues raised by stakeholders and responses given to them by the consultant team and representative of BTWSSE and the deputy mayor of the town are outlined in the Table 14 below.

Table 14 Summary of issues raised during stakeholders consultation

No	Issues raised	Responses given
1	Whether stakeholders will be informed about exact location of proposed project site before the beginning of construction works or not	<ul style="list-style-type: none"> The Enterprise promised to provide the GPs coordinate points of site as well as to show them personally
2	Proposed project site's alignment with the new structural plan of the city	<ul style="list-style-type: none"> The site was selected according to latest revised master plan of the city; and It was selected together with; and approved by the Municipality
3	Timely and appropriate compensation measures	<ul style="list-style-type: none"> Sustainable resettlement strategies will be designed Attempt will be made to prepare a replacement land in the area as far as possible; Resettlement assistance will be offered; and Self-employment opportunities will be facilitated Appropriate and accessible grievance mechanism will be prepared
4	Health risks caused by the proposed project	<ul style="list-style-type: none"> The facility will adopt state of the art technology to treat the liquid wastes to avoid smell and other health risks; After the treatment the water can be used for drinking, irrigation, car wash and other purposes
5	Mechanisms to support children and other members of displaced households	<ul style="list-style-type: none"> Resettlement assistance and livelihood supports will be provided <p>Interested and qualified persons will be:</p> <ul style="list-style-type: none"> offered job opportunities during project construction and implementation phases; organized in small and medium enterprises; and provided with trainings and working spaces
6	the importance of creating a working relations with stakeholders for the future	<ul style="list-style-type: none"> The Enterprise promised to inform and engage stakeholders and closely work with them
7	Engaging community during project implementation	<ul style="list-style-type: none"> Displaced persons will participate in planning, implementing and monitoring of resettlement activities; and
8	Expected buffer zone between FSTP facility and electric power grids	<ul style="list-style-type: none"> 400 meters buffer zone will be established between the proposed FSTP and the electric grid lines

Results of consultations: (1) Participants of consultation clearly indicated that prior community consultation was not conducted on the proposed FSTP project and no representatives neither from the community nor the stakeholders have participated during project planning and site selection phases of the proposed FSTP project; and the Enterprise did not organized any awareness creation and community mobilization programs about the UWSSP-II in general and the proposed subproject in particular. (2) Other result of the consultation is participants unanimously explained that the proposed FSTP site is agricultural land owned by thirty five

households and its expropriation causes socioeconomic damages to the farmers and their families. The issue of compensation especially inadequacy of cash payment is emphasized and land replacement is recommended as a viable and appropriate compensation form. If this not possible, they suggested provision of timely, commensurate and culturally appropriate compensation measure including cash and resettlement assistances to displaced households. (3) Participants of the consultation also described the absence of physical cultural resources that have historical, cultural, religious or archeological significances in the area. (4) The need to design mitigation measures that will address potential health risks and social impacts associated with the proposed FTSP project is also underscored during consultation (5) lastly, they have given their full support to the proposed FSTP project if the above issues are taken into project implementation process.

7. Census of Project Affected Households

The project requires about 22 hectare of land and the proposed site is an agricultural land which is found at Udde County in Bishoftu district. During field visit, the consultant team has observed that the tract of land selected for the project is a private property owned by peasants who are living in the area. At the time of visit, plowing was in progress in some parts of the area. There is no any human settlement (residential houses) around 400m buffer zone to the proposed site. The form of land expropriation is involuntary; and this land acquisition process related to FSTP project in Bishoftu town plainly triggers the WB OP 4.12 of involuntary resettlement in the form of economic displacement. Partial view of PAH survey figure (16).



Figure 16 PAHs consultation at the proposed site at Udde kebele, BT

Though the proposed project will not led to physical relocation of people, involuntary taking of land will directly results in loss of land, means of livelihood and source of income. It has immediate adverse socioeconomic impacts on projected affected persons in the project area. In a situation where such involuntary resettlement is unavoidable, the WB's OP 4.12 stipulates the need to design a resettlement program that will minimize or mitigate adverse socioeconomic impacts caused by project related displacement.

As part of ESIA study, a household level census was conducted on PAPs. Using a survey questionnaire, the household census has identified and enumerated persons who are eligible for compensation and assistance; documented the size of land that will be expropriated from each PAPs; provided the baseline conditions of lives and livelihoods of PAPs. Findings of the census study that will provide a basis for the design of resettlement activities are presented below.

7.1. Demographic Profile of PAH by FSTP Project

According to data collected by household census and Bishoftu District Administrative Office, there are 35 households whose land will be expropriated for the proposed project. Table (15) below presents socio-demographic characteristics of households that will be displaced by FSTP project in Udde Kebele.

Table 15 Demographic characteristics of PAHs at Udde kebele

No.	Household Features	Frequency	Percentage
1	Sex of household head		
	Male	17	48.6
	Female	18	51.4
	Total	35	100
2	Age of household head		
	20-30	3	8.7
	31-40	11	31.4
	41-50	10	28.5
	51-60	7	20
	>61	4	11.4
	Total	35	100
3	Marital Status of household head		
	Married	21	60
	Widow	11	31.4
	Divorce	0	0
	Separated	0	0
	Single	3	8.6
	Total	35	100
4	Ethnicity of household head		
	Oromo	35	100
	Others	0	0
	Total	35	100
5	Religion of household head		
	Orthodox	32	91.4
	Protestant	2	5.8
	Waqqa Fanna	1	2.8
	Total	35	100
6	Number of years living in project area		
	Since birth	29	82.9
	Over 20 years	6	17.1
	Total	35	100

Source: (Green Sober Survey: 2024)

Based on Table (15) above, involuntary taking of land for the proposed FSTP project in BT directly affect 35 households in the project area. From the total displaced households 51.4% (18) of project affected household heads are female while 48.6 % (17) of them are headed by male. Female headed households are the dominant gender group among PAPs. This domination of female reminds the need to pay particular attention to the interests of female headed households and their children during the time of consultation, design and implementation of resettlement activities. To avoid prejudice and discrimination against these members of project affected households, the resettlement program should design a strategy that ensures full participation of and consultation with female headed households in the design and implementation of resettlement activities; that selects a convenient consultation time and place for female headed households; that takes their views and interests into account in preparation of resettlement program; that informs the available resettlement alternatives and enable informed choices.

In terms of age, the majority, 31.4 % (11) and 28.5 % (10), of displaced household heads are adults who are in their productive ages between 31 and 50 and they have the ability to invest their compensation payment in other productive and income generating activities as well as to participate and benefit from job opportunities that will be brought by the project in the area. While 20% (7) of project affected household heads are approaching to their retirement age and their likelihood of using their compensation payment in productive enterprises are slim. However, 11.4% (4) of displaced household heads are elderly people who are older than sixty years of age that may not effectively able to capitalize on either compensation payments or seize economic opportunities brought by the proposed project. Therefore, the design and implementation of resettlement program should consider the special need of the elderly displaced persons and should attempts to devise alternative compensation schemes such as land replacement than cash compensation. The reaming 8.7% (3) of them are young persons who can actively participate in any opportunities given to them.

Table (15) also shows marital status of project affected household heads, accordingly, 60% (21) of them are married, 31.4% (11) are widows, and the remaining 8.6% (3) of persons affected by FSTP project are singles. The social and economic impacts of involuntary taking of land will be higher among widows due to their huge domestic responsibilities and burdens. As a result, the resettlement program should include providing livelihood assistance beside compensation payment for those widows displaced by FSTP project.

As far as social identities of project affected households, 100% (35) of project affected households are ethnic Oromo and 82.9 % (29) of them are native to the project area who have been living there since birth. Religious wise, almost all of project affected persons are followers of Christianity where 91.4% (32) and 5.8% (2) are adherents of Ethiopian Orthodox and Protestant faiths. While one of them is a follower of *Wagga Fanna* faith. Project affected persons are a homogenous groups both linguistically and religiously and they have no experience of living outside the project area which is their birth place. With the beginning of project implementation, an influx of both skilled and semiskilled labors with distinct ethnic and religious backgrounds and their takeover of employment opportunities of in the project area are inevitable. This may lead to potential tensions and conflicts between the hosts and migrant workers. Hence, the priority for job access and other project benefits and opportunities should be given to persons displaced by the project provided that they are willing and fulfilling the requirement.

7.2. Characteristics of PAH Members

All members of displaced household are not equally affected by the impacts of development interventions. Usually, some members of households are more likely affected by adverse impact of project related land acquisition process. The following Table (16) presents the total number of persons, size and types of household members that will be affected by the proposed FSTP project.

Table 16 Characteristics and compositions of PAHs Udde Kebele, BT

No	Household members	Frequency	Percentage
1	Total number of people living in Households	188	100
2	Number of children		
	Sons	83	60.1
	Daughters	55	39.9
	Total	138	100
3	Age of children		
	<7	21	11.1
	7-15	47	25
	15-63	114	60.7
	>64	6	3.1
	Total	188	100
4	Average household size		
	<5	15	42.8
	6-10	18	51.4
	>11	2	5.8
	Total	35	100
5	Members of vulnerable group in the Household		
	Elderly people	6	50
	Relatives and non-relatives	4	33.3
	Mentally ill person	2	16.7
	Total	12	100

Source: (Green Sober Census: 2024)

Based on Table 16 above, a total of 188 (one hundred eighty eight) individuals are living in project affected households. From this total figure, 138 (one hundred thirty eight) of the household members are children of household heads where 83 sons and 55 daughters. Among household members, 11.1% (21) of the children are under the age of seven years whereas 25% (47) of them are them between seven and fifteen ages. The remaining majority of, 60.7%, the children are majors while 3.1% (6) of household members are elderly people aged above sixty years. Beside children, there are 12 relatives members of such as grandparent, nieces, nephews as well as non-relatives who are living in project affected households. In terms of household size, 51.4% (18) of displaced households have household members which ranges from six to ten persons whereas the numbers of individuals living in 42.8% (15) of them have an average household size of less than five persons and below. For the remaining 5.8% (2) displaced household is eleven persons and more.

Involuntary taking of land for the proposed FSTP project in Bishoftu directly affects the lives and livelihoods of hundred eighty eight (188) persons. Since the number of displaced persons is less than two hundred, an abbreviated resettlement plan (ARAP) should be prepared in order to mitigate the adverse social and economic impacts associated with land acquisition.

7.3. Members of Vulnerable Groups in PAHs

Further, some of the displaced persons by the proposed FTSP project are members of vulnerable groups such as children, women, female headed households, widows, people with disabilities

(PWDs), and an elderly who will be disproportionately affected by the adverse impact of land expropriation in the project area. These members of vulnerable groups related to FSTP project are:

- Women: 18 heads of households and 11 widows;
- Children: 68 in their school age and 21 younger than seven years old; and
- Elderly: 6 individuals older than sixty years old
- Mentally ill: 2 persons

These displaced household members’ ability of taking advantages of project benefits whether through cash compensation or employment opportunities as well as their participation in consultation processes of resettlement program design and implementation are limited. Hence, before and during project implementation issues of gender and the special needs of other vulnerable groups should be identified, incorporated and mainstreamed in design and implementation of resettlement action plan as well as in monitoring and evaluation of the proposed FSTP project in the area.

7.4. Educational and Skill Levels of Displaced Household Heads

Displaced persons ability to adapt to and survive in new living circumstances is directly related to their educational status and possession of marketable skills. Educational qualifications and vocation trainings are also crucial for prudent use of compensation money and to seize employment opportunities that will be brought by the proposed FSTP project as well as in the labor market. The following Table 17 presents educational and skill levels of projected affected persons by the proposed FSTP project.

Table 17 PAH heads educational background Udde kebele BT

No.	Education status of Household heads	Frequency	Percentage
1	Education level		
	Illiterate	9	25.7
	Read and write	9	25.7
	Grade 1-8	11	31.4
	Grade 9-12	3	8.6
	Diploma and above	3	8.6
	Total	35	100
2	Training received by Household head		
	Yes	8	22.9
	No	27	77.1
	Total	35	100
3	Training types received by household head		
	Farmer training	2	25
	Driving license	2	25
	University education	3	37.5
	Machine Operator	1	12.5
	Total	8	100

Source: (Green Sober Census: 2024)

The above Table 16 shows that more than half of the household heads displaced by involuntary taking of land by the proposed FSTP project in the area do not have any experiences of formal educational schooling where 25.7% (98) of them do not read and write while 25.7% (9) of them only able to read and write. 31.4% (11) displaced persons have attended elementary school educations and 8.6% (3) have the exposure to high school education. Only 8.6% (3) of displaced persons have college diploma education. From the thirty five displaced household heads, only 22.9% (8) of them have received some types of formal trainings over the area of improved farming practices, poultry, driving license, machine operation and accounting and book keeping. The majority 77.1% (27) of them have no any kinds of formal trainings.

According to the above information, the educational and skills levels of displaced household heads is lower and the only skills and even for those who received some kinds of trainings are related to agriculture. In this regard, land acquisition process related to FSTP project may force them to compete in livelihood alternatives other than agriculture and in a labor market where they are neither prepared nor skilled to compete. Since the WB policy suggests to conceive resettlement activities as part of sustainable development programs, the design and implementation of resettlement plan should consider providing development assistance besides compensation measure such organizing trainings on agribusiness, access to credit services and employment and self-employment opportunities during the phases of project construction and implementation.

7.5. Landholding Status of Household Heads displaced by FSTP project

As indicated in the beginning of this chapter, the land proposed for expropriation for FSTP project is a private property owned by sixty four households and during the household census the proposed land was underway plowing for the coming agricultural season. To determine people eligible for compensation and to establish cut-off date for eligibility, the census has collected information on the size of land that will be taken away from displaced households, forms of ownership rights they have over it and people who are cultivating the land. Table 18 below present data collected from displaced households about these issues.

Table 18 PAH heads' landholding size and forms of ownership

No	Landholding status of household heads	Frequency	Percentage
1	Holding land in the area selected for the project		
	Yes	35	100
	No	-	-
	Total	35	100
2	Size of land taken away by the project		
	<0.25 hectare	6	17.1
	0.25-0.5 hectare	15	42.9
	0.5-0.75 hectare	7	20
	0.75-1.0 hectare	1	2.9
	>1 hectare	6	17.1
	Total	35	100
3	Forms of ownership		

	With title deed	34	97.1
	Without title deed	1	2.9
	Total	35	100
4	Land use		
	Crop land	31	88.6
	Grazing land	1	2.8
	Both crop and grazing land	3	8.6
	Total	35	100
5	Persons cultivating the land		
	My self	21	60
	My husband	3	8.6
	Tenant	5	14.2
	My son	3	8.6
	Shareholders	2	5.8
	My brother	1	2.8
	Total	35	100
6	Use of products		
	For household consumption	1	2.9
	For market	1	2.9
	Both for consumption and market	33	94.2
	Total	35	100

Source: (Green Sober Census: 2024)

Based on the information on the above Table 18, all of the thirty five households hold a plot of land over the area proposed for the construction of FSTP project. However, the size of land they holds over the area is smaller. The size of land holding by the majority of displaced persons is less than a hectare; 42.9% (15) of them holds an area between a quarter and half hectare land; while 20% (7) of displaced persons landholding size fall between half and a third of a hectare land. Only 17.1% (6) of displaced persons are holding more than one hectare land in the area. Regarding to their landholding rights, all of displaced household except one have described that they have a tittle deed which attest their formal rights over the land proposed for the project.

Currently, 60% (21) of displaced persons are cultivating the land themselves while the remaining 40% (14) of displaced persons are owners of land but they do not cultivate the land themselves. The latter group of displaced persons land is cultivated by their sons; sharecroppers; and renters. The land proposed for the construction of FSTP in the project area is a crop land, according to the above table 88.6% (31) of displaced persons use their land for crop cultivation while the remaining households use the land for grazing and mixed purpose. According to the above information, all of the landholding households that will be displaced by the proposed FSTP project are smallholder peasants and they have a formal rights and title deed over the proposed land. Hence, they are eligible to compensation and other resettlement assistance. Other than households heads, there are other individual such as their sons, renters and sharecroppers who are currently cultivating the land. These individuals may not have a formal rights over the land therefore they are not eligible to land compensation but they are entitled to other types of resettlement assistance since involuntary taking of the land will result in loss of livelihoods sources for them.

Majority of displaced households which account 94.2% (35) of them use part of their agricultural produces for household consumption and sell the surplus produces in local market. Whereas the remaining 2.9% (1) of them use the whole produces for their household consumption while only 2.9% (1) displaced person supplies all of its produces for market. Therefore, majority of displaced households that will be displaced by FSTP project in the area are smallholder peasants whose livelihoods are entirely land-based; where land is both their source of food and cash. Hence, the preparation of resettlement plan should explore alternative livelihood means and land-based resettlement strategies.

7.6. Production types and productivity levels of Households PAH

The proposed FSTP project's expropriation of land results in a- permanent economic displacement such as loss of land and its subsequent loss of production system which is the main sources of food consumption and income for displaced households. In this regard, OP 4.12 of the WB prescribes to assist displaced persons efforts to improve or restore their livelihoods and standards of living to pre-displacement level. This census has collected data which establishes economic profile of displaced households during pre-displacement phase of FSTP project. The following Table 19 below presents major production types, average productivity levels and annual incomes of persons displaced by FTSP project.

Table 19 Production types and productivity levels of Households, BT

No	Types of production	Productivity per hectare	Unit	Price per Quintal	Total Revenue
1	Wheat	39.72	Quintal	6,257	248,528.06
2	Teff	30.16	Quintal	13,966	421,212.56
3	Chickpea	40		6,000	240,000
4	Lentils	14		18,000	252,000
	Total				1,161,740.62

Source: (Green Sober Census: 2024)

According to Table 18 above, production system in the project area is crop production and the major crops produced by households are wheat, *teff*, chickpea and lentils. An average annual productivity of these crops per hectare among the households is wheat 39.72 quintals, *teff* 30.16 quintals, chickpea quintals, and lentils 14 quintals. The monetary equivalence of these crop productions are 101,161,740.62 birr according to the current market prices of crops in the project area. Hence, involuntary taking of land by FSTP project will dismantle the production of system of these households and an estimated yearly income of 101, 161, 740.62 birr from crop productions. Therefore, preparation of resettlement plan should explore land-based resettlement alternatives since the livelihoods of displaced persons are entirely land-based. Resettlement measures that will be provided to displaced persons also should be aimed at emulating pre-displacement levels of households' productivity.

Gender Equality: The status of women in project area is lower alike other parts of Ethiopia and they are not provided with equal opportunities to improve their lives and livelihoods as do men.

Implementation of the proposed FSTP project and its benefits are expected to empower women and contribute for gender equality by providing. Some of the expected project benefits are the following: - During construction phase, the project will recruit unskilled and semiskilled women as construction workers and they will be able to generate income as a result of it. When the project starts operation, significant job posts will be available for women to work as secretary, janitors, clerks, and other office works. Besides, both construction and operation phases of the proposed project will create self-employment opportunities for women through engaging in their own business activities such as catering of food, coffee and tea services, among others.

The immediate impacts of these economic opportunities brought by the proposed FSTP project will be instrumental in improving the lives and livelihoods of women; meeting their and their children nutritional and other needs; improving their lifestyles and making them assertive and functioning members of the community. To ensure and enhance the above expected project benefits, the following measures should be taken by the Contractor and the Operator of the FSTP: earmarking at least half of unskilled labors for women; coordinating labor recruitment activities with Offices of Women and Children, SMS Enterprise, and other relevant Offices in the City; organizing them in SMS enterprises, providing basic trainings and facilitating working spaces and credit services for those women willing to engage self-employment.

Monitoring and evaluations mechanisms should be in place to ensure that all potential project benefits and resettlement programs reach PAPs in time and in an efficient grievance free manner, a robust resettlement monitoring and evaluation method should be put in a place that collect, analyze, report and apply information about the progress of resettlement programs according to ARAP. The focus of resettlement monitoring should track the time and cultural appropriateness of compensation measures given to PAPs including restoration of income and standard of living of PAPS as well as delivery of other livelihood supporting entitlements.

In a nut shell, the household census conducted by this ESIA study has identified thirty five households that will be affected by involuntary taking of land for the construction of Bishoftu's FSTP project. The project directly affects the lives of one hundred eighty eight people living in households where ninety four of them are members of vulnerable groups including 68 children, 18 female household heads, 11 widows, 6 elderly and two mentally ill persons. All of households that will be displaced by FSTP project are small landholding peasants whose livelihoods are entirely land-based and with low levels of educational backgrounds and marketable skills other than agriculture. Therefore, the preparation of resettlement plan for these persons that will be displaced by FSTP project in Udde Kebele should involve measures that covers issues, concerns and interests of children, youths and women; preparation of resettlement activities which pay attention to productive skills and livelihood experiences of households; consulting with and participating displaced persons on resettlement planning and implementation activities; preparing land-based resettlement strategies; and providing resettlement assistance to improve or restore the livelihoods and living standards of displaced persons.

8. Outline of the Main Alternatives

Project alternative analysis involves the evaluation and comparison of different project alternatives to identify the one that minimizes potential environmental impacts while achieving the project's objectives.

8.1 Do-Nothing Option/ Without Project Alternative

Do nothing project alternative is an alternative that ignores the implementation of the project in the proposed area. It neglects the construction and operation of FSTP and ignores all of the positive impacts that the project has. In other ways the existing sanitary conditions will be maintained and the land and water bodies found nearby of Bishoftu town will continue to be polluted and loaded with untreated fecal matter.

This option is mostly applicable in situations where the proposed project area is in ecologically or socially sensitive areas, or has significant adverse impacts on which no proper mitigation measures can be formulated to eliminate or minimize the adverse impacts to manageable or acceptable levels.

Hence, the no project option is the least preferred or viable alternative options from both the socio-economic, health and partly environmental perspective. On this basis, the 'No Project Alternative' is rejected as option to be carried forward for the project implementation option is maintained.

8.2 Alternative Analysis for the Site Selection

FSTP construction site alternative analysis involves the consideration of the environmental, social, cultural and economic/financial issues. A careful and adequate analysis of the environmental, social, cultural and economic factors is very imperative for the smooth construction, operation and decommissioning of the FSTP. Before starting Bishoftu FSTP site alternative analysis, Green Sober consultant has made intensive discussion with the MOWE/UWSSP II unit, Oromia Water and Energy Bureau (OWEB) representing the design consultant, BTWSSE and other concerned local community representatives to propose the most suitable site. Among the OWEB, MOWE/UWSSP II and Green Sober consultant representatives three round office discussions were held in the MOWE to agree on the site alternative and technology issues. Not only office level discussion but also a joint site visit was also made on 22 May 2024. The site visit team comprised from UWSSP II, Oromia OWEB), BTWSSE and the Green Sober Consultant.

Three potential alternative sites were considered and analyzed using different environmental and social, safety and economic feasibility multivariate parameters. Specifically the utilized parameters were potential for displacement, proximity to residential, commercial or industrial areas, cultural heritage, protected areas, potable water supply schemes, topographic condition, potential for water pollution, and availability of land, accessibility and distance from the town

center. Hence three site alternatives with their comparative advantages, disadvantages presented in the subsequent section.

Site Alternative I (Golba Site): this site is the proposed site by design consultant. This site is bordering the existing liquid waste open dumping site, Saint Gabriel, Ethiopian Orthodox church on its northern edge. The site is located not more than 200m away from the Bishoftu Hora Arsadi ritual celebration site. From its specific geo-hydrological location, the site is highly ground water recharge area. Regarding ownership of the Golba site, it is partly owned by the public and the other part is owned private small land holders. The nearby residents are complaining on the previous solid and liquid waste management practice and have already developed resistance. They expect the fecal waste also to be transferred to other site. The city master plan has indicated sport field on the site.



Figure 17 Partial view of project site alternative I

Therefore, it is hard to manage the effects of nuisance dust during construction and obnoxious odor during operation phase of the FSTP. And it can also affect the livelihoods of the private farm owners. Moreover, this site has no any access road. The other key point is that due to shortage of open space and high commercial and residential buildings around the Golba site it is very hard to secure 400m buffer area. Furthermore, the town administration has rejected the construction of the FSTP in the Golba site and proposed this site for another public project. Thus, for the aforementioned environmental, social, administrative and cultural effects Golba site can be the least preferred alternative.

Site Alternative II (Abusera site): the second proposed site alternative is located around border of Dukem and Gelan towns locally named as Abusera. The site is located almost 26Km away from the BT. It is a flat terrain and has no significant natural or manmade forest of ecological importance. It is also more than 500m away from any cultural or archeological sensitive site. There are some residential buildings in the site but the majority of the Abusera site is a farm land. Prior to the construction of the FSTP access road construction is curial since there is no any access road. Regarding the ownership of the Abusera proposed site it is private owned so it can result in a physical and economic displacement. The town administration also unwilling to accept this site alternative due to its potential impact on the local land holder farmers. The other key concern can be the transportation cost of the liquid waste during the

operation phase of the FSTP. For this social and economic reasons site alternative II can be less likely preferred.

Site Alternative III (Udde Dinkaka): the third site alternative is along the Bishoftu – Ziquala gravel road. Locally the specific site is named as Dinkaka Udde. It is a flat terrain free from any significant forest vegetation. It is also away from any cultural and archeological site. This site is fully owned by small holder farmers Teff farming land. On the other hand, it has all weather gravel road. The BT administration also recommended this site for its relative environmental, social and economic feasibility. The likely social and environmental impacts of the Dinkaka Udde site can be lower than the other two site alternatives indicated as I and II. Figure 18 depicts the physical feature of the project site.



Figure 18 Alternative project site III location picture taken during the site visit

In addition, a joint Dinkaka Udde site visit and consultation with the BTWSSE deputy manager was made on 22 May 2024. The joint visit included the MOWE UWSSP- II experts, the Oromia water and energy bureau representing the design team, Green Sober consultant and the BTWSSE officials and experts.



Figure 19 Relative location Map of the alternative sites Google map

During this site visit and the consultation all the experts representing the different but concerned institutions agreed on the proposal of the Dinkaka Udde new site for the Bishoftu FSTP construction. The Dinkaka Udde site is the most desirable alternative location compared to the

other two options for this environmental, social, and financial cost. The comprehensive examination of every alternate location listed in Table 20.

Table 20 Parameters and scoring method used for alternative site assessment

1	Criteria: indicators	Score Criteria (1-5)	Weights	Alternative site I		Alternative Site II		Alternative Site III	
	Biotic environment			Score	Value	Score	Value	Score	Value
1.1	Biodiversity and habitats	1. Forests/significant wildlife reservoirs 2. Areas without significant human presence 3. Rural areas, have a fair amount of fauna species. 4. Wildlife species' presence is limited 5. Locations with little or no ecological interest	6.25	2	12.5	3	18.75	4	25
1.2	Proximity to wetlands, protected, Sensitive Areas	1. Inside wetlands /protected area 2. 0-99m; 3. 100-249m; 4. 250-500m; 5. ≥500m	11.25	4	45	5	56.25	5	56.25
2	Natural environment								
2.1	Topography of the site	1. Rough ≥3.5% 2. Relatively rough 2.5-3.49% 3. Relatively flat 1- 2.49% 4. Almost flat 0-0.99%; 5. Flat 0%	13.5	4	54	3	40.5	4	54
2.2	Proximity to a river, stream lake	1. < 50m; 2. 50-99m; 3. 100-249m; 4. 250-500m; 5.>500m	5	3	15	5	15	5	15
2.3	Site outside a flooding zone	1. Frequently flooding Zone 2. Occasionally flooding Zone 3. Rarely flooding zone 4. Extremely rarely flooding zone 5.No flooding zone	5	1	5	2	10	3	15
2.4	Type of soil / Ground Water / Geotechnical stability of the site	1. Unsuitable 2. Suitable requiring large-scale interventions 3. Suitable requiring medium-scale interventions 4. Suitable requiring small-scale interventions, 5. Suitable	3.5	2	7	3	10.5	3	10.5
2.5	Appropriate size	1. Not enough space 2. Not enough space for FSTP and expansion 3. Not enough space for all phases but potential expansion is possible 4. Enough space for the FSTP but any adjacent extension will be limited	4.5	4	18	5	22.5	5	22.5

		5. Enough space for the FSTP for the whole town and future expansion							
3	Social environment								
3.1	Proximity to residences, social structures	1.0-99m; 2. 100-199m; 3.200-249m; 4. 250-499m; 5.≥500m	7.5	2	15	5	37.5	5	37.5
3.2	Proximity to Cultural heritage and religious sites	1.0-99m; 2. 100-199m; 3.200-249m; 4. 250-499m; 5.≥500m	3.75	1	3.75	5	18.75	5	37.5
3.3	Population Density,	1. Inside urban tissue 2. Sparse suburban or village areas. 3. Areas with few residences, which can be resettled with the application of suitable measures. 4. Areas close to settlements or residences but without permanent residences within their boundaries 5. Industrial areas or even uninhibited locations	10	1	10	3	30	4	40
3.4	Traffic and dust pollution,	1. Urban and industrial areas or locations with heavy transportation loads or intense manmade activities 2. Areas with considerable transportation loads or manmade activities 3. Areas with moderate transportation loads 4. Natural areas, rural areas, or locations with low transportation and non-intense manmade activities 5. Natural areas, rural areas, or locations with no transportation and non-intense manmade activities	3.75	1	3.75	4	15	4	15
3.5	Socio-economic factors	1. The area includes Important socioeconomic resource(s) (e.g. important touristic resource) 2.The area includes considerable socioeconomic resource(s) (e.g. commercial or productive) 3. The area includes moderate significance socioeconomic resource(s)(e.g. agricultural) 4. The area includes socioeconomic resource(s) of	5	1	5	3	15	3	15

		low significance (e.g. sheepfolds) 5. The area does not include socioeconomic resource(s)							
3.6	Public opinion	1. Negative; 2. Mostly negative 3. Positive with significant reservations; 4. Positive with reservations; 5. Positive	8.5	2	17	3	25.5	3	25.5
4	Manmade environment								
4.1	Existing Land use,	1. Urban/ important infrastructures (schools, hospitals, etc.) or natural areas (e.g. forests) 2. Sparse residential uses or land uses with considerable importance (e.g. touristic attractions etc.) 3. Land uses common in the wider area with moderate importance(e.g. rural areas) 4. Land uses with no significant importance (e.g. grassland, informal greenery) 5. Industrial areas or disrupted locations (e.g. inactive quarries or disposal sites)	6.25	1	6.25	3	18.75	3	18.75
4.2	Accessibility of the site by an existing road	1. No access road / Access Road doesn't reach the site; 2. Existing gravel access road in poor condition; 3. Existing gravel road in good condition; 4. Existing asphalt road in poor condition; 5. Existing asphalt road in good condition	2.5	1	2.5	3	7.5	3	7.5
4.3	Accessibility and infrastructure availability(road, electric water)	1.≥500m; 2.250-499m ; 3.100-249m ; 4.50-99m; 5.0-49m	3.75	3	11.25	1	3.75	2	7.5
			100	33	231	56	345.25	62	402.5

8.3 Technology Alternatives

8.3.1 Fecal sludge treatment technologies

The primary and sludge treatment methods that are most suitable for BT were identified through a literature analysis, feasibility study, and detailed feasibility study report assessment. For

selecting the best technology alternatives, large amount of complex information needs to be assessed and various types of sanitation value chain options were evaluated and compared by using a Multi-Criteria Analysis (MCA).

In MCA weights were assigned to each criterion based on their relative importance. Weightings changed from one group of options to another, depending on their perceived importance. The total weighting each group is 100% and the group is compared each other. Ranking was given from low (1) to very high (5) scale and then sum of the rankings multiplied by the weightings for each criterion resulted in a score for each option within a group. The highest score identified the preferred option(s) within a particular group. Changing the weightings has the greatest effect on the MCA outcome.

Containment options: The choice of sanitation facility is directly related to the water supply mode of service and on the available space in the compound. The local ground condition, preference, and financial status of the household members also determines the standard of household containment options. The majority of Bishoftu town water supply service customers private yard tap connection. And hence the sanitation facilities fall in group 2 (Holding tank or VIP) and 3 (Pit /communal/public toilet).

Table 21 Type of sanitation facility with water supply mode of services

Group	Water supply mode of service	Sanitation facility	Containment
1	House Connection	Flushed toilets	Holding Tank
2	Yard Tap (private)	Pour Flush, VIP	Holding Tank, VIP
3	Yard Tap (shared)	Free fall	Communal toilet, Dry pit latrine
4	Public tap	Free fall	Dry pit latrine, Communal toilet, public toilet

Source: (CATS and United CE, 2022)

Onsite site sanitation facilities fall into dry and water based technologies. Dry technologies operate without water like dry toilet, Urine-Diverting Dry Toilet and Urinal. While water-based technologies function properly with a regular supply of water such as Pour Flush Toilet, Cistern Flush Toilet and Urine-Diverting Flush Toilet. There are several technology options for collecting and storing products (excreta) generated by dry and water-based technologies include the following: Single pit (SP) , Ventilated improved pit (VIP), Fossa Alterna (FA) ,Twin pits for pour flush (TPF) , Composing chamber (CC), Septic tank (ST) ,Cesspit (CP) , Anaerobic Baffled Reactor (ABR).

The containment technology choice generally depends on applicability in urban & rural area and cultural acceptance in the area; availability of space; treatment efficiency; environmental and health issues; easiness in operation and maintenance – emptying; type and quantity of input products; financial resources; operation and maintenance requirements and cost.

The Multi Criteria Analysis yielded VIP as the most preferred containment for dry sanitation technology and Septic Tank and Anaerobic Baffled Reactor (ABR) as the most preferred

containment for water based sanitation technology for BT and the analysis is presented in Table (22).

Table 22 Multi criteria Evaluation of containment options for BT

No	Collection & storage options	Weight (%)	SP		VIP		FA		TPF		CC		ST		ABR		CP	
			Mark	%	Mark	%	Mark	%	Mark	%	Mark	%	Mark	%	Mark	%	Mark	%
1	Applicability																	
1.1	Applicable in rural areas	3%	5	0.15	5	0.15	5	0.15	5	0.15	5	0.15	3	0.09	2	0.06	3	0.09
1.2	Applicable in urban areas	3%	5	0.15	5	0.15	2	0.06	5	0.15	2	0.06	5	0.15	5	0.15	5	0.15
1.6	Surface requirements	5%	5	0.25	5	0.25	4	0.2	4	0.2	4	0.2	3	0.15	2	0.1	4	0.2
1.7	Cultural Acceptability In Asosa	5%	5	0.25	4	0.2	2	0.1	2	0.1	2	0.1	2	0.1	2	0.1	4	0.2
2	Treatment efficiency																	
2.1	Organic removal	3%	1	0.03	1	0.03	3	0.09	4	0.12	4	0.12	3	0.09	5	0.15	1	0.03
2.2	Pathogen reduction	2%	1	0.02	2	0.04	2	0.04	3	0.06	3	0.06	2	0.04	4	0.08	2	0.04
2.3	Re-use of solids/liquid	2%	1	0.02	2	0.04		0		0		0		0		0		0
3	Environmental and health issues																	
3.1	Odors	5%	1	0.05	2	0.1	2	0.1	2	0.1	2	0.1	4	0.2	4	0.2	1	0.05
3.2	Flies and other nuisance	5%	1	0.05	3	0.15	3	0.15	2	0.1	3	0.15	4	0.2	4	0.2	2	0.1
3.3	Health risks	5%	1	0.05	2	0.1	2	0.1	3	0.15	3	0.15	4	0.2	4	0.2	2	0.1
3.4	Quantity of by-products produced	5%	1	0.05	1	0.05	4	0.2	3	0.15	4	0.2	3	0.15	4	0.2	2	0.1
3.5	Underground water contamination risk	8%	1	0.08	1	0.08	3	0.24	3	0.24	3	0.24	4	0.32	4	0.32	4	0.32
4	Easiness in operation and maintenance-emptying	12%	4	0.48	4	0.48	2	0.24	2	0.24	2	0.24	4	0.48	3	0.36	4	0.48
5	Capital cost	12%	5	0.6	5	0.6	4	0.48	4	0.48	2	0.24	3	0.36	3	0.36	4	0.48
6	Lifetime Operation and maintenance requirements and cost	15%	2	0.3	3	0.45	4	0.6	4	0.6	3	0.45	5	0.75	5	0.75	3	0.45
7	Operation and maintenance requirements and cost	10%	4	0.4	4	0.4	4	0.4	4	0.4	2	0.2	5	0.5	5	0.5	4	0.4
Total score		100%	2.93		3.27		3.15		3.24		2.66		3.78		3.73		3.19	

NB: SP: Single pit, VIP: Ventilated Improved Pit, FA: Fossa Alterna, TPF: Twin pits for pour Flush, CC: Composing Chamber, ST: Septic Tank, ABR: Anaerobic Baffled Reactor, CP: Cesspit.

Fecal sludge Collection/Conveyance Option: As long as the containment is accessible vacuum trucks are the most preferable sludge collection option in Bishoftu town. The vacuum trucks shall have a strong suction capacity to apply for dry pit latrine as well. Moreover, application of mini vacuum tugs and Manual Vault emptying becomes feasible to reach inaccessible containments and collect the fecal sludge at some road side to be transferred to vacuum truck. The utility capacity building will provide training on emptying procedures and the operation and maintenance of the emptying and transportation. Involvement and partnership with privet sector for delivering FSM services encourages specially in sludge emptying, transportation and disposal services.

8.3.2 Technology for Primary Treatment

Primary treatment is used for solid-liquid separation (dewatering) as well as for the treatment of solid and liquid parts of fecal sludge that is generated from the septic tank, pit latrine and other onsite sanitation systems. FST options evaluated by using general as well as specific criteria that includes technical feasibility, financial considerations, environmental and social economic factors. Additional evaluation criteria comprises construction aspect, land and equipment requirement, BOD₅ and solid removal capability, operator skill and energy requirement, and labor input requirement, creating odor free fecal sludge treatment aspect.

The available primary treatment technologies considered for BT fecal sludge include: Unplanted Drying Bed (UDB); Planted Drying Bed (PDB); Up-Flow Anaerobic Sewage Blanket (UASB) reactor; Settling and Thickening (S&T) Tank; Imhoff Tank (IT); anaerobic baffled reactor (ABR) and Anaerobic pond (AP).

Receiving or settling tanks

Course screening: Course screens are classified as preliminary treatment. The proposed FSTP will have coarse screens that remove large solids, rags, and debris from wastewater. The course screens will have openings of 6 mm or larger size. The main purpose of the course screen is to remove grit, sand particles. Types of coarse screens include mechanically and manually cleaned bar screens, including trash racks. The manually cleaned type of screens are considered under this study.

1. Settling and thickening (S&T) tank:

Settling-cum and thickening tank (ST tank) primarily permits heavier seepage particles to sink to the bottom of the tank due to gravity while lighter seepage components (fats, oils, grease, and water) remain above. The supernatant is expelled from ST tanks by an outlet on the other side of the intake, which is rectangular in form. To stop the scouring of settled sludge and the separating of scum, a baffle can be put at the outflow. The tank primarily has two compartments, occasionally three compartments, which can be alternately utilized for loading seepage as illustrated in Figure (20).



Figure 20 Schematic of a Thickening pond

Design: Settling tanks need sufficient volume for sludge accumulation and sufficient depth of the liquid column ($> 1.5\text{m}$) to allow good settling. The tanks should be equipped with baffle walls to maintain hydraulic conditions favorable to good settling and to retain floating scum. Design varies depending on the way of sediment removal. If sediment is removed by pumping or hydrostatic pressure, the tank should have a sludge hopper from where the sludge will be drawn off. If sediment is removed manually or by front-loaders the tank will be equipped with an access ramp. At least two parallel tanks will then be needed to assure continuous operation when one of the tanks is due for emptying. The tank size is estimated by choosing the sludge

removal interval (2 weeks to 2 months) and with the assumed rate of accumulated sludge volume per incoming solids load of 5-9 L/kg TS.

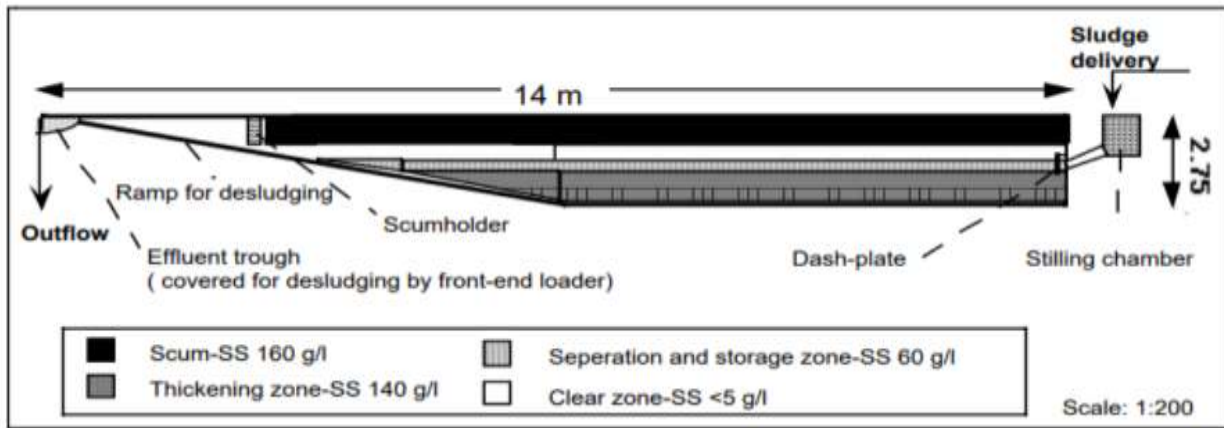


Figure 21 Settling tank with Ramp

Each tank is loaded for a minimum of a week, after which the sludge is allowed to thicken and settle, stabilizing the settled solid through the anaerobic sludge digestion process. Then, at regular intervals, thickened sludge is injected into the sludge drying bed. The proposed settling tank for Bishoftu town FSTP is the other type of settling tank which has sludge dewatering suction pipe to fit with the vacuum truck and the whole content is de-sludge at a regular interval and disposed to drying bed Figure (22). The structure will be fitted with coarse screening at the upstream and the liquid part will be directed to the anaerobic treatment unit.

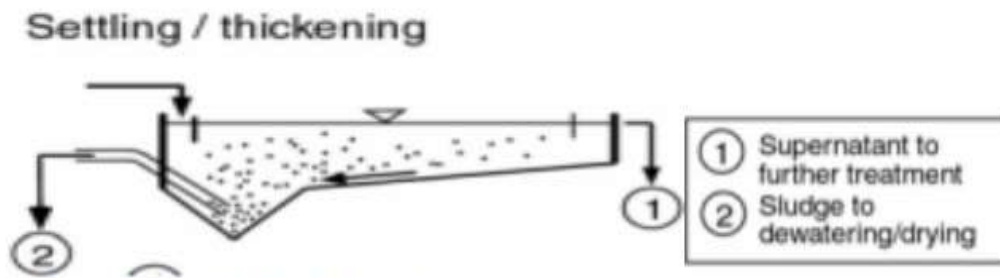


Figure 22 Settling tank with sludge dewatering pipe

Table 23 Comparative analysis of Settling and Thickening (S&T) Tank

Advantages	Disadvantages
Thickened sludge is easier to handle and less prone to splashing and spraying	Requires a large land area
Can be built and repaired with locally available materials	Odors and flies are normally noticeable
Relatively low capital costs; low operating costs	Long storage times
No electrical energy is required	Requires front-end loader for desludging
	Requires expert design and construction supervision
	Effluent and sludge require further treatment

2. Anaerobic baffled reactor (ABR):

ABR is an enhanced septic tank with a series of baffles that compel grey, black, or industrial effluent to flow under and over the baffles from the entrance to the output. ABR is an improved septic tank with a series of baffles along which wastewater or fecal sludge is channeled for primary treatment. The upflow flow patterns are an efficient means of liquid-solid separation that include biological activity, flocculation and settling. Typical inflows range from 2 to 200 m³ per day, a hydraulic retention time (HRT) between 48 to 72 hours, up flow velocity of the wastewater below 0.6 m/h and the number of up flow chambers (3 to 6).

The treatment can be improved as a result of the longer contact time with the active biomass (sludge). Although ABRs are strong and can handle a variety of wastewater types, further treatment is still required before residual sludge and effluents may be adequately recycled or released. An illustration of ABR is given in Figure (23).

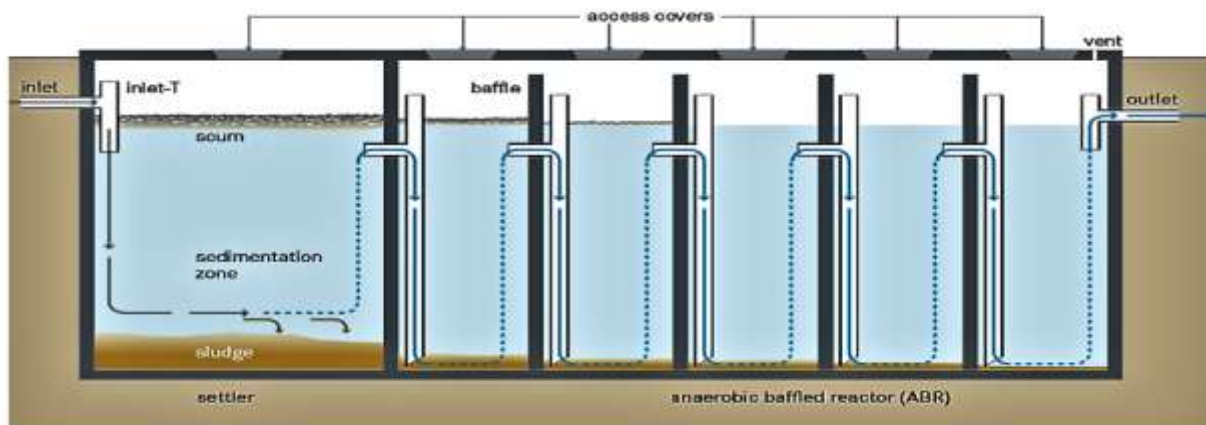


Figure 23 Schematic of the Anaerobic Baffled Reactor (ABR)

There are two types of drying beds. These are unplanted drying bed (UDB) and planted drying Bed (PDB).

3A Unplanted Drying Bed (UDB):

This is a simple, permeable bed that has numerous drainage layers. When bed loaded with sludge, this structure collects leachate that has percolated through the bed and enables the sludge to dry by percolation and evaporation. Between 50 and 80 percent of the volume of the sludge flows out as liquid or evaporates. The percolate has to be collected for treatment or regulated reuse since bacteria are still present. Also the dried sludge must be properly disposed of or utilized as a nutrient-rich soil additive in agriculture after proper treatment by composting. Before adding new sludge, unplanted drying beds must be de-sludged so frequent de-sludging necessitates huge surface areas, personnel, or mechanical power, drying beds are very simple to build and maintain.

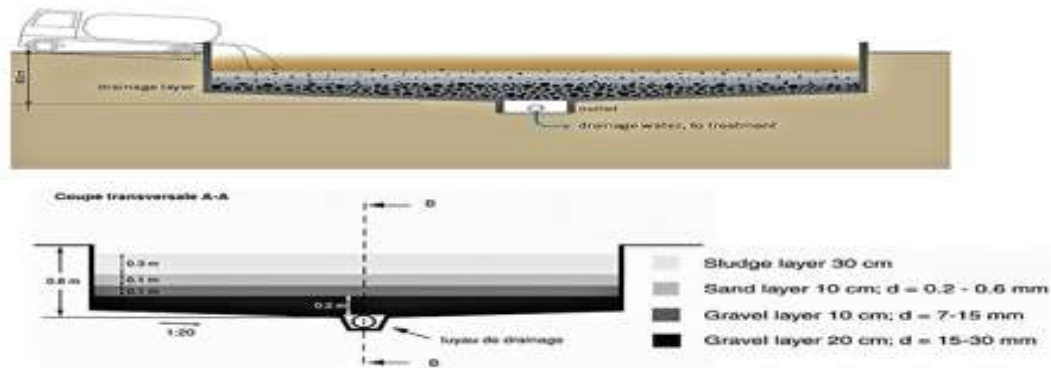


Figure 25 Schematic layouts of an unplanted drying bed

Table 24 Comparative analysis of Unplanted Drying Bed

Advantages	Disadvantages
Relatively low capital costs; low operating costs	High land requirements
Good dewatering efficiency, especially in dry and hot climate	odors and flies are normally noticeable
No energy requirements	Labor intensive removal
Can be built and repaired with locally available materials	Limited stabilization and pathogen reduction
Simple operation, only infrequent attention required	Leachate requires further treatment
No experts, but trained community required	Requires expert design and construction supervision

3B Planted Drying Bed (PDB):

A planted drying bed is comparable to an unplanted drying bed, but the presence of plants adds the advantages of increased sludge treatment and transpiration. To separate the solid from the liquid part of fecal sludge from latrines, septic tanks, biogas reactors, trickling filters, etc., it is a sealed shallow pond filled with various drainage layers. By using a mix of percolation and evaporation, sludge is naturally dried. The filters do not need to be de-sludged after each feeding/drying cycle, which is the main advantage of the planted bed over the unplanted bed.

The plants and their root systems maintain the porosity of the filter, allowing new sludge to be put directly over the preceding layer. Unlike unplanted drying beds, planted drying beds (also known as humification beds) only require desludging once every five to ten years. The removed sludge provides a nutrient-rich soil amendment that may be utilized right away in farming.

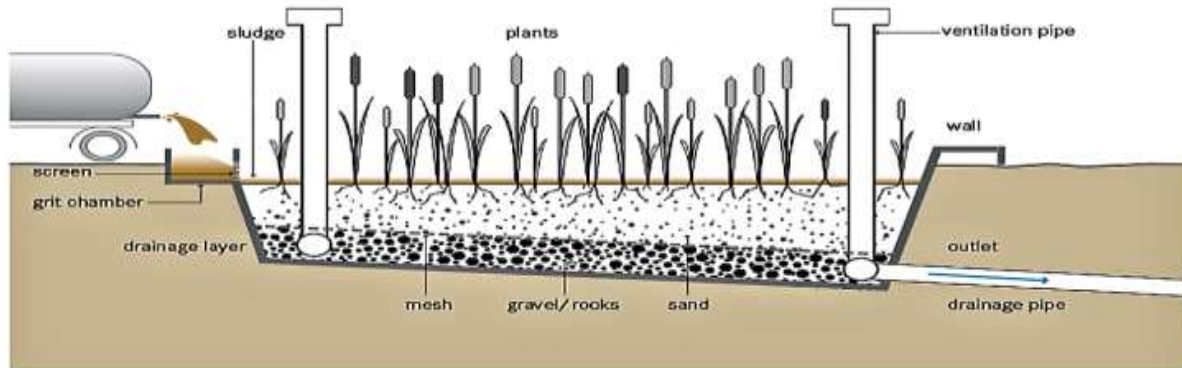


Figure 26 Schematic of a planted drying bed

Utilization of drying bed is well known technology and reliable in resulting wastes with low moisture content of dried solids and relatively good percolate quality (compared to settling facilities). However the resulting solids are not hygienically safe (unlike constructed wetlands). The dried sludge still require further treatment for pathogen removal.

Table 25 Comparative analysis of Planted Drying Bed (PDB)

Advantages	Disadvantages
Can handle high loading	Requires a large land area
Better sludge treatment than in unplanted drying beds	odors and flies may be noticeable
Easy to operate (No experts, but trained community required)	Long storage times
Can be built and repaired with locally available materials	Labor intensive removal
Relatively low capital costs; low operating costs	Requires expert design/construction supervision
No electrical energy required	Leachate requires further treatment
Fruit or forage growing in the beds can generate income	Only applicable during dry seasons or needs a roof and contour bund

4. Up-Flow Anaerobic Sewage Blanket (UASB) reactor:

The UASB reactor uses anaerobic digestion to treat fecal sludge and wastewater, and it has the ability to both decrease sludge volume and create biogas. Before employing the UASB reactor technology, the fecal sludge properties must be examined since fresh or less stabilized fecal sludge will have larger quantities of organic matter but will also include inhibitory substances. Every two to three years, the septic tank's digested fecal sludge is drained; however, because the sludge in the septic tank has already undergone some digestion, this procedure might not be suitable for anaerobic co-treatment. In this instance, the digested fecal sludge's low organic matter concentration will result in poor biogas generation but significant solid buildup, which will raise operating expenses at the expense of small benefits.

Table 26 Comparative analysis of Up-Flow Anaerobic Sewage Blanket (UASB) reactor

Advantages	Disadvantages
High nutrient recycling	High level of skill for operation and maintenance (O&M)
Energy balance and CO ₂ emission	Effluent and sludge require further treatment and/or appropriate discharge
High reduction of BOD ₅	Longer start-up period
Low sludge production	A proper temperature range is required for the anaerobic process (15°C to 35°C), therefore it is not applicable during cold season
A low energy requirement for the treatment process	Some equipment (i.e. pH meter, thermometer etc.) and professional staff is necessary for monitoring the internal condition of the reactor.
Less nutrients required;	A constant source of electricity is required
System can be shut down for extended periods without serious deterioration; and	Need import of electro-mechanical equipment and shortage of locally available spare parts
Can handle organic shock loads effectively.	Requires expert design and construction

5. Imhoff Tank (IT)

The Imhoff tank is a main wastewater treatment method that separates solids from liquids and digests settled sludge (Figure 27). A V-shaped settling compartment sits above a sludge digesting chamber that is tapering and equipped with gas vents.

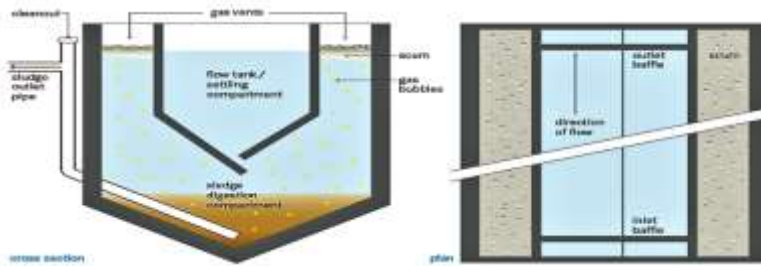


Figure 27 Schematic of an Imhoff Tank

The settling sediments are anaerobically digested in the digestion chamber, producing biogas. In order to avoid the gas from interfering with the settling process, baffles direct it towards the gas vent pipes. Small settlements employ Imhoff tanks, and the subsurface structure severely restricts the usage of land. Low investment expenses are combined with straightforward operation and maintenance. However, because of the low treatment effectiveness, a further treatment of the effluent is necessary. Furthermore, the tanks need to be frequently emptied.

Table 27 Comparative analysis of Imhoff Tank (IT)

ADVANTAGES	DISADVANTAGES
Solid-liquid separation and sludge stabilization are combined in one single unit	Very high (or deep) infrastructure; depth may be a problem in case of high groundwater table
Resistant against organic shock loads	Requires expert design and construction
Small space requirements	Low reduction of pathogens
The effluent remains fresh (i.e., not septic)	Requires desludging
Low operating costs	Inefficient treatment option if not regularly deslugged
Suitable for small settlements and house clusters	Odor occurs from escaping gases
Standardized designs available	Effluent, sludge and scum require further treatment
Simple operation and maintenance	Less simple than septic tank

8.3.2.1 Decision matrix for primary treatment technology (solid-liquid separation)

The groundwater level, land need, energy requirement, skill required, capital cost (CAPEX), operational cost (OPEX), and sludge treatment technical possibilities were taken into consideration while creating the decision matrix for the Bishoftu town for ESIA (Table 28). The selection of fecal sludge treatment technology for Bishoftu town also depends on the UWSSP-II sanitation goals, the minimum/indicative wastewater quality standard values set out within the UWSSP-II ESMF, WBG and EHSG.

Table 28 Main characteristics of the sludge dewatering process

CHARACTERISTICS	UDB	PDB	UASB	S&T	IT	ABR	AP
Land requirements	+++	+++	+	+	+	+++	++
Energy requirements	-	-	+	+	+	-	-
CAPEX	+	+	++	+	++	++	++
OPEX	+	++	++	+	++	++	++
Groundwater level	+	+	+	++	++	+	+
Skill requirement	+	++	++	+	+++	+	+
Discharge standard	++	++	+++	++	++	++	++
Operational complexity	+	++	++	++	++	+	+
Maintenance requirements	+	++	++	++	++	+	+
Complexity of installation	+	++	+++	++	++	++	+
Influence of climate	+++	+++	+	+	+	++	++
Sensitivity to type of FS	++	++	+	+	+	++	++
Chemical product requirement	-	-	+	+	+	-	-
Sludge removal complexity	++	++	+	++	++	++	++
Level of dryness	+++	+++	++	+	+	+	+
Odors and vectors	+++	+++				+++	+++
Noise and vibration	-	-	+	+	++	-	-
NB:- +=Low ; += Moderate = +++; High ; - = No need							

NB: - ABR: An anaerobic baffled reactor; AP: Anaerobic pond; IT: Imhoff Tank; PDB: Planted Drying Bed; S&T: Settling and thickening tank; UASB: Up-Flow Anaerobic Sewage Blanket; UDP: unplanted Drying Bed

The UDB and PDB require a lot of area but no energy need, whereas the UASB reactor has high discharge standards but has moderate CAPEX and OPEX. The groundwater level should be deep for IT and S&T tanks, although the UDB, PDB, and USAB reactor do not depend on it for operation. UDP is determined to be the most appropriate option based on the decision matrix analysis for BT FSTP as liquid-solid separation. Consequently, for Bishoftu Town FSTP, UDP, the principal treatment (solid-liquid separation) technique, was selected. Evaluations conducted with drying beds have shown that they offer effective treatment, simple operation and maintenance methods, resistance to shock loads, and climate adaption.

8.3.3 Technology for leachate /liquid effluent treatment

Secondary Liquid Treatment: To meet the standards for water reuse or release into the environment, the liquid effluents from dewatering technology must first undergo further treatment. This liquid effluent frequently needs extra treatment to fulfill the criteria for discharge quality. Therefore, a low-cost technique should be used (e.g., wetlands, waste stabilization ponds).

Waste Stabilization Ponds (WSP): Stabilization ponds are made up of several ponds with different names depending on what they are used for facultative, maturation, or anaerobic ponds for lowering organic, nutrient, and pathogen loadings through sedimentation and biodegradation under anaerobic, anoxic, and/or aerobic conditions. Stabilization ponds can be anaerobic or/and facultative ponds depending on the organic pollutant concentration. The first anaerobic pond after the primary treatment will still receive some suspended solids that will accumulate on its bottom. After occasional removal, the sediments can be treated together with the solids that have been separated in primary treatment. High ammonia concentrations in the effluent, for example in FS from public toilets, may inhibit growth for algae and bacteria and thus the functioning of ponds.

Advantages treatment is considered relatively simple, cheap in capital, operating, maintenance expenses and well known reliable technology. As a limitation the treatment option requires large area of land requirements and possible inhibition of functioning through NH_3/NH_4 in case of very fresh FS.

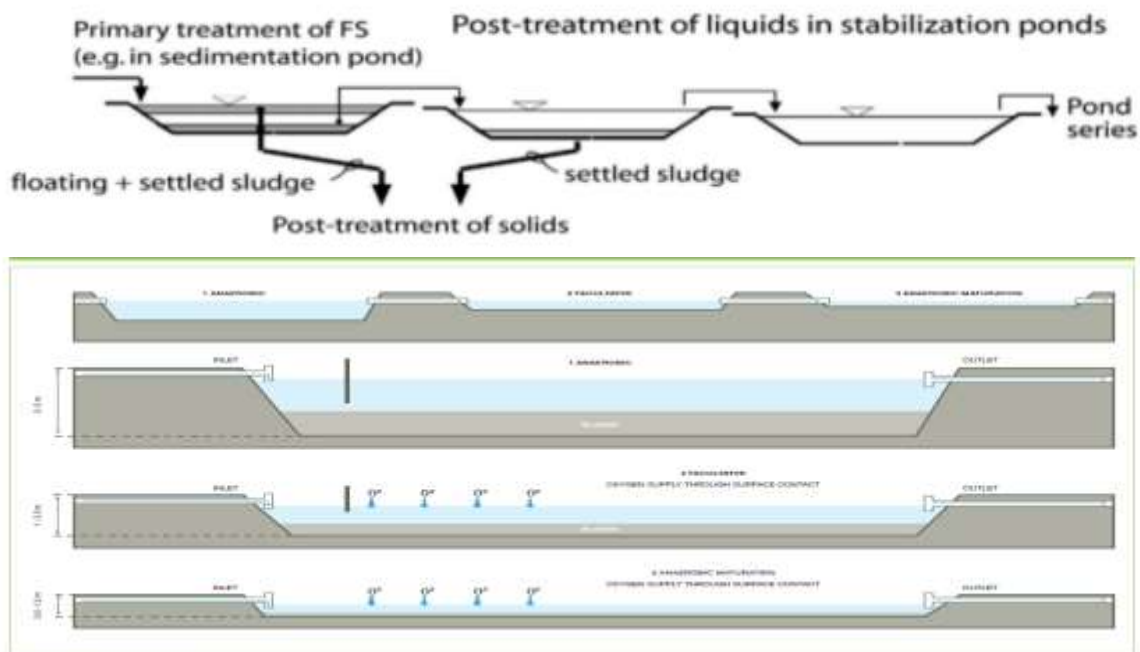


Figure 28 Typical scheme of a waste stabilization system layout

Facultative Ponds: Facultative ponds are generally aerobic, but operate in a facultative manner and have an anaerobic zone. Treatment in a facultative pond is provided by settling of solids and reduction of organic oxygen demanding material by bacterial activity. Dissolved oxygen is supplied by algae living within the pond and atmospheric transfer through wind action. Facultative ponds are usually 4 - 8 feet in depth and can be viewed as having three layers. The top six to eighteen inches is aerobic where aerobic bacteria and algae exist in a symbiotic

relationship. The middle two to four feet is partly aerobic and partly anaerobic, in which facultative bacteria decompose organic material. The bottom one to two feet is where accumulated solids are decomposed by anaerobic bacteria.

Maturation Ponds: Maturation ponds (low-cost polishing ponds), follow either the primary or secondary facultative pond, are primarily designed for tertiary treatment, i.e., the removal of pathogens, nutrients and possibly algae. The maturation ponds, usually 1-1.5 m deep, receive the effluent from the facultative ponds. Their primary function is to remove excreted pathogens.

Table 29 Features of selected treatment options for liquid effluents from dewatering units

	Key Features	Advantages	Disadvantages
Waste Stabilization Ponds	Consists of bioreactors in series operating under anaerobic, facultative and aerobic conditions	Low construction costs	Requires large land area
	BOD removal: 80-95%	Low O&M costs; main O&M requirement includes weeding (to prevent breeding of mosquitoes) and removal of scum	May promote breeding of insects
	Residence time: 20-60 days	Low energy demand	Odor may be generated in some cases
		Appropriate for treating high-strength effluent	Well suited for tropical and subtropical countries
Wetlands	Organic loading rate: 30-110 g COD m ⁻² d ⁻¹ (typical: 75 gBOD ₅ m ⁻² d ⁻¹)	Does not require chemicals, energy or high-tech infrastructure	Requires large land area
	Hydraulic residence time: typically, 3-6 Days	Suited for combination with aquaculture or sustainable agriculture (irrigation)	Delayed operational status (vegetation establishment needed for peak removal efficiency might take 2-3 years)
		Good control of odor	Pretreatment of the effluent may be required to prevent clogging of the filter bed
		Low construction, O&M costs	Not very tolerant to cold climates
		High reduction in BOD, SS and pathogens possible	
		Attractive landscape features	

Constructed Wetlands (CWs): Constructed wetlands are an “eco-friendly” alternative for secondary and tertiary municipal and industrial wastewater treatment. CWs are planned systems designed and constructed to employ wetland vegetation to assist in treating wastewater in a more controlled environment than occurs in natural wetlands. For the treatment of wastewater there are three types of constructed wetlands (Figure 29). The treated water flows horizontally and above ground in Free Water Surface Wetlands (FWSW), whereas it flows horizontally and underground (5 to 15 cm below the surface) in Sub-Surface Flow Wetlands (SSFW).

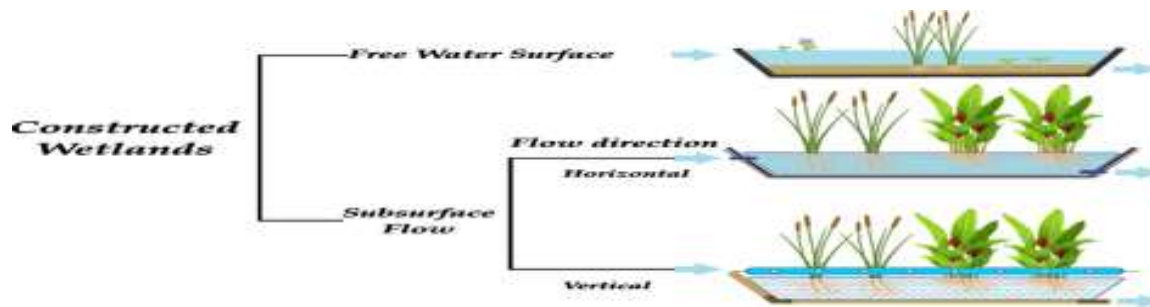


Figure 29 Scheme of types of constructed wetland

In contrast to the other two systems, which constantly function under aerobic circumstances, this causes occasional aerobic-anaerobic situations in the VFCW. The horizontal-flow systems, on the other hand, are more susceptible to clogging, which may be brought on by a high SS content in the liquid to be treated. As a result, they should primarily be employed to remove dissolved pollutants, with the VFCW being more successful at doing so. To properly treat wastewater, a hybrid unit can mix FWSW, SSFW, and VFCW. Based on the parameters utilized for the assessment of secondary liquid treatment options, for the BT maturation pond is prioritized than construction wetlands Table (30).

Table 30 Secondary Liquid Treatment option evaluation

No.	Description	Score	Maturation Pond	Constructed Wetland
1	Construction Method/Costs	20	17	8
2	Equipment	5	5	5
3	Land	5	4	3
4	Pathogen Removal	20	18	15
5	Ammonia Removal	10	5	8
6	Solid's removal	10	6	8
7	Energy Requirement	5	5	5
8	Operator Skills	5	5	4
9	Labour	5	5	4
10	Desludging/Re-planting	10	8	5
11	Mosquito breeding	5	2	5
	Total	100	80	70

Source: (CATS and United CE, 2022)

8.3.4 Proposed sludge treatment options

After analyzing the available technological alternatives, team of experts in GSEMC were reach in agreement with the design consultants about the proposed fecal sludge treatment options for Bishoftu town. So based on the assessment criteria utilized, the top three ranking fecal sludge treatment unit's combinations proposed are:-

1. Sand Drying Bed + Anaerobic Pond + Facultative + maturation Pond (AP+FP+MP)

2. Settling Chamber + ABR+ Facultative+ Maturation (ABR+FP+ MP)
3. Settling Chamber +ABR+ Facultative+ Constructed wetland (ABR+ FP+ CW)

Waste stabilization ponds (AP, FP and MP) can treat the majority of wastewater types and function well in almost any setting. Because temperature and sunlight intensity are crucial for the effectiveness of the removal processes, they are especially well-suited for tropical and subtropical nations. Around the world, ponds are used. Ponds are the most popular method of treatment in many nations and areas. Maturation ponds are needed if the effluent is to be used for unrestricted irrigation or if there are special requirements in terms of microbiological quality for the receiving water body (bathing waters, for example). Maturation ponds play a crucial role in enhancing the treatment of fecal sludge, improving environmental sustainability, and ensuring public health safety.

Based on their technical feasibility, financial considerations, environmental and social economic factors as general criteria and their construction aspect, land and equipment requirement, BOD₅ and solid removal capability, operator skill and energy requirement, and labor input requirement, creating odor free fecal sludge treatment aspect and others, Option I (SDB+AP+FP+MP) suitable for BT.

Table 31 Ranking Alternative treatment for Bishoftu town

S/N	Treatment Configuration	Receiving	ABR	AP	FP	MP	CW	Average Score	Rank
1	Receiving +ABR+AP+FP+MP	44	80	75	86	80		73	1
2	Receiving +AP+FP +CW	44		75	86		70	55	6
3	Receiving Chamber + ABR + FP + MP	68	80		86	80		62.8	4
4	Receiving Chamber + ABR+ FP + CW	68	80		86		70	60.8	5
5	Settling Chamber + ABR + FP + MP	87	80		86	80		66.6	2
6	Settling Chamber +ABR +FP +CW	87	80		86		70	64.6	3

NB: ABR: Anaerobic Baffle Reactor, FP: Facultative Pond, MP: Maturation Pond, AL: Aerated Lagoon, CW: Constructed Wetland, AP: Anaerobic Pond

Source: (CATS and United CE, 2022)

8.3.5 Technology alternative for sludge treatment and disposal

This treated FS cannot be used directly in agriculture since it still contains pathogenic bacteria and parasite eggs. Further treatment is needed to raise the sludge's quality by: 1) Co-composting, 2) vermicomposting, 3) shallow trenches, and 4) solar drying techniques.

Co-composting: Fecal sludge is dewatered, and the partially treated sludge is combined in a ratio of 1:2 or 1:3 with the organic portion of municipal solid waste. The survival of

microorganisms throughout the composting process depends on properly regulated moisture and aeration conditions. Municipal solid waste has strong bulking qualities and is rich in organic content; whereas, feces have a high moisture and nutrition content. A high temperature (50-70°C) is maintained during co-composting for 3 weeks in order to destroy helminthes eggs and harmful bacteria. Stabilized organic matter that may be utilized as a soil conditioner is the final outcome of co-composting. The co-composting procedure takes 10–12 weeks.

Table 32 Comparative analysis of Co-composting

Advantages	Disadvantages
Relatively straightforward to set up and maintain with appropriate training	Requires a large land area (that is well located)
Provides a valuable resource that can improve local agriculture and food production	Long storage times
A high removal of helminthes eggs is possible (< 1 viable egg/g TS)	Requires expert design and operation by skilled personnel
Can be built and repaired with locally available materials	Labor intensive
Low capital and operating costs	Compost is too bulky to be economically transported over long distances
No electrical energy required	

Solar Drying: Treatment by solar drying is generally done in greenhouse structures with glassy covers, concrete basins, and walls. Sludge is disposed of into the concrete basin and processed for about 10–20 days. Options exist for batch or continuous operation, with devices to control the conditions in the greenhouse (e.g., ventilation, air mixing, temperature). The main factors influencing the evaporation efficiency in these systems are the solar variation, air temperature, and ventilation rate, with the initial dry solid content of the sludge and air mixing also influencing.

Table 33 Comparative analysis of Solar Drying

Advantages	Disadvantages
High efficiency for dewatering	Large space requirements
Low energy requirements	Need mechanical means to turn sludge
Low investment cost	Ventilate the greenhouses

Vermicomposting: Earthworms are used in the low-cost composting process known as vermicomposting to break down organic waste. This system for managing fecal sludge is quick, simple to use, economical, energy-efficient, and waste-free. Earthworm biomass and vermicomposting are the two beneficial byproducts of vermicomposting. Practically every type of organic matter may be consumed by earthworms, and they can consume as much as their own body weight in one day.

Table 34 Comparative analysis of Vermicomposting

Advantages	Disadvantages
Compact size	Maintenance requirements
Nutrient-rich compost	Limited types of waste
Reduction of waste	Potential for odor
Educational opportunity	Risk of pests

Shallow trenches: It is a straightforward approach that aids in the cleanup of contaminated soil and does not smell bad or seem unattractive to nearby residents. No matter how much or how little sludge there is, a shallow trench may be employed. However, the area needed and the demand for routine groundwater monitoring is the key limitations of this system.

Decision matrix for sludge treatment technologies option: Based on the sludge treatment technical options, a decision matrix was prepared for WST concerning land requirement, energy requirement, skill requirement, CAPEX, OPEX groundwater level, and discharge standard (Table 35).

Table 35 Decision matrix for sludge treatment technologies

Constraint	Co-composting	Vermicomposting	Solar drying	Shallow trenches
Land requirement	+++	+++	+++	+++
Energy requirement	+	+	+	+
Groundwater level	+	+	++	++
CAPEX	+++	+++	+++	+
OPEX	+++	+++	+++	+
Skill requirement	+	++	+++	+
Discharge standard	+++	+++	+++	-

+: low favorability; ++: moderate favorability; +++: high favorability; -: no need

Based to the decision matrix (Table 35), solar drying treatment is the best alternative sludge treatment technique, co-composting and vermicomposting were strongly advised as a first and second order alternative by an ESIA consultancy team as a secure solution for disposing of dried sludge.

8.4 Fecal Sludge Treatment Process Technologies Adopted For BT

BT lacks an infrastructure facility for the treatment of fecal sludge or wastewater. Currently, vacuum trucks are used to transfer fecal sludge to open dump sites near Golba site. Given this, the various fecal sludge management options and feasibility studies have been examined by joint venture companies CATS (international) and UNICONE (local) with a detailed design of CWIS for BT. Fecal sludge technologies that fulfill the following requirements is proposed. The technology that

- Provide biological treatment for the fresh sludge – It excludes solid Liquid separation only systems for untreated sludge such as gravity thickener, sludge separation chambers, and sludge drying beds
- Have low capital and operating cost – excludes mechanical dewatering, thermal drying, trickling filters
- Have minimum mechanization – excludes fines screens, mechanical dewatering, oxidation ditch
- Require minimum external energy input – excludes mechanical processes and pumped system
- Be compatible with the available skills – excludes gravity thickeners, fine screens, oxidation ditch and composting

Based on the outcome of several technology selection criteria analysis, the proposed technology alternatives for fecal sludge by the design consultant was in agreement with the ESIA consultant team. The prioritized technology alternative design for treating the fecal sludge in BT comprises and sequentially arranged as receiving settling chamber, coarse screen, anaerobic pond, sludge drying bed, facultative pond, and maturation pond. These technological possibilities offered the possibility of successfully treating fecal sludge to generate leachate effluent that could be safely disposed of without damaging the environment or providing health risks to people. Sludge and leachate that would fulfill the minimal or indicative wastewater quality standard values described in the UWSSP II, ESMF/WBG EHS can also be treated using the suggested fecal sludge treatment approach.

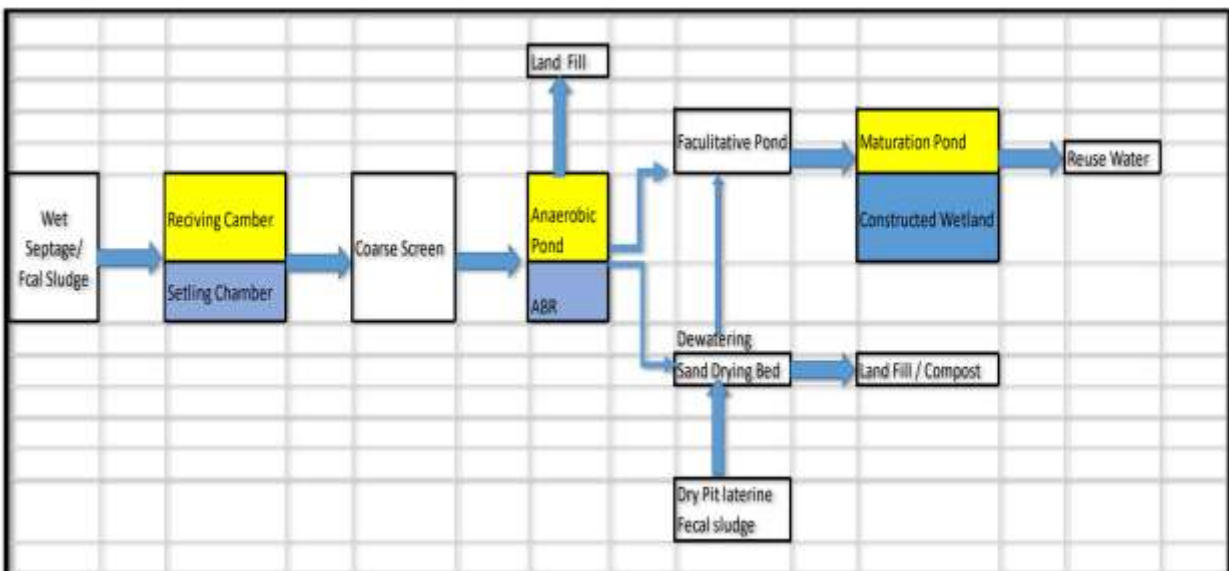


Figure 30 Fecal sludge treatment plant options for BT

9. Potential Sub-Project Impacts

Diverse environmental and social implications will possibly arise from the Sustainable City-Wide Inclusive Sanitation Management project. In this chapter, prediction, and analysis of possible positive and negative impacts of the construction and operation of the sanitation project are presented.

9.1 Assessment Methodology

The impact assessment was done through a standardized structured impact assessment process. The identification of impacts was done first by collecting a comprehensive list of key potential environmental impacts related to the project.

Impact identification: Prediction of possible impact determined in line with what could potentially happen to resources and receptors as a consequence of the project and its associated activities. The sections present the physical, biological, and socioeconomic environment. Moreover, the potential impacts and receptors were identified by the pre-construction, construction, and operational phases. The possible impact receptors in the environment were listed and identified by surveying the existing environmental and socioeconomic conditions through baseline studies and consultation with concerned parties.

Impact Description: Impact description technically characterizes the causes and effects of impacts and their consequences on the local environment. Potential impacts of the proposed project, their characteristics, and the attributes of the receiving environment were predicted and presented for tenable mitigation measure development. Project impact characteristics include whether the impact is: adverse or beneficial; direct or indirect; short, medium, or long-term; and permanent; affecting a local, regional, or global scale; including trans-boundary; and cumulative or not. Each of these characteristics is addressed for every major impact identified during analyses.

Impact Evaluation: The significance of the predicted or identified impacts has been quantified and evaluated by considering the magnitude of the effect and the sensitivity, value, and importance of the affected resource or receptor. For the quantification and evaluation of impacts checklists and interaction matrices were applied. Each major impact is evaluated using the criteria assigned by experts' professional judgment based on the impact intensity, extent, duration, and sensitivity of the receiving biophysical and socio-cultural environment. After the evaluation of impacts, appropriate and justified mitigation measures for the negative impacts and enhancement measures for the positive impacts are forwarded.

Table 36 Classification of Impact Evaluation

Classification	Description
Extent	Evaluation of the area of occurrence or influence of the impact on the subprogram environment; whether the impact will occur on-site , in a limited area (2km radius); locally (5km radius); regionally (city-wide, nationally, or internationally).
Duration	Evaluation of the duration or persistence of impact on the subprogram environment, whether the impact was temporary (<1 year); short-term (1 – 5 years); medium-term (5 – 10 years); long-term (subprogram design period); or permanent (bound design period).
Sensitivity	Assessment of the impacts for sensitive receptors in terms of physical, ecological, social, and cultural settings, and major potential for stakeholder conflicts. The sensitivity classification is: High sensitivity: Entire community Involuntary displacement, Property damage or Loss, biodiversity disturbance and species extinction, destruction of world heritage and important cultural sites, large-scale stakeholder conflict according to RPF, etc. Medium sensitivity: Displacement of some households according to the RPF, moderate level of stakeholder concern, medium and reversible damage to the natural environment, etc. Low sensitivity: No displacements, no potential for stakeholder conflict, negligible impact on the natural environment, etc.
Severity (Overall Impact rating)	Using a combination of the above criteria, the overall severity of the impact was assigned a rating of Severe, Substantial, Moderate, Minor, and negligible. <i>Note:</i> These are just guidelines that will constitute professional judgment required in each case.

Impact severity: The impact severity was determined by professional experts by evaluating the intensity of the impact and the sensitivity of the environmental and social receptors, which is largely subjective. Impact severity assessment was done by assigning numerical descriptors (1-4) to the impact intensity, as well as the environmental and social receptors, for each potential impact. The numerical descriptors are 1, 2, 3, or 4; which are equivalent to very low, low, medium, or high. The impact severity is then calculated as the product of the two numerical descriptors, which is equivalent to negligible, minor, moderate, or major, as indicated in Table (31).

Impact Significance: Impact significance is determined from an impact severity matrix which compares the severity of the impact with the probability of its occurrence. Impact significance criteria are as follows:

- **Major:** These denote that the impact is unacceptable and further mitigation measures must be implemented to reduce the significance. It is **Shaded red** Table (37).
- **Moderate:** Impacts in this region are considered tolerable but efforts must be made to reduce the impact to levels that are as low as reasonably practical. **Shaded Yellow.**
- **Minor:** Impacts in this region are considered acceptable. **Shaded Gray.**
- **Negligible:** Impacts in this region are almost not felt. **Shaded Light green.**

Table 37 Determination of impact severity matrix

			Sensitivity of receptor			
			Very low	Low	Medium	High
			1	2	3	4
Impact intensity	Very low	1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low	2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Medium	3	3 Minor	6 Moderate	9 Moderate	12 Major
	High	4	4 Minor	8 Moderate	12 Major	16 Major

The scale of intensity is defined based on social and ecological considerations and the expert’s professional judgment Table (38).

Table 38 Intensity scale gradation for socio-environmental impacts

Intensity	Criterion
Very low	Environmental changes are within the existing limits of natural variations or carrying capacity
Low	Environmental changes exceed the existing limits of natural variations. The natural environment is completely self-recoverable or renewable.
Medium	Environmental changes exceed the existing limits of natural variations and result in damage to the separate environmental components. The natural environment remains self-renewable.
High	Environmental changes result in significant disturbance to particular environmental components and ecosystems. Certain environmental components lose their self-recovering ability.

Table 39 Overall Impact Rating and Description

Impact Rating	Description of Impact	Significance
Major	<ul style="list-style-type: none"> ✓ Non-compliance with national policy, environmental laws and regulations ✓ Highly noticeable, irreparable effect on the environment ✓ Significant, widespread, and permanent loss of resource ✓ Major defilement of water/air quality and noise guidelines ✓ Causing widespread nuisance both on and off-site ✓ Extensive property damage or loss 	>12
Moderate	<ul style="list-style-type: none"> • Noticeable effects on the environment, reversible over the long term. • Localized degradation of resources restricting the potential for further usage • Increased traffic in sensitive environments • Widespread physical resettlement, affecting livelihoods 	6 – 12
Minor	<ul style="list-style-type: none"> ○ Noticeable effects on the environment, but returning naturally to the original state in the medium term ○ Slight local degradation of resources but does not jeopardize further usage 	2 – 4

	<ul style="list-style-type: none"> ○ A small contribution to the global air problem through unavoidable releases ○ Infrequent localized nuisance ○ Population increase is not expected to stress existing infrastructure 	
Negligible	<ul style="list-style-type: none"> ➤ No noticeable, rapidly returning to the original state by the natural action ➤ Unlikely to affect resources to a noticeable degree ➤ No noticeable effects on regionally endangered species ➤ No significant contribution to the global air pollution problem ➤ Minor elevation in ambient water/air pollutant levels well below guidelines ➤ Temporary or intermittent changes to livelihoods or life quality aspects 	< 2

Cumulative Impacts: Cumulative impact is the effect on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impact results from the aggregated effect of more than one project (or more than an action of the same project) occurring at the same time, or the aggregated effect of sequential projects. Measuring cumulative impacts in an ESIA requires a comprehensive and systematic approach that integrates data collection, stakeholder engagement, and impact analysis. By thoroughly assessing cumulative impacts, decision-makers can make informed choices that promote sustainable development and minimize adverse environmental and social effects. The ESIA identifies the current and probable future impacts of the BTFSTP on the receiving environment.

9.2 Positive Impacts of the project and their Enhancement

The following positive impacts are anticipated during the construction operation and decommissioning phases of the project component.

Environmental protection

Proper treatment of fecal sludge helps to prevent the contamination of water bodies, soil, and the environment. Hence, the provision of adequate sanitation facilities in urban and rural areas has positive impacts on the environment, health of users by greatly reducing the incidence pollution, and enteric and infectious related diseases.

Resource recovery and recycling

The fecal sludge treatment process can extract valuable resources such as water, nutrients (e.g., nitrogen, phosphorus). Sludge application helps to reduce soil erosion and improves the soil quality as a plant growth medium and can help conserve soil organic matter, and sludge stimulates biological activity in the soil (Stamatiadis et al. 1999). The use of composted sludge (decomposed sludge) as fertilizer has the potential to improve crop yield and enable a reduction in cost for nitrogen and phosphorus mineral fertilizers. The nutrients extracted from the fecal sludge can be used as fertilizers, contributing to sustainable agriculture and food production.

Recycling of sludge for fertilizer and biogas energy production and soil amendment is an appealing solution and the resources can be reused or sold, contributing to a more sustainable waste management system.

Enhancement measures: Creating awareness for the general public about the potential of fecal sludge as an alternative fertilizer then chemical fertilizer. Encourage and participate people (vulnerable groups of the society) in compost preparation.

9.2.1 Public health improvement

Safely treating and disposing of fecal sludge, these important to minimize the exposure of communities to untreated waste, reducing the incidence of diseases associated with poor sanitation. Effective treatment significantly reduces harmful pathogens, decreasing the risk of waterborne diseases and improving overall public health.

Enhancement measures: Creating awareness for the general public on how to use and manage the wastewater treatment plant, proper use, regular cleaning, and effective maintenance of both the communal, household, and public toilet facilities. Educate users on the proper use, monitor the regular cleaning, and effective services of developed infrastructures. Ensure the required service and timely maintenance of communal, and public toilets and other related infrastructures.

9.2.2 Urban Service Infrastructure Improvement

The installation of fecal sludge treatment plants, public and communal toilets, will improved the sanitation and service delivery system in the city. Modern waste management system infrastructure induces development and helps improve the sanitation and hygiene level of the society.

Enhancement measure: The infrastructure development should be desirable in type and sustainable. For this to happen, all future development plans must be undertaken within the framework of proactive government policy and strict planning and environmental enforcement. The sustainability of the project is assured if the public/society at large participates actively in all stages of project development. To ensure the sustainability of the infrastructure service, effective and efficient utilization of the developed infrastructure and maintenance for the malfunctioning systems have to be maintained timely with the required standard. Recurrent societal training is required on awareness of waste management sustainable use and ownership of the developed infrastructure.

Employment: The project will provide skilled and unskilled employment opportunities. Temporary jobs will be created during the construction phase and permanent jobs when the overall project is completed and starts operating. This job opportunity will be available for residents, especially the PAHs, women, and youths, in the project area.

Enhancement measure: Unskilled and semi-skilled labor will be recruited preferentially from local communities, provided that they have the necessary, qualification, competence, and desired experience. Wherever feasible, local people should be considered for job opportunities commensurate with their level of skills. In this process special considerations and priority have to be given to vulnerable groups of society like women, the youth, and the disabled.

Adequate occupational health and safety standards training program for artisans (builders, carpenters, plumbers) in the project area has to be facilitated by the project to ensure skill transfer and ensure the work environment is conducive. Information to create awareness about the proposed project activities will be provided to the PAPs targeting vulnerable (female-headed HH, people with disabilities, elderly, and others) and indigenous community groups.

9.2.3 Skill and Knowledge Transfer/Capacity building

The construction and operation of modern sanitation amenities is a new technology for our country and BT. During the implementation, some degree of capacity building will be given (organized and unorganized) through the transfer of new technologies and new skills to (unskilled) labor. This might be done through on-the-job training as well as through exposure to modern practices, management, and logistics procedures. Local sub-contractors and companies are also beneficiaries of the transfer of skills and will also build additional local capacity.

Enhancement measures: Where the required knowledge and skills are available locally, the local people should be given priority, particularly the vulnerable group, proportionate to their level of knowledge, skills, and interests. Programs and technical training courses as well as on-the-job training will be provided in specific skills areas for suitable candidates from local communities.

9.2.4 Income to material/ equipment suppliers and contractors

Some of the instruments and equipment for the project implementation may come from local or international areas. Equipment and materials like gravel, bricks, plumber, steel reinforcement, and cement for civil works can be sourced locally within BC and surroundings. So local suppliers of construction materials and equipment in the project area will benefit financially.

Enhancement measures: Construction materials might be supplied from legal or illegal suppliers but it has to be a contractual obligation for contractors to procure construction materials from quarries/suppliers legitimately licensed /legal by the respective district authorities. Work on local sourcing of construction materials that will boost the livelihoods of residents.

9.2.5 Boost to the Local Economy

The implementation of the project will require large number of work force. The workforce will require and get most of their food and other necessities from the surrounding area and this will

provide a market for the local small businesses. This will in turn increase the incomes of petty traders in the locality and wages will quickly raise household income and stimulate the local economy. Thus the project will stimulate local economic activities by providing opportunities for the provision of basic and other services for the contractors and immediate community.

Enhancement measures: Provide adequate awareness about the business opportunity that that project has to the local community. Encourage vulnerable groups of the local community (women, youth,) to participate in petty trade activities.

9.3 Negative Impacts and Their Mitigation Measures

Unless appropriate mitigation measures implemented, the implementation of the fecal sludge treatment plant in BT adversely affect the socioeconomic environment of the area. The main adverse impacts are presented as follows:-

9.3.1 Pre-construction Phase

In pre-construction phase, activities like topographical surveys, site selection, land acquisition geotechnical investigation, resettlement issues and others are included. The site selection, planning and design processes were already completed. The main impact in this phase is related to land loss for the project-affected households (PAHs).

9.3.1.1 Land loss of PAHs

A screening report identified that, the proposed site (22 hectare) for the construction of FSTP plant is not free from encroachment hence loss of assets and livelihood triggered. Local people involuntarily give up their landholder rights, perennial crops, for the benefit of the proposed project. Although the proposed project do not result in a physical relocation of people, involuntary taking of land causes permanent economic displacement in a form of land losses which is the only means of livelihoods and source of income for project affected people in the area.

The project directly affects the lives of 188 people living in 35 households where ninety four of them are members of vulnerable groups including 68 children, 18 female household heads, 11 widows, 6 elderly and two mentally ill persons. All of households that will be displaced by FSTP project are small landholding peasants whose livelihoods are entirely land-based and with low levels of educational backgrounds and marketable skills other than agriculture. Therefore, it triggers WB safeguard policy of Involuntary Resettlement (OP/BP 4.12). The ESIA team strongly recommended that transparent and inclusive consultation with displaced persons about land acquisition and compensation processes should be undertaken before starting project implementation.

Impact Significance:

The development of FSTP will directly displace 35 households through involuntary taking of land and these displaced households have 188 members where 94 of them are members of

vulnerable groups including 68 children, 18 female household heads, 11 widows, 6 elderly and 2 mentally ill persons. The likelihood of the impact occurring is **high** and duration of impact will also be permanent. The extent of the impact will be on site. The **intensity of the impact and the sensitivity** of the receptor is **high** given the high potential to affect the poor, children, elderly and women. This results in **major impact significance**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

- Aware displaced persons about potential impacts of the project, issues of displacement and compensation issues, and the project in general;
- Conducting ARAP before any civil work by the relevant UWSSP Implementing Agencies-Water and sanitation utilities, with the use of the screening tool as attached to the RPF and resettle the PAHs around the FSTP;
- Displaced persons should be consulted on, offered choices among, and provided with technically and economically feasible resettlement alternatives: preferably land replacement alternative should be sought exhaustively;
- Displaced persons need to be properly compensated for the losses. Displaced persons should directly involve in the entire ARAP study and make their own informed decisions;
- Compensate those affected according to the laid down policies in collaboration with BT Administration, and the municipality, taking Ethiopian laws, Proclamation No. 1161-2019 as well as WB Safeguard policy on involuntary resettlement (OP 4.12) into consideration. Tenable and commensurate compensation must be paid both in cash and kind for loss of land and assets;
- Vulnerable community groups like children, widow female household heads, mentally ill and elderly must get priority during compensation study, and post displacement livelihood rehabilitation works;
- BT administration should provide development assistance such as land preparation, credit facility, trainings or job opportunities for displaced persons;
- Grievance Redress Mechanism (GRM) shall be put in place to resolve all project related grievances;
- Implement an institutional structure or a mechanism for monitoring and evaluating the compensation/resettlement process including the GRM.

The planned and careful adoption of the aforementioned mitigation measures can reduce impact intensity to “**low**” resulting in a residual impact of “**moderate significance**”.

9.3.2 Construction Phase

9.3.2.1 Loss of vegetation cover

The proposed area is a farmland area grasses as dominant vegetation. There are some (5 to 7 scattered *Acacia* trees in the proposed sites. Land clearing and removal of the existing vegetation may result in the alteration of landscape integrity, grasses, and change in land use patterns in the project area. **Impact Significance:** Thus whatever little vegetation may be affected by the proposed construction work, the **intensity of the impact and the sensitivity of the receptor** are **minor** given. This results in **minor impact significance**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
of Intensity impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation strategies:

1. Once the work is completed re-vegetate the perimeters of the FSTP with 5-10 indigenous/endemic plant species per lost plant species during site clearance;
2. Store and reuse the topsoil removed from the site during site preparation properly;
3. Minimize the amount of destruction caused by machinery by promoting non-mechanized methods of vegetation removal;
4. Keep the integrity of the altered landscape through greenery activities.

9.3.2.2. Soil Degradation

Site preparation will involve topsoil stripping, leveling and grading of the right of way (ROW) and this excavation of subsoil during trenching will break up the soil structure. Also, construction equipment engaged in activities might cause light contaminations of soil due to leakage of fuels and lubricants from equipment. Excavated soil may be exposed to agents of erosion and prolonged storage of topsoil can lead to a loss in soil nutrients (leaching effect) viability of seed bank in the soil.

Impact significance: The, receptor sensitivity is assessed to be low and short-term. Since the project will be done by a qualified contractor, medium impact intensity is expected. The duration of exposure of stockpiles is relatively short and the sensitivity of the impact occurrence is medium. Thus both the **intensity** of the impact and **sensitivity** of the receptor are rated as moderate, which results in moderate impact significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation strategies:

1. Develop an excavated soil management plan before the start of construction activities;
2. Topsoil and subsoil removed from the site during site preparation will be stored properly (away from runoff and possible contaminants) for reuse elsewhere or for backfilling and reinstatement;
3. Contour temporary and permanent access roads/laydown areas to minimize surface water runoff and erosion;
4. Avoid using old (not more than 10 years) and properly unmaintained machinery which can most likely lead to oil, grease, and fuel leakages;
5. Excess soil/ cart away must be removed from the site daily and deposited at an authorized approved site;
6. Protect adjacent areas of the construction site from disturbance and wherever possible construction work will take place during the dry season;
7. Prevent sheet and rill erosion of soil through the use of sandbags, diversion berms, culverts, or other physical means.

The adoption of the mitigation measures can reduce impact intensity to “**very low**” resulting in a residual impact of “**minor** significance”.

9.3.2.3 Air Quality and Noise Pollution Dust Emissions

Dust emission: site clearing, earthworks, vehicle movement over unpaved areas, and other activities in the project area will generate elevated level of fugitive dust. Pollution of gases from engines of machineries, vehicles expected. Major dust sources will be vehicle movement over unpaved areas and transportation of raw materials and equipment within the work site.

Air quality: In regions being excavated for trenches, pits, along transportation routes, and at the building site, dust and engine pollution gases may accumulate. Emissions of CO₂, CO, SO₂, NO_x PM₅ PM_{2.5}, and other pollutants are produced by the continuous operation of trucks and equipment during the construction phase of the project. Moreover, some welding fumes such as metal oxides (Fe₂O₃, SiO₂, K₂O, CaO and CO, NO_x can be produced during the construction phase but this work happens in a short time and the impact is localized and temporary.

Noise pollution: The use of heavy equipment including bulldozers, graders, and dump trucks during site preparation and transportation of materials will generate noise and vibrations. The levels of noise generated will depend on the type and condition of equipment employed by the contractor, and the number of employees at a particular time. With noise being perceived as one of the most undesirable consequences of construction activity, it might become a nuisance to the settlements within its environs. Since the noise levels in the area are low or within the

acceptable limit, the activities will therefore temporarily increase such levels. Generally, construction phase noise level exceeding 75 dBA and 70 dBA during the day and night respectively has significant impacts on surrounding sensitive receptors within 50m of the construction site. There is no any settlement in the project area and hence the impact of noise to humans is expected to be low.

Impact significance: Particularly the FSTP site has ambient noise level with good air quality. The construction phase of the project might disturb the ambient conditions. The air quality impacts associated with dust generation and noise pollution to the receptor sensitivity is considered to be “low”. The *intensity* of impact is assessed as **low** resulting in **minor** impact significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Construction workers will be made aware of the permissible noise levels at the workplace and surrounding environment
2. Noise levels at construction sites should not exceed 75 dBA and 70 dBA during the day and night, respectively
3. During periods of off-work time, equipment will be switched off during off-work time whenever possible;
4. Utilize well-maintained and functional working equipment;
5. Avoid using old (> 10 years) or damaged equipment; every week check every day proper functioning of all the machines on duty;
6. Trucks will be covered during haulage of construction materials to reduce spillage of materials and Use spray water for dust suppression over dusty areas
7. Provide the necessary PPE (ear muffs, masks, etc.) to workers whenever needed and as found appropriate;
8. Adjust the travel speeds of construction vehicles to 30 Km/h along the road and should be controlled using traffic signals;
9. Avoid construction activities during the nighttime.

Adoption of these mitigation measures will reduce impact intensity to “**very low**” resulting in a residual impact of **low** significance.

9.3.2.4 Alteration of natural drainage pattern

The natural drainage pattern of a landscape refers to the way water flows through the land, typically from higher elevations to lower elevations. Possible shifting of drainage lines is expected and this may have adverse impact to the flow direction of surface runoff. Alternation of Storm water (surface runoff) direction is the major concern. Development of safe and

efficient drainage line for the management of storm water is particularly important to maintain the environmental safety of the receiving water environment.

Impact significance: The FSTP sites are located nearby of the natural drainage lines. The construction phase of the project might disturb these natural drainage lines and conditions. The impacts associated with the alteration of natural drainage line to the receptor sensitivity are considered to be “medium”. The *intensity* of impact is assessed as *low* resulting in impact **moderate** impact significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Plan and work on integrated water shade management for the natural drainage lines;
2. Work with stakeholders in storm water drainage planning, design, and management activities;
3. Work on flood avoidance strategies as precautionary interventions that involve structural adaptations;
4. Develop flood mitigation strategies (flood responses before and during an event, emergency flood control works);
5. Construct drainage channels within the construction site to allow for the convenient and free flow of storm water;
6. Construct drainage channels in all areas that generate or receive surface runoff water; The channels shall be designed concerning the maximum expected flood discharge;
7. Connect the drainage lines with existing natural drainage lines;
8. Work in collaboration with stakeholders to prevent possible erosion, and flood and for the stabilization of gullies and drainage lines.

9.3.2.6 Traffic congestion /Accidents

Traffic congestion and accidents are anticipated because heavy-duty truck traffic can obstruct or damage roads and increase the likelihood of accidents. Vehicles and trucks transporting construction materials to the site may result in community risk of traffic-related accidents especially if proper signals, and safe speed limits are not put in place or not adhered to. Construction traffic accidents would have a significant social impact and are likely to affect children, women, the disabled, elderly people, and livestock.

Impact Significance: The duration of the risk will be short-term occurring during the construction and operation phases. The receptor sensitivity is **Low** given that the number of people and animals along the roads and near the project area is minimal while the intensity is **Medium** given the temporary nature of the construction activities. However, some of the

impacts like loss of life or severe physical damage may be irreversible. The impact significance is thus assessed to be **Moderate**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Develop a Traffic Management Plan (traffic flow, control measures, work zone management, emergency response) and incorporate proposed arrangements for traffic diversions with details of all necessary budgets and signals;
2. Provide temporary road signs or notices to indicate ongoing works;
3. The client and contractor should choose traffic routes to reduce the impact in the neighborhood and any sensitive areas;
4. Ensure that vehicles for the construction work are operated only by qualified drivers;
5. Park all vehicles only at designated parking areas and use spaces for loading and unloading;
6. All of the drivers have to obey the speed limit of vehicles and know the speed limits, particularly in residential areas;
7. Travel speeds of construction vehicles along the road should be controlled by setting travel speeds and informing through signals;
8. No drivers or personnel under the influence of alcohol or any drug abuse will be allowed onsite;
9. Fencing or placing obstacles to trenches and ditches to avoid interference and accidents of wild and domestic animals and children.

Adoption of these mitigation measures will reduce impact intensity to “very low” resulting in a residual impact of **negligible** significance.

9.3.2.7 Water Pollution

Potential water contaminants associated with the construction activities include sediments, fuels, and lubricating oils; domestic wastes; welding wastes; wastes from paints and solvents and corrosion inhibitors. For instance, Oils and grease lubricants that are used for construction machinery contain hydrocarbons and heavy metals such as lead, chromium, and cadmium, which are known water pollutants. Contaminants introduced by construction phase could be migrated into a key receptors like Bishoftu lakes and groundwater sources of the area.

Impact Significance: The likelihood of the impact occurring is **high**. The duration of the impact will generally be long-term if the water body is polluted. The extent of the impact will be regional since ground water and Lakes are valuable for the surrounding ecosystem, livelihood base for most, and source of water. The *intensity* of the impact is assessed as **medium**

where intensive sedimentation/flooding during the rainy season around the river bank and Lake. The *sensitivity* of the receptor is **medium** given the proximity of the aquatic environment. This results in an impact significance of **moderate**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Maintain and keep all construction equipment in standardized operating condition that can minimize oil, grease, or fuel leakages to the environment;
2. Perform routine maintenance of construction machinery and vehicles at a designated workshop or maintenance area and keep maintenance wastes separately;
3. Locate stockpile areas for (sand, gravel, stone, and topsoil), away from water courses and will be surrounded by a perimeter with sediment and other pollutant traps located at drain exits;
4. Use trained personnel for fuel and oil handling at the project site. Control the amount of fuel and oil spill leaks minimum;
5. Segregate and store all hazardous wastes and empty containers of hazardous materials in a designated area on site and dispose of them per the national hazardous waste management regulation;
6. Perform construction in the dry season to avoid sediment transport.

The adoption of the mentioned mitigation measures can reduce impact intensity to “**very low**” resulting in a residual impact of “**minor significance**”.

9.3.2.8 Solid wastes

Diverse type of solid waste could be generated in the construction phase. To mention few, solid wastes from excavation of soil, rock works, packaging waste, wood, broken glasses, containers, wire cuttings, metal scrap, wooden planks, sharp objects (nails), etc. All of these solid wastes need to be managed at required standard and level. Construction wastes must be disposed of at authorized places in compliance with government rules. If solid waste is not properly managed, can lead to health and safety issues to the environment.

Impact Significance: The likelihood of the impact occurring is **high**. The duration of the impact will generally be long-term if the water body is polluted. The extent of the impact will be regional since the Lake and the river are valuable for the surrounding ecosystem, livelihood base for most, and source of water. The *intensity* of the impact is assessed as **low** where intensive sedimentation/flooding during the rainy season around the river bank and Lake. The *sensitivity* of the receptor is **medium** given the proximity of the selected FSTP to the aquatic environment. This results in an impact significance of **moderate**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Prepare and apply a solid waste management system (waste reduction, collection, sorting reuse, recycling, and landfill) in the project site;
2. Reuse excavation of the ground and foundation works materials for Earthworks and landscaping;
3. Solid waste collection bins shall be placed at strategic locations within the site as collection centers to facilitate the separation and sorting of the various types of waste;
4. The Solid wastes shall be properly segregated and separated to encourage the recycling of some useful resources;
5. The contractor and proponent shall work hand in hand to facilitate the implementation of sound waste management.

9.3.2.9 Hazardous Wastes

Careless disposal of used containers for oil, lubricants, paint, and other toxic substances may pose a health hazard. Plastic containers are not biodegradable and can have long-term and cumulative effects on the environment. The storage and disposal of these waste streams have to be carefully performed to abide by the existing legal framework.

Hazardous waste poses risks or would have major and irreversible effects on both humans and the environment if it is not handled, stored, and disposed of according to engineering best practices. Hazard waste mishandling and uncontrolled disposal would have major health impacts on on-site workers, inhabitants in the project’s area of influence, and people who get in contact with waste during transportation and disposal.

Impact Significance: The probability of impact occurrence is medium. The *sensitivity* of receptors is assessed as ‘medium’ given that some project components particularly toilet sites are located in rural areas, close to green areas, and youth recreational and market centers. The impact intensity is assigned a *low* rating resulting in a *moderate* impact significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Develop temporary adequate sanitary facilities in the construction site or the vicinity of the project area;
2. Segregate and classify Hazardous wastes from the non-hazardous and should be stored in suitable designated storage facilities at the project site;
3. Hazardous wastes such as paints, pipes, accessories, and adhesives should be properly sealed, labeled, secured, kept inside a locked fenced area to prevent access by unauthorized personnel, and covered to prevent water accumulation before transportation;
4. Prepare a hazardous waste management (waste identification and classification, waste minimization, storage and transportation, treatment and disposal) plan;
5. Solid waste storage bins and/or skips are provided at the contractor’s campsite and the construction sites and ensure they are collected or emptied in time.

Adoption of the above mitigation measures will reduce impact intensity to “very low” resulting in a **residual** impact of **minor significance**.

9.3.2.10 Occupational Health and Safety (OHS) Risks

Construction workers exposed to risks of accidents and injuries. Occupational health and safety (OHS) risks might be aggravated by insufficient medical capability, and neglect of safety equipment, precautions, and procedures on the construction site. Construction phase risks related to occupational health (OH) includes lack of safety signage at required areas, improper storage/ handling and use of dangerous substances/ chemicals, inadequate lighting and ventilation in workplaces, lifting of heavy and sharp objects, misuse of equipment and materials and others. To minimize the possible OH risks implementation of safety and health standards required. And every employee shall have sound knowledge of their susceptibility to harm or injury in the workplace.

Impact Significance: high probability of occurrence and the risk involved, accidents could cause considerable damage, financial loss, and harm to human life. While largely reversible, some impacts such as loss of human life and body injury are irreversible. The receptor *sensitivity* is considered a **medium given** that such impacts may be irreversible once they occur. The impact *intensity* is considered to be **medium** resulting in **moderate** impact significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Prepare site-specific health and safety management plan (work-related accidents, risk minimization, safe work practices, and guidelines training);

2. Assign a qualified health and occupational safety officer to oversee OHS matters daily;
3. Monitor construction workers on safe work practices and guidelines (OHS) and ensure that they adhere to them;
4. Provide training on OHS before commencing work on-site and workers must follow safety standards to minimize hazards
5. Standard Safety sign (OSHA) will be used to warn staff and/ or visitors about risk area
6. Provide first Aid kits and ensure availability of trained first aiders within the construction site;
7. Ensure that the camp site is fenced and hygienically kept with adequate provision of facilities (waste disposal receptacles, firefighting, and others);
8. Ensure the Code of Conduct is followed to regulate the performance and behavior of all workers.
9. Personnel will only undertake tasks for which they are trained or qualified;
10. Implement ergonomic interventions, such as job rotation or use of assistive devices, to reduce ergonomic hazards
11. Prohibit the use of alcohol, or “Chat”, in the work area;
12. Provide adequate OHS personnel protective gear (such as nose, ear mask, and clothing) to the employees and good camp management shall be provided. Some PPE includes the following:
 - Face/Eye protection equipment like face shields, safety glasses, and goggles are vital in protecting the face from accidents.
 - Ear-protecting instruments from noise that exceeds 80 Decibels for 8 hours a day requires ear muffs and plugs.
 - For the hand use correct gloves for protecting the hand from chemicals and others.
 - Foot protection boots are also important in the construction phase. Boots might be a toe, water, chemical, and non-slip type.

Adoption of these mitigation measures will reduce impact intensity to “Low” resulting in a residual impact of **minor** significance.

9.3.2.11 Spread of communicable disease

The project will employ more young workers at lower skill levels who are prone to engage in high-risk sexual activity. The gatherings might result in the spread of communicable diseases like sexually transmitted diseases (STDs), HIV-AIDS, and COVID-19. Illicit contact or sexual relationships can be short-term but have long-term and irreversible effects if COVID-19, HIV, or Hepatitis-B were contracted. If this impact occurred, the extent of disease spread would be local, national, or international depending on the origin and next destination of infected persons.

Impact significance: The duration of the impact can be short-term or long-term based on whether the contracted person recovers or passes away ; whether type of communicable disease, COVID-19 HIV/AIDS is contracted or not.

In both COVID-19 and HIV/AIDS cases the extent of the impact will be local or national depending on the origin and final destination of the construction worker. The likelihood of the impact occurring is medium if the contractor does not adequately sensitize workers about

responsible and safe behavior, proper social distancing, use of masks and gloves. The *intensity* of the impact is also medium. *The sensitivity* of the receptor is rated *medium given* that both COVID-19 and HIV/AIDS, if contracted, have a long-term effect. Therefore impact significance is *moderate*.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Develop a communicable disease management plan (incidence monitoring, prevention control measures, case investigation, treatment, and care, etc.);
2. Prepare, sensitize and enforce a Code of Ethical Conduct (CEC); in the camp to encourage respect for the local community Translate the CEC to local language;
3. Orient all construction workers and sensitize them about responsible sexual behavior in project communities;
4. A safety, health, and environment induction course shall be conducted for all workers two times per year, putting more emphasis on HIV/AIDS;
5. Prepare an awareness campaign plan to reduce the risks of spreading HIV/AIDS and other STDs as part of contractual obligation.

9.3.2.12 Social Misdemeanor

Societies have social norms and expectations that guide behavior and promote social cohesion. Adhering to these social norms can help maintain a harmonious and functional society while violating them can lead to social disorder and conflict. An influx of labor to project sites might affect the social misdemeanor of the society. The increased labor force may violate some social norms of the society and may result in incidences of Gender-based violence (GBV), sexual harassment (SH), and sexual exploitation (SE) on the job site or in the neighborhood.

Impact Significance: The probability of impact occurrence is medium. The *sensitivity* of receptors is assessed as ‘medium’ given that some project components particularly FSTP sites are located in rural areas. The impact intensity is assigned a *low* rating resulting in a *moderate* impact significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Hire unskilled and skilled labor from the local population as far as possible to minimize on influx of labor into the community;
2. Communicate and collaborate effectively with local administration addressing the challenges and opportunities presented by an influx of labor;
3. Work together with local governments, businesses, and community organizations to develop strategies for ensuring that workers are paid fair wages;
4. Orient all construction workers and sensitize them about responsible social behavior through workplace education and training in project communities;
5. Provide awareness to newcomers about the norms, and cultures of the project host community;
6. Any new employee should be required to sign a code of behavior.

Adoption of the above mitigation measures will reduce impact intensity to “very low” resulting in a **residual** impact of **minor significance**.

9.3.2.13 Gender-based violence (GBV)

In the construction phase, the number and type of GBV expected to exceed the normal circumstances. Some of the various forms GVB include physical violence, sexual harassment, emotional, and psychological verbal abuse, intimidation, bullying, and unequal treatment. Predominantly male workforce, hierarchical power structures, long working hours, isolated and temporary worksites, poverty, lack of proper accommodation, inadequate security measures, and a lack of policies and procedures to address GBV are some of the contributing factors for GBV in construction phase. Eliminating or minimizing the GBV cases in construction phase need to be prioritized through mitigation measures.

Impact Significance: The probability of impact occurrence is medium. The *sensitivity* of receptors is assessed as ‘medium’ given that some project sites are located in urban areas. The impact intensity is assigned a *low* rating resulting in a *moderate* impact significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Raising awareness and providing training to employees (quarterly) about GBV to reduce incidents of GBV in the workplace;
2. Ensure equal pay for women and men for equal jobs;
3. Providing support services, such as counseling, medical care, and legal aid, to employees who experience GBV;
4. Prepare and implement a code of conduct that among others strictly forbids sexual harassment /GBV and is to be signed by all workers;
5. Establish disciplinary procedures and sanctions for employees who engage in GBV;

6. Consider the safety and security needs of female employees.

9.3.2.14 Physical Cultural Resources: Historical or archaeological artifacts

Physical Cultural Resources (PCRs) can be movable or immovable objects, sites, structures, or groups of structures having archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. From the field visits / on-site survey and the stakeholder engagements held in the project site indicated that there is no legally protected cultural sites in the project area. Consequently, the impact on cultural heritage is insignificance from the proposed project. However, the contractor should take precautionary measures during excavations just in case there are chances of finds. Chance finds procedures (CFP) are procedures that have to be followed when an event of buried PCRs being unexpectedly encountered or a “chance find” during the construction phase of the project and duly reported to respected bodies.

Mitigation Measures: In case of PCR discovery, the contractor should take precautionary measures during excavations just in case there are chance finds. The contractor should report the case to the relevant culture and tourism office found in BT. Necessary measures have to be completed before the construction phase resumes.

9.4 Operation Phase Negative Impacts

9.4.1 Air Emissions, Dust, and Odor

The operation phase of FSTP may result dust, emission, odor which have the potential to cause significant nuisance to people living close to the site and may pose a risk to the health of those working on the site, or visiting the site.

Dust and air emissions. Dust can be a problem, especially during the warm summer period, and during dry weather conditions. During operational phase, cumulative minor air quality impact is expected from small volume of traffic (dust emission) and generators (emergency use). This can be reduced by implementation of few mitigation measures that can be applied at the locality through the regulation to a suitable speed (20 km/h) for all vehicles entering the village’s boundaries, turn on generators only during power cut-off periods, implement preventive maintenance programs for vehicles and equipment, and promptly repair vehicles with visible exhaust fumes.

Odors Fecal sludge treatment processes can generate foul odors and greenhouse gases, such as hydrogen sulfide (H₂S), ammonia, organic, methane and carbon dioxide carried by wind to nearby settlements, thus unpleasant breathing environments. The impact of odor nuisance, though localized, can be of immense magnitude, and will be permanent, and irreversible. Odor can be a significant problem for the people working in the waste treatment plant area and people living in the surroundings of the site. Due to the location waste treatment site and wind direction the probability of the odor reaching the BT is less but there are rural settlements near to waste treatment site where the pungent odor may reach them.

Impact significance: The above impacts will affect the communities neighboring the FSTP, workers, and road users. Given the location of the project site's general wind direction, the likelihood of the impact is **low** and the extent is local. The intensity of impact is assessed as low given that intensive greenery can serve as a windbreak and sensitivity of the receptor becomes **medium**. The impact significance is therefore **moderate**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Plant indigenous trees at the perimeter of the FSTP project area with varying heights as a wind breaker;
2. BTWSSE Project office must ensure proper operation to render unfriendly emissions during discharge of treated leachates due to overloading of the systems or negligence of the operators;
3. Odors generated by the facility can be controlled by the use of suppressants and regular cleaning of the receiving areas;
4. Control the volumetric BOD loading to be between 100-400 gm³ to control odor release;
5. Exercise standardized operation working conditions for site management, operation, and proper functioning;
6. Apply Ferric chloride (FeCl₃) to control the possible generation of hydrogen sulfide (H₂S) odor in the sludge digestion process;
7. Regular maintenance (once per year) of FSTP stabilization ponds, removal of accumulated debris and other solids at the inlets and outlets,
8. Repair annually the embankment eroded by rainfall or damaged by rodents and livestock grazing;
9. Conducting effluent monitoring BOD (before and after the rainy season) and other key parameters, and adjusting the treatment process as necessary to ensure compliance with discharge limit standards of the country;
10. Quarterly exercise maintenance and monitoring to avoid accidental surface runoff intrusion from the manholes of the drainage network, which can overburden the facilities and cause foul odors.

Adoption of the above-mentioned mitigation measures will reduce impact intensity to “**very low**” resulting in a **residual** impact of **minor significance**.

9.4.2 Polluting nearby water sources

Improper treatment and disposal of fecal sludge can lead to the contamination of water sources, including groundwater and surface water quality. This can be a result of overloading of the system, and breakdowns in operating machines, vehicles, and equipment causing deterioration of treatment efficiency.

All effluents discharged to inland waters have to regulate by the discharge limit standards of the Environmental Standards for Industrial Pollution Control of Ethiopia. The regulation sets discharge limits to land waters, the discharge limit for BOD (80 mg/L), and COD (250 mg/L) while the discharge limit for total suspended solids (TSS) is set at 100 mg/L. The pH range of the effluent should be between 6 and 9.

Impact Significance: The likelihood of the impact occurring is medium and its duration will generally be long-term if the water body is once polluted. The *intensity* of the impact is assessed as *medium* given that the design and construction activity will be carefully done by the responsible bodies and the contractor. It is also believed that continuous monitoring mechanisms will be devised and in place to protect both ground and surface water from contamination. The extent of the impact is regional since the pollutants of surface and ground water may cover a large area through ground water flow. The *sensitivity* of the receptor is *medium given* that once, it is contaminated treatment measures would be challenging and long-lasting; resulting in *moderate* impacts.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Establishing water and wastewater quality testing laboratories for the regular testing of the effluent;
2. BTWSSA should ensure adequate operation and management of all the project components to avoid leakages and discharge of inadequately treated effluent;
3. The treated Fecal Sludge should not be discharged directly into the nearby water body, rather it can be utilized for agriculture, industry, energy production, Landscaping, and reclamation;
4. Quarterly laboratory quality tests for effluent and receiving water resources will be done to ensure that the quality of effluent meets the wastewater quality standards values set out within the UWSSPII ESMF, as well as the national discharge standards or requirements;
5. Leakages from treatment ponds and sludge drying beds should be avoided or minimized by regular monitoring and maintenance of the network;
6. A maintenance crew should be in place to monitor and repair the FSTP which is vital to maintain damage or leakage occurs and to avoid accidental surface runoff intrusion into water points;
7. The awareness campaign will be launched every half a year for all the beneficiaries about the proper operation and maintenance of sanitation facilities put in place;
8. Emergency telephone lines should be established to enable the public to immediately notify the BTWSSE of any damages to the FSTP and other components of the network to ensure timely response and repair of such damages.

The adoption of the aforementioned mitigation measures can reduce impact intensity to “very low” resulting in a residual impact of “minor significance”.

9.4.3 Occupational Health and Safety Risks

FSTP can pose several occupational health risks to workers involved in the collection, transportation, and treatment of fecal sludge. Workers who come into contact with fecal sludge, either directly or indirectly, may be at risk of exposure to these pathogens.

Workers at the facilities might experience work-related adverse health risks, risk of slips, trips, and falls and chemicals (as disinfectants or cleaning agents).

Impact significance: Accidents could cause considerable damage, financial loss, and harm to human life. While largely reversible, some impacts such as loss of human life and bodily injury are irreversible. The receptor **sensitivity** is considered **medium** given that although such impacts may be irreversible once they occur, the workers will get adequate training, provided with safety protective equipment, and will have done similar work and have knowledge on how to avoid such incidences. The impact **intensity** is considered to be **medium** since the project office will hire qualified experts who are aware of OHS measures; this gives rise to an impact of **moderate** significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Hire qualified OHS experts for regular monitoring and management of the fecal sludge treatment plant;
2. FSTP Workers have to use standardized PPE, protection gears (cut-resistant and high visibility protective clothing, gloves, safety boots, respiratory protection equipment, and face masks);
3. Develop and work on an Environmental Health and Safety Plan (Hazard identification, risk assessment, Emergency preparedness and response, Monitoring and evaluation, including health and safety measures to avoid accidents and injuries);
4. Routine maintenance including the removal of garbage, screenings, and grit, slashing around the embankments, and repair of the fence shall be done timely;
5. Providing appropriate training for workers at FSTP about ergonomic practices;
6. Provide accessible first Aid in the facility and immediate medical care in case of injuries and accidents;
7. Develop and maintain accident Log onsite to register all injuries/incidents and investigate their causes;
8. Vaccinate all labor working force (hepatitis) at the site and provide regular health examination access;

9. The FSTP should be fenced and signals put in place with security personnel to stop unauthorized people from accessing;
10. Exercise regular fumigation of the FSTP stores, administration rooms, and similar places to minimize, and kill disease vectors such as vermin, rodents, and mosquitoes;
11. Maintain important information on emergency resources (e.g., fire extinguishers, first aid kits, emergency contacts of a doctor, police men) in easily available places;
12. Strictly follow operation following the manufacturer's instructions and Material Safety Data Sheets (MSDS) procedures to store all chemicals utilized in FSTP and storage must conform to compatibility restrictions.

The adoption of the aforementioned mitigation measures can reduce impact intensity to “very low” resulting in the residual impact of “minor significance”.

9.4.4 Fecal Sludge reuse

Sludge reuse have environmental and social benefits like recovery of valuable nutrients, utilization for soil fertility, reduction of waste, energy generation, and others. However, reusing sludge may have potential adverse impacts like biological and chemical contaminants.

Non-pathogen risks result from impurities of non-biodegradable origin such as glass splinters or other sharp objects contained in the sludge. Such impurities can affect the health by physically piercing or cutting those who could be involved in the manipulation of the waste. Health risks due to the attraction and proliferation of rodents and other disease-carrying vectors are common features of improperly managed sludge treatment sites. This can result in health risks for workers, nearby communities, and consumers if sludge is used in agricultural production.

Impact significance: The above impacts will affect the utilizers of fecal sludge, in communities neighboring the FSTP. Given the application of effective sludge management, appropriate treatment technologies, and regular monitoring and testing of sludge quality the potential risk intensity is **low** and the sensitivity of the receptor becomes **medium**. The impact significance is therefore **moderate**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation Measures

1. Utilize effective sludge management through careful planning, appropriate technologies, and regulatory requirements;
2. Avoid use of percolated liquid from the sludge dry bed for irrigation or any use before adequately treating and disinfecting;
3. minimize potential risk and ensure suitability of sludge reuse, by applying regular monitoring and testing of sludge quality ;
4. Conduct public health education campaigns to raise awareness among farmers, communities, and consumers about the safe use and benefits of fecal sludge;

5. Apply adequate treatment of fecal sludge through anaerobic digestion, composting, and thermal treatment.
6. Minimize worker's direct exposure to pathogens and contaminants through appropriate PPE and good hygiene practices
7. Create awareness among these people who are potentially exposed to the direct and indirect health impacts of the sludge;
8. Fence the area to prevent the entrance of dogs and other nocturnal animals; and
9. Keep the area neat and attractive so that flies and rodents cannot be attracted;
10. Engage with local communities, farmers, and other stakeholders to raise awareness about the safe use of fecal sludge and address concerns;
11. Provide training and capacity-building programs for personnel involved in fecal sludge management.

9.4.5 Impact on flora and fauna:

Improperly treated wastewater may affect downstream rivers, riverine and aquatic plants, bird species resting near the rivers through contaminants production and reduce the necessary nutrients available for their growth and development due to eutrophication. Bird species and some domestic animals living in the surroundings of the FSTPs, may be affected by the discharge of improperly treated wastewater and sludge production. This problem is less probable of low significance, and long-term duration in the sense that the risk is always there, but reversible.

Mitigation measures

1. Monitor the proper functioning of the treatment plant;
2. Check regularly the effluent quality for its compliance with acceptable effluent discharge standards;
3. Stop discharging the effluent into receiving streams and rivers, whenever the quality of effluent fails to meet the standard;
4. Promote integrated watershed management schemes around the FSTP which enable to reduce of any potential spillover of liquid wastes into the natural environment;
5. Ensure proper quality control of “treated” wastewater and sludge before releasing;
6. Control any accidental spill of untreated or partially treated wastewater into the environment;
7. Install a regular monitoring system on the quality of water discharged.

9.4.6 Landscape and Land Use Impacts

Land use, scenic, and visual quality: The construction of FSTP along the selected area will permanently change the surrounding landscape scenery into a walled-in enclosure. The location, design, and appearance of FSTP can impact the scenic quality of an area. During the operation phase, water stored in abandoned borrow pits in FSTP forms a breeding ground for vermin, mosquitoes, or other disease-causing and transmitting vectors, posing health risks to local communities and workers.

Impact significance: The duration of the impact will be long-term and the extent of the impact will be on-site. The intensity of the impact given to the proposed facilities the impact is **low**. The sensitivity of the receptor is rated **low** given that no such projects have ever been established so far in the project-affected areas. Therefore, the significance of the impact is rated as **minor**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation measures

1. Incorporating vegetation (trees and shrubs) to improve the visual impact of the facility and provide shade, filter pollutants provide habitat for wildlife;
 2. Using screening elements, such as fencing, walls, or vegetation, can help reduce the visual impact of the facility and provide privacy;
 3. Regular staff training has to be emphasized. The staff has to know maintenance procedures, and customer service and properly trained staff can help maintain malfunctioned structures effectively and efficiently.
 4. Regular maintenance is essential for preserving and enhancing landscape forms.
- Adoption of the aforesaid mitigation measures will reduce impact intensity to “**very low**” resulting in a residual impact of **negligible significance**.

9.5 Decommissioning Phase Negative impacts

Some of the project activities in the decommissioning phase include proper cleaning, decontamination of the project site, dismantling of equipment and metallic structures, demolishing of concrete structure, appropriate disposal of hazardous materials, and transportation of recyclable and reusable materials for site restoration into its original or pre-project condition.

9.5.1 Pollution of Soil and Water bodies

Decommissioning a fecal sludge treatment plant can result in the release of contaminants or pollutants into the surrounding environment, particularly if the plant has not been properly maintained or cleaned. This can result in soil and water contamination, as well as potential health risks to wildlife and humans. Spillage of contaminated water, sludge, chemicals, grease, or oil is the main cause of soil contamination.

Impact significance: The effect of the impact will be long-term and the extent of the impact will be on site. Since a standardized working procedure was followed, the intensity of the impact given for kind of the proposed facilities is **low** but the sensitivity of the receptor is rated highly given that the impact on the natural environment has a long-term effect areas. Therefore, the significance of the impact is rated as **moderate**.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation measure

1. Develop a decommissioning plan (regulatory requirements, hazard assessment, risk management, waste management, etc.) that outlines the steps and working procedures for decommissioning the FSTP, Toilets;
2. Engage local stakeholders, in the decommissioning process;
3. Conducting environmental quality assessment of the water body and the treated waste before the commencement of the decommissioning;
4. Transporting all the hazardous wastes (construction materials, chemical containers) to a predetermined site for treatment, disposal or storage;
5. Use the topsoil and subsoil removed from decommissioning will be stored properly and used for backfilling and reinstatement;
6. Compact the Back-filling materials to a level similar to the original surrounding soils;
7. Monitor through regular sampling of soil, water, and air to identify any potential contaminants or pollutants.

9.5.2 Occupational Health and Safety and Air pollution

Workers involved in decommissioning may be exposed to hazardous materials, biological hazards (pathogens or infectious diseases) through inhalation, ingestion, or contact with the skin or eyes that can pose a risk to their health. Moreover, workers might be exposed to physical hazards (Accidents, falls, and crushing injuries) when they are working in confined spaces, with heavy equipment, or at heights. Certain tasks such as heavy lifting or awkward postures, can pose ergonomic hazards to workers, which can result in musculoskeletal disorders.

Impact significance: Accidents could cause considerable damage, financial loss, and harm to human life. While largely reversible, some impacts such as loss of human life and bodily injury are irreversible. The receptor **sensitivity** is considered **medium** given that although such impacts may be irreversible once they occur, the workers will get adequate training, provided with safety protective equipment, and will have done similar work and have knowledge on how to avoid such incidences. The impact **intensity** is considered to be **medium** since the project office will hire qualified experts who are aware of OHS measures; this gives rise to an impact of **moderate** significance.

		Sensitivity of receptor			
		Very low(1)	Low (2)	Medium (3)	High (4)
Intensity of impacts	Very low (1)	Negligible (1)	Minor (2)	Minor (3)	Minor (4)
	Low (2)	Minor (2)	Minor (4)	Moderate (6)	Moderate (8)
	Medium (3)	Minor (3)	Moderate (6)	Moderate (9)	Major (12)
	High (4)	Minor (4)	Moderate (6)	Major (12)	Major (16)

Mitigation measures

1. Recruit a qualified health and occupational safety officer who will oversee OHS matters on-site;
2. Proper induction/training of the workers work-related accidents before decommissioning commencement;
3. Implement ergonomic interventions, such as job rotation or use of assistive devices, to reduce ergonomic hazards;
4. Provide appropriate, adequate PPE (gloves, masks, protective clothing, OHS personnel protective gear) to the employees;
5. Implement engineering controls, such as ventilation systems and barriers, to reduce exposure to hazardous materials and physical hazards;
6. Cover all trucks during the haulage of materials to reduce dust emissions;
7. Dispose wastes at legally approved dumping area.

9.5.3 Socio-economy impact

Decommissioning a fecal sludge treatment may have economic impacts on the surrounding community, particularly if the plant has been a source of employment or revenue. And hence, decommissioning can result in job losses and reduced economic activity, which can have ripple effects on the local economy. Some unskilled workers will get temporary employment during the dismantling of the plants but the skilled workers that were hired to manage day to day operation of the FSTP are expected to lose their job during this phase.

Mitigation measure

1. Based on their skill, knowledge, experience, and interest, vulnerable community groups must be transferred to another secured job opportunity;
2. Provide financial assistance or grants to affected workers or businesses. This can involve providing loans, grants, or other forms of financial support to help workers or businesses transition to new opportunities;
3. Providing adequate provident fund or pension for those who want to retire;
4. Providing retraining programs in new industries or skills opportunities for workers who have been impacted by the process. Supporting workers to start their businesses;
5. Repurposing the site for other uses, such as a park or community center, can help to mitigate the economic impact of decommissioning.

10 Environmental and Social Management Plan (ESMP)

An environmental and social management plan (ESMP) is a critical component of ESIA that outlines the project-specific environmental and social safeguards as an integral part of the project for execution. ESMP developed to ensure that potential environmental and social risks and impacts associated with a project activity are identified, assessed, and effectively managed. ESMP summarizes the identified potential impacts, mitigation measures, expected out comes, indicators, monitoring, and evaluation. The ESMP establishes a comprehensive framework that outlines the measures and actions that will be taken to minimize or eliminate negative impacts on the environment and local communities while promoting positive social and economic outcomes.

Table 40 Summary of Environmental and Social Management Plan for FSTP at BT

S/ N	Environmental Impacts	Mitigation measures	Responsibility		Execution Time	Cost in USD 1 USD = 118.15 Eth Birr
			Implementing bodies	Supervision		
1	Land loss	<ul style="list-style-type: none"> • Conducting RAP with an independent consultant before any civil work and compensate the PAHs; • Use the RAP report as a guide to determining affected persons; • Consider the cut-off date when the census start date of RAP conducting consultant • Tenable compensation paid both in cash & kind to the PAHs • Vulnerable community groups must get priority during compensation and post-livelihood rehabilitation works; 	BTWSSE, PO, Municipality/ Mayor office & Land administration office	MoWE, WB, Grievance Handling Committee and Regional land administration	One-off	part of the government RAP cost
1	Loss of Vegetation Cover	<ul style="list-style-type: none"> • Re-vegetate (5-10 seedlings have to be planted as a replacement for the removal of a single tree) the perimeters of the FSTP with indigenous/endemic plant species lost during site clearance; • Store and reuse the topsoil removed from the site properly ; • Minimize the amount of destruction caused by machinery and promote non-mechanized methods of vegetation removal; 	Construction Contractor	Supervisory Consultant , EPA	During Construction	84.4.00
2	Soil degradation and removal	<ul style="list-style-type: none"> • Use excavated soil management plan before the start of construction activities; • Protect the topsoil loss and to retain the soil structure; • Store and reuse topsoil and subsoil removed from the site preparation; • Contour temporary and permanent access roads/laydown areas to minimize surface water runoff and erosion; • Avoid using unmaintained and old (not more than 10 years) machineries; • Ensure that all equipment on duty is properly maintained and fully functional; 	Construction Contractor	Supervisory Consultant, EPA Agriculture office	During Construction	1015.7

		<ul style="list-style-type: none"> • Excess soil/ cart away must be removed on a daily basis and deposited at an authorized site ; • Protect adjacent areas of the construction site from disturbance; • Prevent sheet and rill erosion of soil through the use of sand bags, diversion berms, culverts, or other physical means. 				
3	Air quality / Noise pollution, Dust emission	<ul style="list-style-type: none"> • Aware workers for the permissible noise levels at the workplace and surrounding environment; • Regulate the noise levels at construction sites below 75 dBA and 70 dBA during the day and night, respectively • Switched off Equipment's during off-work time whenever possible; • Utilize well-maintained and functional working equipment; • Avoid using of old (>10years) or damaged equipment's ones; • Cover the Trucks during haulage of construction materials to reduce spillage of materials • Use spray water for dust suppression over dusty areas • Provide the necessary PPE (ear muffs, masks, etc.) to workers; • Adjust the travel speeds of construction vehicles 30 Km/h along the road and should be controlled using traffic signals; • Avoid construction activities during night time. 	Construction Contractor	Supervisory Consultant EPA	During Construction	118.5
4	Alteration of natural drainage pattern	<ul style="list-style-type: none"> • Plan and work on Integrated water shade management for the natural drainage lines; • Participate with stakeholders in storm water drainage planning, design, and management activities; • Work on flood avoidance strategies as precautionary interventions that involve structural adaptations; • Flood mitigation strategies (flood responses before and during an event, emergency flood control works); • Construct drainage channels in all areas that generate or receive surface runoff; • Work in collaboration with stakeholders to prevent possible erosion, and flood and for the stabilization of gullies and drainage lines. 	Construction Contractor	Supervisory Consultant , EPA	During Construction	1015.7

5	Traffic congestion /Accident	<ul style="list-style-type: none"> • Develop a Traffic Management Plan and incorporating proposed arrangements for traffic diversions; • Provide temporary road signs or notices to indicate ongoing works; • The client and Contractor should choose traffic routes; • Ensure that vehicles for the construction work are operated only by qualified drivers; • Park all vehicles only at designated parking areas and use spaces for loading and unloading; • All of the drivers have to know and obey the speed limit of vehicles; • Travel speeds of construction vehicles should be controlled by setting travel speeds and informing through signals; • No drivers or personnel under the influence of alcohol or any drug abuse will be allowed onsite; • Fencing or placing obstacles to trenches and ditches to avoid interference and accidents of wild and domestic animals and children. 	Construction Contractor	Supervisory Consultant, EPA. Traffic management	During Construction	592.5
6	Water Pollution	<ul style="list-style-type: none"> • Maintain and keep all construction equipment in standardized operating condition; • Perform routine maintenance of construction machinery and vehicles at a designated workshop area and keep maintenance wastes separately; • Locate stockpile areas away from water courses and will be surrounded by a perimeter with sediment and other pollutant traps located at drain exits; • Use trained personnel for fuel and oil handling in the project site; • Segregate and store all hazardous wastes and empty containers of it in a designated area on site and dispose of them following the national hazardous waste management regulation; • Perform construction in the dry season. 	Construction Contractor	Supervisory Consultant , EPA BTWSSE	During Construction	759.5
7	Solid wastes	<ul style="list-style-type: none"> • Use integrated solid waste management plan ; • Reuse excavation of the ground and foundation works materials for Earthworks and landscaping; • Solid waste collection bins or skips shall be placed at strategic locations within the camp site and ensure they 	Construction Contractor	Supervisory Consultant, EPA	During Construction	507.8

		<ul style="list-style-type: none"> are collected or emptied in time. Work with stakeholders on sound waste management system. 				
8	Hazardous Wastes	<ul style="list-style-type: none"> Segregate and classify Hazardous wastes from the non-hazardous and should be stored in suitable designated storage facilities at the project site; Hazardous wastes should be properly sealed, labeled, secured, and kept inside a locked fenced area to prevent access by unauthorized personnel; prepare a hazardous waste management plan; Develop temporary adequate sanitary facilities in the construction site or in the vicinity of the project area. 	Construction Contractor	Supervisory Consultant, EPA	During Construction	507.8
9	Occupational Health and Safety (OHS) Risks	<ul style="list-style-type: none"> Assign a qualified health and occupational safety officer to oversee OHS matters; Prepare site-specific Health and Safety management Plan; Provide training on OHS training before commencing work on site; Ensure and monitor construction workers on safe work practices and OHS guidelines; Workers must follow safety standards and use protective equipment to minimize hazards Standard Safety sign(OSHA) will be used to warn staff and/ or visitors about risk area Provide first Aid kits and ensure availability of trained first aiders within the construction site; Ensure that the campsite is fenced and hygienically kept with adequate provision of facilities; Ensure the Code of Conduct is followed to regulate the performance and behavior of all workers. Personnel will only undertake tasks for which they are trained or qualified; Implement ergonomic interventions, such as job rotation or use of assistive devices, to reduce ergonomic hazards Prohibit the use of alcohol, or "Chat", in the work area 	Construction Contractor	Supervisory Consultant EPA, Office of Labor and Social Affairs	During Construction	1692.8
10	Spread of communicable	<ul style="list-style-type: none"> A safety, health, and environment induction course shall be conducted to all workers two times per year, putting more emphasis on HIV/AIDS STDS; 	Construction Contractor	Supervisory Consultant ,	During Construction	677.1

	disease	<ul style="list-style-type: none"> • Develop a communicable disease management plan; • Prepare and enforce a Code of Ethical Conduct (CEC) in the camp to encourage workers to respect the local community and to maintain the cleanliness of the camp ; • The workers should periodically be sensitized on the Ethical code of conduct. Translate the code of ethical conduct local language; • Orient all construction workers and sensitize them about responsible sexual behavior in project communities. 		Health office, EPA		
11	Social Misdemeanor Conflicts due to the influx of labor	<ul style="list-style-type: none"> • All construction workers shall be orientated and sensitized about responsible social behavior through Workplace education and training in project communities; • Awareness has to be given to new comers about the norms, and cultures of the project host community; • Any new employee should be required to sign a code of behavior; • Hire unskilled and skilled labor from the local population as far as possible to minimize on influx of labor into the community; • Local governments, businesses, and community organizations to work together to develop strategies for ensuring that workers are paid fair wages. 	Construction Contractor	Supervisory Consultant, EPA, Office of Labor and Social Affairs	During Construction	592.5
12	GBV	<ul style="list-style-type: none"> • Raising awareness and providing training to employees (quarterly) about GBV; • Ensure equal pay for women and men for equal jobs; • Providing support services, such as counseling, medical care, and legal aid, to employees who experience GBV; • Prepare and implement a code of conduct that among others strictly forbids sexual harassment /GBV and to be signed by all workers; • Establish disciplinary procedures and sanctions for employees who engage in GBV; • Consider the safety and security needs of female employees. 	Construction Contractor	Supervisory Consultant ,Women, Children and Youth Affairs office	During Construction	761.7
1	Air Emissions, Dust and	<ul style="list-style-type: none"> • Plant indigenous trees at the perimeter of the FSTP project area with varying heights as wind breakers; • BCWSSE Project office must ensure proper operation to render unfriendly emissions during discharge of treated 	BTWSSE, PO and FSTP Manager	BTWSSE, PO and	During the operation	8463.8

	Odor	<p>leachates due to overloading of the systems or negligence of the operators;</p> <ul style="list-style-type: none"> • Odors generated by the facility can be controlled by the use of suppressants and regular cleaning of the receiving areas; • Control the volumetric BOD loading to be between 100-400 g/m³ to control odor release; • Exercise standardized operation procedures (SOP) for site management, operation, and proper functioning; • Regular maintenance of FSTP stabilization ponds, removal of accumulated debris and other solids at the inlets and outlets, • Quarterly exercise maintenance and monitoring to avoid accidental surface runoff intrusion from the manholes of the drainage network, which can overburden the facilities and cause foul odors. 		Environmental protection office		
2	Polluting Water Resources	<ul style="list-style-type: none"> • Establishing water & wastewater quality testing laboratory ; • BTWSSA should ensure adequate operation and management of all the project components to avoid leakages and discharge of inadequately treated effluent; • The treated Fecal Sludge should not be discharged directly into the nearby water body; • Perform Quarterly laboratory quality tests for effluent and receiving water resources to ensure that the quality of effluent meets the national discharge standards or requirements; • Leakages from treatment ponds & sludge drying beds should be avoided; • A maintenance crew should be in place to monitor and repair the FSTP; • The awareness campaign will be launched every half a year for all the beneficiaries about the proper operation and maintenance of sanitation facilities put in place. 	BTWSSE, PO and FSTP Manager	BTWSSE, PO and Environmental protection office	During the operation	6771.05
3	Occupational Health and Safety Risks	<ul style="list-style-type: none"> • Hire qualified OHS expert for regular monitoring and management of FSTP; • Develop and work on an Environmental Health and Safety Plan; • Routine maintenance including the removal of garbage, 	BTWSSE, PO and FSTP Manager	BTWSSE, PO, Office of Labor and Social Affairs, Health office	During the operation	4231.9

		<p>screenings, and repair of the fence shall be done timely;</p> <ul style="list-style-type: none"> • Providing appropriate training for workers at FSTP about ergonomic practices ; • Provide accessible first Aid in the facility and immediate medical care in case of injuries and accidents; • Vaccinate all labor working force (hepatitis) at the site and provide regular health examinations access; • The FSTP should be fenced and signals put in place with security personnel to stop unauthorized people from accessing; • Exercise regular fumigation of the FSTP stores, and administration rooms ; • Maintain important information of emergency resources in easily available place ; • Strict follow operation following manufacturer’s instructions and Material Safety Data Sheets (MSDS) procedures • Develop and maintain accident Log onsite to register all injuries/incidents and investigate their causes; • Minimize worker's direct exposure to pathogens and contaminants through appropriate PPE and good hygiene practices 				
4	Fecal Sludge reuse	<ul style="list-style-type: none"> • Utilize effective sludge management through careful planning, appropriate technologies, and regulatory requirements • Avoid use of percolated liquid from the sludge dry bed for irrigation or any use before adequately treating and disinfecting; • Minimize potential risk and ensure suitability of sludge reuse, by applying regular monitoring and testing of sludge quality • Apply adequate treatment of fecal sludge through anaerobic digestion, composting, and thermal treatment. • Fence the area to prevent the entrance of dogs and other nocturnal animals; and • Keep the area neat and attractive so that flies and rodents cannot be attracted. 				846.0

		<ul style="list-style-type: none"> Engage with local communities, farmers, and other stakeholders to raise awareness about the safe use of fecal sludge and address concerns. Provide training and capacity-building programs for personnel involved in fecal sludge management. 				
5	Impact on Flora and Fauna	<ul style="list-style-type: none"> Monitor the proper functioning of the treatment plant, Check regularly the effluent quality for its compliance with acceptable effluent discharge standards, Stop discharging the effluent into receiving streams and rivers, whenever the quality of effluent fails to meet the standard Promote integrated watershed management schemes around the FSTP which enable to reduce of any potential spillover of liquid wastes into the natural environment. Ensure proper quality control of “treated” wastewater and sludge before releasing. Control any accidental spill of untreated or partially treated wastewater into the environment. Install a regular monitoring system on the quality of water discharged. 				1269.6
6	Landscape and Land Use Impacts	<ul style="list-style-type: none"> Incorporating vegetation (trees and shrubs) to improve the visual impact of the facility and provide shade, filter pollutants provide habitat for wildlife; Using screening elements, such as fencing, walls, or vegetation, can help reduce the visual impact of the facility and provide privacy; Regular maintenance like fixing leaks, repairing broken fixtures, and replacing damaged or worn-out parts of public toilets are important; Regular Staff training has to be emphasized. 	BTWSSE, PO and FSTP Manager	BTWSSE, PO, EPA office	During the Operation phase	1269.6

1	Pollution of Soil and Water bodies	<ul style="list-style-type: none"> • Develop a decommissioning plan that outlines the steps and working procedures for decommissioning; • Engage local stakeholders, in the decommissioning process; • Conducting environmental quality assessment of the water body and the treated waste before the commencement of the decommissioning; • Transport all the hazardous wastes to a predetermined site for treatment, disposal or storage; • Compact the Back-filling materials to a level similar to the original surrounding soils ; • Monitor through regular sampling of soil, water, and air to identify any potential contaminants or pollutants. 	Contractor	BTWSSE, PO ,EPA Office	Decommissioning phase	1015.7
2	Occupational Health and Safety and Air pollution	<ul style="list-style-type: none"> • Recruiting a qualified OHS who will oversee OHS matters on site; • Proper induction/training of the workers work-related accidents; • Implement ergonomic interventions • Provide appropriate, adequate PPE to the employees; • Implementing engineering controls; • Trucks will be covered during the haulage of materials to reduce dust emissions. 	Contractor	BTWSSE, PO , EPA Office, Office of Labor and Social Affairs, Health office	Decommissioning phase	1692.7
3	Socio-economy impact	<ul style="list-style-type: none"> • Transfer workers , vulnerable community groups to another sector based on their skill, knowledge, experience, and interest,; • Provide financial assistance or grants to affected workers or businesses; • Providing adequate provident fund or pension for those who want to retire; • Providing retraining programs in new industries or skills opportunities for workers who have been impacted by the process. Supporting workers to start their businesses; • Repurposing the site for other uses, such as a park or community center, can help to mitigate the economic impact of decommissioning. 	Contractor	BTWSSE, PO ,EPA Office, Office of Labor and Social Affairs,	Decommissioning phase	3385.5
Total						36002.6

11. Monitoring plan

11.1 Environmental Monitoring and Evaluation

Environmental monitoring and evaluation (EM&E) is a process used to measure and assess the impact of human activities on the environment. EM&E is a critical component of environmental management, as it provides valuable information to decision-makers and stakeholders, allowing them to make informed decisions about how to manage natural resources and protect the environment.

The objective of environmental monitoring is to design a regular plan for the proper and timely execution of the mitigation measures and further help evaluate and design further remedial actions for unforeseen events. Monitoring involves the collection of data on environmental parameters such as air and water quality, soil characteristics, and biodiversity. Hence, monitoring of identified mitigation measures is a key to sound environmental and social safeguard management, project sustainability, and community sense of ownership development.

11.2 Construction monitoring

Construction monitoring refers to the process of overseeing and supervising construction activities to ensure that they are carried out following the project plans, specifications, and applicable regulations. This monitoring is important to assess the status of the environment during project operation, identify unexpected changes, and measure the effectiveness of the operational procedures, to confirm statutory and mandatory compliance.

BTWSSSE shall require contractors to comply with this ESMP and to recruit an environmental and occupational health and safety officer to effect the implementation of this ESMP. Both the project and site managers should familiarize themselves with the ESMP so as to execute required environmental, health and safety supervision roles. The contractor should have a designated environmental officer to follow up day-to-day project construction activities. Construction monitoring is an important aspect of construction project management and is essential for ensuring that the project is completed on time, within budget, and to the required quality standards. The project manager shall be responsible and ensure staff are adequately inducted and trained at site regarding environmental and social management including emergency procedures. The Contractor's site supervisors and foremen will ensure that the provisions in this ESMP are implemented within the sites under their supervision and to collect and transmit relevant information to the environmental and occupational safety and health Officers. The BTWSSSE project office should establish both compliance and effects monitoring plans starting from the pre-construction phase.

11.3 Operation Monitoring and Evaluation

Monitoring and evaluation (M&E) of Fecal Sludge Treatment Plants (FSTPs) are critical for ensuring their effective operation and long-term sustainability. A robust M&E framework helps

in assessing the performance of the plant, ensuring compliance with regulations, and identifying areas for improvement. Here's an overview of key components involved in the operation, monitoring, and evaluation of FSTPs:

- The project office need to work in accordance with establishing Performance Indicators: that includes Technical Indicators (Measure treatment efficiency, like Removal rates of pathogens (e.g., coliforms, helminthes), Reduction of organic matter (e.g., BOD, COD), Nutrient recovery rates (nitrogen, phosphorus).
- Monitor operational indicators like operational efficiency, Environmental Monitoring, Maintain detailed records of operational parameters, such as flow rates, temperature, and chemical additions are activities required in operational phase of the project.
- Equipment performance monitoring, regular sampling of influent and effluent for laboratory analysis to monitor treatment performance, regularly test effluent quality for compliance with local and national discharge standards.
- Monitor the surrounding environment (impact assessment) for any potential impacts from the FSTP, such as groundwater contamination or air quality.
- Social and Economic Monitoring: Gather feedback from local communities (Community Feedback) regarding the plant's operation and any social impacts, such as odor or traffic.
- Evaluate the economic aspects (Cost-Benefit Analysis) of the FSTP, including operational costs, revenue from by-products (e.g., compost, biogas), and overall financial sustainability.
- Periodic Evaluations is required specifically regular evaluations (e.g., annually) to assess overall performance and compliance with established standards. Benchmarking is also required by Comparing plant performance against similar facilities or established best practices to identify areas for improvement.
- Preparing, documenting and disseminating regular reports on performance, highlighting successes, challenges, and recommendations for improvement. The project office need to work with stakeholders and sharing findings with stakeholders is vital to ensure transparency and accountability. Developing action plans to address identified issues promptly, ensuring the FSTP operates effectively and sustainably.
- Provide ongoing staff training (capacity building) for plant operators and staff to enhance their skills and knowledge regarding monitoring and evaluation practices. Facilitate workshops and knowledge-sharing sessions with other FSTP operators and stakeholders to foster collaboration and learning. Moreover, utilizing M&E findings to inform

decision-making and adapt operational practices as necessary to enhance performance on continuous level.

Monitoring and evaluation are essential components of Fecal Sludge Treatment Plant operations, ensuring that they function effectively and sustainably. By establishing clear performance indicators, employing robust data collection methods, and engaging with stakeholders, operators can enhance the efficiency of FSTPs, protect public health, and contribute to environmental sustainability. Regular evaluations and adaptive management practices further support continuous improvement and informed decision-making. The project manager shall have the ultimate responsibility for implementation of ESMP, and monitoring in the construction phase. The following Table 41 examines the extent to which the adverse impacts identified can be controlled through the adoption of mitigation measures.

Table 41 Environmental monitoring plan for CWIS Project at BT

Environmental Impact	Mitigation measures	Monitoring indicator	Method of monitoring	Monitoring institutions	Monitoring frequency	Budget in USD 1 USD = 118.15 Eth Birr
Pre-construction phase						
Land loss	Conducting RAP with an independent consultant before any civil work and resettling the PAHs around the FSTP	RAP document	Measurement	BCWSSE, WB	One –Off	Part of the government RAP cost
	Use the RAP report as a guide to determining affected persons	RAP document, type, and number of HH gets Compensation	Observation & No of RAP document		One –Off	
	Compensate land for land for PAHs	The PAP's acceptance and approval of the RAP	Observation & document		One –Off	
	Consider the cut-off date when the census start date of RAP conducting consultant	Document records & Post PAP/PAHs audit opinions	Measurement		One –Off	
	Tenable compensation paid both in cash & and kind to the PAHs	Documented verification KII with the PAPs & and local community	Observation & document		Every quarter	
	Vulnerable community groups must get priority during compensation, and post-livelihood rehabilitation works	A number of vulnerable groups benefited & satisfied	No of people received compensation	Town Youth Women affairs office	Twice per year	
	Conduct Post livelihood assessment study for re-settlers on an annual basis and work for livelihood improvement	No of post livelihood assessments done	Document and observation	MoWE, BTWSSE, municipality	Once per year	
Construction phase						
Water Resource Pollution	Maintain and keep all construction equipment in standardized operating condition;	Maintenance/status reports, Construction camp site observation	Observation & document	BT/zone EPA		2539.14
	Perform routine maintenance of construction machinery and vehicles at a designated	Machinery catalog and maintenance	Observation & document	BT/zone EPA,	Every month	

	workshop;	status report				
	Locate stockpile areas away from water courses and;	Location of stockpile area and its management	observations	BT /zone EPA, Health office	Every month	
	Use trained personnel for fuel and oil handling at the project site.	The presence of trained personnel in charge of fuel	Number of personnel recruited	BT/zone EPA	Every month	
	Segregate and store all hazardous wastes and empty containers of hazardous materials in a designated area;	HW management plan, storage areas, filed records of Hazardous waste transfer & and disposal	Observation & document	BT/zone EPA	construction phase	
	Perform construction in the dry season.	Month of construction	Observation & document	BT/zone EPA	construction period	
	Maintain and keep all construction equipment in standardized operating condition that can minimize oil, grease, or fuel leakages to the environment;	Number of malfunction equipment	Observation maintenance activity log	Town/zone EPA	Every quarter construction phase	
	Perform routine maintenance of construction machinery and vehicles at a designated workshop or maintenance area and keep maintenance wastes separately;	Maintenance records of machinery	Observation & document	BT/zone EPA, PO	Construction phase	
Removal of Vegetation	re-vegetate 10 seedlings per removed plant at the perimeters of the FSTP with indigenous/endemic plant species;	No areas covered by vegetation trees, bushes, No seedlings planted	Area re-vegetated	BT/zone EPA,	construction phase	2115.9
	Store and reuse the topsoil removed from the site during site preparation properly ;	The amount of top soil stored; reused for backfilling, leveling & greening	Amount of soil Reused Observation	BT/zone EPA		
	Minimize the amount of destruction caused by machinery by promoting non-mechanized methods of vegetation removal;	Applied/practiced non-mechanized methods of vegetation removal	Plants removed by human force	BT/ Zone EPA, BTWSSE		
	All areas planned for clearing of vegetation must be demarcated prior	Demarcated area for vegetation clearance	Observation, area demarcated	BT Zone EPA, BTWSSE		
Soil degradation	Develop excavated soil management plan	Excavated soil management plan documented	Observation & document	BT/ Zone EPA, BTWSSE	construction phase	3385.5

	Protect the topsoil to retain the soil structure and minimize the risk of topsoil loss;	Top soil protection mechanism	Amount of top soil protected observation	BT/ Zone EPA, BTWSSE		
	Topsoil and subsoil removed from the site during site preparation will be stored properly;	Top soil protection mechanism	Amount of top soil protected observation	BT/ Zone EPA, BTWSSE		
	Contour temporary and permanent access roads/laydown areas;	Contour-based constructed Access road	Length of contour-based roads observation	BT/ Zone EPA, BTWSSE		
	Avoid using old (not more than 10 years) and properly unmaintained machinery;	Age of machineries documents Maintenance reports	Average age of working machineries	BT/ Zone EPA, BTWSSE		
	Ensure that all equipment on duty is properly maintained and fully functioning	Maintenance reports	Average no of maintained machinery	BT/ Zone EPA, BTWSSE		
	Excess soil/ cart away must be removed from the site on a daily basis and deposited at an authorized approved site ;	Cart away soil management plan	Amount of cart away soil removed per day observation	BT/ Zone EPA, BTWSSE		
	Protect adjacent areas of the construction site from disturbance	Protected area from damage	Observation	BT/ Zone EPA, BTWSSE		
	Prevent sheet and rill erosion of soil through the use of sand bags, diversion berms, and physical means.	Application and bags, diversion berms	Observation	BT/ Zone EPA, BTWSSE		
	Develop excavated soil management plan before the start of construction activities;	Cart away soil management plan	Observation /document	BT/ Zone EPA, BTWSSE		
Air/ Noise pollution	Construction workers will be made aware of the permissible noise levels at the workplace and surrounding environment;	Type and number of trainings given to workers	Trained individuals and documents	BT/ Zone EPA, BTWSSE		1692.8
	Noise levels at construction sites should not exceed 75 dBA and 70 dBA during the day and night, respectively	Signal indicating the permissible noise level	Posted signals observation	BT/ Zone EPA, BTWSSE		
	During periods of off work time, equipment will be switched off	Signal /notice indicating switching off machinery off work time	Observation signals availability	BT/ Zone EPA, BTWSSE		
	Utilize well-maintained and functional working equipment;	The quality of working equipment	Observation document	BT/ Zone EPA, BTWSSE		

	Avoid using of old (>10years) or damaged equipment's ones	Average age of equipment utilized	Observation document	BT/ Zone EPA, BTWSSE		
	Trucks will be covered during haulage of construction materials to reduce spillage of materials and Use spray water for dust suppression over dusty areas	Type and nature of the truck cover Frequency of water usage for dust suppression	Observation	BT/ Zone EPA, BTWSSE		
	provide the necessary to workers whenever needed and as found appropriate;	Available PPE and type	Observation documentation	BT/ Zone EPA, BTWSSE		
	Adjust the travel speeds of construction vehicles 30 Km/h along the road	Traffic Signal (speed) posted in the required place	Observation documentation	BT/ Zone EPA, BTWSSE		
	Avoid construction activities during night time	Working schedule	Work schedule observation	BT/ Zone EPA, BTWSSE		
Occupational OHS Risks	Prepare site-specific Health and Safety management Plan	Presence of a health and safety plan	Observation documentation	BT/ Zone EPA, Health office /BCWSSE		8463.8
	Assign a qualified OHS officer to oversee OHS matters daily;	Assignment-qualified OHS officer	Expert-recruited observation documentation	BT/ Zone EPA, Health office /BCWSSE		
	Monitor construction workers on safe work practices and guidelines (OHS);	Adherence of workers to safety procedures	Observation documentation	MoWE, BT/ Zone EPA, BCWSSE		
	Provide training on OHS before commencing work on-site	Type of OHS training given	Observation documentation	MoWE, BT/ Zone EPA, Health office/BTWSSW		
	Workers must follow safety standards and use protective equipment to minimize hazards	Utilization of PPE during work time	Observation documentation	BT/ Zone EPA, Health office Social affairs/BTWSSE		
	Standard Safety sign (OSHA) will be used to warn staff and/ or visitors about risk areas;	OSHA Safety Sign Posted for staff	Observation documentation	BT/ Zone EPA, Health office Social affairs/BCWSE		
	Provide first Aid kits and ensure availability of trained first aiders within the construction site;	Available first Aid Kit type and trained individual	Observation documentation	BT/ Zone EPA, Health office Social affairs/BTWSSE		
	Ensure that the campsite is fenced and	Availability of	Observation	BT/ Zone EPA,		

	hygienically kept with adequate provision of facilities	secured fences, sanitation facilities	documentation	BTWSSE		
	Ensure the Code of Conduct is followed to regulate the performance and behavior of all workers.	Available code of conduct	Observation documentation	BT/ Zone EPA, BTWSSE		
	Personnel will only undertake tasks for which they are trained or qualified	Available Work allocation procedure	Observation documentation	BT/ Zone EPA, Social affairs/BTWSSE		
	Implement ergonomic interventions, such as job rotation or use of assistive devices, to reduce ergonomic hazards	Type of job rotation practice	Observation documentation	BT/ Zone EPA, Health office Social affairs/BTWSSE		
	Prohibit the use of alcohol, or "Chat", in the work area;	Alcohol, chat Restricting Notice /signals in the work area	Observation documentation	BT/ Zone EPA, Health office Social affairs/BTWSSE		
	Provide adequate OHS personnel protective gear (such as nose, ear mask, and clothing	Available Personnel protective gear		BT/ Zone EPA, Health office Social affairs/PO		
Alteration of natural drainage pattern	Plan and work on Integrated water shade management (Soil and water conservation through physical, and biological) for the natural drainage lines;	Available Integrated water shade management plan	Observation & document	BT/ Zone EPA, BTWSSE	construction phase	3046.9
	Participate with stakeholders in storm water drainage planning, design, and management activities;	The number and type of stakeholder participation documented	Observation & document	BT/ Zone EPA, BTWSSE	construction phase	
	Work on flood avoidance strategies as precautionary interventions that involve structural adaptations;	Flood avoidance strategies practiced	Observation & document	BT/ Zone EPA, BTWSSE	construction phase	
	Flood mitigation strategies	Flood avoidance strategies practiced	Observation & document	BT/ Zone EPA, BTWSSE	End of the construction phase	
	Construct drainage channels within the construction site to allow for the convenient and free flow of storm water.	Length and size of drainage line constructed	Observation & document	BT/ Zone EPA, BTWSSE	construction phase	
	Construct drainage channels in all areas that generate or receive surface runoff water. The channels shall be designed about the	Length and size of drainage line constructed	Observation documentation	BT/ Zone EPA, BTWSSE		

	maximum expected flood discharge ;					
	Work in collaboration with stakeholders to prevent possible erosion, and flood and for the stabilization of gullies and drainage lines.	Number of type of Collaborative activities related to flooding	Observation documentation	BT/ Zone EPA, BTWSSE		
Slope Failure due to Earthworks	Protect very weak landform slopes by using engineered structures	Applied engineered structures for protecting slope	Observation & document	BT/ Zone EPA, BTWSSE	construction phase	1692.7
	Undertake all construction activities during the dry season which will minimize the risk;	Season of construction period	Observation documentation	BT/ Zone EPA, BTWSSE	Pre-construction	
	Use the best available methods of construction technology to minimize the risk of blockages and constrictions;	Documented evidence applied methods	Observation & document	BT/ Zone EPA, BTWSSE	Entire construction phase	
	Backfill and restore the eroded channels related to natural contours;	Amount of soil/ material Backfilled eroded channels, contours	Observation & document	BT/ Zone EPA, BTWSSE	Entire construction phase	
	Protect the susceptible areas of the project by using temporary or permanent drainage works;	Protected drainage area	Observation & document	BT/ Zone EPA, BTWSSE	Pre-construction	
	Perform Earthwork construction activity during the dry season by trained professionals who understand the risks and hazards associated with slope failure;	Month/ Season of construction	Work schedule Observation documentation	BT/ Zone EPA, BTWSSE		
	Monitoring the slope before and after the rainy season (two times) for signs of instability, such as cracks, bulges, or settling;	Number of slope monitoring made per year	Observation documentation	BT/ Zone EPA, BTWSSE		
	Implement effective erosion control measures (re-vegetation, erosion control blankets, or sediment control basins).	Practice of erosion control measures	Observation documentation	BT/ Zone EPA, BTWSSE		
Solid wastes	Prepare and apply a solid waste management system on the project site;	Practice of SWMS and documentation of it	Observation documentation	BT/ Zone EPA, BTWSSE		1523.5

	Reuse excavation of the ground and foundation works materials for Earthworks and landscaping;	Amount of soil reused for landscaping	Observation documentation	BT/ Zone EPA, BTWSSE		
	Solid waste collection bins shall be placed at strategic locations within the site as collection centers to facilitate the separation and sorting of the various types of waste;	Available solid waste bins	Observation documentation	BT/ Zone EPA, BTWSSE		
	The Solid wastes shall be properly segregated and separated to encourage the recycling of some useful resources;	Practice of Solid waste segregation	Observation documentation	BT/ Zone EPA, BTWSSE		
	The contractor and proponent shall work hand in hand to facilitate the implementation of sound waste management.	Practice of SWM	Observation documentation	BT/ Zone EPA, BTWSSE		
Hazardous Wastes	Develop temporary adequate sanitary facilities in the construction site or the vicinity of the project area;	Developed/ available sanitary facilities	Observation documentation	BT/ Zone EPA, BTWSSE		3046.9
	Segregate and classify Hazardous wastes from the non-hazardous and should be stored in suitable designated storage facilities at the project site;	Classified/segregates HW	Observation documentation	BT/ Zone EPA, BTWSSE		
	Hazardous wastes should be properly sealed, labeled, secured, kept inside a locked fenced area to prevent access by unauthorized personnel, and covered to prevent water accumulation before transportation;	Labeled secured HW storage area	Observation documentation	BT/ Zone EPA, BTWSSE		
	prepare a hazardous waste management plan;	Available HWMP	Observation documentation	BT/ Zone EPA, BTWSSE		
	Solid waste storage bins and/or skips are provided at the contractor's camp site and the construction sites and ensure they are collected or emptied in time.	Available SW bins storage area	Observation documentation	BT/ Zone EPA, BTWSSE		

Traffic congestion /Accident	Develop a Traffic Management Plan and incorporate proposed arrangements for traffic diversions with details of all necessary budgets and signals;	Developed TMP, Warning Signs, posters	Observation documentation	BT/ Zone EPA, BTWSSE/ transport office		2031.3
	Provide temporary road signs or notices to indicate ongoing works;	Available road traffic signs	Observation documentation	BT/ Zone EPA, BTWSSE/ transport office		
	The client and Contractor should choose traffic routes to reduce the impact in the neighborhood and any sensitive areas;	Approved detour routes	Observation documentation	BT/ Zone EPA, BTWSSE/ transport office		
	Ensure that vehicles for the construction work are operated only by qualified drivers;	Available driving licenses of drivers	Observation documentation	BT/ Zone EPA, BTWSSE/ transport office		
	Park all vehicles only at designated parking areas and use spaces for loading and unloading;	Demarcated area for parking	Observation documentation	BT/ Zone EPA, BTWSSE/ transport office		
	All of the drivers have to obey the speed limit of vehicles and know the speed limits, particularly in residential areas;	Notice/ sign indicating the speed limit	Observation documentation	BC/ Zone EPA, BTWSSE/ transport office		
	Travel speeds of construction vehicles along the road should be controlled by setting travel speeds and informing through signals;	Available traffic signals on the roads	Observation documentation	BT/ Zone EPA, BTWSSE/ transport office		
	No drivers or personnel under the influence of alcohol or any drug abuse will be allowed onsite;	Code of conduct signed by the driver	Observation documentation	Town/ Zone EPA, BTWSSE/ transport office		
	Fencing or placing obstacles to trenches and ditches to avoid interference and accidents of wild and domestic animals and children.	Work area Protecting structures	Observation documentation	BT/ Zone EPA, BTWSSE/ transport office		
Spread of communicable disease	Develop a communicable disease management plan	Developed CDMP	Observation documentation	BT/ Zone EPA, BTWSSE/ Health office/social affairs		3385.5

	prepare and enforce a Code of Ethical Conduct (CEC); in the camp to encourage respect for the local community and to maintain the cleanliness of the camp at all times;	Available code of conduct and signed by workers	Observation documentation	BT/ Zone EPA, BTWSSE/ Health office/social affairs		
	The workers should periodically be sensitized on the Ethical code of conduct. Translate the code of ethical conduct local language;	Number of training given on CEC	Observation documentation	BT/ Zone EPA, BTWSSE/ Health office/social affairs		
	Orient all construction workers and sensitize them about responsible sexual behavior in project communities;	Number of training given on sexual behavior	Observation documentation	BT/ Zone EPA, BTWSSE/ Health office/social affairs		
	A safety, health, and environment induction course shall be conducted for all workers two times per year, putting more emphasis on HIV/AIDS;	Number of training given on STDS	Observation documentation	BT/ Zone EPA, BTWSSE/ Health office/social affairs		
	Prepare an awareness campaign plan to reduce the risks of spreading HIV/AIDS and other STDs as part of contractual obligation.	No awareness given on HIV/AIDS	Observation documentation	BT/ Zone EPA, BTWSSE/ Health office/social affairs		
Social Misdemeanor Conflicts due to the influx of labor	Hire unskilled and skilled labor from the local population as far as possible to minimize on influx of labor into the community;	Employment record of local people	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		22000.6
	Effective communication and collaboration are key to addressing the challenges and opportunities presented by an influx of labor;	Challenges resolved by Collaborative work	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		
	Local governments, businesses, and community organizations to work together to develop strategies for ensuring that workers are paid fair wages;	Strategies developed to minimize the influx of labor	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		

	Any new employee should be required to sign a code of behavior;	Signed code of behavior (COB)	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		
	All construction workers shall be orientated and sensitized about responsible social behavior through Workplace education and training in project communities;	Number type of training given on social behavior	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		
	Awareness has to be given to new comers about the norms, and cultures of the project host community.	Trainings given to new comers about cultural norms	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		
GBV	Raising awareness and providing training to employees (quarterly) about GBV to reduce incidents of GBV in the workplace;	Trainings given on GBV	Observation documentation	Town/ Zone EPA, BTWSSE/ Social affairs/security		1692.8
	Ensure equal pay for women and men for equal jobs;	Payment rates for similar jobs	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		
	Providing support services, such as counseling, medical care, and legal aid, to employees who experience GBV;	Number of support services given to employees	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		
	Prepare and implement a code of behavior that among others strictly forbids sexual harassment /GBV and is to be signed by all workers;	Code of behavior (COB) signed by employees	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		
	Establish disciplinary procedures and sanctions for employees who engage in GBV	Disciplinary procedure applied	Observation documentation	BT/ Zone EPA, BTWSSE/ Social affairs/security		
Operational phase						
Air Emissions, Dust and Odor	Plant indigenous trees at the perimeter of the FSTP project area with varying heights as wind breakers;	Number and type of trees planted at FSTP	Observation documentation	BT/ Zone EPA, BTWSSE,	operational phase	3554.8

	BCWSSE ensures proper operation to render unfriendly emissions during the discharge of treated leachates due to overloading of the systems or negligence	Available Standardized working procedures	Observation documentation	BT/ Zone EPA, BTWSSE,	operational phase	
	Odors generated by the facility can be controlled by the use of suppressants and regular cleaning of the receiving areas;	Application of suppressants, cleaning activities	Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	
	Control the volumetric BOD loading to be between 100-400 g/m ³ to control odor release;	Testing result of BOD loading	Laboratory reports Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	
	Exercise standardized operation working conditions for site management, operation, and proper functioning;	Applied working procedures	Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	
	Apply (FeCl ₃) to control the possible generation of H ₂ S odor in the sludge digestion process;	The application rate of FeCl ₂ for an odor removing	Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	
	Regular maintenance (once per year) of FSTP stabilization ponds, removal of accumulated debris and other solids at the inlets and outlets,	Maintained structures	Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	
	Repair annually the embankment eroded by rainfall or damaged by rodents and livestock grazing;	The number and type of maintenance done	Observation documentation	BT/ Zone EPA, BTWSSE, PO	Entire operational phase	
	Conducting effluent monitoring BOD (before and after the rainy season) and other key parameters, and adjusting the treatment process as necessary to ensure compliance with discharge limit standards of the country;	Effluent Test result of BOD	Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	
	Quarterly exercise maintenance and monitoring to avoid accidental surface runoff intrusion from the manholes of the drainage network, which can overburden the facilities and cause foul odors.	Maintenance's performed at the required interval	Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	

Polluting Water Resources	Establishing water & and wastewater quality testing laboratory for the regular testing of the effluent;	Available standardize testing laboratory	Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	3385.5
	BCWSSA should ensure adequate operation and management of all the project components to avoid leakages and discharge of inadequately treated effluent;	Operational manual and procedures	Observation documentation	BT/ Zone EPA, BTWSSE	Entire operational phase	
	The treated FS can be utilized in Agricultural, industry, energy production, Landscaping, and reclamation;	Amount of Utilized FS for agriculture, biogas, soil amendment, etc.	Observation documentation	BT/ Zone EPA, BTWSSE Agriculture,	Entire operational phase	
	A quarterly laboratory quality tests for effluent and receiving water resources	Available laboratory test results	Observation documentation	BT/ Zone EPA,	Entire operational phase	
	Leakages from treatment ponds & and sludge drying beds should be avoided or minimized by regular monitoring & and maintenance of the network;	Reported monitoring and maintenance activities	Observation documentation	BT/ Zone EPA, BTWSSE, Enterprises office	Entire operational phase	
	A maintenance crew should be in place to monitor and repair the FSTP which is vital to maintain damage or leakage occurs and to avoid accidental surface runoff intrusion into water points;	Available crew members for monitoring and repair	Observation documentation	BTWSSE,BT/ Zone EPA,	Entire operational phase	
	An awareness campaign launched every half a year for all the beneficiaries about proper operation and maintenance of sanitation facilities put in place;	The number of Awareness given per year	Observation documentation	BTWSSE,BT/ Zone EPA,	Entire operational phase	
	Emergency telephone lines should be established to enable the public to immediately notify the PO of any damages to the FSTP	Available emergency call information	Observation documentation	BTWSSE,BT/ Zone EPA,	Entire operational phase	
Occupational Health and Safety Risks	Hire qualified and trained OHS experts for regular monitoring and management of the fecal sludge treatment plant;	Hired OHS and environmental expert	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	2539.1

	FSTP Workers have to use standardized PPE, protection gears	Type and kind of PPE applied in FSTP	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	Develop and work on an Environmental Health and Safety Plan	Developed EHSP	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	Routine maintenance including the removal of garbage, screenings, and grit, slashing around the embankments, and repair of the fence shall be done timely;	Activity reports	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	Providing appropriate training for workers at FSTP about ergonomic practices ;	The number and type of training given	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	Provide accessible first Aid in the facility and immediate medical care in case of injuries and accidents;	Available first Aid kit	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	Develop and maintain accident Log onsite to register all injuries/incidents and investigate their causes;	Documented /Available accident log sheet	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	Vaccinate all labor working force (hepatitis) at the site and provide regular health examination access;	Type of vaccine and No of staff vaccinated	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	The FSTP should be fenced and signals put in place with security personnel to stop unauthorized people from accessing;	Signal posted, fenced structure	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	

	Exercise regular fumigation of the FSTP stores, administration rooms, and similar places to minimize, and kill disease vectors such as vermin, rodents, and mosquitoes;	Number of fumigations completed per year	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	Maintain emergency information in an easily available place ;	Information/sign posted/ indicated	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
	Strict follow operation following manufacturer's instructions and Material Safety Data Sheets procedures to store all	MSDS available	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office	Entire operational phase	
Landscape and Land Use Impacts	FSTP should have adequate ventilation.	Level of ventilated area	Observation documentation	BTWSSE,BT/ Zone EPA,, Health office Agriculture office	Entire operational phase	2369.9
	Incorporating vegetation (trees and shrubs) to improve the visual impact of the facility and provide shade, filter pollutants provide habitat for wildlife;	Number and kind of trees planted	Observation documentation	BT/ Zone EPA, Agriculture office /BTWSSE	Entire operational phase	
	Using screening elements, such as fencing, walls, or vegetation, can help reduce the visual impact of the facility and provide privacy;	Fenced structure of toilets	Observation documentation	BT/ Zone EPA, office / BTWSSE	Entire operational phase	
	Regular maintenance such as fixing leaks, repairing broken fixtures, and replacing damaged or worn-out parts	Maintenance activity reports	Observation documentation	BT/ Zone EPA, /BTWSE	Entire operational phase	
	Regular Staff training about cleaning techniques, maintenance procedures, and customer service handling	Number of staff got training on cleaning	Observation documentation	BT/ Zone EPA /BTWSSE	Entire operational phase	
Decommissioning Phase						
Pollution of Soil and Water bodies	Develop a decommissioning plan that outlines the steps and working procedures for decommissioning of the FST	Available decommission plan	Observation documentation	BT/ Zone EPA /BTWSSE	Decommissioning phase	2539.1

	Engage local stakeholders, in the decommissioning process;	Work engagement minutes	Observation documentation	BT/ Zone EPA /BTWSSE	Decommissioning phase	
	Conducting environmental quality assessment of the water body and the treated waste	Laboratory test results	Observation documentation	BT/ Zone EPA /BTWSSE	decommissioning phase	
	transporting all the hazardous wastes to a predetermined site for treatment, disposal or storage;	Amount of HW transported	Observation documentation	BT/ Zone EPA /BTWSSE	decommissioning phase	
	Use the topsoil and subsoil removed from decommissioning will be stored properly and used for backfilling and reinstatement;	Application of top soil for backfilling	Observation documentation	BT/ Zone EPA /BTWSSE	decommissioning phase	
	Compact the Back-filling materials to a level similar to the original surrounding soils ;	Rehabilitated area	Observation documentation	BT/ Zone EPA /BTWSSE	decommissioning phase	
	Monitor through regular sampling of soil, water, and air to identify any potential contaminants or pollutants.	Laboratory test results	Observation documentation	BT/ Zone EPA /BTWSSE	decommissioning phase	
Occupational Health and Safety and Air pollution	Recruiting a qualified health and occupational safety officer who will oversee OHS matters on-site;	Recruited personnel	Observation documentation	BT/ Zone EPA, Health office/BTWSSE	decommissioning phase	2539.1
	Proper induction/training of the workers related accidents before decommissioning commencement;	Number of training given	Observation documentation	BT/ Zone EPA, Health office/BTWSSE	decommissioning phase	
	Implement ergonomic interventions, such as job rotation or use of assistive devices, to reduce ergonomic hazards;	Level and interval of job rotation	Observation documentation	BT/ Zone EPA, Health office/BTWSSE	decommissioning phase	
	Provide appropriate, adequate PPE to the employees;	Utilized PPE	Observation documentation	BT/ Zone EPA, work and social affairs, BTWSSE	decommissioning phase	
	Implementing engineering controls, such as ventilation systems and barriers, to reduce exposure to hazardous materials and physical hazards;	Type of engineering controls applied	Observation documentation	BT/ Zone EPA, Health office/BTWSSE	decommissioning phase	
	Trucks will be covered during the haulage of materials to reduce dust emissions	Reduced emissions from trucks	Observation documentation	BT/ Zone EPA, /BTWSSE	decommissioning phase	

Socio-economy impact	Based on their skill, knowledge, experience, and interest, vulnerable community groups must be transferred to another secured job opportunity;	Number of Supported workers	Observation documentation	BT/ Zone EPA, social affairs office/BTWSSE	decommissioning phase	5078.3
	Provide financial assistance or grants to affected workers or businesses. This can involve providing loans, grants, or other forms of financial support to help workers or businesses transition to new opportunities;	Amount of financial assistance given	Observation documentation	BT/ Zone EPA, social affairs office/BTWSSE	decommissioning phase	
	Providing adequate provident fund or pension for those who want to retire;	Amount of Provident fund given	Observation documentation	BT/ Zone EPA, social affairs office/BTWSSE	decommissioning phase	
	Providing retraining programs in new industries or skills opportunities for workers who have been impacted by the process. Supporting workers to start their businesses;	Number of training given	Observation documentation	BT/ Zone EPA, social affairs office/BTWSSE	decommissioning phase	
Total cost						58.823.1

11.4 Reporting

During construction phase of the project, concise monthly monitoring reports should be compiled by the contractor. The report will highlight the different activities undertaken to manage environmental and social aspects of the project in line with contract specifications, laws, standards, policies, and plans of Ethiopia and WB safeguard policies. The report will be discussed during the monthly progress meetings among the zone/town EPA, the project office, the contractor, and other stakeholders as necessary.

The environmentalist and social specialist of supervising engineer will approve the contractor's monthly environmental and social monitoring report. This monitoring report will be submitted to the region EPA and the project office for final approval. The EPA's Environmental Management and Social specialist will also independently monitor the implementation of the ESMP and/or verify the accuracy and content of the contractor's monitoring report. The report will also be shared with the MoWE, WB, and other relevant stakeholders. Approval of the environmental monitoring report will be a base for the supervising engineer to approve payment of the respective environmental and social bill of quantity (BoQ) items.

During the operation phase monitoring report mostly relies on the regional EPA and the project office for effective project execution. The role of the project office is both implementing and internal monitoring. Environmental safety officer at BCWSSE is responsible for controlling the overall implementation and monitoring of the project. The System already started and E&S expert has been recruited in line with the UWSSPII proposal to undergo such activities. The regional EPA monitoring reports should be shared with the project office, and MoWE for further remedial actions.

11.5 Environmental Audit

Audits will be necessary both during construction and project operation. Both construction and post-construction audits can be conducted internally by the project office or by a Consultant hired by the project office with technical support from FSTP. Construction audits will aim to verify compliance to impact mitigation requirements. Post-construction audits are a regulatory requirement to ensure effects and compliance monitoring and the implementation of the mitigation measures within 12 months and not more than 24 months after the start of the operation of the FSTP. EPA has a mandate, to order the project office to hire consultants, conduct audit studies, and disclose the findings to interested public bodies as a regulatory requirement (National EIA proclamation 299/.2000).

11.6 Grievance handling procedure

Grievance handling procedure is the avenue for affected persons to lodge a complaint or express a grievance against the project, its staff, or contractors during project implementation. It also describes the procedures, roles, and responsibilities for addressing grievances and resolving disputes. Every aggrieved person shall be able to trigger this mechanism to quickly resolve their complaints.

The objectives of the grievance handling are to:

- Ensure that appropriate and mutually acceptable corrective actions are identified and implemented to address complaints;
- Verify that complaints are satisfied with outcomes of corrective actions;
- Avoid the need to resort to judicial proceedings.

The grievance mechanism at each project facility will be fed from four main sources:

- Project-affected persons(PAPs) or project affected Households (PAHs)
- Local community residents and the respective local leaders;
- Supervising engineer, clerk of works, or contractor; and
- Monitoring team who will forward issues/concerns identified in the field.

According to the RPF (2016), the grievance resolution committee is indicated in Table 42 below.

Table 42 Grievance Resolution Committee

No	Institution/ individual representation	Role
1	Municipality representative	Chairperson
2	Community representative	Member
3	Representative of PAPs	Member
4	Women affairs	Member
5	Two respectable citizens from society including one from the underserved community, one of them should be women	Members
6	Representative of implementing agency	Secretary and member

Steps of the grievance process

Step One: Receipt of complaint: A verbal or written complaint from a complainant will be received by the clerk of works or Grievance Redness Committee and recorded in a complaints logs. The log will indicate grievances, the date lodged, action taken to address the complaint or reasons the grievance was not acted on; information provided to the complainant, and the date the grievance was closed. Grievances should be lodged at any time, either directly to the clerk of works, Grievance Redness Committee (project office), or through the local council chairperson.

The process for complaining is:

- Clerk of works on site or project office receives a complaint(s) from the complainant and records it in a log (in Amharic);
- The clerk of works or grievance redness committee reads the recorded grievance for the complainant to confirm correct detail of the complaint has been documented;
- Both the complainant and clerk of work or GRC sign the log to confirm grievance was accurately recorded.

Step Two: Determination of corrective action: If in his/her view, a grievance can be solved at this stage, the clerk of works or GRC will determine a corrective action in consultation with the aggrieved person. Remedial action(s) and the frame within which they must be accomplished have been described and the person responsible for implementing them will be recorded in the complaint log. Grievances will be resolved and status reported back to complainants within 5 days. If more time is required this will be communicated clearly and in advance to the aggrieved person. For cases that are not resolved within the stipulated time, detailed investigations will be undertaken and results discussed not more than 15 from lodging a grievance.

Step Three: Meeting with the complainant: The proposed remedial action and the timeframe in which it is to be implemented will be discussed with the complainant within 5 days of receipt of the grievance. Consent to proceed with the corrective action will be sought from the complainant and witnessed by a local government chairperson.

Step Four: Execution of Corrective Actions: Mutually agreed corrective action will be commenced by the project office or its contractor within the agreed time frame. The date of the completed action will be recorded in the log against the complainant's grievance.

Step Five: Verification of the Remedial Actions: To verify satisfaction, the aggrieved group or person will be asked to return if not satisfied or bring the case to court with the corrective action.

Step Six: Action by the project office and/or the contractor: If the project office or contractor cannot solve the grievance within 15 days, S (He) will refer it to court through the social safeguard and or occupational safety and health professional. It is believed that most of the possible grievances can be solved at this level.

12. Institutional Arrangement and ESMP implementation

12.1 Overview of the service chain organization

Incomplete institutional frameworks frequently lead to both a lack of accountability and conflicts amongst stakeholders, which frequently results in this predicament. Every component of the service chain affects the overall performance of the service and hence clear responsibilities and duties need to be defined as interdependent components. Coordination between each link in the chain is crucial to a successful FSM system.

BTWSSE created institutional arrangement as per ESMF by recruiting project coordinator, environmental and social safeguard specialist and procurement officers (totally 3 staffs) for the duty to implement the project. BTWSSE has fulfilled the E&S staff per the ESMF requirement. Experts and institutional arrangements which are currently available at BTWSSE will be used for the implementation of ESMP. The Environmental and social safeguards in BTWSSE will provide oversight on the implementation of the environment (ESIA) and social (RAP) components of the program. Thus, BTWSSE already allocated environmental and social development specialist for the overall environmental and social safeguard issues. For the efficient implementation, adequate safeguard training should be given for safeguard experts of BTWSSE.

During the construction period, OHS experts need to be recruited by the contractor and supervising consultant to implement and monitor the day-to-day project construction activities and ESMP. The Contractor's site supervisors and foremen will ensure that the provisions in this ESMP are implemented within the sites under their supervision and collect and transmit relevant information to OHS experts. The contractor shall submit regular weekly and monthly progress reports to the project coordinator. The supervising consultant should report to BTWSSE and project coordinator on quarterly bases.

Mitigation measures proposed for socio-economic issues like compensation to damaged properties, lost/degraded plots of land should be handled by a committee, composed of representatives of all stakeholders, including BCWSSSE, local government administrative organs, NGOs, and the affected group. Both the project and site managers should familiarize themselves with the ESMP to execute required environmental, health, and safety supervision roles. The project manager shall have the ultimate responsibility for the implementation of ESMP and will therefore ensure that all of the resources are duly provided and ensure staff are adequately inducted and trained at the site regarding ESMP including emergency procedures. While the operational phase of ESMP will be implemented by BTWSSE.

Hence experts and operators will require training and expertise assistance to perform the ESMP environmental monitoring plan. The proposed training program for different staff with their field of training is given in Table 43 below in addition to on-the-job training by the environmental consultants.

Table 43 Training Programs for capacity building and associated costs

S.N.	Capacity building activity	Phase of project	Participants	Budget (USD) 1 USD = 118.15 Eth Birr
1	Awareness raising and sensitization workshops	Start of construction and operation phases	Representatives of stakeholders and responsible staffs (50)	8463.8
2	Technical trainings on environmental and social safeguard and OHS issues	Beginning of the three phases	Environmental and social safeguard and OHS staffs	8463.8
3	Review workshops on quarterly and annual bases	Construction and operation phases	Officials and staffs (8 years)	16927.6
4	Trainings on project management and coordination	Construction and operation phases	Officials and staffs (4 rounds)	8463.8
Total				42,319.0

12.2 Role distribution among the stakeholders

A variety of stakeholders such as the town's water supply and sewerage authority, municipal services, private entrepreneurs, universities and others tend to involve in the management of FS service chain. The institutional study showed that multiple government ministries share responsibilities for managing fecal sludge. The potential stakeholder duties are compiled in Table 44.

Table 44 Stakeholders in the fecal sludge sector and their possible involvement in the management

Stakeholder	Laws	Coordinati on	Collection & Transport	Treatm ent	Resource Recovery	Enforce ment	Training & Information	Monitoring
MoWE,MoH,MOUPH	X	X				X	X	X
WSSE		X	X	X	X	X	X	X
EPA	X	X	X	X	X	X	X	X
Police						X		
Private Companies			X	X	X			
SME			X		X	X		
NGO							X	X

12.3 ESMP Implementation costs

Even though it is very rough and subjective the overall ESMP cost estimated during construction, operation, and decommissioning phase is about **150,859.2 (One hundred Fifty Thousand Eight Hundred Fifty Nine) USD**. This price estimation is not exhaustive due to the very wide nature of the study and market dynamics. Thus assuming the market dynamics and complexity of the study, the price estimation might have an error of $\pm 30\%$ of the current value.

Table 45 Summary of budget estimate for ESMP CWIS, BT

No	Component	Project phase	Reference	Estimated cost in USD 1 USD = 118.15 Eth Birr
1	ESMP	Throughout all phases	Table 40	36002.6
2	Environmental and Social Monitoring	Throughout all phases	Table 41	58,823.1
3	Training and capacity building	Throughout all phases	Table 43	42,319.0
	Subtotal 1+2+3			137,144.7
	Contingency 10%			13,714.5
	Total			150,859.2

13. Conclusion and Recommendations

13.1 Conclusion

The findings of the environmental impact assessment of the proposed project results in both positive and negative impacts. To mention some of the positive impacts of the project, FSTP can contribute to sustainable development by improving public health, protecting the environment, reducing open defecation, recovering valuable resources, creating job opportunities, and improving access to sanitation services in town and the nation at large. The long-term environmental and social benefits include reduced morbidity and increased productivity of households; increased enrolment of children in educational institutions and improved tourist destination and economic development.

The ESIA study identified major negative impacts during the construction and operation phases as follows; involuntary economic displacement, land expropriation, landscape and integrity change, water, air, and noise pollution, social misdemeanor, and related others. These impacts can be minimized by applying the indicated mitigation measures outlined in the ESMP of this report. The BTWSSE project office, municipality, and the contractor have to work hand in hand for the implementation of proposed mitigation measures. The regulatory work, monitoring, and evaluation mostly rely on the Zone/ town EPA, WB in addition to the project office itself. For the PAHs, the local community (youth women, vulnerable group's kebele leaders) should properly involve in the compensation procedure, study, and decision-making to minimize grievance and ensure tenable benefits from the project development.

In conclusion, if the FSTP operates in conformity with the legal requirements provided in the ESMP, the benefits of the project to the nation will be by far outweighing its potential negative effects.

13.2 Recommendations









For the effectiveness and timely implementation of mitigation measures, the EMP shall be included in the bid document of civil works and need to become part of the civil works contracts.

- Strict observation of environmental and social management and monitoring plans are required ;
- The outlined informations in the ESIA report have to be exercised and respond to the regular environmental monitoring results;
- Ensure that worker's occupational health and safety standards are maintained through capacity building, proper training, and providing protective clothing;
- The project proponent is to provide reports, and transparent and accessible information on environmental performance to stakeholders and regulatory authorities;
- Annual environmental audits should be carried out on the project to ensure compliance of the project with the mitigation measures outlined in the Environmental and Social Management Plan (ESMP);
- Involvement of all relevant stakeholders is proposed throughout the process to ensure project acceptability.

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Appendix

Appendixes	Appendix title	Attached document
1	List of study Team in charge of the ESIA	 Appendix 1 Team in charge of the ESIA.zip
2	Public consultation meetings and engagement participants	 List Public consultation meetings and engagement participants BT.zip
3	Chance Find Procedure	 Appendix 3 Chance Find Procedure.zip
4	Consultation minuets	 Stakeholders participation BT.zip  Public Consultation on Bishoftu.zip
5	Environmental Guidelines for Construction Contractors	 Appendix 5 Environmental Guidelines for Construction Contractors.zip
6	TOR	 Appendix 6 TOR MOWE 2ND UWSSP.zip
7	Data collection tool	 Appendix 7 Data collection tools.zip
8		