Environmental and Social Impact Assessment (ESIA) Report for BSL 3 National Reference Laboratory Complex (Updated)

Proponent: FDRE Ministry of Health and the Ethiopian Public Health Institute (EPHI) with Financial support of WBG

Submitted to: FDRE Environmental Protection Authority, Addis Ababa, Ethiopia

Consultant: Basal Consulting

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EXECUTIVE SUMMARY

The Ethiopian Public Health Institute (EPHI) Strategic Plan Management and the Ethiopian Action Plan for Health Security are planning to construct and equip Biosafety Level Three (BSL 3) National Reference Laboratory (NRL) complex building to improve the capacity and status of the institute to conduct specialized testing with a focus on the diagnosis of emerging and re-emerging lethal pathogens. The proposed NRL building will be a 7-story building (G+6) that fulfills the minimum requirements for the height of buildings in the designated area. The building will have a total gross floor area of 12,000m^2, consisting of 8000m^2 of Laboratory spaces and 4,000 m^2 of Laboratory Office spaces, including related support spaces. The project is planned to construct BSL3 NRL and associated facilities at EPHI. The NRL building will consist of a BSL-3 laboratory suite, General Laboratory support facilities, a Proficiency Testing Panel Production Centre (PTPC), Bio Bank Centre, Central Warehouse and a laboratory medical equipment maintenance Centre. The implementation of BSL 3 will have significant positive impacts and adverse impacts if appropriate mitigation measures are not taken. In 2019, ZG Environment Consultancy (ZGEC) has already completed the Environmental and Social Impact Assessment (ESIA) study and the Infection Control and Waste Management Plan (ICWMP), which outline the potential environmental and social impacts due to the project. However, the ESIA study did not address the impacts associated with the decommissioning of the old incinerator and installation of a new incinerator, the feasibility of the proposed wastewater treatment and options for onsite wastewater treatment, and the capacity of wastewater treatment plants, incineration residues and wastewater sludge. Therefore, updated ESIA and ICWMP are prepared to assess and evaluate the existing and anticipated impacts during the construction, operation and decommissioning of the proposed BSL 3 project and propose enhancement mechanisms for the positive impacts and mitigation measures to reduce the effects of the negative impacts.

During updating the ESIA. a mixed-method approach was employed for data collection, analysis and triangulating qualitative and quantitative data. Data were collected from project staff, target beneficiaries, stakeholder consultation, onsite field visits, public consultations, and secondary data from previous ESIA reports and institutions focusing on quantitative data. A consultation was conducted with relevant stakeholders (from community representatives, representatives of the religious institutions and members of the different sector offices and participants from the EPHI) in the following stages: during the early data collection stage

(January 22, 2019), on the first draft ESIA (February 28, 2019), on the final draft ESIA (May 2, 2019) and on the updating of ESIA study (June 23/2022).

The scope of this updated ESIAcovered a description of the proposed project, provisions of the relevant environmental laws, a description of the baseline environmental and social conditions of the project area, project alternatives, impact prediction, identification and analysis (positive and negative), stakeholder consultation, appropriate mitigation measures, provision of environmental and social management and monitoring plan outline, development of infection control waste management plan, conclusion and recommendation. The ESIA have considered only impacts with moderate and severe impact significance for the preparation of environmental and social management and monitoring plan.

The updated ESIA revealed that the proposed project will have both positive and negative impacts on the environment and society during the pre-construction, construction, operation and/or decommissioning phases. Positive benefits of the prosed project may arise either from short-term job opportunities during construction, or long-term job opportunities during operation. The implementation of the prosed project may have positive socio-economic and political impacts such as employment generation, income generation, and regional integration through strengthening the Africa CDC's regional disease detection and response systems and linking them together into an effective network and establishing infectious disease control systems for the benefit of African Union member states and its citizens. On the other hand, implementation of the project will have also site-specific potential adverse environmental and social impacts. The adverse impacts of the project can be classified into three stages namely pre-construction and construction, operation phases and decommissioning phases. The pre-construction phase will give rise to fugitive dust and vehicle exhaust emissions, soil compaction and soil structure change a rise in noise level and clearing of some plants from the project site. Land clearing activity before construction begins has a temporary adverse impact on the ecological integrity of the land on which the project is planned to be situated. Site clearing will also cause erosion, siltation and changes in natural water flow during summer. Other construction impacts include air pollution, soil pollution and erosion, noise and vibration impacts, impacts on landscape and visual receptors, traffic and public safety impacts, wastewater generation impacts, solid waste generation impacts, impact on plant, animal and soil biodiversity, impacts on historical buildings, risk of social conflict and crime, gender-based violence, impact on traffic and public safety, increased burden on public service

provision and accommodations, and child right violation and occupational health and safety Impacts.

Beyond the adverse impacts expected from the construction and pre-construction stages, the project is expected to have negative impacts during operations. These are soil pollution, noise and vibration, impact on plant, animal and soil biodiversity, impacts on utility, risk of social conflict and crime, gender-based violence, impact on traffic and public safety, increased burden on and competition for public service provision and accommodation, air pollution, water pollution. In addition, the proposed BSL 3 NRL project will result in the generation of solid waste impacts (hazardous and infectious), and liquid wastes which may cause an impact on human health and the environment at large. Furthermore, the proposed project may have OHS impacts and risk of a communicable disease as a result of activities during the operational phase. Concerning the views of local communities towards the project, almost all residents and stakeholders welcomed the project.

It was found that the World Bank Environmental, Health, and Safety Guidelines apply and prevail over national legislation for Air Emissions and Ambient Air Quality, Wastewater and Ambient Water Quality, Hazardous Material Management, Waste Management, Health Care Facilities, Occupational Health and Safety, Community Health and Safety, Construction and Decommissioning such as Environment, Occupational Health and Safety and Community Health and Safety for this specific project as it is more stringent. Hence, World Bank Environmental, Health, and Safety Guidelines will serve as a main reference to monitor the implementation of ESMP.

The mitigation and monitoring measures should be implemented based on the management plans to minimize or reduce the environmental and social impacts, especially for those with medium and severe level impacts. .Implementation of the mitigation measures will be verified through environmental and social monitoring plans using the specified budget. The identification of alternatives provides a basis for choice among options available for decision-making. The development of its separate septic tank at EPHI for hazardous and non-hazardous liquid wastes and offsite treatment of hazardous wastewater and disposal and treatment of the non-hazardous waste to the Kality wastewater treatment plant is the feasible option. For hazardous solid waste, the construction/installation of another incinerator that fulfills the World Bank Environmental Health and Safety Guidelines for Healthcare Facilities (2007) is the preferred option considering the waste characteristics generated from EPHI BSL

3 NRL. Landfill of non-hazardous solid waste at the Repi landfill will be also a feasible option. Fly and bottom ash from the incinerator will be stored in a secured and roof cover landfill within EPHI. Analysis of different alternatives indicated that retaining the proposed establishment project site and implementation of the project with recommended mitigation measures and offsite treatments of hazardous wastewater are assessed as the most feasible option which will balance the project benefits and adverse impacts.

Overall, the ESIA study team recommends that the project proponent should oversee the implementation of mitigation measures at each stage of the project cycle to avoid, minimize and offset those impacts which are identified in this report as well as immediately report and prepare a management plan for any unforeseen impacts. There is no appropriate treatment infrastructure in the vicinity and Addis Ababa City administration for hazardous and infection liquid waste and ash formed from hospital and clinical facility incinerators. Therefore, it is the responsibility of the EPHI, Ministry of Health, Addis Ababa City Administration and Federal EPA to construct a clinical wastewater treatment plant and secured landfill for all health facility wastes in Addis Ababa.

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ACRONYMS & ABBREVIATIONS

AAWSSA	Addis Ababa Water Supply and Sewerage Authority
ACRIFP	Africa CDC Regional Investment Financing Program
AMR	Antimicrobial Resistance
BSC	Biological Safety Cabinets
BSL	Biosafety Level
CAV	Constant Air Volume
CDC	Centres for Disease Control and Prevention
CDM	Clean Development Mechanism Change
DMC	Data Management Centre
EIA	Environment Impact Assessment
EID	Early Infant Diagnosis
EPA	Environmental Protection Authority
EPHI	Ethiopian Public Health Institute
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and social Management Plan
GTP	Growth and Transformation Plan
HSTP	Health Sector Transformation Plan
HVAC	Heating, Ventilation and Air Conditioning
ICWMP	Infection Control and Waste Management Plan
KWWTP	Kotebe Wastewater Treatment Plant
MoLSA	Ministry of Labor and Social Affairs
MoWCA	Ministry of Women and Children Affairs
MPA	Multiphase Programmatic Approach
NIH	National Institutes of Health

NPEW	National Policy on Ethiopian Women
NRL	National Reference Laboratory
OSH	Occupational Health and Safety
PTPC	Proficiency Testing Panel Production Centre
SEUs	Sectoral Environmental Units
TF	Trickling Filter
TGE	Transitional Government of Ethiopia
UASB	Up-flow Anaerobic Sludge Blanket
UNFCCC	United Nations Framework Convention on Climate
VAV	Variable Air Volume
WHO	World Health Organization
WSP	Waste Stabilization Pond
ZGEC	ZG Environment Consultancy

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1. INTRODUCTION

1.1 Project Background

Ethiopia has a three-tiered national reference laboratory system with the existing national reference laboratory serving as the hub. At present, there are 35 laboratories, nationwide, but their facilities are, generally, inadequate for the scope of services proposed by the project and quality varies significantly among them. The Ethiopian Public Health Institute (EPHI) Strategic Plan Management (2015/16 to 2019/20) and the Ethiopian Action Plan for Health Security (2018-2022) foresee the construction and equipping of the proposed BSL-3 level state-of-the- art National Reference Laboratory complex to elevate the capacity and status of the institute to conduct specialized testing, with a particular focus on the diagnosis of emerging and re-emerging risk group 3 ethological agents/pathogens. The construction and equipping of the proposed BSL 3 laboratory will bolster the capacity of EPHI for advanced public health research, provision of quality referral diagnostic services and timely detection of causative agents of epidemic disease outbreaks thus facilitating quick and effective response to public health threats. Ultimately, strengthening the Ethiopian Public Health Institute will allow the government to improve the national Laboratory System, National and Regional Antimicrobial resistance (AMR) Surveillance System and networking, Sub-national, National and Regional Data Management Centre (DMC) for public health: promote "data sharing and use for action", Building resilient Public Health and Emergency Management systems, Infrastructure, project management and human resource development.

World Bank Group financed Africa CDC (Centres for Disease Control and Prevention) Regional Investment Financing Program (ACRIFP) aims to offer financial protection and expansion and improving availability of services in a bid to make basic and quality assured health care accessible to the Ethiopian population. The ACRIFP project is designed as Multiphase Programmatic Approach (MPA) and it will be implemented in Africa CDC, Ethiopia and Zambia. The project is designed to support US$20 million for Africa Centres for Disease Control and Prevention, US$150 million for the Federal Republic of Ethiopia and US$60 million Republic of Zambia. The Project Development Objective is to strengthen the Africa CDC's regional disease detection and response systems and link them together into an effective network of networks. It will support the Africa Centre for Disease Prevention and Control (CDC), Ethiopia and the Southern Africa regional collaborating center in Zambia to establish infectious disease control systems for the benefit of African Union member states and their citizens.

In Ethiopia, activities (goods, technical services, and civil works) to be financed by the project, include, inter alia: (i) the design, construction, equipping and furnishing and maintenance of a Biosafety Level 3 (BSL-3) national reference laboratory (NRL) including a laboratory medical equipment maintenance centre; (ii) establishment of a Proficiency Testing System and panel production for standard quality assurance, bio bank centre for reference materials of all sorts, central warehouse to serve as logistics supply hub for Africa CDC and the East Africa RCC countries; (iii) construction, equipping and furnishing of 15 laboratories along Ethiopia's borders; (iv) equipping and furnishing 8 Biosecurity Level 2 (BSL-2) district laboratories already constructed by the Global Fund; and (v) a set (4) of programs designed to improve laboratory capacity building and operational effectiveness.

The implementation of BSL 3 within the EPHI campus will have significant positive impacts as mentioned in impacts identification and analysis. The project will have also adverse biophysical and socio-economic impacts if appropriate mitigation measures are not taken.

This ESIA and ICWMP describing the potential environmental and social risks associated with the laboratory and the proposed mitigation measures for the risks have already been prepared by ZG Environment Consultancy (ZGEC) in 2019. However, the ESIA study has not covered the risks associated with the decommissioning of the old incinerator and installation of a new incinerator, the feasibility of the proposed wastewater treatment system and options for onsite wastewater treatment, and the capacity/due diligence of wastewater treatment plants (such as Kality, Sendafa, and Koteb proposed by the client) for the handling of the partially treated wastewater, incineration residues and wastewater sludge. Therefore, updated ESIA and ICWMP are prepared to identify, assess and describe the major impacts related to the construction, operation and decommissioning of the proposed BSL 3 laboratory, to provide possible mitigation measures for potential adverse environmental and social impacts, to prepare an environmental and social management plan, and an ICWMP.

1.2 Objectives of the ESIA

1.2.1 General Objective of ESIA

The general objective of this ESIA report is to update the ESIA study and ICWMP prepared for the proposed BSL 3 NRL project in the EPHI campus, propose enhancement mechanisms for the positive impacts and mitigation measures to reduce the effects of the negative impacts.

1.2.2 Specific Objectives of ESIA

Specifically, this ESIA study was conducted:

- to assess impacts associated with the decommissioning of the old incinerator
- to identify mitigation measures for impacts due to decommissioning of the old incinerator
- to assess the impacts associated with the installation of a new incinerator
- to identify mitigation measures for impacts due to the installation of a new incinerator
- to assess the feasibility of the proposed wastewater treatment
- to determine the options for onsite wastewater treatment
- to determine the capacity of wastewater treatment plants, incineration residues and wastewater sludge
- to update environmental and social management and monitoring plan and an ICWMP

1.3 The Significance of the Project

The Government of Ethiopia has developed a Health Sector Transformation Plan (HSTP), which is part of the second Growth and Transformation Plan (GTP II). HSTP is also the first phase of the 20-year health sector strategy called 'Envisioning Ethiopia's Path to Universal Health Care through the strengthening of Primary Health Care'. The overall desire of the Government of Ethiopia is to have the highest possible level of health and quality of life for all its citizens, attained through providing and regulating a comprehensive package of promotive, preventive, curative and rehabilitative health services of the highest possible quality equitably. The construction and equipping of the proposed BSL-3 level state-of-the-art National Reference Laboratory complex will capacitate the institute and heighten the status of the laboratory facility to conduct specialized testing, with a particular focus on the diagnosis of emerging and re-emerging risk group 3 ethological agents/pathogens. The construction and equipping of the proposed BSL 3 laboratory will also bolster the capacity of EPHI for advanced public health research, provision of quality referral diagnostic services and timely detection of causative agents of epidemic disease outbreaks thus facilitating quick and effective response to public health threats.

2 METHODOLOGY

2.1 Approaches of the ESIA Study

The ESIA approach of the EPHI BSL 3 laboratory was structured to cover the requirements under the ESIA Proclamation (Proclamation № 299 of 2002). To this end, previous published and unpublished literature and other information were collected to gain a complete understanding of existing environmental conditions in the area.

Thus, the study team employed a mixed-method approach for data collection, analysis and triangulating qualitative and quantitative data collected from project staff, target beneficiaries, stakeholder consultation, onsite field visits, public consultations, and secondary data from previous ESIA report and institutions focusing on quantitative data.

The consulting team used a wide variety of data sources and data collection methods as needed and at every stage of the study process. Primary data was collected through key informant interviews (KII), public consultation and collection and review of documents particularly previous ESIA report and others from different sources and stakeholders. In addition, physical observations were conducted at project sites and available waste management facilities in Addis Ababa to witness project activities at the field level which helped the team to triangulate secondary information with reality.

For the intended purpose questionnaires/ checklists/ guides and different formats were designed to gather the required information on the set of variables identified to understand the current situation of the project impact/risk (both positive and negative) in the project site that can help to design appropriate environmental and social management and risk mitigation plan at the city administration level.

2.2 Data Record Review

Based on the prepared checklists by the consultancy firm to identify the major information sources and relevant data needed from each relevant source, the detailed description of the project concerning design (site plan and architectural drawings) construction and operation were taken from the previous ESIA study. Additionally, relevant documents to obtain necessary baseline information on demographic trends, land use practices, climate condition, soil condition, hydrology, education coverage, health service provisions, local and national development strategies and plans as well as the policy and legal issues were also gathered from Gulele Sub-city, Woreda 09 Administrator.

2.3 Field Visits and Observation

The field visits along with observations were mainly focused on the physical evaluation of the project area (landform trends, land use patterns, biodiversity, natural resources, hydrology and presence of houses, waste management practices, properties and other assets such as buildings and other facilities affected by the project), and available waste management facilities in Addis Ababa to assess the capacity and current situations of the facilities. It was also focused on the observation of socio-cultural and socio-economic activities. Additionally, the field visits were planned to enable the determination of the exact physical environmental features to be affected within the proximity of the project site and to identify the potential positive and negative impacts.

2.4 Stakeholder and Public Consultations

As this project is Schedule I type, stakeholder and public consultation for BSL 3 NRL lab ESIA project were conducted three times; twice in the previous study (initial and disclosure consultations) and once during the update of the ESIA report. During the consultation in the update, there were no complaints raised from stakeholders and public. The only concern from the public is the implementations of the project as it has significant positive impacts to the community, the country and the region at large. The public also raised the issue of implementations during consultations that conducted for environmental and social audit of BSL 2 NRL. Disclosure will be also done after the approval of the report by WBG.

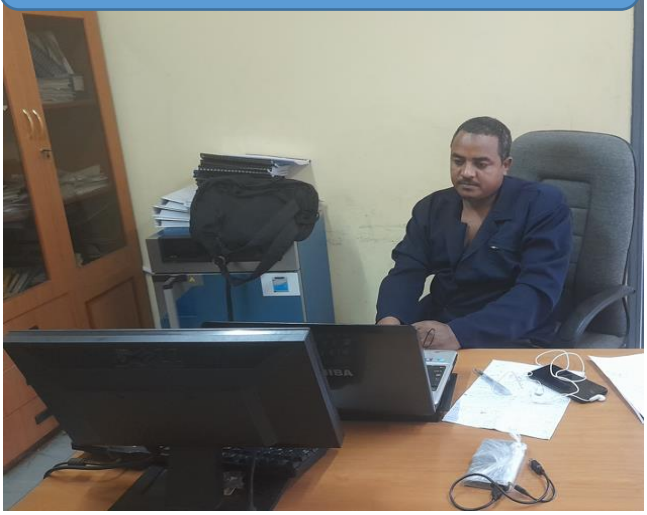
During updating ESIA report, prior to the filed visit, the team had multiple consultation and briefing session with the EPHI team. In the process, the design of the BSL3 NRL was obtained from EPHI, and discussion was made on the project site, layout setting, details of workflow and schedules. To facilitate the public and stakeholder consultation, the team of experts conducted stakeholder mapping in consultation with local authorities. The major stakeholders identified were the local government officials at Gulele Sub-city Woreda 09 administrator such as the health office, environmental protection office, social affairs office and residents and commercial centers around the EPHI compound.

Community participation and consultation is an important steps in the ESIA methodological process. Public consultation is instrumental in assessing the socio-economic impacts of the project. We have consulted selected residents and commercial business owners and representatives from St. Paulose Hospital. The residents were selected from the different age groups in the presence of Kebele administrators and delegates from the city EPA office to

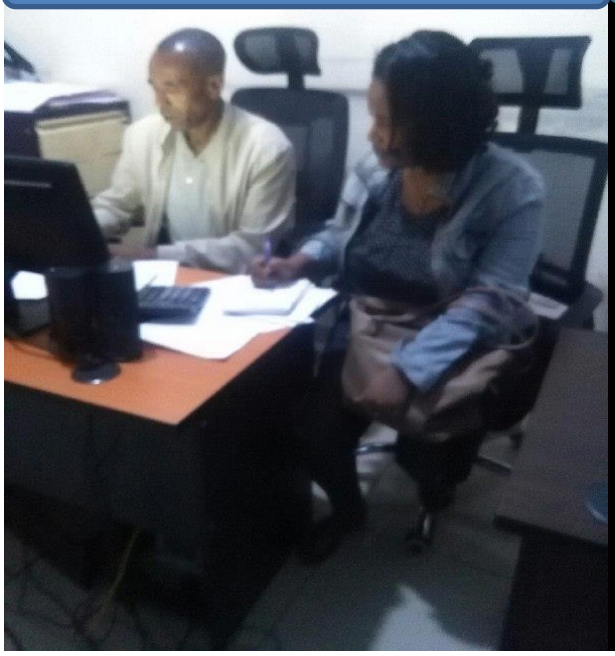
enhance project success and create good will between the public and the proponent. Participants in the community consultations included community members, women, youth and other residents in the area (Figure 2). A total of 27 participants were presented during the public consultations. Therefore, representatives from different age groups and sex (11 male and 16 female) were consulted at the project sites (EPHI Hall).

Kotebe Wastewater treatment plant site manager

Kaliti Wastewater treatment plant site manager



Gulele Sub-city Agriculture office



Gulele Sub-city Culture & tourism office

Figure 1: Stakeholder consultation Participants

Figure 2: Participants during public consultation (Update of ESIA study)

Figure 3 Participants during public consultation (previous ESIA study, January 22, 2019)

2.5 ESIA Methodological Flow

This section describes the broad principles and methodological steps of the ESIA indicating the techniques applied for impact identification, quantification, analysis and mitigation. The assessment process constitutes a systematic approach to the evaluation of a project in the context of the natural, regulatory and socio-economic environments of the area in which the project is proposed to be implemented. The process adopted to undertake the ESIA study for the BSL 3 laboratory project is summarized below:

Step 1 Screening: Environmental and Social screening of the projects was carried at the initial stages of the ESIA process by ZG Environment Consultancy to determine the level of assessment that needs to be carried out for the project. Though the type of projects falling into the different categories are essentially similar, the national environmental screening system follows a different approach from the World Bank by adopting a list of scheduled projects grouped into different categories.

Environmental Impact Assessment Proclamation (No. 299/2002) aims primarily at making the ESIA mandatory for categories of projects specified under a directive issued by the EPA.

The ESIA procedural guideline published by Federal EPA in 2003 has outlined the categories of development projects and activities that will require full, partial and no environmental and Social impact assessment (ESIA). Under schedule II activities of the ESIA guideline the type of Activities that are required to conduct a Preliminary ESIA study report are listed. One of the activities identified under it is *"*Hospitals and Dispensaries*"*. As such the proposed NRL project is not directly included in the list of scheduled activities; however, apparently it is an important part of health facilities such as hospitals. In addition, the project will include the construction of an incinerator. Thus, it is prudent to consider the proposed NRL development project as schedule I activities listed under the section. As a result, to fulfill its requirements under the national ESIA law, the project proponent (EPHI) will have to conduct and submit a full environmental impact assessment study for the development project. This ESIA report is prepared to fulfilling the national ESIA requirement and will be submitted to the competent authority in this case the Federal Environmental Protection Authority for review and approval.

The BSL-3 NRL Project Classification: The proposed NRL project construction, equipping and operation will be restricted within the EPHI institute premises except waste management/ pollutants generated that may go beyond the boundaries of the institute. The project will not directly affect ecosystems such as wetlands, forests, grasslands, etc. Therefore, according to World Bank classification, the proposed NRL project is classified under ***Category A***. because 1) the occupational and public health risk associated with highly sophisticated BSL-3 the risk associated with medical waste incinerators; and 3) the risk associated with medical wastewater treatment.

Step 2 Scoping: The first step in the ESIA was to define the proposed project activities and the natural, regulatory (i.e. legal) and socio-economic environments in which these activities will occur. This is achieved through scoping. Scoping identifies which of the activities has the potential to interact with the environment. Scoping was conducted early in the ESIA process so that a focus on the priority issues (i.e. those that have the greatest potential to affect the natural and/or socio-economic environment) can be established for the rest of the ESIA process.

Step 3 Detailed data gathering and review: Following step 2, engineering, environmental and socio-economic data were assessed in greater detail to ensure all of the proposed project activities and their consequences were considered in all stages of the development.

Step 4 Existing environmental conditions: To identify any potential impact on and potential change to the natural and socio- economic environments, it was essential to have a thorough understanding of the existing environment prior to the commencement of the proposed activities. In this regard there was a need to characterize the existing baseline environmental and socio-economic conditions including establishing the prevailing conditions for a range of media as follows:

- Natural environment media such as water, air, soil and groundwater, flora and fauna;
- Socio-economic media such as demographics, economic activity and service provisions

Step 5 Project alternatives: The initial step in defining the project was to identify, at a conceptual level, viable alternatives to the project so that a viable base-case design may be realized.

Step 6 Consultations: Project stakeholder consultation is a vital component of the ESIA process. The consultation process focuses on providing information on the proposed NRL development project in a manner that can be understood and interpreted by the relevant audience, seeking comments on key issues and concerns, identifying potential impacts and offering the opportunity for alternatives or objections to be raised by the potentially affected parties and other stakeholders. All relevant stakeholders were identified and consultations at all levels of the ESIA study were conducted. By conducting the consultations, the people that will be affected by or have an interest in the proposed project were having an opportunity to express their opinions and concerns.

Step 7 Identification and analysis of the environmental impacts: Key potentially beneficial as well as adverse impacts on the physical, biological and socio-economic environment associated with the construction and operation phases of the proposed BSL-3 NRL project were identified with the help of checklists, site survey and consultations with stakeholders and affected parties.

Step 8 Developing ESMP: Effective and efficient environmental and social monitoring and auditing are put in to exert if and only if mitigation/enhancement measures are well-pinpointed within the Environmental and social Management Plan (ESMP). Thus, possible measures indicated in this report were scrutinized after an in-depth review of various literatures in the context of Ethiopia's economic, social, ecological, political, and legal policy framework bases. The steps include identifying environmental problems and concerns

throughout the project`s life cycle period, identifying project alternatives and options and simultaneously selecting the best alternatives and options. The concerns that rose during public consultation and stakeholder meetings were taken into consideration for devising ESMP.

2.6 Documents and Guidelines Used

Information on existing environmental conditions was obtained from a review of various published and unpublished sources. Ethiopian FDRE Environmental Protection Authority ESIA guideline documents were followed to guide step by step activities of this study. These documents helped decide the extent of the ESIA study for this specific project. In addition, a review of the previous ESIA report, Socio - Economic Profile of Addis Ababa city Administration particularly Gulele Sub-city, Woreda 09, World Bank Safeguard Policies, and various guidelines including the IFC EHS guidelines were also made. The review also examined technical and supervision documents from previous and ongoing World Bank projects and other similar Environmental and Social Management Framework (ESMF) documents (Screening documents) including Africa CDC Regional Investment Financing Project ESMF, national and international regulatory policies, legal and administrative frameworks.

2.7 Methods for Impact Identification, Analysis and Prediction

Methodologically, multi-criteria method was used to predict the likely positive and/or negative impacts of the NRL project using Matrix Values of likelihood and consequence. The project was divided into 3 phases (construction, operation and decompositions phase) for the sake of simplicity and impact identification processes. Then, the possible impacts on human health (occupational and public), socioeconomic and bio-physical components of the environment were anticipated. Impact prediction was employed through case-by-case examination of the processes, machineries, raw materials and products employed which are integrated with impact management mechanisms planned by the company.

2.7.1 Impact Analysis

Once all the important impacts have been identified, their potential size and characteristics were predicted and evaluated systematically by a team of experts based on physical, biological, socio-economic and cultural data to estimate the likely characteristics and parameters of impacts (e.g. magnitude, spatial occurrence, etc.). For this analysis weighted

matrix was used to assist the total impact estimation (as well as assign values). The result analysis is displayed in Table 1.

Table 1: Impact classification

Character (C)	Negative (-)	Neutral (0)	Positive (+)
Disturbance (D)	Important (3)	Regular (2)	Limited (1)
Significance (S)	High (3)	Moderate (2)	Low (1)
Occurrence (O)	Very probable (3)	Probable (2)	Unlikely (1)
Extension (E)	Regional (3)	Local (2)	Specific (1)
Duration (D*)	Permanent (3)	medium- term (2)	Short -term (1)
Reversibility (R)	Irreversible (3)	Partial (2)	Reversible (1)
Total	18	12	6

The total impact for the identified anticipated impacts was assessed by using below formula.

If environmental disturbances (D) occur too frequently or occur multiple times during an ecosystem's recovery period classified as important. If disturbances occur periodically and predictably it is called regular and the disturbance occurs in a limited time and area it is called limited.

Significance of impacts is high/Severe, if the natural, cultural or social processes will be altered to the extent temporary. Medium/Moderate impact significance occurs if where the affected environment altered but the natural, cultural or social functions and processes are continuing in a modified way. The impact significance is low when natural, cultural or social functions and processes are not affected.

The **occurrence** of the impact can be very probable if the impact is very likely to occur under normal operational conditions. If the impact is likely to occur at some time under normal operating conditions it is occurrence will be probable. Unlikely impact is unlikely but may occur at some time under normal operating conditions

If the **extension** of impacts is regional, the distribution of impact will occur at a regional level. If the distribution of impacts occurs at a national level, it is called local and if the distribution of impact occurs onsite, it is called specific.

If the **duration** of impacts is permanent, the length of expected impact occurrence has been measured based on permanent effects. If the duration will cease after the operation of the site

(5-15 years), it is called medium term, and if the duration stays from 0-5 years of life or period, it is called a short term.

If the impacts are **irreversible,** the impact will remain after the implementation of mitigation measures. If the reversibility of the impact is partial, some of the impacts are reversible after the application of mitigation measure and removal of the impacts. If the impact is **reversible**, the impact will be reversed after the application of mitigation measures and removal of the impacts.

Total Impact (TI) = C x (D + S + O+ E + D* + R)

The result is interpreted as follow:

Negative (-) impact	Positive (+) impact
Severe (≥-15)	High (≥15)
Moderate (-15>-9)	Moderate (15>9)
Low (≤-9)	Low (≤9)

2.8 Impact Mitigation and Enhancement Measures

Based on the impact assessment, feasible and cost-effective mitigating and benefit enhancement measures that may reduce potentially significant adverse environmental impacts to acceptable levels were recommended under this step.

2.9 Report Structure

This ESIA report is formatted according to the national ESIA guideline 001/2010. This format suggests beginning with the executive summary which describes the overall activities of the ESIA study. The introductory part started with a brief background of the project stating why the specific project needs to pass through the ESIA process. It also states that objectives and approaches of the ESIA study together with a summary of the report structure. The second section of the report summarizes the methods of impact identification and analysis. The third chapter deals with about scope of the environmental and social impact assessment. The fourth chapter of the report is about gaps &/or assumptions in the ESIA process. The legal and institutional contexts which are specifically related to the project are described in fifth chapter. The biophysical and socio-economic baseline data is described in section six. The seventh chapter deals with project description focus on nature of the project, design requirements and operations specifications and project equipment description. Analysis of

alternatives is described in chapter eight. Project activities during the pre-construction, construction, operation and decommissioning phases are described under section nine. The tenth chapter is the major part of the report which identifies the major impacts of the project. It contains both beneficial and potential adverse impacts related to the project. Mitigation measures and management plans are described in the eleventh chepter and twelfth chapter of the report. Environmental and social monitoring program (ESMP) contains a subsection describing the monitoring plan with responsible bodies and the time frame of monitoring under the thirteenth chapter. ICWMP was also described in chapter fourteen. The public and stakeholder consultation is describes in fifteenth chapter. The sixteenth chapter is the Grievance Redress Mechanism (GRM) and the seventeenth chapter is the conclusion and recommendation which is reached mainly based on the findings of the ESIA study. After the reference section supporting attachments including checklists, interview guides, and photocopies of other documents are annexed.

3 SCOPE OF THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

The EPHI campus is in a densely built-up area. The assessment and consultations have considered the likely impacts of air emissions from incinerators in the EPHI campus on the surrounding neighborhoods. Furthermore, the management approach and disposal of residuals of the incinerators, including hazardous fly ash, have been given due attention in this assessment. Similarly, effluent management and disposal have been given due attention in this assessment.

The spatial and temporal scope of the proposed BSL 3 NRL project ESIA study is bounded by the location, construction and operation activities of the project. The spatial scope of the project will consist of the areas of direct and indirect impact zones of construction and operations of BSL 3 and other facilities within the EPHI compound.

The direct impact zone is considered to be those areas where the existing biophysical, socio-economic and environmental components are likely to be directly affected by the activities of the project components. These include St. Paulos Hospital to the West and North, Residential and commercial areas to the east and south, and its neighbor.

The project sites form the center of influence for the direct impact zone. Accordingly, the spatial scope is centered at EPHI campus areas. The indirect impact zone of the project is related to an increase in the capacity of EPHI for advanced public health research, provision of quality referral diagnostic services and timely detection of causative agents of epidemic disease outbreaks thus facilitating quick and effective response to public health threats. Such secondary effects could result in indirect impacts to the social, political and human environment as well as to natural resources affected by a new development projects.

The temporal scope of the ESIA study would mainly focus on assessing the potential impacts that are likely to occur during the preconstruction, construction, operation and decommission of BSL 3 NRL project. The environmental and social impact assessment would identify the direct and indirect impacts on humans, water, air, biodiversity, land use, landscape, sound environment, gender-based violence, occupational health and safety, infrastructure, traffic and accidents, public health and safety, social conflict and impacts on animal and plant biodiversity. It will also develop relevant mitigation/enhancement /offsetting measures and monitoring, and institutional strengthening measures to be undertaken during project implementation and operation.

4 GAPS &/OR ASSUMPTIONS IN ESIA PROCESS

Impact identification and analysis are based on professional judgments and negative and positive impacts are ranked as high, moderate, and low based on biophysical conditions and subjective judgments by the professional. However, we try to quantify impacts using Matrix Values of likelihood and consequence to make an objective evaluation of impacts.

Impact mitigation measures are devised for impacts with moderate and above impact significance. Regarding the probability of impact occurrence, some impacts are definite, probable and improbable which means that the occurrence probability varies from impact to impact. These assumptions and analyses may not be correct always.

The environmental and social impact identifications and analysis is based on the assumptions that clinical and domestic wastes are managed separately based on the waste segregation methods and separate safety tank will be constructed for clinical waste contaminated wastewater and domestic wastewater and all mitigation measures are in place and the proponents implement the project phases as per the management plan developed in this study.

Waste generated from EPHI BSL 3 will be highly infectious and hazardous. Impact identification and analysis is based on the assumptions that, there will be proper segregation of medical waste into non-hazardous waste (i.e., plastics, paper, food and liquids not considered to be infectious), infectious waste, and sharps waste and the liquid components of the waste are steamed out of the vessel, re-condensed and drained to a municipal sewer. Solid wastes will be also incinerated using an appropriate incinerator and the ash will be stored in a secured and concrete-based safety tank.

5 LEGAL, INSTITUTIONAL AND POLICY FRAMEWORK OF THE ESIA OF THE PROJECT

5.1 The Constitution of Ethiopia

According to the constitution of the FDRE, the foundation for human rights, natural resources and environmental management is included in its basic contents beginning from its permeable that shows the desire of the nations, nationalities and peoples of Ethiopia for development. The Constitution states clearly the development and conservation of the environment by the government and the people in that the constitution expresses that the government and all Ethiopian citizens shall have the duty to protect the country's environment and natural resources, the government along with the people and other stakeholders shall design and implement programs and projects of development. In this the 1995 FDRE constitution guarantees that Citizens have the right to benefit from the country's legacy of natural resources (FDRE, Art.89). Besides the constitution under Article 92 sub article 2 and 3 explicitly noted that any design and implementation of programs and projects of development shall not damage or destroy the environment and the People have the right to full consultation and to the expression of views in the planning and implementations of environmental policies and projects that affect them directly**.** One of the objectives to conduct ESIA on the establishment project of the industry is to assess the existing socio-economic impact of the firm on the surrounding areas.

5.2 Policy Framework

5.2.1 Environmental Policy of Ethiopia

Until 1997, Ethiopia did not have a comprehensive environment policy as such. The Environmental Policy of Ethiopia was issued in 1997 to provide overall guidance in the conservation and sustainable utilization of the country's environmental resources in general. The overall objective of the environmental policy is to promote the sustainable social and economic development of the country through, *inter alia,* sustainable management and utilization of the natural resources of the country. Among the specific objectives, the environmental policy seeks to achieve are ensuring the conservation, development and sustainable use of essential ecological processes and life support systems, biological diversity and renewable natural resources; and the empowerment and participation of the people in environmental management.

For the effective implementation of the Environmental Policy of Ethiopia the policy encourages the creation of an organizational and institutional framework from the federal to community levels. The Environmental Policy of Ethiopia provides several guiding principles that require adherence to principles of sustainable development; in particular, the need to ensure that Environmental Impact Assessment:

a) Considers impacts on human and natural environments;

b) Provides for early consideration of environmental impacts in projects and programs design;

c) Recognizes public consultation;

d) Includes mitigation and contingency plans;

e) Provides for auditing and monitoring; and

f) Is a legally binding requirement.

5.2.2 Biodiversity Conservation and Research Policy

The biodiversity policy was approved in 1998 and it provides policy guidance toward the effective conservation, rational development and sustainable utilization of the country's biodiversity. The policy objectives accentuate public participation in biodiversity conservation, development and utilization, and also ensure that communities share the benefit accrued from the utilization of the genetic resources and their traditional knowledge. The policy consists of comprehensive provisions on the conservation and sustainable utilization of biodiversity, and it underlines the requirements for implementers to adopt during the planning and operational phase of projects and for those projects engaged in biological resource utilization to follow ESIA procedures.

5.2.3 Ethiopian Water Resources Management Policy (1999)

The overall goal of the 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 aims to ensure access to water for everyone fairly and in a sustainable way, protect water resources and sources, and promote cooperation for the management of river basins.

5.2.4 The National Policy on Ethiopian Women (NPEW), 1993

The National Policy on Ethiopian Women (NPEW) was adopted in 1993 by the Transitional Government of Ethiopia (TGE) as the first policy document that attempts to promote and protect the rights of women and to domesticate the international commitment entered into by the government. The NPEW has assessed the situation of women in Ethiopia and concluded that discrimination against women has been perpetuated in various forms depending on their ethnic background, culture and religion. It further noted that Ethiopian women experience a ban from owning the means of production, are victims of natural as well as man-made disasters, face prejudicial attitudes in the country's political, social and economic life, and are still subjected to discriminatory laws.

The objectives of NPEW are:

- To facilitate conditions conducive to the speeding up of equality between men and women so that women can participate in the political, social, and economic life of their country on equal terms with men, ensuring that their right to own property as well as their other human rights are respected and that they are not excluded from the enjoyment of the fruits of their labour or from performing public functions and being decision-makers,
- To facilitate the necessary condition whereby rural women can have access to basic social services and to ways and means of lightening their workload
- To eliminate, step by step, prejudices as well as customary and other practices, that are based on the idea of male supremacy and to enable women to hold public office and to participate in the decision-making process at all levels

5.2.5 Policy on HIV/AIDS, 1998

The Government approved the first national policy on HIV/AIDS in 1998 as the Policy on HIV/AIDS of the Federal Democratic Republic of Ethiopia. The policy has the overall objective of providing an enabling environment for the prevention and mitigation of HIV/AIDS.

The specific objectives are to:

- Establish effective HIV/AIDS prevention and mitigation strategies to curb the spread of the epidemic

- Promote a broad, multi-sectoral response to HIV/AIDS, including more effective coordination and resource mobilization by government, NGOs, the private sector, and communities
- Encourage government sectors, NGOs, the private sector, and communities to take measures to alleviate the social and economic impact of HIV/AIDS,
- Support a proper institutional 'home and community' based healthcare and psychological environment for PLWHA, orphans, and surviving dependents,
- Safeguard the human rights of PLWHA and avoid discrimination against them,
- Empower women, youth, and other vulnerable groups to take action to protect themselves against HIV,
- Promote and encourage research activities targeted toward preventive, curative, and rehabilitative aspects of HIV/AIDS.

5.3 Proclamations

5.3.1 Environmental Protection Organs Establishment Proclamation (No. 295/2002)

The proclamation was made to re-establish the federal Environmental Protection Authority (EPA), to establish Sectoral Environmental Units and Regional Environmental Protection Agencies. The EPA was established to formulate policies, strategies, laws and standards, which foster social and economic development in a manner that enhance the welfare of humans and the safety of the environment, sustainable development projects and to spearhead in ensuring the effectiveness of the process of their implementation.

The EPA, among others, has the powers and duties to:

- Coordinate measures to ensure that the environmental objectives provided under the Constitution and the basic principles set out in the environmental Policy of Ethiopia are realized;
- Prepare, review and update, or as necessary, cause the preparation of environmental policies strategies and laws in consultation with the competent agencies, other concerned organs and the public at large and upon approval, monitor and enforce their implementation;
- Liaise with competent agencies in the field of environmental protection and rehabilitation and support them in capacity development;

- Establish a system for environmental impact assessment of public and private projects, as well as social and economic development policies, strategies, laws, and programs; and
- Provide advice and support to regions regarding the management and protection of the environment.

Sectoral Environmental Units (SEUs): Every competent agency (sectoral) is required by Proclamation No. 295/2002 to establish or designate an environmental unit that shall be responsible for the coordination and follow-up so that the activities of the competent agency are in harmony with this Proclamation and with other environmental protection requirements.

5.3.2 Environmental Impact Assessment Proclamation (No. 299/2002)

Environmental Impact Assessment Proclamation aims primarily at making the ESIA mandatory for categories of projects specified under a directive issued by the EPA. This law describes that the proponent should recruit an independent consultancy firm for preparing the ESIA report to be reviewed by EPA to reach at the final decision. It also stipulates the full power of the EPA or equivalent authority to exempt some projects from ESIA requirements as well as to suspend or cancel environmental authorization even after the project is licensed. Procedures that need to be followed in the process of conducting an environmental impact assessment and what is expected from the developer are described in the Proclamation. Here the proclamation signifies the procedures of the Environmental Impact Study Report that express the environmental impact study report shall contain sufficient information to enable the authority or the relevant regional environmental agency to determine whether and under what conditions the project shall proceed. Additionally, the proclamation accentuates an environmental impact study shall contain, as a minimum, a description of:

(a) The nature of the project, including the technology and process to be used

(b) The content and amount of pollutant that will be released during implementation as well as during operation and under sub-article

(c) Measures proposed to eliminate, minimize or mitigate negative impacts

The main objective of the study under this firm is how the above article of the proclamation could apply to the current project establishment.

5.3.3 Environmental Pollution Control Proclamation (No. 300/2002)

Primarily aims to ensure the right of citizens to a healthy environment and to impose obligations to protect the environment of the country. Relevant to this particular project, the law addresses the management of solid waste; establishment of environmental concerns on the bio-diversity policies and monitoring of pollution. In this connection, the proclamation provides a basis from which the relevant environmental standards applicable to Ethiopia can be developed while sanctioning the violation of these standards as criminally punishable offenses.

To ensure the implementation of environmental standards and related requirements, inspectors belonging to the EPA or the relevant regional environmental agency are empowered by the proclamation to enter, without prior notice or court order, any land or premises at any time, at their discretion. Such wide powers derive from Ethiopia's serious concern and commitment to protecting the environment from any hazards by sub-projects such as the proposed one.

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

The Proclamation discusses measures related to waste handling and disposal stating that any person shall collect waste in an especially designated place and in a manner, which does not affect the health of the society. It also emphasizes that no person shall dispose of solid, liquid or any other waste in a manner which contaminates the environment or affects the health of society.

5.3.5 Public Health Proclamation (No. 200/2000)

As stated in its preambles the purpose of this proclamation is to implement the health policy of the country and for the promotion of public health and the creation of a healthy environment for the future generation thereby enabling it to assume its responsibilities. The proclamation states that any employer shall ensure the availability of occupational health services to its employee for the health and safety of the work environment. It is also prohibited according to the law to use machinery which generates excessive noise. This Proclamation makes provision for the protection of public health.

The proclamation states that collection of waste should be in a designated place that does not affect the health of the public and disposition of waste shall be made in a manner that will not affect the environment or human health. Furthermore, the proclamation clearly states in its

penalty clause that failure to abide by this proclamation on public health shall result in both civil and criminal liability.

5.3.6 Food, Medicine and Health Care Administration and Control Proclamation (No. 661/2009)

The main objectives of this proclamation related to the environment are;

- To protect public health from unsafe, inefficacious and poor quality modern and traditional medicines,
- To protect the public from health risks emerging out of unsafe and poor quality food and,
- To avert health problems due to substandard health institutions, incompetent and unethical health professionals, poor environmental health and communicable disease;

5.3.7 Ethiopian Water Resources Management Proclamation, No. 197/2000

The proclamation is decreed to ensure that the water resources of the country are protected and utilized for the highest social and economic benefits of the people of Ethiopia, to follow up and supervise that they are duly conserved, ensure that harmful effects of water are prevented and that the management of water resources is carried out properly. It proclaims that all water resources of the country are the common property of the Ethiopian people and the state. It has provisions on general principles of water use and management, inventory of water resources, and professional engagement in water resource management and supply. Among other articles, the proclamation indicates the requirements on water bank management and prevention of harmful effects on water resources in articles 24 and 25 of the proclamation.

The supervising body in collaboration and consultation with the appropriate public body may:

- Delimit the boundaries of the banks of certain water bodies;
- Prohibit clearing and cutting trees or vegetation and construction of residential houses within the delimited banks of water bodies;
- The appropriate public bodies shall, before allowing or causing the founding of towns or villages, request the supervising body for technical advice to prevent or avoid damages, adverse impacts or accidents which may occur as a result of floods and other factors related to water.

The Act is of relevance to the proposed project in the prevention of water resources near the projects from pollution. It will also be applicable in the approval of water permits for abstraction from any water sources for the projects.

5.3.8 Labour proclamation No. 1156/2019

It is essential to ensure worker-employer relations are governed by basic principles of rights and obligations to enable workers and employers to secure durable industrial peace; sustainable productivity and competitiveness through cooperative engagement towards the all-round development of our country; whereas, there is a need to create a favorable environment for investment and achievement of national economic goals without scarifying fundamental workplace rights by laying down well-considered labour administration, and determine the duties and responsibilities of governmental organs entrusted with the power to monitor labour conditions; occupational health and safety; and environmental protection together with bilateral and tripartite social dialogue mechanisms.

5.3.9 Proclamation on Hazardous Waste Management and Disposal Control No. 1090/2018

The purpose of this proclamation is to prevent and control problems of environmental pollution caused by the mismanagement and disposal of hazardous waste. It is also to control the generation, storage, treatment, recycling, and reuse of hazardous waste to prevent harm to human and animal health as well as the environment.

The proclamation applies to a legal person who generates reuses, recycles, stores, transports or disposes hazardous waste at large in the country.

Regarding the management of waste, the proclamation directs that the waste producer has to minimize the release of hazardous waste by reducing hazardous substances in raw materials during production. The proclamation clearly stipulates the responsibility of the waste generator as follows:

- Collect, segregate, and dispose or to be disposed of hazardous waste by an authorized body
- Ensure that the container of hazardous waste is properly packed and carefully labeled in Amharic and English languages
- Keep a record of the type of hazardous waste that exists in the temporary container and show at any time when requested by the appropriate inspector

- Not to store hazardous waste for more than one month

The proclamation states that the reuse of hazardous waste is allowed provided it does not make harm human health, animal health and the environment. However hazardous waste must be removed properly if it is proven it is impossible to recycle after treatment.

According to this proclamation, the movement of hazardous waste is illegal if it is carried out without the permission of an authorized body. It is also deemed to be illegal if it contravenes the Basel convention ratified by Ethiopia and other national laws related to hazardous waste.

In its penalty clause, the proclamation clearly put that the authorized ministry may suspend a person's trading license for 15 days if it fails to comply with the requirements and conditions of transportation, storage and recycling of hazardous waste. It also states that storing, transporting and recycling hazardous waste without obtaining authorization from pertinent government bodies shall be punished with rigorous imprisonment of 5 years and a fine of birr 500,000. The same penalty applies to releasing untreated hazardous waste into the environment.

5.4 Environmental and Social Impact Guidelines

The FDRE EPA has issued some guidelines and standards which are endorsed by the National environmental council. The purpose of these guidelines and directives is to ensure that development projects integrate environmental considerations in the planning process as a condition for their approval. These include Directive No.1 /2008, which was issued to determine projects subject to environmental impact assessment. Other draft environmental guidelines prepared and posted on the website of the EPA that are widely used for several years now include the following:

5.4.1 ESIA Procedural Guideline (draft), November 2003

This guideline outlines the screening, review and approval process for development projects in Ethiopia and defines the criteria for undertaking an ESIA. According to this ESIA procedural guideline, projects are categorized into three schedules:

- **Schedule 1**: Projects which may have adverse and significant environmental impacts thus requiring a full Environmental Impact Assessment;
- **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 ESIA study; and

- **Schedule 3:** Projects which would have no significant environmental and social impact and do not require an ESIA.

However, projects situated in environmentally sensitive areas such as land prone to erosion; desertification; areas of historic or archaeological interest; important landscapes; religiously important areas, etc. will fall under Schedule I irrespective of the nature of the project.

5.4.2 Environmental Impact Assessment Guideline, May 2000

The guideline provides the policy and legislative framework, the general ESIA process and key sectoral environmental issues, standards and recommendations for environmental management in key sectors such as agriculture, industry, transport, tannery, dams and reservoirs, mining, textiles, irrigation, hydropower and resettlement projects.

5.4.3 Guideline for Environmental and Social Management Plan (draft), May 2004

This guide outlines the fundamental contents that need to be featured while preparing ESMPs for proposed development projects in Ethiopia and provides template forms to be used for such purposes. The guideline also guides the preparation of institutional arrangements for the implementation of ESMPs.

5.4.4 Guideline for Social, Environmental and Ecological Impact Assessment and Environmental Hygiene in Settlement Areas (2004)

It aims to strengthen the positive impacts and reduce or eliminate the negative impacts of social and economic activities on environmental well-being and human health in settlement areas. In addition, carrying out voluntary and informed consultation, sustainable improvement of life, and ensuring environmental sustainability are three of the six principles of the guidelines.

The guidelines require project proponents to describe the main negative environmental and social impacts anticipated from the implementation of project activities, devise mitigation plans for the negative impacts, and ensure that all phases of environmental and resource development and management, from project conception to planning and implementation to M&E, are based on the decisions of the local people. They promote the perception of heritage conservation.

5.4.5 Occupational Health and Safety (OSH) Guideline, 2008

The 2008 Occupational Health and Safety (OSH) guideline Directive provides guidance, based on the Labor Law, concerning occupational health and safety requirements and outlines

the general duties and responsibilities of employers, rights and duties of workers, and responsibilities of the Labor Inspection Service.

5.4.6 Medicines Waste Management and Disposal Directive

The objective of the directive is to protect the public and the environment from health risks and hazards of medicines waste by ensuring safe management and disposal practices.

The major components of the directive are;

- Medicines which are unfit for use shall not be stored for more than six months,
- Approval and authorization of disposal of medicines shall be sought from the appropriate organ,
- Any medicines waste disposal practice, including diluting and flushing of liquid medicines into sewers and burning of packaging materials, shall be attended by an inspector of the appropriate organ,
- After the disposal of medicines waste has been carried out, disposal certificates shall be issued by the appropriate organ,
- Disposal sites shall be environment and society friendly and shall be approved by an appropriate organ following EIA,
- Re-use of any medicines waste including re-packing and re-labeling is prohibited,
- Scavenging of medicines is prohibited and security measures to prevent scavenging shall be in place at disposal sites and temporary storage areas,
- Any health institution which does not have a disposal facility approved by the appropriate organ shall not carry out medicines waste disposal,
- Without prejudice to sub-article (8) of this article, any health institution which does not have an approved disposal facility shall use the disposal referral system of licensed disposal firms, respective medicines suppliers or central disposal sites, and
- Customs and Revenue Authorities and police officers shall adhere to this directive for the proper disposal of confiscated medicines.

5.4.7 Regulation Pertaining to Noise with Limit Values and Ambient Air Quality Standards

Ethiopia has developed its standard to prevent significant industrial pollution by indicating standards which must be observed and by indicating pollution limits beyond which the

environment would not tolerate. The limit values specified in the standard are applied to emissions to the atmosphere, emissions to water and noise.

The sensitivity to noise is usually greater at night-time than it is during the day, by about 10dB (A). The upper limits of noise permitted are the following:

Table 2: Noise standards to be applied where people live or work

		Limits in dB (A) Leq	
Area Code	**Category of area**	**Day time[1]**	**Night time[2]**
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45

1: Day time reckoned to be between 6.00 am to 9.00p.m

2: Night time reckoned to be between 9.00 p.m. to 6.00 am

5.4.8 Solid Waste Management Standards in Ethiopia

There is a Solid Waste Management Standard developed by the Ministry of Urban Development and Construction but was not adopted by the cities until recently. We also have examined the legal system that governs waste such as the solid waste management proclamation and environmental pollution control proclamation (Table 3).

Table 3: Breakdown of Solid Waste Management Proclamation No. 513 and the Environmental Pollution Control proclamation

Solid waste management Activity	**Law or Act**	**Description**
Source reduction/segregation - households	Solid Waste Management proclamation, Article 11.1	Households shall ensure that recyclable solid wastes are segregated
Collection and storage	Solid Waste Management proclamation, Article 11.2	Urban administration shall ensure that adequate HH solid waste collection facilities are in place to ensure the installation of marked waste bins by streets and in other public places guaranteeing the collection of solid waste from bins with

		sufficient frequency
Transportation	Solid Waste Management proclamation, Article 13.2	Urban administration shall set the standards to determine the skills of drivers and equipment operators and prevent overloads of solid waste
Treatment	Environmental Pollution Control Proclamation, Article 5.1	All urban administrations shall ensure the collection, transportation, and, as appropriate, the recycling, treatment or safe disposal of municipal waste through the institution of an integrated municipal waste management system
Disposal/Landfill	Solid Waste Management proclamation, Article 14,15	Construction of solid waste disposal sites and auditing existing solid waste disposal waste
Recycling and reuse	Solid Waste Management proclamation, Article 7.1	Manufacturer or importer of glass containers or tin cans shall collect and recycle glass or tins
Hazardous waste	Environmental Pollution Control Proclamation, Article 4.2	Any person engaged in the collection, recycling, transportation, treatment, or disposal of any hazardous waste shall take appropriate precautions to prevent any damage to the environment or human health or well-being.

5.4.9 Health and Safety Guidelines for Public Health Laboratories in Ethiopia, 2010

The guideline guides laboratory waste disinfectant, handling, and disposal and serves as a helpful reference and guide for all public health laboratories in the country.

5.4.10 National Hygiene and Sanitation Strategic Action Plan 2015/16-2019/20

This Plan focuses scale up community-led, and school-led total sanitation and hygiene and sanitation marketing, build adaptation and resilience to climate change in the health sector. A

separate national strategy is under development to address large-scale and communal off-site sanitation needs in urban areas in Ethiopia.

5.4.11 Medicinal Waste Management and Disposal Directive, 2011

The directive applies to (a) disposal of medicinal waste, but not to medical equipment or management of other healthcare waste generated by health institutions, and (b) all government, and nongovernmental and private organizations involved in medicinal waste handling and disposal. The Directive requires disposal firms to have secured an appropriate disposal site depending on the Environmental Impact Assessment conducted with the support of the Federal Environmental Protection Authority. In addition, a disposal firm is required to have all the facility and practice standards prescribed under this Directive.

5.4.12 Guideline for Waste Handling and Disposal in Health Facilities (2006)

The guideline was developed to:

- Enable health professionals to protect themselves against health hazards which might be encountered as a result of their occupational
- Create awareness among healthcare workers about the importance of the safe disposal of waste generated at health facilities
- Prevent and control environmental pollution by waste carelessly disposed of from health facilities;
- Provide technical support to health professionals and environmental health workers engaged in day-to-day health inspection and control activities.

The National health care waste guideline outlines the categorization of health care waste, the details of principles, procedures and actions that should be followed in managing the health care wastes daily, suggest safe collection, storage and transportation mechanisms for both within and out of the health care facilities, suggest the type of waste treatment options for both solid and liquid (infectious & hazardous) wastes including incineration options, recommend minimum health care waste management options/standards for different health care facilities and provide guidelines for monitoring systems and reporting procedures for HCWM at all levels

5.4.13 COVID-19 Guidelines and Protocols

Coronavirus disease -2019 (COVID-19) is an infectious disease caused by SARS COV-2. It was first detected in Wuhan city, China in December 2019. The disease was declared a a Public Health Emergency of International Concern and then a pandemic on Jan 30, 2020, and March 11, 2020, respectively.

In Ethiopia, in response to the outbreak, Emergency operating centers were activated at a Public Health Emergency of International Concern. National and regional public health institutes.

EPHI has been developing different guidelines and protocols to guide leaders and managers at all levels, health professionals, other support staff, and relevant stakeholders who are working in response to COVID-19. The followings are some of them which are relevant to BSL 3 NRL projects;

- EPHI_PHEOC_COVID-19_MPHSS_Guides_For_Quarantine_Amh (Posted on June 11, 2020,
- EPHI_PHEOC_COVID-19_MPHSS_Guides_For_Quarantine_Eng (Posted on June 11, 2020)
- EPHI_PHEOC_COVID19_MPHSS_Guides_Self_Care_TIPS_Mental_Health_Eng (Posted on June 11, 2020)
- EPHI_PHEOC_COVID-19_Death_Care_Burial_Management_Eng.pdf (Posted on June 2, 2020)
- EPHI_PHEOC_COVID-19_Cleaning_Disinfection_Protocol_Eng.pdf (Posted on June 2, 2020)
- EPHI_PHEOC_COVID-19_Guide_for_Rational_Use_PPE _Eng.pdf (Posted on June 2, 2020),
- EPHI_PHEOC_COVID-19_WaSH_Guideline_Eng (Posted on June 2, 2020)
- EPHI_PHEOC_COVID-19_IPC_Interim_Guideline _Eng (Posted on June 2, 2020),
- EPHI_PHEOC_COVID-19_SOP_for_Mask_and_Glove_Utilization_Eng (Posted on June 2, 2020),
- EPHI_PHEOC_COVID-19_Discharge_Criteria_Eng (Posted on May 26, 2020)
- EPHI_PHEOC_COVID-19_Laboratory_Diagnosis_Eng (Posted on May 26, 2020)
- EPHI_PHEOC_COVID19_Minimum_Standards_Quarantine_Isolation_Treatment_Eng (Posted on May 26, 2020)

- EPHI_PHEOC_COVID-19_Risk_Communication_Guide_Eng (Posted on May 26, 2020)
- Infection Prevention and Control Interim Protocol for COVID-19 In Health Care Settings in Ethiopia,
- Health Care Waste Management SOP for COVID-19,
- Ethiopian health care facility COVID-19 Preparedness and response protocol
- Pre-triage format for COVID-19 infection,
- Protocol for transporting COVID-19 patients,
- Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected,
- Risk communication and community engagement readiness and initial response for novel coronaviruses

5.5 Criminal Code of FDRE (NO 414/2004)

To contribute towards the promotion of a fair judicial system in the country pursuant to Article 55(1) of the constitution this new criminal code is enacted. The criminal code put punitive measures under articles 519 to 521. As stated in article 519 regarding environmental pollution the criminal code states that any breach of the relevant law, discharging a pollutant into the environment is punishable with a fine up to birr 10000 or five years rigorous imprisonment. Furthermore, article 520 indicates that failure to manage hazardous waste or materials by relevant laws is punishable with a fine of birr 5000 or three years of rigorous imprisonment or both. Acts contrary to ESIA are also punishable with simple imprisonment of one year.

5.6 Institutional Framework for National Environmental Management

5.6.1 Environmental Protection Authority (EPA)

At the National level, the EPA is mandated with responsibilities for the management of environmental issues. An amendment to the definition of powers and duties of the executive organs of the FDRE which was made in 2013 (proclamation no. 803/2013) gives the EPA powers to fulfill its role in ensuring the realization of the environmental objectives provided under the constitution. EPA is involved in the development of environmental policy and legislation; setting environmental quality standards for air, water and soils; monitoring pollution; establishing systems and procedures for ESIA; and establishing a national environmental information system. Enforcing the laws and policies including ESIA,

environmental and social monitoring and auditing, for all projects or activities that fall under the control of the Federal Government also falls within the responsibilities of the EPA. EPA will be responsible to check the implementations of each activity in all phases as per the ESIA management plan.

5.6.2 Ministry of Women and Social Affairs (MoWSA)

MoWSA is responsible for the coordination and implementation of the Social Protection Policy. Given the multidimensional nature of the policy implementation, a Federal Social Protection Council was established consisting of members from the relevant federal offices and other stakeholders. To implement the policy across the federal structure, institutional arrangements and accountability mechanisms were established from regional to zonal, Woreda, and Kebele levels.

MoLSA also plays an overarching role in the design, amendment, implementation and monitoring of occasional safety and health policies, directives, and guidelines, and makes sure that sector ministries and other executive organs perform their responsibilities related to health and safety issues in their respective mandate areas.

The Ministry is also responsible for the follow-up of the implementation of international conventions and national laws about women and children, conducting/commissioning research and formulating policies and guidelines, collaborating with organizations working on women and child issues, and providing capacity-building support to ensure the equal participation and benefit of women and the protection of children's rights and security.

The MoWCA is also working intensely for the overall development of women in the formulation and implementation of policies relating to women and children, women empowerment, prevention of oppression of women, ensuring security at the workplace along with ensuring total socio-economic development of women. The MoWSA is responsible for the coordination and monitoring of the development activities related to women and children through Women in Development focal points of different Ministries. The MoWSA works for the overall welfare of women and children, the establishment and preservation of legal and social rights of women and children.

5.6.3 Regional Environment Bodies

Proclamation 295/2002 requires regional states to establish or designate their own regional environmental agencies. The regional environmental agencies are responsible for the coordination, formulation, implementation, review and revision of regional conservation

strategies as well as environmental monitoring, protection and regulation (Article 15). Relating to ESIA specifically, Proclamation 299/2002 gives regional environmental agencies the responsibility to evaluate ESIA reports of projects that are licensed, executed or supervised by regional states and that is not likely to generate inter-regional impacts. Regional environmental agencies are also responsible for monitoring, auditing and regulating the implementation of such projects. The institutional standing of regional environmental agencies varies among regions. In some regions, they are established as separate institutions, while in others they are within Regional Sector Bureaus (e.g., Bureau of Land Use Administration). In some cases, the regional environmental protection Authorities (REPAs) have expanded their structures down to the Woreda level and city administration level, though the Woreda environment protection offices are not accountable directly to the REPAs.

5.7 International Conventions Ratified by Ethiopia

Ethiopia has ratified several international/multilateral environmental conventions and many of the principles and provisions in those conventions have been well addressed in the national environmental policies and regulations. Some of these conventions include the following:

- Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, Done at Aarhus, Denmark, On 25 June 1998
- Cartagena Protocol on Bio-Safety to the Convention on Biological Diversity Convention on Biological Diversity, Rio, 5 June 1992
- Convention for the Protection of the World Cultural and Natural Heritage Paris, 23 November 1972.
- International Labour Organisation (ILO) Forced Labour Convention, 1930 (No. 29)
- ILO Equal Remuneration Convention, 1951 (No. 100)

Ethiopia is a party to four international conventions, which directly or indirectly deal with pesticide production and use. These include:

- Persistent Organic Pollutants of Stockholm Convention, which tries to eliminate organochlorine and other equally dangerous organohalogen chemicals from the earth.

- Bamako Convention, which prohibits the importation of hazardous wastes into, and their movement in, Africa.
- Basel Convention, which strictly regulates the movement of hazardous waste globally. Recently, it has incorporated the prohibition of the importation of hazardous wastes into developing countries from the Bamako Convention.
- The first Prior Informed Consent or Rotterdam Convention, tries to ensure that anybody buying a chemical has complete and accurate information about the nature and impacts of that chemical before he/she decides and notifies his/her consent in writing to the exporter.

Because Ethiopia ratified Stockholm Convention and Basel Convention, it has international obligations on proper management of hazardous wastes and minimization of dioxins emission. This has implications for medical waste management and the proper operation of incinerators.

5.8 World Bank Safeguard Policies and Guidelines

5.8.1 World Bank Operating Policies

The World Bank requires ESIA of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. ESIA is one of the environmental and social Safeguard Policies that WBG uses to examine potential environmental risks and benefits associated with Bank lending operations. The Bank's Environmental Assessment policy and procedures are described in Operational Policy/Bank Procedures - OP/BP 4.01. Detailed advice and guidance on the conduct of environmental assessment are provided publicly by the World Bank in its Environmental Sourcebook and updates. During project preparation, the World Bank examines the implications of the proposed project for a series of policies below:

The applicable World Bank safeguard policies as it applies to the proposed NRL BSL 3 project are summarized in table 4.

Table 4: World Bank Group Applicable Operational Policies, Procedures

Safeguard Policies	**Triggered?**	**Explanation**
OP/BP 4.01	yes	The project will finance the construction NRL BSL 3

Environmental Assessment		project. The proposed project is Category A. covers impacts on the natural environment (biodiversity, air, water and land, noise and vibration impacts, landscape and visual receptors impact, solid waste generation impacts, impacts on hazardous and infectious waste generation, traffic and public safety impacts, risk of social conflict and crime, gender-based violence, increased risk of communicable diseases and burden on local health services, It triggered OP 4.01. Thus, the present ESIA, and Environmental and Social Management Plan (ESMP) have been prepared in response to OP/BP 4.01.
OP/BP 4.11 Physical Cultural Resources	Yes	The proposed NRL BSL 3 activity will be implemented in a new area and there are no archaeological sites and materials inspected from the project implementation site. However, the implementation of the project may increase the vulnerability of cultural objects to theft, trafficking or abuse for residents that are found to the east of the sub-project site.

The construction, operation and decommissioning phase of the proposed NRL BSL 3 project will be restricted within the project site that may go beyond the boundaries of the institute. According to the World Bank classification, the proposed NRL BSL 3 project is classified under Category A.

5.8.2 World Bank Guidelines

Under its "General EHS Guidelines, the World Bank has several guidelines, many of which are applicable to various components of the proposed project namely:

- Air emissions from onsite waste combustion units ("incinerators")
- Hazardous waste management
- Noise
- Occupational health and safety (against biological and radiological hazards).
- Community health and safety including traffic safety such as during project construction or disease prevention (where incinerators emission waft into and

affect not only local communities but also patients visiting or admitted in hospital including their attendants and the hospital staff).

- Construction and decommissioning.

While most of the above WBG guidelines apply to the proposed project in one way or the other, in sections below are discussed four environmental, health and safety (EHS) guidelines, namely:

- EHS Guidelines - Air Emissions and Ambient Air Quality
- EHS Guidelines - Waste Management
- EHS Guidelines - Health Care Facilities
- EHS Guidelines - Hazardous Materials Management
- EHS Guidelines - Construction and Decommissioning

5.8.2.1. World Bank Group Environmental Health and Safety Guidline for Healthcare Facility: "Air emissions and ambient air quality"

The Health care facilities Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. These EHS guidelines are designed to be used together with the General EHS Guidelines document, which provides guidance on common EHS issues potentially applicable to all industry sectors.

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in facilities by existing technology at reasonable costs. Application of the EHS Guidelines to require projects with "significant" sources of air emissions, and potential for significant impacts on ambient air quality to prevent or minimize impacts by ensuring that emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards. The EHS Guidelines recommend that applicability of specific technical recommendations should be based on national regulations, when it differs from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. Currently, Ethiopia has no Air emission levels for hospital waste incineration facilities, however the World Bank EHS Guidelines Health Care Facilities guideline (WHO, 2006) will be used for this project. The Guideline values for process emissions and effluents are indicative of good international industry practice with recognized regulatory frameworks.

These guidelines are achievable under normal operating conditions in appropriately designed and operated facilities through the application of pollution prevention and control techniques.

5.8.3 Comparison of National Requirements for HCWM and Occupational Health versus International Standards

The national requirements for hazardous waste management and occupational health and safety broadly drive from the six basic legislations that set legally binding rules which should be met by the project proponents. This legislation includes Proclamation 300/2002 on Environmental Pollution Control, Proclamation 513/2007 on Solid Waste Management, Public Health Proclamation 200/2000, Food Medicine and Health care Administration and Control Proclamation no.661/2009, Ethiopian Water Resources Management Proclamation, No. 197/2000 and the FDRE Labour Proclamation no. 377/2003 which are briefly reviewed in the preceding sections.

From the perspectives of hazardous waste management generated from health care facilities such as the proposed BSL 3 laboratory, the significant national laws that set the key requirements to involve the Public health proclamation 200/2000 and the Food Medicine and Health Care Administration and Control Proclamation no.661/2009. According to the Public Health Proclamation 200/2000, any solid, liquid and other wastes generated from hospitals (i.e. health care facilities) should be handled with special care and their disposal procedures should meet the standards set by the public health authorities. Moreover, the Food, Medicine and Health Care Administration and Control Proclamation no.661/2009 of Ethiopia stipulates that handling and disposal of solid and liquid wastes derived from different institutions must not be harmful to public health; the emphasis is on ensuring the availability of necessary hygiene requirements in controllable health-related institutions. In addition, it indicates that any waste generated from health care facilities must be handled with special care and their disposal procedures must meet the standards set by the relevant executive organ.

In order to enforce these framework laws of the proclamations, the FMoH and the Food Medicine Health Care Administration and Control Authority have issued two important pieces of documents that elaborate and describe the requirements for Health Care Waste Management at the national level. These are the Ethiopian Health Care Waste Management National Guideline (November 2008) and the Ethiopian Medicines Waste Management and Disposal Guideline (August 2011). These directives and guideline documents set the national

minimum practices that health care facilities should apply in managing their health care wastes.

On the other hand, the IFC EHS (World Bank Group) and WHO guidelines related to health care facilities are usually considered benchmark International Good Practice Standards. More specifically, about the proposed BSL 3 Laboratory project the WHO Laboratory Biosafety Manual (third edition, 2004) and the IFC EHS guideline for Health care Facilities appear to be directly applicable as international best practice requirements to the proposed BSL 3 laboratory project.

A comparison of the detailed requirements of the International best practice standards (i.e. the WHO and IFC EHS guidelines indicated above) with the national guidelines for health care waste management reveals that there is a great similarity in the set of requirements for the approaches, methods and procedures outlined for managing the health care wastes. The health care waste minimization, segregation, colour coding & collection, packaging, storage, sterilization, handling, transport and final disposal requirements of the FMoH Health Care Waste Management National Guideline are broadly identical to those specified in different sections of the WHO and IFC EHS guidelines. Therefore, a comparison of the National HCWM requirements with the International best practice standards does not show any major gap in addressing the proper handling of the highly infectious waste anticipated to be generated by the proposed BSL 3 laboratory.

Concerning emission levels released from Health Care Facilities, the above-mentioned national guideline for HCW doesn't set standards for emissions released from medical waste incinerators and associated wastewater treatment facilities. There is no such emission standard for medical waste incinerators and effluent treatment plants set by the competent national authorities (i.e. EPFCCC, MoH). However, there are such standards that can be drawn from International best practices. For example, according to the UNEP-POPs-BAT/BEP Guideline for Waste Incinerators, it is stated that with a suitable combination of primary and secondary measures, PCDD/PCDF performance levels in air emissions no higher than 0.1 ng I-TEQ/Nm3 (at 11% O2) are associated with best available techniques. It is also noted that the best available techniques for discharges of wastewater from effluent treatment plants are associated with PCDD/PCDF concentration levels well below 0.1 ng I-TEQ/l. Accordingly, this is taken as the performance standards for air effluent emissions from incinerators and wastewater treatments of HCF associated with the best available techniques. On the other hand, the IFC EHS guideline for Health Care Facilities also provides emission levels for air

and effluent releases as shown in the following table 15 (*Air Emission Levels for Hospital Waste Incineration Facilities).*

It is worth noting that the World Bank Environmental Health, and Safety Guidwline for Healthcare Facility (2007) emission standards for PCDD/F from HCW incinerators are in agreement with the UNEP-POPs-BAT/BEP Guideline for Waste Incinerators.

While most of the above WBG guidelines relate to the proposed project in one way or the other, the World Bank Environmental, Health, and Safety Guidelines apply and prevail over national legislation or lesser standards namely for Air Emissions and Ambient Air Quality, Wastewater and Ambient Water Quality, Hazardous Material Management, Waste Management, Health Care Facilities, Occupational Health and Safety, Community Health and Safety, Construction and Decommissioning such as Environment, Occupational Health and Safety and Community Health and Safety for this specific project as it is more stringent.

6 ENVIRONMENTAL AND SOCIO-ECONOMIC BASELINE

This section describes the environmental and social baseline conditions of the area in which the proposed BSL 3 NRL project is to be located and in which potential impacts from the implementation of the project may be experienced. The description is designed to enable the identification of particularly sensitive receptors and resources around the proposed site that may be vulnerable to impacts arising from the project.

6.1 Biophysical Environment Baseline

6.1.1 Location

The proposed BSL 3 NRL project will be situated within the campus premises of the EPHI which is found in Gullele Sub City, Woreda 09, on Swaziland Street. Being an urban core, the Swaziland Street is dominated by houses and buildings occupied by commercial and business entities. The EPHI campus is surrounded by mixed residential and business areas such as the Ethiopian commercial Bank branch (about 1.5 km far away from the EPHI incinerator facility), the Ethiopian Pharmaceutical Supply Agency (about 1 km far away from the EPHI incinerator facility), religious coordination office (1 km far away from EPHI incinerator facility), shops (about 1 km far away from EPHI incinerator facility), pharmacies (about 1 km far away from EPHI incinerator facility), and health care facilities (about 2 km far away from EPHI incinerator facility), are common on this woreda, EPHI is being the oldest centre have proximity to Paulos Hospital Millennium Medical College and new buildings are constructed adjacent to the project site. The project site is bounded by access roads in all directions.

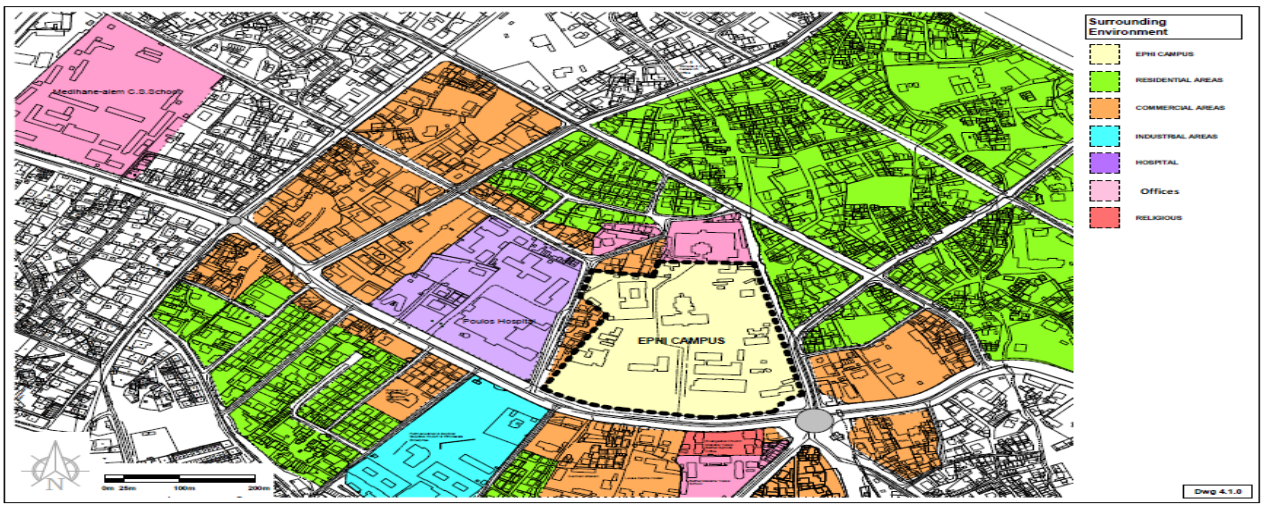


Figure 4: The EPHI campus location and its surroundings

6.1.2 Topography

Addis Ababa lies at an elevation of 2,200 metres and is a grassland biome, located at 9°1′48″N 38°44′24″ECoordinates: 9°1′48″N 38°44′24″E. The city lies at the foot of Mount Entoto and forms part of the watershed for the Awash River. From its lowest point, around Bole International Airport, at 2,326 metres (7,631 ft) above sea level in the southern periphery, Addis Ababa rises to over 3,000 metres (9,800 ft) in the Entoto Mountains to the north.

Addis Ababa is built on the steep escarpment of Mount Entoto and stretches farther to the south, where it turns out to be of a gentle slope nature and relatively of lower altitude. According to the Atlas prepared by the Addis Ababa City Administration Integrated Land Information Centre, the general elevation of the city ranges from as high as 3020 masl on the top of Mount Entoto to as low as 2000 masl in the river valleys of the southern edge in Akaki-Kaliti.

The topography of the Gulele sub-city and the project area has a slope of undulating nature and ranges from 2700 to 2806m above mean sea level. The topographic condition of the project site can be expressed based on qualitative and quantitative values. The qualitative approach describes the project site's relative topographic features concerning the local topographic condition. With this respect, the project site is categorized under flat topography. The quantitative approach describes the altitude of the project site measured from the universal reference point, the sea level.

6.1.3 Climate

The city has a subtropical highland climate and it has a complex mix of highland climate zones, with temperature differences of up to 10 °C (18 °F), depending on elevation and prevailing wind patterns. The high elevation moderates temperatures year-round, and the city's position near the equator means that temperatures are very constant from month to month. As such the climate would be maritime if its elevation was not taken into account, as no month is above 22 °C (72 °F) in mean temperatures.

Mid-November to January is a season for occasional rain. The highland climate regions are characterized by dry winters, and this is the dry season in Addis Ababa. During this season the daily maximum temperatures are usually not more than 23 °C (73 °F), and the night-time minimum temperatures can drop to freezing. The short rainy season is from February to May. During this period, the difference between the daytime maximum temperatures and the night-

time minimum temperatures is not as great as during other times of the year, with minimum temperatures in the range of 10–15 °C (50–59 °F). At this time of the year, the city experiences warm temperatures and pleasant rainfall. The long wet season is from June to mid-September; it is the major winter season in the country. This period coincides with summer, but the temperatures are much lower than at other times of year because of the frequent rain and hail and the abundance of cloud cover and fewer hours of sunshine. This time of the year is characterized by dark, chilly and wet days and nights.

6.1.4 Soil and Geology

Though there are several soil types found in Ethiopia, the major soil types found are Nitosols, Vertisols, Cambisols, Acrisols, Luvisols, Lithosols, Aluvisols, Arenosols and Regolsols. In general, most of the soils are of good agricultural potential. However, soils on the highlands (such as Addis Ababa) of the country have been subjected to serious erosion due to human activities. Although there are different types of soils, expansive soils are predominant in Addis Ababa. These soils are either black or grey in colour with thicknesses ranging from a few centimetres to several meters. Soil map of Addis Ababa as well as field observation reveal that the site is dominantly covered with black cotton soil. The black cotton soil cover above the weathered rock is with an average of 0.8m thickness. The black cotton soil in the site is characterized by high plasticity and a high degree of swelling. The black cotton soil horizon is thin along the southern and western peripheries of the area around the project location where rocks are outcropped because of erosion.

6.1.5 Ambient Air Quality

The ambient air quality of Addis Ababa city is not regularly monitored. Thus, data on ambient air quality are scarce. However, few studies show the emergence of air pollution problem in the city. A study on the state of air pollution was conducted in 2012 by the Addis Ababa Institute of Technology by taking twelve traffic-congested sites in the City.

Measurements carried out as part of the baseline assessment for the present proposed NRL project at selected locations in EPHI and the project area indicated an environment free from carbon monoxide, ammonia and nitrogen oxide emissions (Table 5).

Table 5: Air quality at the proposed project site

O_2%	PID (ppm)	Particulates (µg/m^3)	Remark
20.9	1.2	25	Southwest corner of the sample collection area

6.1.6 Noise and Vibration

The major sources of noise in Addis Ababa city is a transportation and human activities. The most common form of noise pollution is from transportation, principally motor vehicles along the highway. EPHI is found near Swaziland Street and this Street is a major thoroughfare with multiple lanes of traffic going in both directions and a roundabout on the southwest corner of the EPHI campus, resulting in the most common form of noise pollution from traffic activities.

6.1.7 Water Resources

6.1.7.1 Surface Water Resources

The main surface water resources present in and around Addis Ababa are the Akaki Rivers which traverse the city from north eastern and northwestern parts of the city down to the southern plains culminating at Lake Aba-Samuel. The Gulele area is one among those which form the upper catchment and headwaters/springs for the Akaki River Basin. The catchment area of the Akaki River Basin is divided into two sub-catchment areas. These are the Great Akaki River (Eastern and Southeastern) sub-catchment and the Little Akaki river (Western and southwestern) sub-catchment. Within the Akaki river basin, there are several perennial rivers. The most important ones are Big Akaki, Little Akaki and Kebena. The NRL project area is situated within the upper catchment of the Akaki river basin. It is observed that the great and little Akaki are also the major carriers of wastes released into it and its small tributary streams. The wastes entering into the river systems include municipal and industrial wastes of solid and liquid nature. As a result, the rivers are observed to sustain continued water pollution as has been confirmed by numerous studies. The Akaki Rivers and its catchment belong to the Awash Basin. No streams are available near the project site that impacts the surface water. However poor waste management practices during operations and construction phases may result in polluted stormwater runoff during the rainy season and cause pollution.

6.1.7.2 Groundwater Resources

EPHI has its own borehole on the campus which is used as the main source of water supply during water interruption. The static water level of the borehole is 80 meters from the surface. The location site of the boreholes is beyond the minimum distance from existing contaminants such as the incinerator and liquid waste retention safety tank. It is found to the northwest of the EPHI Campus (x=0470396, y=1000274) and has a distance of about 300 meters from the incinerator and 250 meters from the liquid waste management facility. It has a reservoir tank in case of problems with the supply system. In addition, the campus gets a water supply from the city administration. The borehole is located away from sources of contamination and sighting a slope, so the risk of contamination is minimal.

6.2 Biodiversity of the Project Site

With regard to flora and fauna in the immediate zones surrounding the EPHI and the project area where the proposed NRL shall be built, one can hardly see any remnant of natural vegetation, in general, except for the few ornamental and common eucalyptus trees and fencing trees/shrubs. There is no recreational park or animal sanctuary around the project areas that could be impacted due to the implementation of the proposed NRL project. Being an urban core area, it couldn't provide a good habitat to support diverse wildlife species. As a result, there are no rare or endemic animal species known to be in the Project area.

6.2.1 Flora

Information about the state of biodiversity was collected through a reconnaissance survey, using checklists, and through interviews and discussions with the administration. A reconnaissance survey was made on the campus on Jun 02, 2022, to observe the overall vegetation found and particularly in the sites where the new BSL 3 NRL buildings will be constructed. The plants especially trees are planted in a well-structured manner on the campus and almost all tree species in the construction sites are exotic tree species that are planted mainly for ornamental purposes (Table 6). There are a total of seven species of plant that will be affected by the project activity.

The selected site has old buildings (Figure 5) that has been used for laboratory purpose for vaccine research and development and offices related to these activities. The offices will be deconstructed and around these buildings, there are few tree species. These trees will be destroyed during the construction process. However, other trees that are planted in line following the road will not be affected by the activities.

Figure 5: Plant biodiversity found within the project site (Photo Taken by the study team)

Table 6: Name and quantity of native plant biodiversity species in the project area (only affected by the project)

Sr no.	Name of plant	Local Name	Qty
1	*Podocarpus falcatus*	Zigba	11
2	*Dracaena fragrans*	Serte	2
3	*Acacia abyissinica*	Girar	3
4	*Enset edule*	Enset	1
5	*Juniperus procera*	Tsid	2
6	*Dovyalis caffra*	Koshim	2
7	*Vemonia amygdalina*	Girawa	16

6.2.2 Fauna

There is no recreational park or animal sanctuary around the project areas that could be impacted due to the implementation of the proposed BSL 3 NRL project at the EPHI Campus. Being an urban core area, it couldn‘t provide a good habitat to support diverse wildlife species. As a result, there are no rare or endemic animal species known to be affected in the Project area. However, as a research institute, EPHI has been using laboratory animals such as mice, Rabbits, guinea pigs and sheep for research purposes and has impacts on these animal biodiversities.

6.3 Socio-Economic Baselines

6.3.1 Population and Demographic Characteristics

Addis Ababa is the capital city of Ethiopia and it holds 527 square kilometres of area. It is also the largest city in the country by population, according to the 2007 population census, a total population of 2,739,551 inhabitants and 662,728 households were counted living in 628,984 housing units in Addis Ababa, which results in an average of 5.3 persons to a household. Gulele Sub city has a population of 267,381 out of which 48.35% are male and 51.65% female. Although all Ethiopian ethnic groups are represented in Addis Ababa, the largest groups include the Amhara (67.04%), Oromo (19.00%), Gurage (16.34%), Tigrayan (5.18%), Silt'e (2.94%), and Gamo (1.68%). Languages spoken include Amharic (71.0%), Oromiffa (10.7%), Gurage (8.37%), Tigrinya (3.60%), Silt'e (1.82%) and Gamo (1.03%). The religion with the most believers in Addis Ababa is Ethiopian Orthodox with 74.7% of the population, while 16.2% are Muslim, and 7.77% Protestant. (CSA 2010). The city has through recent years seen a strong annual growth rate, and population counts. In 2017 the population of the city is estimated at about 4 million. According to the Gulele Sub-city report, the population of Woreda 09 in 2014 comprises a male of 15,476 and a female of 17,217 with a population density of 165.60 (Table 7).

Table 7: Gulele Sub-city, Woreda 9 Population number in 2014 (Source: Gulele Sub-city Health office)

Population		**Population Density (population / Hectare)**	**Age (15-49) Female**	**Children's (Age<1**	**Children's (Age >5)**
Male	**Female**				
22,404	23,319	231.60	15.838	1022	3271
Total Population= 45,723					

6.3.2 Education

According to Gulele Sub-city Woreda 09 report, the Woreda has six private and three government kindergarten schools, nine private and five government primary schools, four private and one government secondary and preparatory school and two private colleges. There is not any data about the educational coverage of the Woreda.

Table 8: Educational Institutions in Woreda 9 (Source: Gulele sub city, Woreda 09 Education Bureau)

Level of Education	**No of schools**		**No of students**		**Total No of students**
	private	**Government**	**Male**	**Female**	
0 Class		2	17	23	40
KG	6	3	1432	1312	2744
Primary school	9	5	4733	5056	9789
Secondary and preparatory School	4	1	2939	3032	5971
College	2				

6.3.3 Healthcare Services

According to the FMOH health and health related indicators report (FMOH 2017/18), in Ethiopia, there are 338 hospitals owned by the government and 43 hospitals owned by private organizations and a total of 4063 government health Centres as well as 3867 private primary, medium and specialty clinics. In Addis Ababa, there are 12 government hospitals and 25 private NGO hospitals and a total of 98 health Centres and 980 primary, medium and specialty clinics owned by the private sector. Among the 12 hospitals, seven of its provide referral and advanced specialty services for all patients referred for advanced treatment and care from across the nation. Gulele Sub-city Woreda 09 has four medium private clinics, one private dental clinic, one government health centers, and one specialized government teaching hospital (Table 9). The top ten diseases occurred frequently in the woreda from leading to the least frequently occurred are acute upper respiratory infection, tonsilities, hypertension, Urinary truct infection, Dyspepsia, examination for driving license, Amoebiasis, other medical care, diarrhea and general medical examination.

Table 9: Health institutions in Woreda 9 (Source: Gulele sub-city, Health Bureau and FMHACA Office)

Name of Health Institution	**Owner**	**Specific Place of the Institution**
Kidus Lukas medium clinic	Private	Rufael
Meherafe Hulet medium clinic	Private	Paulos Medehaniyalem

Kidus Rufael medium clinic	Private	Rufael
Mamo and Dr. Kassahun medium clinic	Private	Medehaniyalem
Selam Health Center	Government	Paulos Medehaniyalem
Dr. Fetleworek Medium Dental Clinic	Private	Paulos Medehaniyalem
Yoko Medium Clinic	Private	Medehaniyalem
St. Paul's Hospital	Government	Next to EPHI

6.3.4 Economic Activities and Employment

Addis Ababa is home to 25% of the urban population in Ethiopia and is one of the fastest-growing cities in Africa. It is the growth engine for Ethiopia and a major pillar in the country's vision to become a middle-income, carbon-neutral, and resilient economy by 2025. Addis Ababa's economy is growing annually by 14%. The city alone currently contributes approximately 50% of the national GDP,highlighting its strategic role in the overall economic development of the country. The economy of Addis Ababa is dominated by the service sector, which contributed 75% of the city's GDP in 2014. The service sector is followed by the industry sector which accounted for 24.3 % of the GDP. Despite the strong economic growth trends, Addis Ababa faces significant development challenges. For example, unemployment and poverty levels in Addis Ababa remain high, estimated at 23.5% and 22% respectively. More than one in four households report an unemployed adult compared to one in 10 households in other urban areas, and the informal sector employs about 30% of the economically active labor force in the city (WBG, 2015).

6.3.5 Infrastructure

6.3.5.1 Water

Addis Ababa has not yet reached full coverage of water supply or sewerage, and also faces significant and growing water scarcity. It is estimated that only 44% of the population has access to clean water 23 and 30% has access to piped sewerage or vacuum truck service. Addis Ababa has two sources of water – surface and groundwater. Surface water comes from 3 dams that feed into 2 treatment plants such as Geffersa, Legedadi, and Dire Dams. They are in the east and northwest of the city and flow to the city with gravity. There are 3 primary well fields for groundwater extraction with a total of about 50-60 wells. They are in the southeast section of the city. Water is collected into tankers via gravity and treated, and then pumped to the city. The per capita distribution is estimated to be around 40 litres/day, well below the city's goal of 110 litres/day. Ababa Water and Sewerage Authority (AAWSA) is

currently supplying water to certain parts of the city on a rotating basis, with some areas receiving water only two days a week through distribution lines or water trucks.

The groundwater is from a volcanic aquifer, making recharge from retention ponds infeasible. In addition to the city water supply, EPHI has been using the groundwater and has a reservoir tank in case of problems with the supply system; the institute can still get access to water. It is expected that the development project will use its borehole source as it will have an impact on the water supply of the city administration.

6.3.5.2 Electricity

Ethiopia has set a target to achieve universal access to electricity by 2025. Power generation for the electric grid currently depends almost entirely on hydropower. In Addis Ababa, about 87 percent of the population have access to electricity mainly for household lighting and for industries. However, the majority of the Addis population still relies on biomass fuel for cooking and heating (Mondal *et al.*, 2015). There is no available data for electric access to the Woreda. EPHI uses an electric source from the national grid and a diesel generator is used for laboratories and other facilities during power interruptions.

6.3.5.3 Transport and Roads Infrastructure

Addis Ababa City has both international and local transport links which include the Bole International Air Port, the Ethio-Djibouti Railway and the road network. The Airport is within the city in a south-easterly direction outside the ring road. It is easily accessible by car or taxi and buses run nearby. Addis Ababa has adequate roadway connections with most of the regional states and different parts of the country. The national network is being improved under the Road Sector development program (RSDP) according to the city development Plan report. Because of inadequate planning, there is a critical lack of a hierarchical system in the road network. Moreover, there are bottlenecks of narrow bridges, poorly designed intersections, and alignments. Public transport facilities are inadequate. With linear developments adjacent to the arterial road network, there is no form of access control. On-street parking and inadequate traffic management are significant factors which limit the capacity of the existing network (Minalu, 2018).

According to the Addis Ababa traffic Management agency, the road access from Pastor to Winget is divided by three paths and each path is divided into two equal parts. However, highway traffic is registered from 6:30 AM to 10:00 Am from Asko to Piasa and high traffic has registered from 4:00 to 8:00 PM from Piasa to Asko. Based on this, there is a restriction

on the use of the middle path for vehicles that move from Piasa to Asko from 6:00 AM to 1:00 PM and from 1:00 PM to 8:00 PM for vehicles that move from Piasa to Asko. There is also a restriction on the movement of vehicles greater than 3.5 tons from 7:00 AM to 10:00 AM and 3:00 to 8:00 PM on this road.

6.3.5.4 Archeological Artefacts and Tourism Sites

Addis Ababa is a big, sprawling city and has numerous tourism resources. The tourist attraction in Addis Ababa are classified under (1) Historical buildings, (2) Parks, (3) Monuments, (4) Museum, (5) Center of theatres, (6) caves, (7) churches, (8) Mosques, (9) Market and shopping center, (10) natural tourist attractions and (11) events. In terms of ownership, they are owned by the government, religious institutions and privately.

In Gulele Sub-city Woreda 09, there are seven registered historical buildings including Dr. Thomas Lambie buildings at EPHI (Table 10). The all-stone building which is gracefully landing on the spacious campus of EPHI was built in 1930 by an American missionary named Dr. Thomas Lambie. It originally housed four doctors and five nurses and served as a hospital (George Memorial Hospital) to society. This building is formally recognized for its heritage value by Addis Ababa city administrations. In 1952 the Imperial Ethiopian government agreed with the institute Pasteur D'Paris which lead to the establishment of the Institute of Microbiology with the name Institute Pasteur d'Ethiopie, this name is still used by society. Currently, the building has been used as administrative, laboratory service and store for chemicals and lab reagents.

Table 10: Historical Buildings found in Gulele sub-city Woreda 09 (Source: Gulele sub-city cultural and tourism office)

Sr No	Name of heritage	Specific place	Owner
1	Medhaniyalem School	Gulele	A.A University
3	Muse Fasika primary school	Gulele	No 2 primary school
3	Dr. Tomas Lambe	Paul's Medhaniyalem	EPHI
4	Shae Hojele	Rufael	Gulele Sub-city, Woreda 9 house development office
5	Radio communication and ICT Division	Gulele,W-9	Federal Police
6	Belata Heruye Wolde	8th police station	Ethiopian Science Academy

	Selasie House		
7	Tserha Areyam Kidus Rufael Church	Rufael	Ethiopian Orthodox Tewahedo Church

Figure 6: Dr. Tomas Lambe Building within the EPHI campus

6.3.5.5 Solid Waste Management Facilities

The Addis Ababa City Administration, UNDP MDG Carbon and UNDP Ethiopia Country Office worked together to support the development of the Repi Landfill Gas Clean Development Mechanism (CDM) Project under the United Nations Framework Convention on Climate Change (UNFCCC). This project is responsible to convert non-hazardous solid waste generated in the city to power energy. It is close to the existing landfill which introduces better management practices of municipal solid waste in Addis Ababa.

According to the Repi landfill office report, the landfill has a total area is 19.2 hectares and is located in Addis Ababa, part of Nifas Silk Sub-City, Woreda 02 (right) and most of the landfills in Kolfe Keranyo Sub-City, Woreda 01 (left). The Repi landfill is supported by synergetic technology called Repi Waste to energy Power plant.

The Repi waste to energy power plant located beside the landfill consumes about 1,200 tons of solid waste per day with net energy production of 25 MW. Wastes that are not suitable for incineration are dumped in the landfill..

The landfill can receive non-hazardous waste including packaging, clean glass and plastic, paper and cardboard, and office products, kitchen wastes and non-contaminated containers from the project. Hazardous and contaminated solid wastes need to be incinerated onsite the reduced volume of medical waste and landfills in a secured area to avoid ground and surface

water pollution. Repi landfill cannot accommodate sludge and ashes from medical wastes and need to construct a secured landfill for the disposal of ashes.

The Repi landfill has faced a landslides which were damaged some of the leachate ponds, currently, The Addis Ababa city Government is working to rehabilitation of this dumpsite, to avoid additional incidents or additional risk to the surrounding community and increase the landfill life span. Activates like terracing for land slide management, landfill emission reduction, gas venting, and leachate collection are being implemented. The city Government also put in financial support and then in-kind support to supplement the process. The project has tried to rehabilitate the landfill using the 'Fukuoka Method' The project repaired facility and prevented further erosion and landslides in the surrounding settlements. The 'Fukuoka Method' is a sustainable landfill and solid waste management system developed in Japan by Professor Yasushi Matsufuji of Fukuoka University. "It is a semi-aerobic landfill concept. Semi-aerobic is changing from anaerobic to aerobic conditions. It is very useful to accelerate decomposition and to reduce methane gas."

The facility has also applied is the gas venting pipe system that reduces the heat inside the decomposing waste.Having this vertical pipe creates an updraft, an automatic air movement. By this it can take in more oxygen into the landfill body, and can increase aerobic decomposition which can significanctly reduce amount of methane produced. In order to decrease the emission of carbon dioxide to the environment, "phytocapping" is implemented around the landfill which would offer an additional and economical way of reducing methane emission from landfills.

The fly and bottom ash collected from the power plant is managed by using it for access road construction and as daily waste cell cover within the facility. Leachate collection is also developed for the site by facilitating the drainage system. The collected leachate is treated by evapo-transmission in the pond. They are also planning to construct a central composting and working to improve the capacity of waste to energy plant to generate more energy from the solid waste.

The Addis Ababa City Sanitation Agency has demonstrated commendable efforts and has extensive plans to maintain and enhance waste disposal site due diligence. As per the Agency report, the Repi landfill will start the new upgrading project by the end of 2023, and upon completion, is expected to meet both national and international Environmental Health and

Safety standards for a landfill. . After the waste is dumped, it is carefully arranged in a sloppy way so that it does not pose a risk of collapse. .

Figure 7: Repi landfill (left) and Power plan (right) (Photo taken by study team)

6.3.5.6 Municipal Waste Management Facility

Sewage disposal is the responsibility of the Addis Ababa Water Supply and Sewerage Authority (AAWSSA). It operates with seventeen wastewater treatment plants. The main ones are Kality and Kotebe and in twelve condominium areas. The available liquid waste management facility can't receive clinical and infectious wastes from the project. The Kality wastewater treatment plant has a capacity of 100,000 m^3/day and it receives about 74,600 m^3/day of municipal wastewater. The treatment plant can also receive municipal waste from the project either through a vacuum truck or by connecting to the swear line is available to that catchment area.

a) Kality Wastewater Treatment Plant

The Kality wastewater treatment plant has recently upgraded to a capacity of 100,000 m^3/day in 2018 with the support of the World Bank Group. Currently, it receives about 74,600 m^3/day of municipal wastewater from all Sub-cities of Addis Ababa through sewer lines except Bole, Yeka and Lemi Kura. According to Addis Ababa Water and Sewerage Authority, there is a sewer line in the proximity of EPHI which is designed to convey the wastewater to the Kality wastewater treatment plant. However, the line is not connected to EPHI sanitary facility yet.

The treatment plant uses Up-flow anaerobic sludge blanket (*UASB*) and Trickling Filter (TF) technology for the treatment of the wastewater. In this technology, wastewater enters at the bottom of the reactor and flows upwards through a so-called “sludge blanket”, consisting of a granular sludge bed. UASB configuration enables an extremely efficient mixing between the biomass and the wastewater, leading to rapid anaerobic decomposition. The operation of a UASB reactor fundamentally revolves around its granular sludge bed that gets expanded as the wastewater is made to flow vertically upwards through it. The microflora attached to the sludge particles removes the pollutants contained in wastewater, thus biofilm quality and the intimacy of sludge-wastewater contact are among the key factors governing UASB reactor success. The generated biogas facilitates the mixing and the contact between sludge and wastewater, and the three phase gas-liquid-solid separator, located in the upper part of the reactor, allows for extracting biogas, separating it from liquid effluent and residual sludge particles. Two year plant data (2021 and 2022) shows that the plant has overall efficiency of 97.47%, 89.39%, 94.18%, and 95.64% for BOD5, COD, TSS, and VSS, respectively (Table 11). The effluent quality conforms to the national and international standards. The design of the wastewater treatment plant ensures the necessary sewage treatment so that the final effluents can be used for unrestricted irrigation purposes, and disposal to the environment. Also, the sludge produced is widely being utilized for urban agricultural activities.

Figure 8: Kaliti Wastewater treatment plant (Photo taken by the study team

It has also a solar sludge drying plant (the latrine water station). The plant has been receiving an average of about 1,500 cubic metres of liquid waste every day from toilets by Vacuum trucks. It consists of different parallel ponds. The dewatered sludge has stored within the site (Figure 9).

Figure 9: Solar sludge drying plant in Kality Wastewater treatment plant

The Kality wastewater treatment plant, which operates below its design capacity, can accept an additional 25,400 m3/day of domestic wastewater. As it was constructed with the support of the World Bank Group, the plant adheres to national and World Bank EHS standards, including treated effluent quality, occupational health and safety, storm water management, and monitoring. It also implements an Environmental and Social Management Plan (ESMP), overseen by the World Bank Group biannually.

The plant is managed by CGGC, a contractor required to comply with standard effluent quality for service payment. Influent and effluent, as well as sludge, are monitored daily by the operating company. It is environmentally and socially friendly. The plant uses only two chemicals: sodium hypochlorite and sodium metabisulfite for chlorination and dechlorination, respectively. As it has adopted a more natural approach, the plant has minimized its environmental impact.

Furthermore, the wastewater treatment plant administration has established a grievance redress mechanism (GRM), providing an effective system for handling complaints and grievances.

Table 11: The Kality Wastewater Treatment Plant Effluent Quality (Source: Kality Wastwater Treatment Plant Administration Unit,, June/2023)

Parameters		Year					
		2021			2022		
		Influent	Effluent	Plant Efficiency	Influent	Effluent	Plant Efficiency
BOD	Y-Average	368.33	9.51	97.38	379.15	8.99	97.56
	Y-Min	208.67	5.75	96.85	245.58	5.00	97.73
	Y-Max	541.67	13.83	97.45	580.00	14.83	97.39
COD	Y-Average	621.05	63.77	89.37	641.85	62.25	89.40
	Y-Min	355.55	47.58	85.63	416.25	45.08	86.92
	Y-Max	900.08	70.81	91.88	1005.92	80.83	91.06
TSS	Y-Average	285.32	18.37	93.55	312.59	15.14	94.81
	Y-Min	146.36	9.17	93.06	174.67	9.92	93.31
	Y-Max	480.75	53.33	88.96	565.17	23.33	95.57
VSS	Y-Average	227.87	8.99	95.73	230.24	9.52	95.55
	Y-Min	96.06	5.25	93.89	117.42	6.33	93.04
	Y-Max	394.14	14.33	95.96	441.33	14.42	96.37
pH	Y-Average	7.51	7.60		7.27	7.41	
	Y-Min	7.11	7.17		6.95	7.07	
	Y-Max	7.89	7.96		7.64	7.78	

b) Kotebe Wastewater Treatment Plant

The Kotebe Wastewater Treatment Plant (KWWTP) is found in Bole Sub-city, Woreda 11 at the Eastern Catchment at a Longitude of 38° 51‘06.76‘‘E and Latitude 8° 58‘28.71‘‘N. The catchment is situated in the North East of Addis Ababa. It has an approximate size of 9450 ha. The treatment plant is a Waste Stabilization Pond (WSP) comprised of two anaerobic, three facultative, and two maturation ponds configured in parallel. It is a shallow basin in which raw sewage is treated entirely by natural processes involving both algae and bacteria.

The anaerobic ponds are a six meter depth and receive wastewater with high organic loads from Yeka Abado, Tafo and Ayat Condominium. It has an installed capacity of 4000 m^3/day and currently receives 20,000 m^3/day of sewage (Figure 10). It requires maintenance as the

wastes from the inlet are contaminated with the treated effluent at the outlets. Currently, it receives wastes which are five times from its installed capacity and there is no way to receive waste from the project.

Even if the facility doesn't receive clinical wastes from any health facility, it is not the preferred treatment option for liquid waste generated from clinical laboratories. The Waste stabilization pond is less efficient in cold climates and may require longer detention times in these areas. In addition, it is not very effective at removing heavy metals from wastewater. The effluent also requires additional treatment to meet the discharge standards of the country.

Figure 10: Kotebe Waste Stabilization Pond (Facultative and Maturation ponds)

The waste stabilization pond has also a solar sludge drying plant (the latrine water station). The plant has been receiving an average of about 1,450 cubic metres of liquid waste every day from toilets by Vacuum trucks. It consists of different parallel ponds. The sludge removed from the station is disposed of within the plant and needs to be characterized for further use (Figure 11).

Figure 11: Kotebe wastewater treatment station solar sludge drying plant (left) and sludge accumulated (right) within the site

Kotebe Wastewater Treatment Plant does not have the additional capacity to receive municipal wastes from the project as it is operating above its installed capacity (five times). The plant is not properly maintained and the effluent from the inlet is mixed with outlets before treatment. Officially, the plant didn't receive any clinical wastes from the health facility and this plant is not the treatment choice for both clinical and municipal wastes from the project.

6.3.5.7 Storm Water Drainage

There is an onsite storm water system for the existing infrastructure. During the construction of the new building, the contractor should apply prevention and mitigation measures for flood. These include the construction of elevated structures to limit the stormwater within the project site, the highway road to the south, construction of floodwalls, floodgates, levees, and evacuation routes.

In addition, there will be the construction of a drainage system by carrying out preliminary calculations to determine the quantity of runoff from the site. For the preliminary calculations, it has been assumed that the entire development site will be impermeable, whether through building development or hard landscape areas and roads.

7 DESCRIPTIONS OF PROJECT

7.1 The Nature of the Project

The proposed BSL 3 National Reference Laboratory (NRL) building complex would be designed to lie on 1,700m^2 area. In conformity with the city master plan, the proposed NRL building will be a 7-story building (G+6) that fulfills the minimum requirements for the height of buildings in the designated area. The G+6 NRL building will have a total gross floor area of 12,000m^2, consisting of 8000m^2 Laboratory spaces and 4,000 m^2 of Laboratory Office spaces, including related support spaces. The proposed NRL building would be divided into two main blocks with a connecting section. A large block accommodates the main laboratory spaces and the second and smaller block accommodates Laboratory Offices. The central connecting section houses common facilities like stairs, elevators, toilets, small conference rooms and a pantry. All blocks are connected on every floor. Shared Common Equipment rooms will be provided on each laboratory floor to facilitate the efficient use of shared or infrequently used equipment. All Main Laboratory and Laboratory Office Spaces are arranged along a double-loaded corridor. All Laboratory traffic is separated from the general traffic, allowing Laboratory professionals to travel back and forth between Main laboratory spaces and Laboratory Support spaces without having to cross public areas.

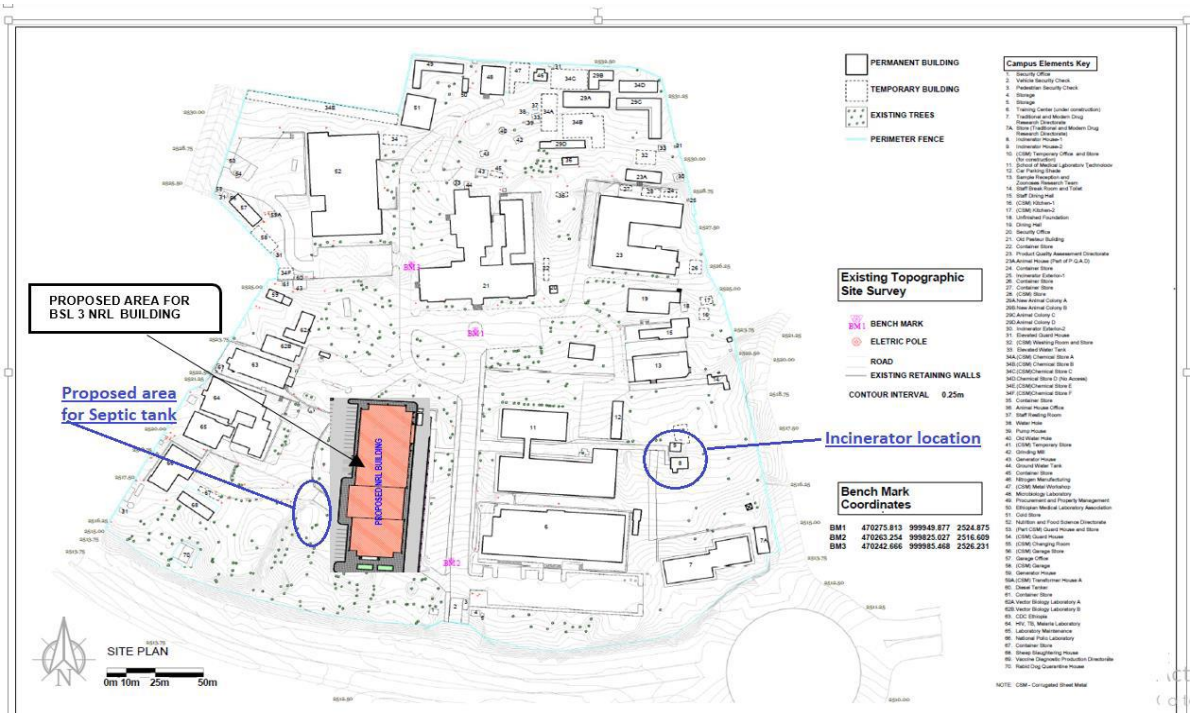


Figure 12: Site Map Showing the Location of the BSL-3 NRL Complex and Associated Facilities at EPHI

The design and shape of the NRL building have taken into consideration the maximum and minimum widths of typical laboratory and office spaces as well as the surrounding access roads and parking. The Design of the NRL would also allow for inline, continuous expansion of Laboratory, Laboratory Office Space and BSL-3 spaces. Provisions for parking, sidewalk access, roadway access as well as green area allocation were carefully considered in the design.

The Parking area for the proposed project is proposed to be in front of the NRL building, on the South side facing the main road, with direct access from the central axis. This double-sided parking area will act as a buffer zone from the noisy street. The main entrance of the NRL is proposed to be on the southeast corner of the building. The delivery and service access of the proposed NRL building is recommended to be on the northwest corner of the building, facing north. This location will place on the opposite side of the NRL building's main entrance, which will help to separate the two functions.

The NRL building will consist of BSL 3 laboratory suite, General Laboratory support facilities, Proficiency Testing Panel Production Centre (PTPC), Biobank Centre, Central Warehouse and a laboratory medical equipment maintenance Centre. The design of these facilities has based in part on the types of work that will occur in each Laboratory and the inherent risks associated with that work. The design of the laboratories has followed the principles of biosafety and biosecurity.

BSL-3 Laboratory: Pathogens worked within this laboratory have high individual risk and generally low community risk. Generally, they are pathogens that can cause serious human or animal disease but do not ordinarily spread from one infected individual to another. All work is performed in bio-contained environments using appropriate engineering controls.

Facility design criteria/requirements generally included in the proposed NRL project consist of:

- A method for decontaminating all laboratory waste would be available within the facility,
- Access to the laboratory is through two self-closing doors. A clothing change room ante-room will be included in the passageway between the two self-closing doors,
- All windows in the laboratory will be sealed,
- An eye wash station shall be readily available or centrally located in the corridors
- Bench tops would be impervious to water, resistant to heat and any chemicals that may be used in the laboratory,

- Biological Safety Cabinets (BSC) would be installed so fluctuations of room air supply and exhaust do not interfere with proper operations,
- Laboratory will be separated from areas that are open to unrestricted traffic flow within the building. Laboratory access is restricted,
- Lockable self-closing doors with windows for viewing the occupants,
- Showers will be installed to be used when zoonotic risk group 3 pathogens are being used,
- Single-pass inward directional airflow is recommended,
- Sinks for hand washing would be available,
- Spaces around the doors and ventilation openings should be capable of being sealed to facilitate space decontamination,
- Walls would be constructed to produce a sealed smooth finish that can be easily cleaned and decontaminated. Ceilings would be constructed sealed and finished in the same general manner as walls.

A ducted ventilation system that provides sustained directional airflow by drawing air into the laboratory from clean areas toward potentially contaminated areas.

Proficiency Testing Panel Production Centre (PTPC): The PTPC will produce PT samples for Microbiology, Hematology, Parasitology, HIV Viral Load, HIV Early Infant Diagnosis (EID), serological tests, biochemistry, blood transfusion, immunological tests, mycology, and other samples. The PTPC will characterize samples, store them, and transport and distribute them to BSL 2 laboratories as well as prepare a report and provide feedback to participant laboratories. The agents used in the PTPC have moderate individual risk and low community risk. It is usually a pathogen that can cause human or animal disease but is unlikely to be a serious hazard to laboratory workers, the community, livestock or the environment. The exposures may cause serious infection, but effective treatment and preventative measures are available and the risk of spread of infection is limited. Processes that include the generation of aerosols should be conducted in primary containment such as biological safety cabinets. The PTPC is generally designed like a BSL 2 laboratory is recommended by CDC's BMBL recommended design criteria for BSL-2 laboratories. The PTPC benches and other furniture will be installed based on the design layout. The floors, walls and working services would be designed to withstand accidental spills of the chemicals used in the laboratory. Floors would be covered up with walls and cabinets to ensure spills cannot penetrate underneath floors/cabinets.

PTPC facility design criteria/requirements generally included in the proposed NRL project consist of:

- Lockable self-closing doors with windows for viewing the occupants.
- Sinks for hand washing would be available,
- The Centre is designed so that it can be easily cleaned. Walls would be painted with washable, hard non-porous paints,
- Bench tops would be impervious to water, resistant to heat and any chemicals that may be used in the laboratory,
- A method for decontaminating all laboratory waste would be available within the facility
- An eye wash station shall be readily available or centrally located in the corridors,
- Single-pass inward directional airflow is recommended,
- A method for decontaminating all laboratory waste would be available within the facility,
- An eye wash station shall be readily available or centrally located in the corridors,
- Furniture would be able to support anticipated loads and uses. Bench tops would be impervious to water, and resistant to heat and any chemicals that may be used in the laboratory.

Bio bank Centre: EPHI critically needs to establish a bio bank that meets international standard. The planned bio bank stores leftover specimens with full information collected from health facilities. The bio bank infrastructure and storage system depend on the type of material being stored, the required storage conditions, the anticipated period of storage, and the intended use of the materials, and the storage system is fundamental to maintaining high sample quality. The data and databases related to bio specimen annotation, quality, storage location, and use, are important attributes of bio bank infrastructure. Bio specimen storage infrastructure will have two types of storage systems used for bio specimen storage: ultra-low-temperature (or low-temperature) storage systems and ambient-temperature storage systems. “Ultra-low temperature” can be defined as temperatures below −80 °C (e.g. LN2), and “low temperature” as temperatures between 0 °C and −80 °C.

Liquid nitrogen storage: Liquid nitrogen (LN2) facilities contain LN2 in liquid-phase tanks and vapour-phase containers. Cryogenic storage using LN2 is an effective long-term storage system because its extreme ultra-low temperatures slow down most biological, chemical, and physical reactions that may cause biospecimens to deteriorate.

Mechanical freezers storage: Mechanical freezers are used for a variety of storage systems with temperatures ranging from low temperature to ultra-low-temperature conditions, including −20 −40 °C, −70 °C to −80 °C, and −150 °C, and come in a wide range of sizes and configurations.

Refrigerators: Refrigerators would be used for samples that can be maintained at ambient temperature. However, the longevity of biospecimens being stored is enhanced if they are stored below ambient temperature, due to biomolecular degradation that can occur at high ambient temperatures.

Ambient-temperature storage: the other method for to be used in a biobank is a specific biological storage matrix that would be used for long-term maintenance of some biological components at room temperature. Formalin-, PAXgene-, or ethanol-fixed, paraffin-embedded tissues and lyophilized samples can be stored at ambient temperatures. Dried samples, such as blood spots on filter paper, can be stored at ambient temperature. The benches and other furniture will be installed based on the design layout. The floors, walls and working services would be designed to withstand accidental spills of the chemicals used in the biobank. Floors would be covered up with walls and cabinets to ensure spills cannot penetrate underneath floors/cabinets. Facility design criteria/requirements for biobank generally included in the proposed NRL project consist of:

- Lockable self-closing doors with windows for viewing the occupants,
- Sinks for hand washing would be available,
- The biobank is designed so that it can be easily cleaned. Walls would be painted with washable, hard non-porous paints,
- Bench tops would be impervious to water, resistant to heat and any chemicals that may be used in the laboratory,
- Single-pass inward directional airflow is recommended,
- Lockable self-closing doors with windows for viewing the occupants,
- Sinks for hand washing would be available,
- Finishes and surfaces that can be easily cleaned and will not harbour potential contamination if spills were to occur like carpet and cloth,
- Spaces between benches, freezer/refrigerators, and equipment would be accessible for cleaning.

Central Warehouse: The warehouse is an auxiliary facility which will be part of the BSL 3 laboratory. Its main utility is to provide and maintain sustainable supply and storage of reagents, chemicals and consumables bound to activities of the BSL 3 laboratory. The furniture will be installed based on the design layout. The floors, walls and working services would be designed to withstand accidental spills of the chemicals stored. An emergency shower, an eye wash station, a fire alarm, and other security devices would be readily available and centrally located in the corridors. Spaces between shelve, tables benches, freezer/refrigerators, and equipment would be accessible for cleaning. All building materials would be chemical resistant, especially toward the stored chemicals. In particular, the flooring will be damp- and chemical-proof. Moreover, to avoid contact with hazardous substances all surfaces would be easy to clean. At the same time, a skid-proof flooring will prevent occupational accidents due to falls. Storage facilities would also preferably be constructed of non-combustible materials to avoid dissemination of hazardous chemicals, should a fire threaten the storage facility.

The central warehouse is allowed only to authorized personnel. Therefore, constructive arrangements would be made to control access. Furthermore, access to the facility and its alleyways will be large enough and designed according to the activities carried out (use of handling equipment, for instance). In case of emergency, the rescue teams would also be able to access the storage facility quickly. Thus, stairs and steps close to the entrance of the facility would be avoided. There would be emergency exits on the facility size and configuration. Escape doors would be designed in such a way that they open to the outside and that they would be opened easily from the inside without the use of any key. An eye wash station, first aid kits fire alarm, and other security devices would be readily available and centrally located in the corridors.

Laboratory medical equipment maintenance Centre: equipment maintenance Centre is an auxiliary facility which will be part of the BSL 3 laboratory. Its main utility is to provide maintenance and calibration services for BSL 3 laboratory medical equipment and NRL for sustainable laboratory services without interruption of the services. The floors, walls and working services would be designed to withstand accidental spills of the chemicals stored and well ventilation. Spaces between shelve, tables benches, maintenance and calibration equipment, and equipment would be accessible for maintenance and cleaning. Enough space for storage of spare parts and tools. An eye wash station, first aid kits fire alarm, and other security devices would be readily available and centrally located in the corridors.

An access to the facility and its alleyways will be large enough and designed according to the activities carried out (use of handling equipment, for instance). In case of emergency, the rescue teams would also be able to access the storage facility quickly. Thus, stairs and steps close to the entrance of the facility would be avoided. There would be emergency exits on the facility size and configuration. Escape doors would be designed in such a way that they open to the outside and that they would be opened easily from the inside without the use of any key.

7.2 Design Requirement of the proposed BSL 3 Laboratory and operation Specifications

The BSL-3 laboratory which is going to be built at EPHI would be designed and operated following guidance for BSL-3 laboratories established by reputable international organizations (CDC 1999, NIH 2001, WHO 2004). The laboratory will be tested for verification that the design and operational parameters have been met before operation. Annual verification of BSL-3 laboratory is recommended by the WHO biosafety manual and CDC BMBL.

7.2.1 General Design and Safety Requirements for the BSL3 Lab

The BSL3 laboratory will consist of an **anteroom** and laboratory rooms. It will have gas-impermeable walls, ceilings and floors. Air gaps under doors would be acceptable for directional airflow. If door gaps are sealed, the laboratory must not leak gaseous decontamination materials. The BSL3 laboratory will be designed for ease of maintenance, so that access to critical mechanical equipment (ventilation ducts, fans, piping, etc.) is outside containment. The laboratory will consist of high-quality room construction with special consideration given to joints, finishes and penetrations. There will be a room for large equipment decontamination.

The room will be capable of being sealed for decontamination with gaseous paraformaldehyde and must have a connection to the HVAC exhaust system. All shutoffs (steam, water, natural gas) will be external to containment. All tall and/or heavy fixtures and equipment (e.g. biological safety cabinets, autoclaves, freezers, incubators, etc.) will be fitted with a seismic anchoring system/device engineered to withstand earthquake stresses equal to 7.0 on the Richter scale. Work surfaces, floors, walls and ceilings will be designed, constructed and finished to facilitate easy cleaning and decontamination. The laboratory will be located away from public areas and corridors used by laboratory personnel who do not

work in the BSL-3 laboratory. The BSL3 must pass third-party inspection and tests to verify that design and operational parameters have been met.

7.2.2 Anteroom Specifications

The anteroom of the lab will have two doors to access the laboratory. Anteroom doors will be interlocked or alarmed, so only one door may be opened at a time or placed sufficiently apart so that one person cannot open both doors at the same time. Air gaps under doors would be acceptable for directional airflow, i.e., doors are perpendicular to each other and the anteroom is of sufficient size. A manual override would be provided for emergency exit. The anteroom will have ventilation separate from the laboratory to maintain the containment envelope in the event of a ventilation failure. The anteroom will be large enough to provide storage for clean gowns, laboratory coats, or uniforms that must be donned before entry and removed before leaving the suite. It also provides space for a log book, a wall calendar, and a laundry hamper. The anteroom will have communication capabilities installed. Biohazard warning symbol, list of personnel authorized, and access rules will be posted on or near the door that can be easily noticeable.

7.2.3 Specifications for Floors, Walls and Ceilings

The BSL-3 lab at EPHI will be constructed using concrete footing and stem walls with concrete slab-on-grade floors. Walls would be steel stud framed and roof construction would consist of metal decking over steel bar joists. The exterior walls would have an application of stucco and the painting of the building would be visually consistent with surrounding structures.

The lab floors will be impermeable to liquids, monolithic/seamless, or have welded seams. Floors must be easily cleaned, with chemical-resistant flooring (vinyl, or epoxy with fiberglass reinforcement) with a slip-resistant, smooth, hard finish. For monolithic floors, either a 100-mm-high, readily cleanable, integrally coved sheet flooring base, or a readily cleanable, 100-mm-high, vinyl or rubber base should be used. For epoxy floors, if silicone sealants are used for penetrations, the silicone must be applied after the epoxy has been installed. Floors would be monolithic and slip-resistant.

The walls of the lab must be durable, washable and resistant to detergents/disinfectants (masonry, gypsum board, fiberglass-reinforced plastic, etc.). Walls will also be painted with durable glossy acrylic or epoxy paint. For epoxy paint, if silicone sealants are used for penetrations, the silicone must be applied after the epoxy has been installed. Wall/ceiling

penetrations will be kept to a minimum and sealed with non-rigid, non-shrinking silicone or latex sealant. For fire-rated walls, sealant will be applied before stopping.

The ceiling of the BSL3 lab must be washable and resistant to detergents/disinfectants. The ceiling has to be painted with durable glossy acrylic or epoxy paint. If silicone sealants are used, the silicone will be applied after the epoxy. The ceiling must be of monolithic construction (i.e., gypsum board, not removable tiles). The ceiling must be high enough over Class II A2 biological safety cabinets (BSCs) to allow a canopy/thimble connection or the opening of the canopy/thimble door(s). The ceiling height would be at least 10 feet to allow 14 inches of clearance above BSCs. All penetrations in floors, walls and ceiling surfaces would be sealed, or capable of being sealed to facilitate disinfection, to aid in maintaining appropriate ventilation system air pressures and to keep pests out.

7.2.3.1 Doors

Lab doors to be installed for this lab would be self-closing and lockable. Doors need to be open inward slide open. If sliders are used, they must be made of safety glass and a trackless design should be considered. The door between the anteroom and the corridor must have a door sweep for pest control. Door openings should be sized to allow the passage of large equipment. Wall-door frame connection would be made airtight at the time of frame installation. Doors and frames will be of solid finish construction, with the required fire ratings and include panic hardware, hardware appropriate for high-use and kick plates. Doors would be coated metal which is chemical resistant. Methods for restricting access to only those individuals with demonstrated need, proper clearance, and training must be in place. Notices will be posted outside the first door to notify potential entrants of the hazards contained within and the measures they must take to protect themselves.

7.2.3.2 Windows

Windows (safety glass, permanently closed, sealed with silicone or latex sealant) would be installed so that the interior of the adjacent room, except change rooms and restrooms, is visible. Windows must not allow viewing from public areas. Interior sills will be sloped away from windows for ease of cleaning or to minimize dust collection.

7.2.4 Eyewash/Safety Shower

Emergency eyewash will be in each BSL-3 room. A combination emergency eyewash/safety shower unit must be near places if personnel is exposed to splash hazards (determined during

programming). Emergency eyewash and emergency eyewash/safety shower units would be sited and installed.

7.2.5 Plumbing

All penetrations must be perpendicular to the surface and must be sealed to be gas-tight. Penetrations must also be sealed with non-rigid, non-shrinking, silicone or latex sealant. For fire-rated walls, sealant will be applied before stopping. All pipes in the BSL-3 laboratories would be secured to prevent movement. Fixtures must be resistant to the corrosion of bleach and other disinfectants. Back-flow prevention devices will be installed on all faucets (including industrial water). All pipes will be identified by using labels and tags. Water supply control will be located outside the containment area. Plumbing should discharge directly to a sanitary sewer.

7.2.6 Sinks

Hand-washing sinks in the lab will be available in each room near exits. Sinks will be hands-free. Infrared sensors are preferable but may not be suitable for all laboratories. In cases where infrared sensors cannot be used, knee-operated sinks are preferable to foot-operated. Each sink will have chemical-resistant traps (for disinfectants), a coved backsplash, hot-cold water and a pre-mixing faucet. The hand washing sink will be accompanied by a paper-towel dispenser and a hands-free soap dispenser mounted within easy reach.

7.2.7 Autoclave

An autoclave in the lab will be equipped with interlocked doors. Decontamination cycles would be determined during programming; gravity and liquid cycles are typical. Appropriate autoclave size should be determined prior to purchase. The body of the autoclave will be located outside the containment to provide easy access for maintenance. Enough space adjacent to the contaminated (input) door must be present for waste collection. Control panels should be located internally and externally for containment. Bioseals or other equivalent means would be used to create a seal on the wall. The floor under the autoclave would be monolithic, seamless, or heat-sealed, coved and water-tight. Floor penetrations, if essential, would have water and gas-tight seal at the monolithic floor. The walls and hard ceilings will have epoxy paint. Exposed pipes would be insulated. The autoclave should be seismically anchored. A curbed corrosion-resistant basin would be installed to prevent leakage. A canopy hood will be provided over the exit door of the autoclave to contain heat and steam. The

installation will be signed off by a professional engineer. The autoclave room must have a minimum of 10 air changes per hour.

7.2.8 Fire Safety and Alarms

Fire alarms must be audible above ambient noise. A wall-mounted ABC Dry Chemical fire extinguisher must be mounted near the exit door of the anteroom. Laboratory-safe refrigerators or metal flammable cabinets will be used to store flammable/combustible materials. Alarms are provided for: fire hazards, ventilation failure, differential pressures below 0.05” wg, -80°C ultra-cold freezers and intrusion detection systems. Alarms will be connected to the building control system and to the campus public safety department. Alarms should be audible and visible throughout the laboratory. Alarms would be differentiated from each other so that each can be easily identified. Alarms will be on UPS power.

7.2.9 Vacuum System/Pump

Vacuum lines will be protected with liquid disinfectant traps and HEPA filters, or their equivalent. Filters will be replaced as needed. An alternative is to use portable vacuum pumps (also properly protected with traps and HEPA filters). If an individual vacuum pump is used, it would be located in the laboratory. Noise and maintenance issues would also be addressed.

7.2.10 Electrical Requirements

In this BSL3 lab, emergency power will be provided for HVAC (including controls), alarms, emergency lighting, biological safety cabinets, storage freezers and incubators. UPS power would be provided to alarms, and when possible, to biological safety cabinets. An independent circuit would be provided for each biological safety cabinet. Wall/ceiling penetrations would be kept to a minimum and will be sealed with non-rigid, non-shrinking silicone or latex sealant. For fire-rated walls, sealant will be applied before stopping. Junction boxes would be cast and/or sealed airtight (e.g. closed cell foam compatible with gaseous paraformaldehyde). Light fixtures are surface or pendent-mounted. Circuit breakers will be located outside containment and are labeled.

7.2.11 Heating, Ventilation and Air Conditioning (HVAC) System Requirements

The HVAC system would be Constant Air Volume (CAV). Variable Air Volume (VAV) is not recommended. Electronic direct digital controls are used to manage the system. Recirculation of exhaust air will not be allowed. A dedicated exhaust system is required. The outside exhaust must be dispersed away from occupied areas and air intakes, or the exhaust

must be HEPA-filtered. Locating the exhaust stacks on the roof and discharging upward at a velocity greater than 3,000 fpm is recommended. An exhaust HEPA is required (see HEPA filter section). The need for a redundant exhaust fan would be determined by users, to allow continuing work. Air supply and exhaust system capacity should be ≥ 125% of the laboratory's requirements to provide for future adaptability and flexibility. The HVAC system creates directional airflow drawing air from rooms/areas of low hazard into rooms/areas of higher hazard. Inward directional airflow will be maintained by providing 15% more flow of exhaust airflow than supply air, and sufficient to maintain the differential pressure between rooms in the 0.05-0.20" Wg range. The air balance accommodates biological safety cabinet canopy/thimble connection or Class II type B2 cabinet exhaust requirements. Inward directional airflow will be verified before entry. Devices to indicate/confirm directional airflow into the laboratory (e.g., 0 - 0.20" Wg Magnehelic gauges, digital differential pressure monitors or both) will be installed. If the exhaust system fails, the lab must not become positively pressured. Whenever possible, the supply and exhaust fans will be electrically interlocked. Exhaust ductwork will not be positively pressurized.

Supply and exhaust dampers would be gas-tight and closable from outside the facility to facilitate decontamination with gaseous paraformaldehyde. Local visual and audible ventilation system failure alarms are required for laboratory personnel. Air supply diffusers will be located so that airflow at the biological safety cabinet face is unaffected (laminar diffusers preferred). Ductwork would be located external to the laboratory; if exposed in the laboratory, ductwork is clear of walls to allow for cleaning, maintenance and leak testing. The ductwork will be gas-tight 316 stainless steel up to the HEPA filter. All ducts will be constructed in a leak-tight manner with seams and joints usually welded airtightly. The biosafety officer will determine if exhaust ductwork is to be welded. If the exhaust ductwork is welded, welded joints will be recommended for all connections except for the damper(s) (use flange and bolt connections for quick change-out in the future). Coil units (for supplemental cooling) should not impact cleaning or provide a breach of containment. Elbows will be limited whenever possible to reduce the amount of background noise generated.

7.2.12 HEPA Filter

The HEPA filters in this lab will be "bag-in, bag-out," and the housing accommodates gas decontamination and filter testing (gas-tight dampers and housing). To facilitate filter change-

out, the HEPA filter housings will not be more than five-feet high. When HEPA filters are installed, a Magnehelic gauge or other pressure-monitoring devices will be put in, with the display placed in the most accessible location that is practical to measure pressure drop across the filters. A HEPA could be required on the autoclave exhaust, ultracentrifuge vent and sewer vent. HEPA filters must comply with DOE-STD-3020-97 (or the latest edition). Arrangements will be made to permit periodic leak testing of exhaust system HEPA filters. The system also needs to comply with ASME AG-1.

7.2.13 Laboratory Furniture and Casework

Furniture and casework in the lab will be sturdy and capable of supporting anticipated loading and uses. In addition, they will be spaced so that areas around and under benches, cabinets and equipment are accessible for cleaning. Benchtops will be impervious to water and resistant to acids, alkalis, organic solvents and moderate heat. They will also have marine/drip edging for spill control. For future flexibility, modular mobile casework will be used. Ergonomic considerations will be made while designing laboratory furniture and casework (e.g., adjustable work-surface heights, selection of biological safety cabinets, adequate knee clearances for seated work, adequate toe clearances for standing work, wall cabinet heights, etc.). Fixed casework, if used, will be sealed /caulked to the walls on installation to facilitate cleaning and prevent harbourage for vermin. If fixed casework is used, it would be installed before the coved flooring so that the coving can extend up toe-kicks. For storage, closed cabinets will be used rather than open shelving. Chairs and other furniture would be covered with a nonfabric material that can be easily decontaminated. Tall or movable cabinets/shelves would be seismically anchored. To facilitate cleaning, cabinets/shelves would be made to have angled tops or be built up to the ceiling.

7.2.14 Security

The EPHI BSL3 lab access controls will be provided to record entry and exit times and dates. Palm scan, proximity card, keypad entry with codes unique to each worker, card key or equivalent will be used. Access to mechanical and support areas will be limited. Security measures will meet the requirements of the Select Agent Regulations if the facility is to be used for selecting agent work or storage. Security measures will meet the guidelines outlined in the latest version of the CDC-NIH's Biosafety in Microbiological and Biomedical Laboratories.

7.2.15 Commissioning of the BSL3 Lab

Commissioning of the BSL3 lab would be performed by a third party in the presence of the proposed BSL3 lab's Biosafety Officer. The biosafety officer will furnish checklists for the containment features to be evaluated, depending on the facility design. Initially, the lab needs to pass a series of inspections and tests to meet standards that have been pre-developed, authorized, and specified in the design and construction documents before bio hazardous agents are used. These are in addition to the desired outcomes by the commissioning team identified before initiation of construction activities. A properly designed and constructed bio containment facility, including its structural and mechanical safety systems, must meet predetermined performance criteria and be operational upon completion of construction.

The integrity of the critical components of the biological containment systems will be verified by the testing and certification requirements. Certification of the BSL3 lab, including structural components and safety systems, will be included as part of the overall commissioning processes normally undertaken to verify that the design and construction meet applicable standards and that the facility can operate following the design intent. Commissioning testing must also be performed without degradation to the facility or mechanical system that is being tested. All equipment and materials would be tested/evaluated prior to installation; duplicate testing is recommended. BSCs will be certified by NSF 49 after the BSC is anchored in its final location. All HEPA filters will be tested to meet NSF 49 after installation. The integrity of seals will be demonstrated by visual inspection. The integrity of epoxy coatings may be tested using ASTM D4541 Standard Test Method for pull-off Strength of coatings using portable adhesion testers. Autoclave installation will be attested by the sign-off of a professional engineer.

7.2.15.1 Qualification of the Construction Agency/Contractor for the Lab

Finding and hiring the right construction agency for the construction of BSL 3 lab at EPHI is the key step to the success of the project. The construction agency with satisfactory qualifications and expertise helps in making the containment laboratory functional and achieving standards of biosafety practices for safer working environments. The following essential qualification criteria will be considered when hiring a construction agency for the proposed BSL3 lab: (i) the minimum average annual turnover during the last three financial years (as per their audited balance sheets) must be adequate to make sure that agency would be able to complete the project. (ii) successful and timely completion of at least one similar

project (construction, testing, commissioning and validation of BSL-3 laboratory) including civil, electrical, HVAC works, BMS, door interlocks, access control system, primary barrier containment equipment, decontamination system, etc. Additionally, the ability of the construction agency for designing and planning, correct evaluation of architectural layout plans, men and material movement plans, zoning plans, specialized systems and services schemes, services and utility schemes, laboratory commissioning and validation protocols, laboratory security protocols and integration of laboratory and equipment will be assessed.

7.2.15.2 Operation and Verification Procedures of the Lab

The EPHI BSL-3 lab would be operated according to all guidelines and requirements established by the CDC and NIH (CDC 1999), WHO, 2004, BMBL (2005). Prior to operating the BSL3 using select agents, the lab would be assessed by pertinent Ethiopian environmental regulatory organs at the Ministry of Health and Environment Commission of Ethiopia to verify that the BSL3 meets biosafety level requirements for working with the biological agent. The verification will be conducted as per the standard. The lab will be functional only if it meets the minimum standards set by CDC. No select agents would be handled in the proposed BSL-3 laboratories without first obtaining approval from pertinent environmental and health regulatory organs in Ethiopia. Microorganisms that are not select agents would also be used in the BSL-3 laboratories but would still be handled according to CDC, WHO and NIH guidance and requirements. Risk analysis will be performed before any infectious microorganisms are handled in the BSL-3 lab following CDC and WHO guidance. Besides, the local medical community would be informed of the microorganisms to be handled in the BSL-3 laboratory and would be aware of the methods of identification and control of associated diseases.

Lab work associated with infectious microorganisms will be approved and authorized by EPHI management based on the following:

- Biological Weapons Convention Treaty (BWC 1972) permits defensive research for developing vaccines and protective equipment,
- Work Smart Standards, which include adopted standards from CDC (CDC 1999), NIH (2001) and, BMBL (2005), WHO,
- The EPHI Biosafety Committee, a diversified group of EPHI operational-level researchers and representatives from all EPHI-affected institutional and regulatory

compliance organizations who are responsible for the first-level reviews of projects/microorganisms and provide recommendations,

- The lab would undergo a readiness review before start up to ensure that the infrastructure for safe operation is implemented and that the health and safety of workers, the public and the environment is protected,
- Compliance of lab operations with a variety of non-governmental organizations that guide the transportation of infectious agents including the *Dangerous Goods Regulations*, the *Infectious Substances Shipping Guidelines* of the International Air Transport Association (IATA 2001), and the *Guidelines for Safe Transport of Infectious Substances and Diagnostic Specimens* of the World Health Organization (WHO) (WHO 1997),

7.2.15.3 Sample Arrival and processing at the EPHI BSL-3

Sample shipments would only be received at the BSL-3 facility operating within the parameters specified in all established guidelines and requirements. The protocol for receiving and handling samples would be worked out before receipt and reviewed and approved by the EPHI Biosafety Committee of the BSL3. All incoming packages (regardless of origination point) containing infectious agents would be packaged in DOT-approved packages. These packages could be about 6 to 8 inches (15 to 20 cm) in height and about 3-4 inches (8 to 10 cm) in cylinder diameter. All shipping containers would be made of plastic and samples would be double-or triple-contained. Transportation and interstate shipment of biomedical materials and import of select agents would be subject to the requirements of Ethiopian Environmental and Public Health regulations as well as best international practices. Strict chain-of-custody procedures for samples arriving at the EPHI BSL3 lab receiving site would be followed. Due to the perishable nature of the samples at the BSL-3 facility, receiving and shipping of samples normally would only occur during weekday daylight hours and samples must be opened and used or restored (put in growth media) within 8 hours of arrival.

External packaging material from packages received at the lab would be inspected, removed, autoclaved, and disposed of according to to waste handling procedures specified below. Samples would be stored in the BSL-3 laboratory within a locked freezer or refrigerator, according to the needs of the sample for preservation. Inventories of all samples and cultures would be kept. Samples and cultures would be identified by a numeric or alpha-numeric code rather than by the name of the microorganism or source. Sensitive information about samples

and results would be maintained elsewhere at EPHI safely and securely following security requirements. The samples could also be immediately processed, in which case the materials would be placed directly into culture media (such as a liquid or semi-solid nutrient material or media). All preparations and manipulations of cultures or samples would only occur within a fully operating BSC.

Culture of Samples

For culturing, samples would be removed from their primary containers in a BSC tube and flask. A plate containing a specific nutrient media would be inoculated with the sample to create a culture. All culture work would be completed and cleaned up within one work shift (8 hours) except for materials being incubated. Culture and culture-storage containers would typically be made of plastic and always be double-contained. The culture container would be transferred to a temperature-controlled incubation chamber to grow the organisms (multiply the number of microorganisms) for a period lasting up to several days. Centrifugation of live, intact microorganisms would be conducted in sealed containers placed inside sealed tubes to minimize the potential for aerosolization of microbes or, if appropriate, centrifugation could be conducted inside a BSC. Cultured materials, which are sources for research materials, could be "lysed" (broken open) or killed (inactivated) by the addition of a variety of chemicals such as detergents or by using a chemical phenol. The lysed or killed cells and the culture media could be processed into biological material that would later be analysed by various research methods at various EPHI research laboratories, and potentially at other laboratories off-site. Following incubation (hours to days), all cultured materials would be cleaned up within one work shift (8 hours). Many cultures would be archived in small quantities and maintained in the ultra-freezers in each laboratory.

7.3 Project Equipment Description

7.3.1 Construction Phases Process, Wastes & Output Processes

Construction phase prcoeesses of the proposed projecta includes site preparation, land clearing, digging trenches for the perimeter wall, erecting the perimeter wall, access gates and constructing a security office/post, soil compaction for the parking, loading areas and paths, building the site foreman's office, digging the internal sewerage network trenches and laying the network pipes, building material storage, soil excavation for the foundations, digging trenches for the sewerage network and installing it to connect, filling the foundations, lining the foundation with PVC, erecting construction pillars, erecting the walls for the buildings,

constructing the roofs and water tanks| fitting and plumbing the water network around the buildings, electrical fittings in the buildings and around the site with switchboard, transformers etc., plumbing and piping the office and storage units, installing emergency generators and water pumps| installing elevators and escalators, establishing sewerage facilities and connections, erecting a fence around the site, landscaping the site and facilities, installing in house amenities such as lights, doors, windows floors, carpets etc. and interior decoration, installing facility waste management equipment e.g. bins, installing perimeter and internal site lights i.e. streetlights, and painting the internal roads and placing signs around the site.

7.3.1.1 Equipment

Equipments used during the construction processes of the project are Chainsaw, Compactor, Spades, Wheelbarrow, Hammers and bolt and nut fasteners, Handsaw, Bolts, Nut, Screws and nails, Ropes, Ladders, Electric and Gas Welders, Electric saws and grinders, Gas cutters, Spirit Level, Road Roller, Trucks, Hand drills and drill bits, Glass cutters, Wire cutters, Shears, Cranes, Mobile Electric Power Generators, Concrete mixer trucks, Wheel loader, Forklift & Telescopic Forklift, Tractor, Excavator, Asphalt Paver, Dump truck, mixer and concrete batching plant.

7.3.1.2 Materials & Energy

Materials and energy used during the construction phase process of the proposed project are Sand, Fuel and Oil, Electricity, Water, Cement and ceramic Tiles, Concrete, Polythene, Bricks and Gravel, Water, Steel, Concrete pipes, Steel pipes, PVC pipes, Polyfilla, Adhesives and paints, Ceramics tiles, Copper wires, Plastic, Electricity, Gas (acetylene & oxygen), Cardboard, PVC, Glass, Bricks, Asphalt, Bitumen and soundproof materials.

Selective (backfill) material: The source of materials must be considered to keep transport costs and resultant emissions to a minimum. In addition, Site Specific Environmental Management Plan (SSESMP) could be conducted and get an environmental clearance certificate from the Addis Ababa city administration EPA to source backfill materials. The contractor has to prepare also environmental management plan for sourcing backfill materials.

7.3.1.3 Decommissioning Existing Buildings and Incinerator

The construction of BSL 3 NRL requires the removal of old buildings that have used for Anti rabic vaccine research and development, offices and waiting areas for suspected dogs. The

project will also construct a new incinerator by decommissioning the old incinerator within the EPHI campus.

The clinical waste incinerators and their associated ductwork are located in the southeast of EPHI approximately 30 meters to the east of the EPHI training centre building. The floor area of the incinerator rooms is approximately 48 m^2 (functional) and 30 m^2 for the old incinerator (non-functional) respectively.

Consideration of Alternative during Decommissioning

As both chimneys are located inside the concrete service duct in the eastern corner of EPHI with limited access, removal of the chimneys will cause severe disruption to the EPHI operation and residents to the eastern boundary if the decommissioning and demolition works are carried out in one single phase.

- To minimize disruption and disturbance, the decommissioning and demolition works would be best undertake in 2 Phases, i.e. the decommission and demolition of the two incinerator units and associated ductworks within the incinerator room in the first phase whilst the vertical flues (chimneys) would be demolished when Blocks are being demolished.
- In Phase 1, the incinerator units, the wall-mounted control panel and the horizontal ductworks section will be decommissioned and demolished. The two vertical flues (chimney) of the incinerators will be decommissioned, and disconnected from the horizontal ductworks section (at ceiling level) and sealed up only, but not demolished. In addition, the opening of the chimneys at the rooftop will be sealed up to minimize the entry of rainwater if it is done during the rainy season. The stainless steel plate will be securely fastened or welded in place to cover each end of the chimneys with regular maintenance and inspection. All works except the sealing up of the chimneys at the rooftop will be carried out inside the Incineration Room under full containment to avoid the release of any residual ash to the environment.
- In Phase 2, the chimneys will be demolished when Blocks are to be demolished. The demolition of the chimneys will be undertaken inside the service duct from the top down starting from the rooftop area under full containment to avoid the release of any particulate and dust into the environment. However, no demolition works of Blocks would be commenced before the completion of the demolition of the chimneys.

- The decommissioning and disposal works will be carried out by a Specialist Contractor appointed by the project proponent or its representative.
- All residual ash collected from the incinerator shall be the disposed of at a secured landfill (See Section 7.3.2.6) to be constructed in EPHI before commissioning.

Fly ash and bottom ash from incineration is generally considered to be hazardous, because of the waste would have heavy metal content and dioxins and furans. During decommissioning of the old incinerator, these wastes (ashes) should be collected in polyethylene material and stored in a secured and protected landfill to be constructed on the EPHI campus. As there is no available space for disposal of such kind of waste in Addis Ababa, EPHI needs to construct a secured and concrete-based landfill for the disposal of ashes.

The secure hazardous-waste landfill must have two impermeable liners and leachate collection systems. The double leachate collection system consists of a network of perforated pipes placed above each liner. The upper system prevents the accumulation of leachate trapped in the fill, and the lower serves as a backup. Collected leachate is pumped to temporarily hazardous liquid waste collection sites (Safety tank). To reduce the amount of leachate in the fill and minimize the potential for environmental damage, an impermeable cover is placed over the landfill.

7.3.1.4 Expected Wastes

A high volume of excavated soil, solid waste: (paper, polythene, metal shavings, cement, concrete, welding particles, plastics, sand, grey water, adhesives, paints, soil, plants, cloth, rubber). Air emissions from vehicles engines and burning and friction operations (COx and SOx). Oil and fuel spills from vehicles and storage of oil and fuel. Dust from the movement of vehicles and excavation activities, liquid wastes from concrete batching plants. Sewerage and domestic/municipal waste are also expected wastes.

Excavated soil should be disposed of by selecting degraded areas and getting environmental clearance from the city administration. Liquid wastes from the toilet and washing facility from construction workers will be collected in an underground basin safety tank with a capacity of 20 M^3. Liquid wastes from concrete beaching plants should be collected in a pond which is secured by a fence and reused the water after settling the solid residue.

The most common types of wastes generated from demolition activities of the building are wood, rubble, aggregates, ceramics, metals, and paper products. Although, there is no typical percentage of each waste stream generated from demolition activities, the quantity of

demolition wastes from the laboratory building buildings is estimated to be 1.3 to 1.6 tons/m^2 of the ground floor area of the structure.

Construction demolishing waste processing and recycling techniques can be considered during the removal of old buildings. These include;

- Reception, weighing, and visual inspection;
- Manual pre-selection (for unsegregated streams), rejection, and diversion to alternative treatments;
- Screening of large materials; and
- Manual separation of plastic, wood, and other waste streams, if required;

7.3.1.5 Access Gate

EPHI has two access gate. The main gate from the highway of Swaziland Street, should not be allowed to access construction workers and machineries used during construction. The contractor should arrange access gates next to the main gate to the south of the project site. The movement of vehicles should be restricted only for one way to prevent damage to plants within the campus. The construction activities should be restricted only to the area and should be separated from the institute community by a fence.

7.3.1.6 Green Area Plan

EPHI is known by green space development and it is a component of green infrastructure. It is an important part of the institute's open spaces and provided by the campus and can serve as a health-promoting setting for all institute community members and the surrounding urban community. It is, therefore, necessary to ensure that the construction activities of the BSL 3 NRL project should not affect the green areas and ornamental plants within the institute except for some trees within the project site.

7.3.1.7 Common Area

All buildings are designed to have a common area such as car parks and access ramps, corridors, hallways, lobbies and reception areas, stairways, lifts, and fire escapes.

7.3.1.8 Parking Spaces

The project will have parking space in front and to the sides of buildings. The project will also include internal access roads for vehicles to access the building and others to the southeast and west of the project site in addition to the existing access road.

7.3.2 Operational Phase Utility, Services and Wastes

7.3.2.1 Utility Requirements

In order for the project to achieve its objectives, varying quantities of utilities will be necessary as ancillary and primary inputs. These utilities and facilities, whose sources are described in this sub-section, include Water, Electricity, Sewerage, and Storm Water Drainage.

Water

The direct source of potable water for the project during its full operation will be the Addis Ababa water supply system**.** EPHI has been using the groundwater and has a reservoir tank in case of problems with the supply system. It is expected that the development project will drill a new bore in addition to the existing borehole and use them as sources of water supply as it will have an impact on the water supply of the city administration.

Electricity

There is no available data for electric access to Woreda. EPHI uses an electric source from the national grid. The EPHI campus is already connected to the public EEP electric network via four transformers providing power supply to the various laboratory and other facilities in the campus. In addition to the electric connection, there are about four standby diesel generators set with an Automatic Transfer Switch that provide an alternative power supply during power blackout by the national grid.

Sewerage

According to Addis Ababa Water and Sewerage Authority information desk report, there is a sewerage system in the vicinity of EPHI. However, the sewer line is not connected to EPHI sanitary facility yet. Therefore, the project will have its own septic tank as means of onsite retention for domestic (non-hazardous) wastes. For the wastewater from the laboratory, the institute should construct a separate safety tank (100 m^3) which is concrete based to prevent groundwater contamination. The waste will be treated in a treatment facility after the construction of a vaccine laboratory by the Covid 19 emergency response project financed by WBG. The project site is located in Woreda 05, Akaki-Kaliti Sub-city, Addis Ababa Ethiopia.

Storm Water Drainage

Public consultation revealed that there is a high risk of flooding among the residents during the summer season. The contractor should apply prevention and mitigation measures for flood. These include the construction of elevated structures to limit the stormwater within the project site, the construction of floodwalls, levees, and evacuation routes.

7.3.2.2 Services Provided

Currently, EPHI laboratories provide several laboratory services for the community and public health management including referral laboratory services for the whole country. The EPHI laboratories are Microbiology laboratories, TB culture and molecular laboratory, Hematology laboratory, clinical chemistry laboratory, HIV molecular laboratory, Parasitology, Virology (Polio, measles & influenza) laboratories, food microbiology laboratory, Vaccine production and diagnostic laboratory, Environmental and zoonosis laboratories. These laboratories have been providing services for diseases diagnosis, monitoring of treatment outcomes, early detection of epidemic diseases and generating data for researchers

7.3.2.3 Waste

The Ethiopia Healthcare Waste Management National Guideline 2021 categories HCW into nine classes [(Non-Hazardous Waste (Class 1), Clinical Waste (Class 2), Sharps (Class 3), Pathological and Anatomical Wastes (Class 4), Hazardous pharmaceutical and cytotoxic waste (Class 5), Highly Infectious Wastes (Class 6), Radioactive Wastes (Class 7), Waste with high contents of heavy metals (Class 8), and Effluents (Class 9)] (FMoH 2021).

It is well known that during the operation of these laboratories, solid and liquid waste includes hazardous, infectious and non-hazardous waste. The wastes generated from the existing EPHI laboratories are summarized below in table 12.

Table 12: Waste generated from the existing EPHI laboratories and BSL 3 NRL with estimated average quantity, type and source (assumed that 25% waste from the existing EPHI facility will be generated from BSL 3 NRL)

Type of waste	**Waste description**	**Source facility/laboratory**	**Quantity of waste generated per day**		**Treatment Method**
			Existing EPHI	BSL 3 NRL complex	
Infectious waste	Items contaminated with blood and body fluids, including cotton, specimens, Cultures; stocks and microorganisms; dishes and devices used for culture, gloves, pipette tips, culture tubes, tissues, and other wastes	Microbiology laboratories, TB culture and molecular laboratory, Hematology laboratory, clinical chemistry laboratory, HIV molecular laboratory, Parasitology, Virology (Polio, measles & influenza) laboratories, food microbiology laboratory, Vaccine production and diagnostic laboratory, Environmental and zoonosis laboratories including mobile BSL 3 lab	104 kg	25kg	Infectious wastes are disinfected /sterilized using an autoclave at the laboratory; finally incinerated at high temperature in EPHI compound and the ash is placed in a secured area (transferring stations) until it is disposed to the final landfill.
Pathological waste	Human tissues, fluids; body parts; unused blood products,	Microbiology laboratories, TB culture and molecular laboratory, Hematology laboratory, clinical chemistry laboratory,	8 kg	2 kg	Chemical disinfection,/sterilization using autoclave at the

		HIV molecular laboratory, Virology (Polio, measles & influenza) laboratories, Vaccine production and diagnostic laboratory, and zoonosis laboratories.			laboratory; finally incinerated at high temperature in EPHI compound and ashes are disposed of in concrete-based secured area transferring stations.
Sharps	Needles; syringes; scalpels; blades; glass, etc.	Microbiology laboratories, TB culture and molecular laboratory, Hematology laboratory, clinical chemistry laboratory, HIV molecular laboratory, Parasitology, Virology (Polio, measles & influenza) laboratories, food microbiology laboratory, Vaccine production and diagnostic laboratory, Environmental and zoonosis laboratories, and specimen collection section.	9 kg	2.25 kg	All used sharps will be placed in specific cardboard boxes and incinerated in an appropriate double-chamber (>850°C) incinerator in the EPHI compound.
Liquid Waste	Waste generated in the laboratories (biological and chemical liquid waste)	Microbiology laboratories, TB culture and molecular laboratory, Hematology laboratory, clinical chemistry laboratory, HIV molecular laboratory, Parasitology,	360 litres	360 liters	All effluents are disinfected with bleach and drained to a septic tank or cesspool for both storage and treatment

		Virology (Polio, measles & influenza) laboratories, food microbiology laboratory, Vaccine production and diagnostic laboratory, Environmental and zoonosis laboratories.			in the compound of EPHI.
	Sanitary liquid waste		1640 litres	410 liters	Sanitary liquid waste is drained to a septic tank or cesspool for both storage and treatment in the compound of EPHI.
Non-hazardous Waste	paper, cardboard and other non-contaminated materials	Generated from all EPHI laboratories and facilities	60 kg	15 kg	Non-hazardous wastes are incinerated after sorting.
Laboratory animal waste	Laboratory animals such as Mouse, Rabbits, guinea pigs and sheep	Microbiology laboratories, , Hematology laboratory, clinical chemistry laboratories, , Virology (Polio, measles & influenza) laboratories, Traditional Medicine	240	80 Kg	Incinerated in high temperature in EPHI compound and ashes are disposed of in a concrete based secured area

Regarding the proposed BSL 3 NRL complex, clinical waste (class 4), sharps (class 3) highly infectious wastes (class 6), chemical wastes (class 8), and Effluents (Class 9) are expected to be the most generated waste from the EPHI BSL 3 Laboratory complex and the following waste are the lists of wastes generated from the operation of the laboratory:

I. **Waste cultures and stocks of microorganisms or etiologic agents (class 6):**

- Cultures and stocks of infectious agents or microorganisms
- Cultures of specimens from medical and pathological laboratories.
- Disposable containers, materials, and supplies that may have been contaminated during the manipulation of microbial cultures and stocks
- Wastes from the production of biological (including all tissue culture materials).

II. **Human pathological wastes including human blood,** blood products and their containers Waste **(class 4 and 6),**

- Pathological waste consists of human tissues; organs; body parts; dialysate; cerebrospinal, synovial, pleural, peritoneal, and pericardial fluids; and their respective containers.
- Human blood and blood products waste (e.g. blood plasma, platelets, red or white corpuscles, and other derived licensed products such as interferon, etc.)
- Items saturated or dripping with human blood or blood products.
- Items caked with dried human blood or blood products.

III. **Used sharps waste** (class 3),

- This category includes used hypodermic needles, syringes (with or without the attached needles), glass Pasteur pipettes, scalpel blades, blood vials, test tubes, needles with attached tubing,
- Broken plastic culture dishes, unbroken glass culture dishes, and other types of broken and unbroken glassware that were in contact with infectious material including microscope slides and covers lips.

IV. **Chemical waste** (class 8),

- Chemicals used in the production of biological, laboratory reagents; film developer; disinfectants (such as formaldehyde, chloroform, phenol, ethyl alcohol, isopropyl

alcohol, amyl alcohol, and sodium hypochlorite) that are expired or no longer needed; solvents; outdated, contaminated and discarded chemicals

V. **Non-hazardous waste** (class 1),

- Although the generation of the non-hazardous waste is almost negligible from the BSL 3 laboratory, there may be paper, cardboard and other non-contaminated materials from BSL 2 laboratories, PTPC, Biobank, central warehouse and LEMC.

VI. **Liquid Waste** (class 9),

- Biological and chemical liquid waste generated in the laboratories

7.3.2.4 Waste Management Practices

All biological wastes from BSL-3 are decontaminated and marked as "treated biohazard waste" prior to disposal in designated containers for treated infectious waste. Decontamination and disposal are the responsibility of the person/laboratory generating the waste.

EPHI's laboratories have Safety Manuals and SOP for waste handling and disposal. EPHI has a regular training program on biosafety and biosecurity and waste management. Most of the staff are trained in biosafety and biosecurity and waste management. Staff working in the EPHI's laboratories are vaccinated according to the specific risk group. In addition, laboratories have been implementing quality management systems including biosafety and biosecurity and some of the EPHI's laboratories (National Reference TB Laboratory, Microbiology laboratories, HIV) have already got accreditation on ISO 15189:2012, Medical Laboratories-Requirements for quality and competence international standards and EPHI Food Science and Nutrition Laboratory got accreditation on ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories international standards. Moreover, a Microbiology laboratory has received a certificate of competency to perform Microbiology tests and Good Laboratory Practice from the American Society for Microbiology (ASM) and Africa society of Laboratory Medicine (ASLM). EPHI has been also operating Polio and influenza laboratories accredited by WHO. Since 2017, EPHI has Mobile BSL 3 lab which also helped to gain some experience in a BSL3 lab.

EPHI has waste disposal locations, pickup procedures, a safety manual for waste management and a BSL-3 mobile laboratory waste management procedure. The proposed BSL-3 laboratory will have procedures for compliance with all applicable regulations for

collecting, storing, processing, and disposing of sanitary liquid wastes, solid wastes and hazardous wastes generated from the BSL-3 lab at EPHI.

All biological waste from the BSL-3 laboratory would undergo either autoclaving or chemical disinfection. These wastes would be discharged from laboratory sinks, floor drains, or tissue digesters and would be held and disinfected in retention tanks before being discharged into the sanitary sewer system. Tap water entering the BSL-3 laboratories through spigots in the sinks or shower heads would have backflow preventers to protect the potable water distribution system from contamination. Biological cultures could be disposed of in the sinks after undergoing treatment with chemical disinfectants for an appropriate amount of time. The autoclaving process involves placing waste to be autoclaved in a special container. When autoclaving occurs, an indicator strip on the container changes its colour. This allows facility workers and waste management workers to be able to tell at a glance whether waste has undergone autoclaving. To manage the waste generated from the proposed BSL 3 laboratory the following mitigation strategies will be implemented.

i) Waste Minimization

The best practice is to ensure that all laboratory section minimize their waste generation to the barest possible minimum. Appropriate plans, strategies and actions would be established to ensure adequate HCW minimization at the source. Accordingly, EPHI BSL 3 laboratory will implement the following waste minimization strategies

- Make Purchasing restrictions to ensure the selection of less wasteful materials;
- Recycle materials and products if applicable
- Ensure good management and control practices, especially in the purchase and use of pharmaceuticals; and
- Enforcing rigorous and careful segregation of the HCW at the source.

ii) Waste Segregation

Proper segregation of waste at source generation (at each laboratory section/department) is essential, efficient and effective in managing HCW. It helps in reducing the quantity of waste requiring treatment before final disposal and ultimately reduces the cost of waste treatment/management. Segregation involves putting different classes of wastes into separate and appropriate temporary storage color-coded containers/bags as recommended by the Health Care Waste Management National Guidelines. Waste segregation and waste colour coding work hand in hand is takes place. The waste generated from the BSL 3 laboratory

complex, described above, will be segregated and color-coded as outlined below in Table 13 as recommended by WHO.

Table 13: BSL 3 laboratory waste collection and segregation methods

Waste categories	Colour of the container and markings	Type of container	Collection frequency
Infectious waste	Yellow with biohazard symbol (highly infectious waste would be additionally marked HIGHLY INFECTIOUS).	Leak-proof strong plastic bag placed in a container (bags for highly infectious waste would be capable of being autoclaved).	When three-quarters filled or at least once a day.
Sharps waste	Yellow, marked ***SHARPS*** with biohazard symbol.	Puncture-proof container.	When filled to the line or three-quarters filled.
Pathological waste	Yellow with a biohazard symbol.	Leak-proof strong plastic bag placed in a container.	When three-quarters filled or at least once a day.
Chemical waste	Brown, labeled with appropriate hazard symbol.	Plastic bag or rigid container.	On demand.
Non-hazardous Waste	Black	Plastic bag inside a container or container which is disinfected after use.	When three-quarters filled or at least once a day.

iii) Colour Coding

Color coding is done by using colors to differentiate waste classes from one another. It is efficient and helps in the process of waste segregation at the source. It is also simple, and easy to use and thus can be understood even by illiterate patients, particularly at health posts where the illiteracy level is high. Color coding is one of the efficient ways of achieving segregation of waste and for sorting out items such as paper, plastic, glass and metal for recycling. All HCF in Ethiopia must use the same color coding scheme as this helps to minimize and avoid a waste class from mixing with other waste classes. This is also

advocated in the Ethiopia National Healthcare Wastes Management Guidelines document. The recommended colour codes for health facilities are shown in Table 14. As expected, there will be a wider range of waste classes generated at secondary and tertiary healthcare facilities when compared to primary healthcare facilities. Thus, it is expected that the use of a broader colour scheme is applied at the former when compared to the latter. For the sake of uniformity and homogenous colour coding for SHC will be an expanded version from that used in the Health Posts.

The following guidelines would be included for the color-coding system:

- **Black:** All bins or bags containing non-risk HCW.
- **Yellow:** Any kind of container filled with infectious HCW, including safety boxes.
- **Red:** Any kind of container filled with heavy metal or effluent.
- **White:** Any container or bin filled with drug vials, ampoules, or glass bottles for glass recycling or reuse.

Table 14: Three-bin system used at all health faculties in Ethiopia

Segregation category	**Color Coding**	**Container**	**Examples**
Non-risk/ non-hazardous waste		Bag or bin	paper, ash, cardboard
Infectious clinical waste (different types)	**Yellow**	Bag or bin	Laboratory waste, materials potentially infected blood, swabs Cultures of TB laboratories, contaminated blood clots and Glassware
Sharp waste	**Yellow**	Bag or bin	Syringes with needles, blades
Effluents	**Red**	Flask or container	Wastewater

iv) Packaging

Infectious waste would be contained from its point of origin to the point at which it is treated and no longer infectious. The packaging would be appropriate for the type of waste involved.

v) Labeling

An important aspect of colour coding is labeling. All waste bags or containers would be labeled with basic information in Amharic language and or in English. Basic label information would include type of waste in the container; name of the laboratory section, date of collection and, warning of hazardous nature.

- Identify the source of HCW or date of generation in case of an accident or improper segregation of the waste, ensure that the workers responsible for HCW management handle the different types of wastes safely, and ensure that each staff member feels more responsible for what they put into the bag/receptacle
- Ensure that Medical Departments gather data on the amount of waste produced in each department.

vi) Collection of Waste from BSL 3 NRL Complex

Collection of waste is extremely important particularly to avoid over spilling of waste out of collection containers. Collection would be done promptly and routinely or as often as required. This will reduce the probability of contaminated wastes coming into contact with the public. Collection of waste would be done by approved and trained personnel fully equipped with appropriate PPEs and conveying machineries such as laboratory trolleys and carts. BSL 3 laboratory staff will be actively involved in the collection of waste as would the waste handlers. They would ensure that their containers/bags (Bins/boxes and collection receptacles) are never more than three-quarter full before sealing them at their points of generation.

vii) Handling Waste at BSL 3 NRL Complex

When handling waste, handlers will wear protective clothing at all times including face masks, aprons, boots, and heavy-duty gloves, as required.

Sharps

- When handling sharps, needles will not be recapped or bent.
- Syringe will be placed in a safety box immediately.

When there is a need to use needle removers, it will take place immediately after the injection. Safety boxes will be fully and properly assembled before use.

Infectious waste bins:

Infectious waste bins would be covered before collection. It would be cleaned and disinfected with 0.5% chlorine solution after emptying and before reuse.

viii) Waste Handling Safety Measures at BSL 3 NRL Complex

a) All personnel handling infectious medical waste will wear gloves and additional protective medical clothing and personal protective equipment (PPE) appropriate to the level of risk they encounter and will remove any protective medical clothing used before leaving the work area and to place it in a designated area or container. A list of PPE is described in this chapter. When performing procedures where splashing is not expected, gloves are the minimum PPE that would be worn;

b) Protective medical clothing and PPE would not be submitted for laundering unless sterilized;

c) When performing procedures where splashing may occur or when infectious medical waste bags or containers may contact more than the worker's hands and wrists, the following medical protective clothing and PPE is provided in addition to gloves;

- Appropriate protective medical clothing would be of a material that does not permit infectious medical waste from penetrating and reaching workers' clothes or skin;
- Eye protection, surgical face masks, and face shields when personnel may reasonably anticipate facial exposure to infectious medical waste.

Additionally, immunization will be undertaken for staff members, as necessary (e.g. vaccination for hepatitis B virus, tetanus immunization).

ix) Waste Storage at BSL 3 NRL Complex

Storage is classified into internal and external. Consideration for storage will be based on the classification or type of waste being dealt with and the potential risk of infection to health care workers and waste disposal staff.

Internal storage is the temporary placement of waste at the point of the generation before transfer to external storage points. A storage location for the HCW would be designated inside the BSL 3 laboratory. The waste in the bin-liners or containers would be stored in a separate area, room or building appropriate to the quantity of waste produced bearing in mind the frequency of collection. Segregation of hazardous waste from general waste would be maintained in storage. There would be planned periodic cleaning and disinfection of

temporary storage areas and the containers. The storage time for HCW before it is transferred to external storage facilities would be on daily basis. External storage refers to the transit point where waste is stored after removal from primary storage to the time it is collected and transported for treatment and final disposal. External storage location would be isolated at the EPHI compound where larger containers found near to incinerators would be used to store waste until it is incinerated.

To ensure that waste is kept separate, the central storage receptacles for each colour-coded bags will be placed in similarly colour-coded receptacles.

BSL 3 laboratory at EPHI will designate an area within its premises where waste may be temporarily stored until final collection for disposal and onward treatment. It is expected that the BSL 3 laboratory must manage the HCW it generates. Such a general storage location would be located at the back of the facility and away from the view of the public and it would be included in the design of the proposed BSL 3 building. In addition, waste storage area will be large enough to contain all the hazardous waste produced by the institute with space capacity to cope with any maintenance or breakdown of the treatment unit. The storage area would be totally enclosed and secured from unauthorized access, inaccessible to animals, insects, and birds, and easy to clean and disinfect with an impermeable hard-standing base, good water supply, drainage, and ventilation.

x) Waste Transportation

Consideration for transportation must be based on the classification or type of waste being dealt with and the potential risk of infection to health care workers and waste disposal staff. Transportation is classified into on-site transport and off-site transport, since the waste generated from the BSL 3 NRL complex is treated at the EPHI facility, off-site transport will be done for fly and bottom ash, sludge and wastewater (if required)**.**

a) On-site transportation

The on-site transport involves conveying wastes from the various points of generation within a laboratory to a temporary storage location also within the same area for solid wastes. For solid wastes, wheeled and colored bins will be used to transport large amount of infectious wastes and non-infectious wastes. Hazardous and non-hazardous wastes will be stored in separate safety tank that collectively receives waste from different laboratories of the institute thorugh pipes.

b) Off-site Transportation

Refers the transport of wastes from EPHI BSL 3 laboratory to off-site treatment facilities using liquid waste transport vehicle (vacuum truck).

7.3.2.5 Incineration of Solid Wastes

Currently, EPHI has two incinerators but it has been using only one incinerator because the second incinerator has been working for more than 20 years and it is getting old and the capacity of the existing incinerator to burn is 50kg per hour. EPHI is used as a backup incinerator when the second incinerator is non-functional.

The existing incinerator has a capacity of 100 kg/hr with an operating temperature range of 750°C to 1050°C. It consumes about 200 lit/day of diesel oil and the stack height is also 8 meters. However, this incinerator does not fulfill the minimum emission standard specified in the preceding section which is based on the WB EHS guidline for healthcare facilities (2007). So, the two incinerators in EPHI (one is getting old served more than 20 years and the other which doesn't meet the minimum standards of the WB EHS guidline for healthcare facilities (2007)) will be decommissioned. Therefore, the construction of another incinerator that fulfills the national standard is the preferred option considering the waste characteristics generated from EPHI BSL 3 NRL. The incinerator will be a pyrolytic technology with a capacity of 50Kg/hr and operating temperature of 50 kg/hr and a chimney height of 12 meters. It will have a pneumatic/hydraulic waste loading system and automatic and manual removal of ash. The detailed specification of the incinerator is presented in Annex VI.

7.3.2.6 Solid Waste Disposal Methods for BSL 3 NRL complex

Disposal of hazardous ash: Fly ash and bottom ash from incineration is generally considered to be hazardous, because the waste would have heavy metal content and dioxins and furans may cause potential impacts on water, soil and the biological environment.

All EPHI laboratories use waste bags for waste collection. Sharp items are collected in safety boxes and special hard plastic bottles that are designed for sharp materials. EPHI laboratories use colour coding (red or yellow bags for infectious waste) of HCW according to its type and use a labeling system for the containers. After the decontamination of wastes generated from laboratories, samples are collected and carried to the incinerators by personnel dedicated to waste handling using a cart. The personnel uses appropriate PPE during collection and transportation according to the EPHI safety manual and waste management procedures. Infectious and hazardous wastes from laboratory EPHI will be

burned in Pyro lytic Technology incinerators that are designed for medical and pharmaceutical hazardous waste management and fulfill the emission standard (Table 15).

Table 15: Air Emission Levels for Hospital Waste Incineration Facilities

Pollutants	**Units**	**EHS Guidance value**
Total Particulate Matter (PM)	mg/Nm^3	10
Total organic carbon (TOC)	mg/Nm^3	10
Hydrogen chloride (HCl)	mg/Nm^3	10
Hydrogen fluoride (HF)	mg/Nm^3	1
Sulfur dioxide (SO_2)	mg/Nm^3	50
Carbon monoxide (CO)	mg/Nm^3	50
NO_X	mg/Nm^3	200-400 (a)
Mercury (Hg)	mg/Nm^3	0.05
Cadmium + Thallium (Cd + Tl)	mg/Nm^3	0.05
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	mg/Nm^3	0.5
Polychlorinated dibenzodioxin and dibenzofuran (PCDD/F)	Ng/Nm^3 TEQ	0.1

Notes:

a. 200 mg/m^3 for new plants or for existing incinerators with a normal capacity exceeding 6 tones per hour, 400 mg/m^3 for existing incinerators with a nominal capacity of 6 tones per hour or less

b. Oxygen level for incinerators is 7 percent

Assessment of the solid waste management facility in Addis Ababa revealed that there is only one functional landfill called the Repi landfill. It has a total area is 19.2 hectares and is believed to have a capacity of 3600 tons per day. It receives only mainly household waste and non-hazardous wastes, office and commercial wastes. Therefore, there is no available space for hazardous waste disposal in Addis Ababa.

Fly ash and bottom ash from incineration require a secured landfill for storage. The solid waste disposal facilities must be constructed in low topography areas with fine slopes using burial pits to prevent groundwater contamination. The appropriate site will be near the incinerator (x=0470494, y=1000065) southeast of the campus, near to the old incinerator. Ideally, the pit should be lined with low permeability material such as clay and plastic or

concrete-based materials at the bottom to prevent the pollution of shallow groundwater and should be fenced in to prevent scavenger access.

Description of Secured Landfill: Hazardous wastes must be deposited in so-called secure landfills. A secure hazardous-waste landfill must have two impermeable liners and leachate collection systems. The double leachate collection system consists of a network of perforated pipes placed above each liner. The upper system prevents the accumulation of leachate trapped in the fill, and the lower serves as a backup. Collected leachate is pumped (or moved to via gravity) to a safety tank. To reduce the amount of leachate in the fill and minimize the potential for environmental damage, an impermeable cap or cover is placed over the landfill or protects the landfill from rain or flood. If leachate leaks into either of the collection systems, it is should be connected to the safety tank to be treated outside the EPHI campus.

Essential Components of a Secured Landfill (Water and Sanitation Program, 2008)

- Liner system at the base and sides to prevent migration of leachate to the surrounding environment. Typically consists of a high-density polyethylene (HDPE) membrane, layers of clay, and sand or gravel
- Leachate collection and drainage facility to the safety tank,
- Fenced buffer zone and a green belt around the landfill facility to serve as a visual and protective barrier,
- A final cover system at the top to prevent infiltration of water and support surface vegetation,
- An environmental and waste monitoring system (including a weighbridge),
- Safety provisions and basic amenities (for example, roads, lighting arrangements, water supply, protective gear, toilets, and health checks).

Non-hazardous solid wastes from BSL 3 NRL and other facilities of EPHI will be segregated and disposed of in the Repi landfill in collaboration with Addis Ababa Water and Sewerage Authority.

7.3.2.7 Liquid Waste Generated from BSL 3 NRL Complex Treatment and Disposal

There are multi-layered risks involved in the whole cycle of liquid waste management; especially during the collection, transportation, and disposal of clinical liquid wastes. Liquid contaminated wastes such as pathologic, hazardous chemicals, and infectious require special handling, as they may pose an infectious risk to healthcare workers with contact or handle the waste. Therefore, to reduce exposure to such harmful chemicals, it is necessary to design

wastewater storage and treatment plants that will treat liquid waste sustainably before disposal.

The previous ESIA study recommended onsite partial treatment of wastewater using Septic tanks, sand/media filters, aerobic treatment unit (Aeration-clarifier unit) and ultraviolet irradiation and transported to a centralized treatment/disposal for treatment. However, an assessment of liquid waste management facility in Addis Ababa revealed that there is no available waste treatment facility that treats clinical wastes. In addition, there is no available space to install a wastewater treatment plant within the EPHI compound. The unavailability of space, core residential and commercial areas, and construction of an onsite wastewater treatment plant within the EPHI compound won't be a reliable option for implementation.

Moreover, the use of a sand filter before equalization and aeration tank would not be effective for heavily polluted clinical wastewater. The process majorly depends on the organic loading rate (depends on the strength of the wastewater) and hydraulic loading rate (the amount of wastewater applied to the filter in one day). Strong wastewater containing high levels of organic material can reduce the filter's performance over time and increase the need for maintenance. The project generated 360 litre/day of liquid waste from the laboratory and sand filters is less effective at removing certain pathogens and other wastes from wastewater at high hydraulic loading rates. In addition, the use of a sand filter (before the aeration tank) for clinical wastes requires continuous cleaning for heavily polluted wastewater and requires a preliminary sedimentation step. In addition, the waste created during re-rinse or cleaning of the filter must be treated or disposed of, which is accompanied by extra costs. Therefore, a Sand filter is not the preferred choice for clinical-based and public health base laboratories without the configuration of equalization and aeration tank.

Considering all the above, the team of consultants recommends onsite storage of hazardous wastes using a separate safety tank and offsite treatment of the wastewater by construction wastewater treatment plan outside the EPHI compound. For the construction of a clinical waste wastewater treatment plant, the Ministry of Health has agreed to construct a wastewater treatment plant in the Ethiopian Covid-19 Emergency response project in the EFDA Vaccine laboratory Site considering the amount of wastewater generated by the proposed BSL 3.

Onsite Storage of Wastewater

Currently, EPHI is managing liquid waste with the use of an onsite waste treatment system. The treatmentsystem mainly focused on the physical separation of scum and grits from the liquid waste and the retention of microorganisms on porous organic materials packed in a septic tank

and soak-away pits. In EPHI the treatment system is composed of one big septic tank//manhole that collectively receives waste from different laboratories of the institute. Once the waste is submerged in the holding tank, the waste is then flows into the consecutive of double-chambered septic tank and soaks away pits. The septic tank allows the waste to rest in the first chamber and so that the sludge precipitates. Once the sludge is retained, the effluent further enters into soak-away pits. These soak-away pits are packed with different porous-sized gravels, cobbles and sands of different mesh size. Around 4 septic tanks and more than 4 soak away pits are used for liquid waste treatment in the current waste treatment of EPHI. This treatment plant can be applied for wastewater coming from the various buildings and especially from the toilet and sanitary area and sent to the Kality wastewater treatment plant for further treatment. Therefore, the sanitary waste generated from the proposed BSL-3 lab will be also first collected in some underground basins safety tanks and disposed of in the Kality wastewater treatment plan via vacuum truck.

Separate concrete-based safety tank will be constructed for hazardous wastewater generated from BSL 3 (100 m^3). This waste will be temporarily stored in an underground safety tank which is made with concrete to prevent groundwater pollution.

Offsite Hazardous Wastewater Treatment Plant

EPHI has no adequate space for the construction of a wastewater treatment plant nor an available wastewater treatment plant in Addis Ababa for healthcare wastes. Therefore, there is a need to construct an offsite wastewater treatment plant in collaboration with MoH and EFDA. The MoH has agreed to construct a wastewater treatment plan during the implementation of component 4 (Quarantine, Isolation and Treatment Centers and regulatory infrastructure) of the Ethiopia COVID-19 Emergency Response Project which is financed by WBG.

The project will finance the regulatory infrastructure and capacity for safety surveillance of the COVID-19 vaccine which includes refurbishing and equipping the vaccine laboratory under the Ethiopia Food and Drug Authority (EFDA). EFDA secured 10,000 M^2 of land for the construction of a vaccine laboratory. The project site is located in Akaki Kaliti sub-city, Woreda 05, commonly known as Seferegenet district. The project site is an industrial zone which is bounded by a metal work factory to the east and north, warehouses to the south and an access road to the east (Figure 13.). This laboratory will have significant importance in terms of facilitating licensing and registering any potential COVID-19 candidates in the future. Since the laboratory will generate hazardous and infectious wastes, separate collection

and treatment are required for wastewater from the laboratory. Therefore, the design and construction of a wastewater treatment plant for the vaccine laboratory should consider the wastewater generated from BSL 3 and the components of the wastewater treatment plant will consider three Stages of treatment for efficient on-site treatment as per the Global Environment Facility recommendations.

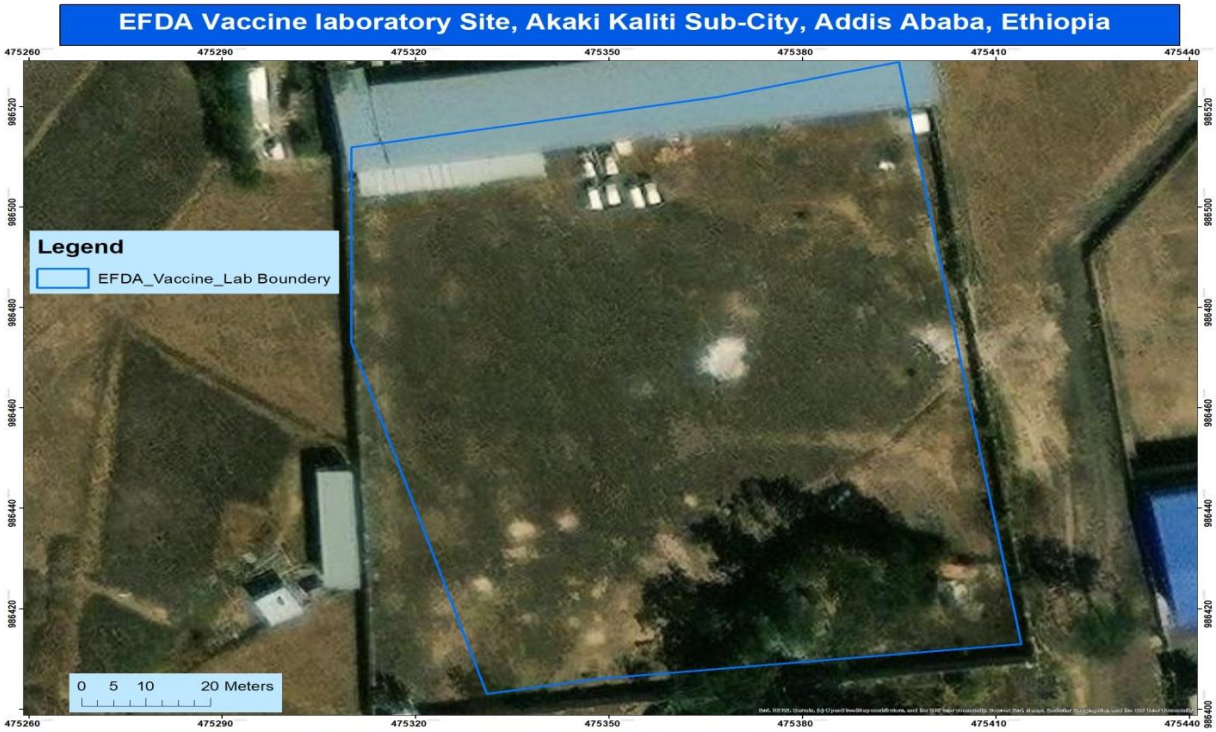


Figure 13: Google Map of EFDA vaccine laboratory project site

The offsite treatment plant of BSL 3 will have three stages for efficient off-site treatment and discharge to the environment. These include primary, secondary and tertiary treatment.

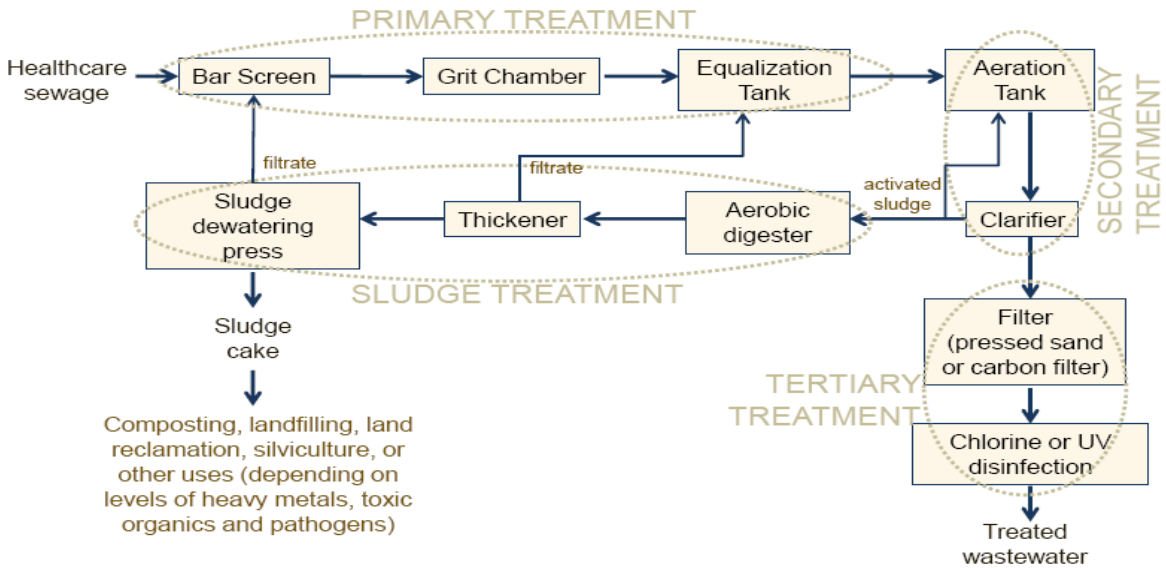


Figure 14: Flow diagram of proposed EPHI wastewater treatment plant (GEF, Module 23)

The primary treatment involves the screening of wastewater to remove solid particles. The screened solid particles will be then incinerated at 850°C to 1200^{0}C in a waste incinerated tank. The objective of the primary treatment is to remove of heavy solids. After the screening process, the wastewater will be pumped into a biological process tank in which intermittent aeration and coagulant (aluminum) will be provided for the simultaneous removal of nitrogen and phosphorus. The wastewater was then pumped to a membrane bioreactor which consists of a ceramic membrane having a pore size 0.2 μm. The sludge retention time of the biological process will be approximately 30 days. The permeate collected after membrane filtration will be pumped for ozonation in which 3.4 mg O3/L of wastewater will be provided for maximum removal of pharmaceuticals. Following the ozonation process, the treated wastewater will be passed through a carbon filter or sand filter. After the Sand or carbon filter treatment, the water will be polished using UV radiation for the removal of viruses. The UV installation consists of one UV lamp of 220 W. Ethiopia has no health facility related effluent quality standard rather ambient environment standards. Hence, World Bank Environmental Health Safety Guideline for Healthcare Facilities (2007) will be applied to monitor the wastewater quality discharged to the public sewer after fulfilling the limit values for discharges to water (Table 16). The sludge generated during the biological process will be dewatered, dried, and then passed to an incineration tank.

Table 16: Effluent Levels for Health Care Facilities, World Bank Environmental Health Safety guideline for Healthcare Facilities (2007)

Table: Effluent Levels for Health Care Facilities		
Pollutants	**Units**	**Guideline values**
pH	S.U	6 – 9
Biochemical Oxygen Demand (BOD5)	mg/L	50
Chemical Oxygen Demand (COD)	mg/L	250
Oil and grease	mg/L	10
Total Suspended Solid (TSS)	mg/L	50
Cadmium (Cd)	mg/L	0.05
Chromium (Cr)	mg/L	0.5
Lead (Pb)	mg/L	0.1
Mercury (Hg)	mg/L	0.01
Chlorine, total residue	mg/L	0.2
Phenol	mg/L	0.5

Total Coliform bacteria	MPN[a]/100 ml	400
Polychlorinated dibenzodioxin and dibenzofuran (PCDD/F)	Ng/L	0.1
Temperature increase	^{o}C	<3[b]
Notes: [a]MPN = Most Probable Number [b]At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity		

7.4 EPHI BSL 3 laboratory Staffing and Capacity Building

7.4.1 Staffing

The proposed BSL3 lab will have both professional and auxiliary staffs that are required for the continuous and proper operation of the facility. The BSL-3 facility will employ the following on full-time bases, but not limited to the laboratory manager, the number of personnel will be determined based on the workload.

- Laboratory Director,
- Laboratory scientist,
- Laboratory quality Manager,
- Biosafety and biosecurity Officer,
- HVAC technician,
- Electrical technician,
- Equipment and instrument maintenance technician,
- Well-trained security staff,
- Cleaners,
- Waste handlers,
- Incinerator Operators,
- Wastewater treatment Plant Operators

7.4.2 Roles and Responsibilities

The EHPI will have a strong biosafety and security unit to address and comply with regulations and recommendations for biosafety and biosecurity, and waste management as well as the health and safety of the staff, researchers, community, and environment. Roles and responsibilities of the staff in the biosafety and biosecurity unit, wastewater treatment plant unit, incinerator facility and that of EPHI as a host institution are outlined below:

7.4.3 Ethiopian Public Health Institute (EPHI)

EPHI management will be responsible for the overall management of the proposed BSL3 lab. To maintain regulatory compliance and to protect personnel, the community and the environment from biohazards, EPHI management will be responsible for:

- Appointing laboratory director, biosafety and biosecurity officer and other technical and support staff required for the BSL-3 lab
- Ensuring appropriate training is provided to personnel conducting research with biohazards or recombinant or synthetic nucleic acid materials.
- Ensuring that research conforms to the provisions of best international practices such as the *NIH Guidelines, BMBL, WHO Biosafety Manual and this ESIA.*
- Establishing and maintaining a *Biosafety Committee*
- Establishing and maintaining a health surveillance program for personnel.
- Reporting, when required, any significant problems, violations or significant research-related accidents or illnesses to pertinent Ethiopian Public Health and Environmental issues regulatory organs.
- Facilitating the preparation of guidelines, policies and plan relevant for smooth functioning of the lab
- Finance the construction/procurement of medical wastewater management facility and incinerator, and oversee the proper functioning of the medical waste management facilities

7.4.4 EPHI Biosafety and Biosecurity Committee

The Biosafety Committee will oversee the review, approval and oversight of biohazards in research activities at the EPHI campus. Specifically, the committee will be responsible for the assessment of facilities in collaboration with the Biosafety Officer, and developing procedures, practices, and training of research personnel, or taking other steps necessary to assure compliance with WHO standards, *CDC Guidelines, the BMBL,* and other pertinent standards and regulations. To successfully carry out these responsibilities, the committee members should have sufficient knowledge and expertise in biomedical research practices and biosafety and biosecurity. The Committee has the authority to approve, require modifications to secure approval, disapprove, suspend or terminate research activities as required to assure compliance with applicable regulations and guidelines. Besides, Biosafety Committee will monitor ICWMP implementation, and supervise the Infection control and

waste management system of EPHI campus and the committee will be responsible to act for any deviation from the waste management procedure practices or malpractice during waste handling transportation, storage, treatment and disposal.

7.4.5 BSL 3 NRL Laboratory Director

EPHI will appoint a scientist and knowledgeable in appropriate laboratory techniques, safety procedures, and hazards associated with handling biohazards as a laboratory director. Responsibilities of the laboratory director:

- Accept direct responsibility for the health and safety of those working with biohazardous materials and/or select agents and toxins.
- Coordinate, perform and document the risk assessment for the biological agent(s)
- Develop and maintain the BSL3 Biosafety Manual in collaboration with the biosafety officer and other expertise
- Adhere to approved emergency plans for handling accidental spills and personnel contamination.
- Comply with permit and shipping requirements for biohazards. This includes permits, material transfer agreements, and other documentation for international, interstate and intrastate transport of genetically modified and biohazardous material.
- Develop specific biosafety Standard Operating Procedures (SOPs) for biohazards used in the laboratory.
- Ensure compliance by laboratory personnel with relevant regulations, guidelines, and policies.
- Ensure all appropriate personal protective equipment is provided and used. Ensure proper training, including refresher training, and instruction for laboratory personnel in safe practices and protocols, including, at a minimum, training in aseptic techniques and characteristics of the material(s) used.
- Ensure the integrity of the safety equipment (e.g. biological safety cabinets), maintain biological containment (e.g., purity and genotypic and phenotypic characteristics), and ensure correct procedures or conditions are followed to prevent a release of or exposure to recombinant or synthetic nucleic acid molecules and/or biohazards, select agents or toxins.
- Propose appropriate microbiological practices and laboratory techniques to be used for the research.

- Provide to all laboratory staff the protocols that describe the potential biohazards and the precautions to be taken.
- Immediately report any significant problems pertaining to the operation and implementation of containment practices and procedures in writing to the Biosafety Committee
- Supervise laboratory staff to ensure that the required safety practices and techniques are employed. Correct work errors and conditions that may result in accidents, injuries, or the release of biohazards.
- Ensuring that personnel are adequately trained
- Ensuring that individuals working in the facility are experienced and proficient in handling the biological agents at the appropriate level of containment
- Ensuring that any visitor or contractor is escorted by an individual trained and approved to enter the facility
- Monitor and authorize access of all persons entering the BSL-3 laboratory. Access is limited to those who understand the nature of the biohazard, have adequate laboratory-specific biosafety training and agree to comply with all precautions.
- Oversee Medical Waste Management practices of the lab
- Ensure compliance by a waste handler, wastewater treatment Plant and incinerator personnel with relevant regulations, guidelines, and policies of infection control and waste management.
- Ensuring that individuals working in the wastewater treatment plant and incinerator are experienced and proficient in handling transportation, storage, treatment and disposal of waste including infection control,
- Ensuring that waste handler, wastewater treatment plant and incinerator personnel are adequately trained in waste management and risk management in the wastewater treatment plant and incinerator facility respectively.

Laboratory Scientist

The responsibilities of the Laboratory Scientist

- Supervise and perform tests on various microbiological activities regularly.
- Maintain knowledge of various testing methods and perform all manual and automated operations on various supplies.

- Perform tests on component samples, identify any contamination and perform analysis for appropriate source for same and initiate corrective actions.
- Perform various cultures of microorganisms in isolation according to SOP.
- Perform tests on all incoming ingredients and document all records.
- Develop and prepare documents for all protocols.
- Perform molecular testing according to SOP
- Develop various testing processes for all raw materials and equipment and monitor all finished products.
- Investigate all issues and prevent any GMP problems with the procedure
- Maintain accurate records and perform tests on all activities conducted in a laboratory.
- Develop and document various microbiology laboratory processes and prepare final reports.
- Performs laboratory analysis and records findings and methodologies in an appropriate hard or electronic file for future reference
- Assists initiate and guide junior researchers in the adoption and adaptation of new laboratory methods and technologies
- Follow infection control and waste management procedure during handling of waste

Laboratory Quality Manager

The responsibilities of the Laboratory quality officer

- Develop, Update, revise, and maintain the Laboratory's Quality Manual, Standard Operating Procedures, and other quality documents.
- Perform internal audits of the Laboratory, including both technical and quality systems audits.
- Perform and document corrective action, including follow-up monitoring to gauge the effectiveness of the corrective action.
- Perform analytical tests in the laboratory as assigned by the Laboratory director.
- Follow all quality assurance/quality control procedures as outlined in the laboratory quality manual
- Performing all QA/QC procedures for analytical tests
- Calibration of pipettes, thermometers, and other measuring equipment.

- Maintain current demonstrations of capability for all test procedures in the laboratory for which quality assurance oversight will be performed.
- Maintain training records for all laboratory staff, including demonstrations of capability.
- Schedule and complete semi-annual proficiency testing for tests
- Ensure the fulfillment of compliance by laboratory scientists, Biosafety officers, waste handlers, wastewater treatment plant and incinerator personnel including other support staff with relevant regulations, guidelines, and policies of infection control and waste management.

Biosafety and biosecurity Officer

Biosafety and biosecurity officer is responsible for advising about, developing, implementing and supervising the safe and efficient collection, transportation, storage treatment, disposal and recycling of waste

- Advise on risk assessment for all proposed work with biological agents and the development of codes of practice
- Advise on waste disposal policy and arrangements u Advise on disinfection policy u Prepare contingency plans for action following accidents and incidents involving biological agents u
- Advise and assist management in investigations following accidents and incidents involving biological agents u Carry out periodic inspections of containment facilities
- Develop, implement, and maintain the institute's biosafety program to address issues of biosafety and biosecurity.
- Perform and review the required risk assessment to determine the appropriate biosafety level and personal protective equipment (PPE) for handling recombinant and synthetic nucleic acid molecules or biohazards.
- Advise scientists/researchers on proper waste disposal methods.
- Assist scientists/researchers in the development of plans for preventing and handling accidental spills and personnel contamination.
- Investigate laboratory accidents involving biohazards and recombinant and synthetic nucleic acid molecules.
- Develop, implement, and maintain the institute's program for select agents and

toxins.

- Perform periodic inspections to ensure that laboratory standards are rigorously followed.
- Promote regulatory compliance and a safe laboratory environment.
- Provide advice on laboratory security.
- Provide technical advice to the laboratory director and the Biosafety Committee on research safety procedures.
- Provide technical advice to ensure compliance by waste handler. wastewater treatment Plant and incinerator personnel with relevant regulations, guidelines, and policies for infection control and waste management including infection control.
- Provide technical advice to ensure that individuals working in the wastewater treatment plant and incinerator are experienced and proficient in handling transportation, storage, treatment and disposal of waste
- Provide technical advice to ensure that waste handler, wastewater treatment plant and incinerator personnel are adequately trained in waste management and risk management in the wastewater treatment plant and incinerator facility.
- Supervise the infection control and waste management system of the EPHI campus and
- Ensure the implementation of the Infection control and waste management procedure during waste handling transportation, storage, treatment and disposal
- Provide training and resources for the safe use and practices for those working with potential biohazards, and laboratory equipment.

Incinerator Operator

The responsibilities of the Incinerator Operator:

- Monitor and control the variations in waste compositions, the waste feed rate, and the combustion temperature
- Adhere to the proper Incinerator operating procedures
- Incinerator loading and prevention of waste spillage
- Follow Infection control and waste management procedure during waste handling transportation, storage, treatment and disposal
- Reporting Incinerator failures

Wastewater treatment Plant Operator

- Effluent sampling and management of data associated with BSL 3 NRL wastewater treatment facility
- Follow waste management procedures during waste handling transportation, storage, treatment and disposal
- Managing the inspection and cleaning of septic tanks and sand/media filters
- Inspection and maintenance of wastewater treatment facility
- Preparation of inventory report and procurement plan for the sustainability of the treatment facility.

Security Staff

The security department will be responsible for completing a risk assessment of the space, before the laboratory opening, and as needed. Security staff will also be responsible for monitoring the activity of the exterior locations of the storage space and lab and its surroundings.

Visitors, Vendors, and Contractors

Contractors must ensure that appropriate Personal Protective Equipment (PPE) is available for their own workers. All visitors, vendors, and contractors must:

- Comply with all security requirements and procedures.
- Be accompanied by an approved person at all times while in areas with select agents or toxins.
- Use Personal Protective Equipment (PPE) provided for them by the laboratory

Waste handlers

Waste handlers have principal Duties and Responsibilities: the waste handlers are responsible for collecting, separating, containing, transporting, processing and/or shipping solid waste & regulated medical waste following the relevant department and hospital procedures and all regulatory requirements

- Collect, separate, contains, labels and transports solid waste, medical waste & recyclable goods from generation points to specified collection locations and incinerator
- Empties relines, & cleans solid & medical waste containers according to procedures

- Segregates waste for containment prior to shipping offsite for incineration.
- Monitors available waste compactor capacity; alerting a supervisor to ensure that unit is emptied before reaching full capacity.
- Operates solid waste and soiled laundry chute systems according to procedure
- Separates, contains, seals, labels, weighs, & stores high-risk infectious (red bag) waste to be incinerated
- Separates recyclables (glass, metal, paper, cardboard, etc.) for pickup. Operates baler according to department procedure for recycling cardboard/plastic
- Cleans and disinfects medical waste carts and totes. Maintains waste area facility in a clean and orderly condition; sweeps and cleans area at the end of each shift.
- Assures safe working conditions at all times as designated by the SOP; utilizes safety equipment and/or protective equipment as directed (i.e. safety gloves and eye protection), follows defined safety procedures.
- Follow waste management procedures during waste handling transportation, storage, treatment and disposal including infection control.
- Ensuring the safe and efficient collection, transportation, disposal and recycling of waste

Laboratory cleaners

These individuals perform different washing and cleaning activities outside the main BSL-3 laboratory this includes

- Cleans laboratory equipment, such as glassware, metal instruments, sinks, tables, and test panels, using solvents, brushes, and rags:
- Mixes water and detergents or acids in a container to prepare a cleaning solution according to specifications.
- Washes, rinses, and dries glassware and instruments, using water, acetone bath, and cloth or hot-air drier.
- Scrubs walls, floors, shelves, tables, and sinks, using a cleaning solution and brush.
- May sterilize glassware and instruments, using an autoclave.
- May maintain inventory reports and logs on cleaning materials and solutions.
- Follow waste management procedures during waste handling transportation, storage, treatment and disposal including infection control.

7.4.6 Training and Capacity Building

- The staff working within the containment laboratory must be well-trained in the concepts and practices on GMP and biosafety and biosecurity of the facility.
- All employees must have a clear understanding of any identifiable risks to their health arising from work and the actions to be taken in dealing with situations in which exposure may occur.
- The level of training provided should be appropriate to the level of risk and the complexity of the work being undertaken.
- Biosafety training must be regularly scheduled and presented to all persons who work in or who enter the Proposed Biosafety Level 3 laboratory. Comprehensive training must be provided for each new person prior to beginning work. Training continues for all laboratory staff with sessions presented one or more times in any one month. Training must focus on biosafety or other health and safety policies, practices and procedures to be followed for any activities with the laboratory. Enough instruction must be provided to cover the entire gamut of biosafety training at least once each year.
- All researchers receiving these biohazardous materials must be notified in writing of the risks associated with these materials, and of the need to handle the materials using BSL-3 practices and procedures. Documentation of biohazardous materials transfers must include the institution, Principal Investigator, date sent, nature and amount of material transferred, and the biosafety level required for this work.
- Training and agreement to comply must be documented (e.g., in a log or person-specific file). Visitors and maintenance personnel who enter the BSL-3 laboratory must be fully informed of the potential risks, required practices and procedures that they must follow. They must be instructed about the signs and symptoms of any biohazardous materials manipulated or stored in the laboratory
- Training should not be limited to those working on the bench. Laboratory managers, supervisors and safety advisors should be appropriately trained to ensure that they are competent, and they should maintain their professional competence through refresher training or other means. It is also necessary for auxiliary staff (e.g. cleaners and porters) and others (e.g. maintenance staff, external contractors and administrative staff) to receive enough and appropriate

information, instruction and training about the hazards they may encounter when working in a laboratory. They should also be appropriately supervised while carrying out their work.

- Training should consider the breadth of work that is likely to be undertaken within a laboratory and the different levels of risk associated with the work, eg from working with samples suspected of containing biological agents to large-scale propagation and concentration of biological agents. It may be necessary to gain experience of and become proficient in techniques and procedures using agents that are in a lower hazard group. Since laboratory workers may work in a number of laboratories throughout their careers, the keeping of personal training records/portfolios (suitably endorsed by the relevant employer) provides a useful means of demonstrating professional development and competence to future employers.
- Training programs and protocols must be developed by the Biosafety Officer
- Laboratory workers should be trained to understand and tackle any kind of emergency situations within the containment laboratory without panic while ensuring their own safety first and ensuring that laboratory equipment is put into safe operating mode
- The BSL-3 Biosafety Officer and the Principal Investigator should receive appropriate training before the operation begins.
- Wastewater treatment plant and incinerator operators should receive appropriate training on waste management and risk assessment and management before the operation begins.
- Incinerator operators should be trained to understand and tackle any kind of emergency situation in an incinerator without panic while ensuring their own safety first and ensuring that equipment is put into safe operating mode.
- Wastewater treatment plant operators should be trained to understand and tackle any kind of emergency situation in a wastewater treatment plant without panic while ensuring their own safety first

7.5 Source of Energy and Consumption

The main source of power supply for the proposed NRL project will be an electric connection from the national grid. The EPHI campus is already connected to the public EEP electric network via four transformers providing power supply to the various laboratory and other

facilities in the campus. In addition to the electric connection, there are about four standby diesel generators set with an Automatic Transfer Switch that provides an alternative power supply during power blackout by the national grid.

7.6 Capacity and Experience of the Implementing Organization (EPHI)

7.6.1 Exiting Biosafety and Waste Management Practices at EPHI

EPHI's laboratories have Safety Manuals and SOP for waste handling and disposal. EPHI has a regular training program on biosafety and biosecurity and waste management. Most of the staff are trained in biosafety and biosecurity and waste management. Staff working in the EPHI's laboratories are vaccinated according to the specific risk group. In addition, laboratories have been implementing quality management systems including biosafety and biosecurity and some of the EHPI's laboratories (National Reference TB Laboratory, Microbiology laboratories, HIV) have already got accreditation on ISO 15189:2012, Medical Laboratories-Requirements for quality and competence international standards and EPHI Food Science and Nutrition Laboratory got accreditation on ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories international **standard**s. Moreover, Microbiology laboratories have received a certificate of competency to perform Microbiology tests and Good Laboratory Practice from the American Society for Microbiology (ASM) and the Africa society of Laboratory Medicine (ASLM). EPHI has been also operating Polio and influenza laboratories accredited by WHO. Since 2017, EPHI has Mobile BSL 3 lab which also helped to gain some experience in a BSL3 lab.

All EPHI laboratories use waste bags for waste collection. Sharp items are collected in safety boxes and special hard plastic bottles that are designed for sharp. EPHI laboratories use colour coding (red or yellow bags for infectious waste) of HCW according to its type and use a labelling system for the containers. After decontamination wastes generated from laboratories and samples are collected and carried to the incinerators by personnel dedicated to waste handling using a cart. The personnel uses appropriate PPE during collection and transportation according to the EPHI safety manual and waste management procedures. Infectious wastes from laboratory EPHI has been burned in Pyrolytic Technology incinerators (See figure 15) that are designed for medical and pharmaceutical hazardous waste management. They can dispose of highly hazardous pathological waste and all medical waste. The pyrolytic incineration technology also called controlled air incineration or double-chamber incineration, is a reliable and commonly used treatment process for health-care waste disposal.

The laboratories use an autoclave to treat positive bacterial cultures, blood samples, syringes or any waste produced from testing. In EPHI's labs, liquid wastes, which contains pathogens, blood and hazardous chemical, except hazardous chemical they are treated with disinfectants, and finally it is disposed off into the septic tanks. Chemical, wastes are treated using neutralizing/dilution methods. All non-infectious wastes are collected at the central waste collection area and then transported by the municipality vehicle transported to disposal sites.

7.6.2 Existing EPHI Incinerator

The EPHI's incinerators comprise a pyrolytic chamber and a post-combustion chamber and the waste is thermally decomposed through an oxygen-deficient, medium-temperature combustion process (800– 900°C), producing solid ashes and gases. The gases produced in this way are burned at high temperatures (900– 1200°C) by a fuel burner in the post-combustion chamber, using an excess of air to minimize smoke and odors. The incinerators are properly functioning and have neither created disturbance nor nuisance to the local community around the area. EPHI's Incinerators are located east part (See below the location in the figure) of EPH, the surrounding place is an open field, and store. Although EPHI has two incinerators, EPHI is currently using only one incinerator because the amount of waste generated at EPHI cannot be beyond the capacity of one incinerator, and the second incinerator has been working for more than 20 years and it is getting old and the capacity of the existing incinerator to burn is 50kg per hours, EPHI is using as back up incinerator when the second incinerator is non- functional. The second incinerator has been working for more than eight years and it can burn 100 kg per hour and currently, the incineration of waste is performed on average 4 times a week. The detailed specification and emission standards claimed by the manufacturer of the incinerator are summarized in tables 11 and 12. However, no detailed documented data/information on the existing incinerator is not found.

Table 17: Summary of emissions to the atmosphere by the EPHI incinerators

S.N	Substance	Emissions to atmosphere*
1.	Particulate	30 mg/Nm³
2.	CO	100 mg/Nm³
3.	Sulphur Dioxide	200 mg/Nm³
4.	HCL	30 mg/Nm³
5.	Nitrogen Dioxide	300 mg/Nm³
6.	Dioxins and Furanes	0.1 mg/Nm³

**Smoke does not exceed No. 1 Ringelmann Scale*

Regarding the incinerator operator's capacity, there are 2 personnel working as operators and they are trained every year on incinerator operation, and preventive maintenance, waste management safety and PPE utilization, risks associated with incinerator and mitigations, spill management. Concerning incinerator maintenance, EPHI has a team of Medical Equipment maintenance working on performing preventive and curative maintenance for medical equipment, BSC, HVAC, incinerator and other related equipment so that the team has been performing preventive maintenance on an annual based and according to the manufacturer recommendation including replacement of parts if required. In addition, the incinerators have been mechanical failures and most of the mechanical failures were maintained by EPHI bioengineers (trained by the manufacture) with limited technical assistance from suppliers however no evidence showed the cost for the periodical maintenance of the incinerators since the spare part have been purchased by partners as support. Regarding monitoring and compliance records, no evidence showed the regulatory body carrying out sampling and testing of emissions. There has been no ESIA conducted for the existing incinerators.

Table 18: Specification for Existing EPHI incinerator

Specification	**Information**
Model of incinerator	Incino B
Type of waste	Medical
Country of manufacture	United Kingdom
Year of manufacture	2008
Technology use	Pyrolitec
Capacity	100kg/hr
Fuel type	Diesel
Chimney Height	20m from the ground
Chimney weight	2500Kg
pre-treatment criteria	None
Number of burners	2 (Primary Chamber and Secondary Chamber)
Primary combustible temperature	750 to 850oC
Secondary combustible temperature	950 to 1100oC
Incinerator weight	19000Kg

Figure 15: Incinerators at EPHI for Waste Management

With regard to emissions to the atmosphere, one of the existing incinerators (which is eight years old) complies with UK environmental standards the emissions to the atmosphere, summarized in table 17 above. As incinerators are properly functioning, there is no complaint from the community and it has neither created disturbance nor a nuisance to the local community around the area. However, these incinerators do not meet the current acceptable emission standard such as EU and WB.

7.6.3 Existing Liquid Waste Management Practice at EPHI

Currently, EPHI is managing liquid waste with the use of an onsite waste treatment system. The treatment system mainly focused on the physical separation of scum and grits from the liquid waste and the retention of microorganisms on porous organic materials packed in a septic tank and sock-away pits. In EPHI the treatment system is composed of one big septic tank//manhole that collectively receives waste from different laboratories of the institute. Once the waste is submerged in the holding tank, the waste is then flowing into the consecutive of a double-chambered septic tank and sock-away pits. The septic tank allows the waste to rest in the first chamber and so that the sludge precipitates. Once the sludge is retained, the effluent further enters into sock-away pits. These sock-away pits are packed with different porous-sized gravels, cobbles and sands of different mesh sizes. Around 4 septic tanks and more than 4 sock away pits are used for liquid waste treatment in the current waste

treatment of EPHI. The construction material used for these treatment units is pre-casted concrete materials. These materials were used to prevent the infiltration of effluent into the groundwater. The disposal of treated wastewater and sludge from septic and sock-away pits are currently outsourced to the Addis Ababa water and sewerage authority (Kaliti liquid waste treatment and Kotebe sludge management plants respectively).

Treated wastes have reduced levels of organic or nutrient content, not to mention an undetectable level of heavy metals. On the other hand, the toxicological investigation shows that the waste does not have a lethal effect and the skin irritation test on rodents shows that the treated waste has no negative effect.

7.6.4 EPHI's Capacity and Experience In Biological Research and Diagnostic Laboratories

EPHI has considerable experience in biological research and diagnostic laboratories for several decades of years. Based on the information provided by the EPHI National Laboratory Capacity Building director and Laboratory accreditation and Quality Improvement team, EPHI has operated BSL-2- equivalent laboratories for at least the last 50 years without any infections associated with their activities. Also, there were no unintentional releases to the environment or to the public associated with the EPHI biological research and diagnostic laboratories. In addition, EPHI also operates a mobile BSL 3 laboratory for the last 2 years, and EPHI has a biosafety and biosecurity team working on biosafety and biosecurity at EPHI. There has been no incidence of laboratory-acquired infections recorded for EPHI workers. Based on extensive experience with the safe handling of biological materials at EPHI, it is projected that the diagnosis and scientific research to be conducted at the proposed BSL-3 facility would not result in significant impacts on normal operations to workers or the public as well as to the environment.

7.6.5 Experiences and Capacity of Ethiopia Managing BSL3 Laboratory

As clearly indicated in its Strategic Plan of 2015/16-2019/20, the Ethiopian Public Health Institute has long been planning to establish BSL3 capacity to ensure the protection of health and safety of health care workers when dealing with highly infectious and exotic agents that pose a high individual risk infection with severe to fatal disease in humans while investigating unknown etiologic agents of fatal diseases of epidemic proportion or conducting researches involving dangerous pathogens. The institute has thus considered the inclusion of this activity in the WB- Africa CDC Regional Investment Financing Program as a golden opportunity to

realize its longstanding vision. As part of this, the Ethiopian government has expressed a strong commitment and made necessary preparations including the identification of a site for state-of-the-art Reference Laboratory construction with a BSL3 suite in EPHI's existing campus. In addition, the government is committed to key aspects of designing, constructing and equipping the BSL3 laboratory facility in accordance with WHO biosafety standards and guidelines, and also in collaboration with other partners (CDC, WHO). The FMoH will recruit appropriate experts to ascertain the costs for the construction of the proposed facility as well as its maintenance and long-term operation. Even though there is a crucial need for having a brand new well established BSL3 Laboratory for better management of public health diseases and responses to outbreaks, Ethiopia has ample experience in the proper use and reliable management of BSL3 laboratories.

Information was extracted from the environmental public health laboratory of EPHI.

7.6.6 Mobile BSL3 Laboratory at Ethiopian Public Health Institute

Procurement and installation of Ethiopia's BSL3 mobile laboratory were made possible through an extraordinary technical and financial partnership between the Federal Ministry of Health (FMOH) and the United Nations Country Team (UNCT) in Ethiopia. The acquisition of this mobile lab was decided at the time of the Ebola outbreak in West Africa from 2014 to 2016. This was part of multiple efforts undertaken by the FMOH to prevent, detect and contain an unexpected spread of the virus to Ethiopia.

Currently, the laboratory has a standard Biosafety Manual, well-trained laboratory professionals and Biomedical Engineers to manage the laboratory and its functions. The Biosafety Manual describes extra precautionary measures to be undertaken to protect the health and safety of the staff and the community through which the mobile lab passes or where it is stationed. EPHI will deploy this Mobile BSL3 laboratory to outbreak sites in the country usually in remote areas where there is limited access or no diagnostic capacity to support response to a disease outbreak.

In addition, EPHI has accumulated several years of experience in managing and operating many BSL2 laboratories located on its premises and has been implementing Biosafety and Biosecurity programs as part of the GHSA initiative under the coordination and leadership of a dedicated Biosafety and Biosecurity Team. The institute has also been implementing a Pathogen Asset Control System (PACS) at relevant laboratories for the last three years and has systems in place for the proper management of liquid and solid laboratory wastes. Capacity for Biomedical Engineers has gone through rigorous training courses

provided by Eagleson Institute in the USA on the installation, maintenance, validation and certification of Biological Safety Cabinets (BSC) of all types.

7.6.7 BSL-3 Laboratory Located at National Animal Health Diagnostics and Investigation Centre

This laboratory is also one of the high containment laboratories in Ethiopia and is located at the National Animal Health Diagnostics and Investigation Centre (NAHDIC) on the outskirt of Addis Ababa (25km) in Sebeta town and was established in 2009. NAHDIC is the referral and references veterinary laboratory in Ethiopia. It is the Centre of excellence for animal disease surveillance, investigation, diagnosis and research which plays substantial roles in promoting the export of animals and animal products, improvement of the livelihood of farmers and pastoralists, provision of professional support for investors involved in animal farming and transfer of technologies to stakeholders. This laboratory was established in response to the emergence of avian influenza and the need to get prepared to detect the disease but also considering the importance of such a facility for handling other high-risk Zoonotic diseases.

This laboratory has contributed a lot during the Ebola outbreak in West Africa in ruling out suspected Ebola cases in Ethiopia. The investigations were routinely carried out by laboratory professionals from EPHI who have previously received comprehensive training in South Africa on the laboratory diagnosis of the Ebola Virus. These professionals are currently managing EPHI's mobile BSL3 laboratory described above. Currently, NAHDIC itself has adequate well-trained laboratory staff with strong leadership and a robust system for the proper management of the BSL3 facility.

7.6.8 AU-Pan African Veterinary Vaccine Centre (AU-PANVAC) Laboratory

The Pan African Veterinary Vaccine Centre, an African Union Agency, was launched in 2004 in Bishoftu town of Ethiopia (42 km from Addis Ababa). The mission of the laboratory is to promote the production and use of good-quality vaccines and reagents for the control and eradication of animal diseases in Africa. This laboratory is accredited to ISO17025 standards and is currently providing services in the Quality Control of Veterinary Vaccines produced in Africa and imported into Africa, producing biological reagents for the diagnosis of various animal diseases and surveillance activities, facilitating the standardization of veterinary vaccines production, promoting the transfer of appropriate vaccine production technologies in Africa and providing technical support services to veterinary vaccines and quality control laboratories. Ethiopia, as a member of AU, is benefiting a lot from all services being provided

by PANVAC including experience sharing on the safe use and management of the BSL3 laboratory facility.

7.6.9 EPHI's Commitment for Sustainable Financing of the Operation and Maintenance of the BSL3 Facility Beyond the Project's Life Period

EPHI's proposal to the Africa CDC Regional Investment Financing Program as related to the designing, construction, furnishing and equipping of the National Reference Laboratory with a BSL3 suite is only to finance the activities including covering costs for initial validation, certification and full-fledged operationalization of the BSL3 facility. As such, EPHI is fully aware, committed and able to finance the operation and maintenance of this special facility beyond the project's life period.

8 PROJECT ALTERNATIVES

In the early stages of the development of the proposed BSL-3 project in EPHI, different project alternative option has been considered from the point of view of site layouts, alternative designs, alternative processes and materials and waste management practices. The "no action" alternative was also considered to evaluate the scenario in the absence of the project taking place.

8.1 No project alternative

The "No action" option will not be preferred for several reasons. Firstly, Ethiopia's public health system is continually tested by both recurrent and unexpected disease outbreaks and faces the continual challenge of managing the health consequences of natural and manmade disasters, crises, and conflict. Moreover, Ethiopia's proximity to multiple fragile states and its status as a major land and air transportation hub greatly exacerbates its vulnerability to epidemic disease simultaneously exposing the African continent to the potential undetected rapid spread of such disease. Therefore, the EPHI foresees the construction and equipping of the proposed BSL-3 NRL to elevate the capacity and status of the institute to conduct specialized testing, with a focus on the diagnosis of emerging and re-emerging lethal pathogens. Hence, the construction and equipping of the proposed BSL 3 laboratory will bolster the capacity of EPHI for advanced public health research, provision of quality referral diagnostic services and timely detection of causative agents of epidemic disease outbreaks thus facilitating quick and effective response to public health threats.

Secondly, the proposed BSL-3 project will serve as the Centre of Excellence and Regional Reference Laboratory of the East Africa RISLNET. Accordingly, with the level of laboratory capacity to be developed by the proposed BSL-3 NRL project, EPHI will be well set to effectively support the implementation of Africa CDC's strategies and initiatives for the promotion of public health in the Horn of Africa Region. The institute will be well positioned to assume continental responsibilities and functions for the advancement of public health as host for the Africa CDC and member of the Regional and Continental Networks of African National Public Health Institutes.

Thirdly, the land use types in the EPHI campus mainly constitute a considerable built-up area mixed with open and undeveloped parts. Thus, the No-action alternative option will not have much significance in helping to preserve environmentally sensitive or aesthetically attractive plots of land within the EPHI campus. Instead, the no-project alternative will prolong the

underutilization of the available land resource in the EPHI campus for a designated types of land uses by the Addis Ababa City Master plan.

In summary, the “No-action” option will undermine the huge socio-economic and political benefits that Ethiopia and other Countries in the region can harness from the development and operationalization of the proposed BSL-3 NRL project

8.2 Alternative Site

The site selection process for the proposed NRL project was confined to the premises of the EPHI campus. Several Laboratory and public health research and training facilities are already present within the EPHI compound and were in use for several decades now. The EPHI campus has developed its own ten years master plan which provides a comprehensive framework for facility planning and site utilization from 2015-2025. The campus master plan has been instrumental in identifying and justifying the site selection for the proposed new National Reference Laboratory (NRL) building in the EPHI campus. The options of selecting other locations outside the EPHI campus for the NRL were simply rendered irrelevant due to the favourable conditions the campus master plan create for efficient use of available land, skilled manpower, workflow, shared facilities, and in ensuring the bio-safety and bio-security of the NRL. Installation of the secondary or tertiary wastewater treatment plant for the project within the EPHI campus is not feasible due to the core residential and commercial area and there is no adequate space for the construction of a wastewater treatment plant within the EPHI. Therefore, Onsite storage of hazardous wastes using a separate safety tank and the construction of an offsite wastewater treatment plant outside the EPHI Compound is the most feasible options.

8.3 Alternative Schedule

This option entails carrying out the proposal at a later time thereby offsetting its impacts to that time. The only benefit is improvement in baseline conditions and technologies that may be involved with the proposal. However these are not guaranteed and it may only lead to delays in development, therefore carrying out the proposed project with mitigation would be a preferred option due to this uncertainty. In addition, carrying out the proposed project at later time may lead to more operational and logistic costs due to increasing inflation and standards of living.

8.4 Alternative Designs

BSL 3 NRL will be well organized, adequately supervised and staffed reference laboratory with the necessary space, facilities and equipment to perform all the services commensurate. The project design will ensure compliance with the national construction quality standards for the national reference laboratory, particularly BSL standards (building material quality, mixing design, soundproofing, ventilation, illumination, sanitation, radiation protection, plumbing, parking space and green area). The working environment is kept organized and clean, with safe procedures for the handling of specimens and waste material to ensure client and staff protection from unnecessary risks at all times.

The BSL 3 laboratory will consist of an anteroom and laboratory rooms. It will have gas-impermeable walls, ceilings and floors. Air gaps under doors would be acceptable for directional airflow. If door gaps are sealed, the laboratory must not leak gaseous decontamination materials. The BSL3 laboratory will be designed for ease of maintenance, so that access to critical mechanical equipment (ventilation ducts, fans, piping, etc.) is outside containment. The laboratory will consist of high-quality room construction with special consideration given to joints, finishes and penetrations. There will be a room for large equipment decontamination.

8.5 Technology Alternative

8.5.1 Waste Management Technology Alternative

8.5.1.1 The Sanitary Landfill Alternative

Sanitary landfills, if properly constructed and operated, could provide a relatively safe disposal method for municipal solid waste including healthcare wastes. This method, however, requires a larger space for compaction of each day's waste and there is no readily available sanitary landfill in Addis Ababa city that can receive and safely dispose of healthcare wastes. Hazardous, infectious and contaminated wastes should be segregated at the source and temporarily stored until incinerated.

As there is no available land hazardous wastes, fly ash and bottom ash from incineration require a secured landfill for storage. Ideally, the pit should be lined with low permeability material such as clay and plastic or concrete-based materials at the bottom to prevent the pollution of shallow groundwater and should be fenced in to prevent scavenger access. The leachate should also connect to the septic tank for further treatment.

Non-hazardous wastes will use Repi landfill for final disposal of the waste after segregation of wastes at the source and storage of wastes temporarily within the EPHI compound (Transferring stations). Therefore, the use of the Repi landfill will be the preferred option for the disposal of non-hazardous waste generated from the proposed BSL 3 NRL.

8.5.1.2 The Waste Incineration Technology Alternative

Incinerators, if operated properly, eliminate pathogens from the waste and reduce waste to ashes. However, certain types of healthcare waste e.g. pharmaceutical waste or chemical waste require higher temperatures for complete destruction. Higher operating temperatures and cleaning of exhaust gases limit the atmospheric pollution and odors produced by the incineration process.

The existing incinerator has a capacity of 100 kg/hr with an operating temperature range of 750°C to 1050°C. It consumes about 200 litres/day of diesel oil and the stack height is also 8 meters. However, this incinerator does not fulfill the minimum emission standard specified in the preceding section which is based on the WB EHS Guidelines for Healthcare Facilities (2007).

Therefore, the construction of another incinerator that fulfills the WB EHS Guidelines for Healthcare Facilities (2007) is the preferred option considering the waste characteristics generated from EPHI BSL 3 NRL. The incinerator will be a pyrolysis incinerator with a capacity to burn 50 kg per hour with emission reduction device control (Fabric filter coated with catalyst) made from PTFE, with parallel dedusting, lower contamination of filter dusts because of PCDD/PCDF destruction at the catalytic surface that has high-efficiency reduction of dioxin upto <0.1 ng TEQ/m3.

8.5.1.3 Effluent Waste Management Alternative

Construction of Onsite Waste Water Treatment Plant

The effluent from the plant must meet the national effluent discharge quality standards, including the Quality Standards for Classified as a health care facility by WBG before discharge to the environment. This requires an initial equalization, to ensure dampening peaks of pollutant and flow rate; a neutralization and floating section, to adjust the pH of wastewater and to remove the oil and the suspended solids before entering the biological milieu; a fine screen to remove solids to protect the membrane (MBR); biological section, to remove the biodegradable organic substance and the nitrogen compounds. The membrane Bioreactor (MBR) process has been considered to ensure high efficiency of the process and to

minimize land usage; and a section for tertiary treatment, to remove the non-biodegradable organic substance (dosing ozone and using GAC filter - Granular Activate Carbon) A complete sludge line to reduce sludge volumes to be disposed or incinerate. In addition, it requires its own infrastructure such as electric power, water supply and boiler. This requires adequate space and social acceptance as core residential and commercial areas of EPHI. Therefore, Onsite storage of hazardous wastes using a separate safety tank and the construction of an offsite wastewater treatment plant outside the EPHI Compound is the most feasible option.

Use of Existing Sewer Line: Use of a public sewer line is one of the options considered for treating and disposing of liquid waste generated from the proposed BSL 3 lab at the municipal main or trunk sewer. This involves the construction of a system to connect the municipal sewer line and it is inexpensive. This alternative is possible currently because there is a municipal sewer line near to EPHI compound to which an EPHI sewer system could be connected for non-hazardous wastes. The EPHI can use a vacuum truck for the transport of non-hazardous waste to the Kaliti wastewater treatment plant until it connects to the municipal sewer line.

Onsite Retention using Septic Tank: The septic tank is the most common small-scale decentralized treatment unit for grey water and wastewater from the laboratory department. It is basically a sedimentation tank. Its shape can be rectangular or cylindrical. Safety tanks are cost-effective, long-lasting, low-maintenance cost, and limited technical requirements.

The collected wastes should be handled, transported and treated using a wastewater treatment plant from the country to prevent the pollution of the environment by the waste. Considering the above requirements, the onsite retention of effluent wastes (infectious, hazardous and toxic) is one option for waste management system followed by offsite treatment at EFDA vaccine laboratory site before disposal to the environment.

8.5.2 Selected Technology Alternative

Considering the available space, presence of residential and commercial area around the project site, management requirement, public health concern, the team of consultants recommend the construction of a separate septic tank for hazardous and nonhazardous wastes and disposal of nonhazardous liquid waste in Kality wastewater treatment plant using vacuum truck and treatment of hazardous liquid wastes using offsite wastewater treatment plant to be constructed by EFDA in collaboration with MoH. The proponent (EPHI) should also install

an incinerator for the clinical and pathological wastes and the ashes formed within it should be also stored in a secured and concrete-based landfill within the EPHI compound. Nonhazardous solid wastes should be also segregated at the source and stored in temporary landfill at EPHI until disposed to the Repi landfill.

8.6 Utilities

8.6.1 Electricity

The traditional paradigm of energy supply for research facilities worldwide involved access to grid power from the national source and backed up by on-site fuel-based generator power. Diesel generators, which have long been the default on-site power option, have become increasingly expensive to fuel and maintain. As a proportion of total health service costs, fuel costs can be particularly high, especially in the most resource-constrained settings. Therefore, diesel generators are preferred if and only if the power supply is interrupted. The EPHI should also consider using on-site renewable energy sources such as solar energy either as a primary or backup source for minor operations such as road lighting.

8.6.2 Water

Water is required both for domestic and laboratory uses. Domestic water includes both drinking and cleaning purposes. BSL 3 uses include water used for cleaning, solvent, sanitary facility, toilet flushing, greenery and others.

The two main options that exist for water use is to either use a variety of sources that reduce over-reliance on municipal supply (borehole, and rainwater harvesting) and/or use the Addis Ababa water and sewerage authority. EPHI has also its own borehole source as an alternative source of water supply.

The former option which is the best case has the advantage of ensuring consistent supply while placing as minimal pressure as possible on the city water demand and infrastructure. It also promotes wise use, water recycling and captures strategies that ensure effective usage and conservation of water. The disadvantages of this option are that it will involve the construction of extra facilities and management resources for the treatment plan and therefore extra costs. Therefore, the borehole can be remaining as one of the alternatives for water supply for both the existing facility and the project in addition to municipal supply from Addis Ababa Water and Sewerage Authority.

8.7 Transport

Transportation infrastructure is vital in accessing the institute. The Project site will be accessible by a separate gate to avoid damage to the existing infrastructure and overcrowded of the main gate which is used for the day-to-day operation of EPHI

8.8 Materials

Alternative for the materials that will be used in the project involves using locally procured materials and the second option involves primarily importing materials. The former alternative is the preferred option since it will ensure the project contributes to the national economy by creating business opportunities for the local suppliers of these materials while conserving the environment by ensuring the most environmentally friendly suppliers are contracted. For service that demands high quality and unavailable materials, the contractor can use importing materials.

9 PROJECT ACTIVITIES

9.1 Pre-construction and Construction Phase

The pre-construction activity includes the removal of the existing building and decommissioning of the old incinerator. When the old facilities are vacated and/or decommissioned, any chemical, radioactive or biological contamination must be dealt with and all of these materials must be removed and disposed of properly as per the waste management plan.

The construction activities include site preparation, infrastructure utilities installation, erection, demolition, assembling, altering, installing or equipping of buildings, structures, roads or appurtenances thereto, including land clearing, grading, excavating and filling.

The major activities during the construction phase are civil construction work, vehicular movement, loading and unloading civil items and plant machineries, on-site storage of civil items and plant machineries, erection of plant and civil structures, power supply, maintenance of construction machinery and disposal of solid wastes.

9.2 Operation and Maintenance Phase

The proposed NRL building would be divided into two main blocks. The first block accommodates the main NRL building which consists of a BSL-3 laboratory suite and general Laboratory support facilities and the second block is a multi-purpose building which accommodates Proficiency Testing Panel Production Centre (PTPC), Bio-bank Centre, Central Warehouse and a laboratory medical equipment maintenance Centre.

The PTPC will produce PT samples for Microbiology, Hematology, Parasitology, HIV Viral Load, HIV Early Infant Diagnosis (EID), serological tests, biochemistry, blood transfusion, immunological tests, mycology, and other samples. The planned bio-bank stores leftover specimens with full information collected from health facilities. Liquid nitrogen (LN2) facilities contain LN2 in liquid-phase tanks and vapor-phase containers. It has also a central warehouse facility which will be part of the BSL 3 laboratory. Its main utility is to provide and maintain sustainable supply and storage of reagents, chemicals and consumables bound to activities of the BSL 3 laboratory.

9.3 Decommissioning Phase

Decommissioning is the last phase in the lifetime of such facilities, following their design, construction, operation and permanent shutdown. Decommissioning activities such as the

removal of inventory to obtain a state of passive safety, dismantling and removal of the components, systems and equipment including decontamination as appropriate with the aim of re-utilization of facilities for production after construction or making the facility suitable for any activity after construction or operation. Here, it is important to give clues on the need for identifying and screening the likely impacts with their significance encountered per the project`s phases, mentioned above.

10 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

10.1 Impact Identification

The following main environmental and social impacts shall be identified through professional judgment and a matrix system based on the biophysical and socio-economic baseline data and project characteristics.

Table 19: Impact identification

Expected impact	**Project phases**			**Remark**
	Construction	**Operation**	**Decommissioning**	
Protect and Promote the *Health of the community*		√		The project will develop infrastructure that will create foundation to contribute to the preservation and improvement of public health in the East Africa region through addressing priority *public Health* and Nutrition problems by doing problem-solving research, public health emergency management, establishing and maintaining quality laboratory systems.
Create employment opportunity	√	√	√	Professional, middle, contract and daily laborers will be employed in the company during the construction, operation and decommissioning phase. Improvement of health services results in a moderately good human capital condition which intern improves the workforce's abilities, efficiency, and quality of life.
Income Generation and Economic Activity	√	√		It enhances the economy locally and nationally through income generation, an influx of construction workers, upgrading and increasing income, and availability of skilled workforce through research and innovation.
Research and community services		√		EPHI conducts research based on the national public health research agenda and on priority

				public health and nutrition issues. The institute conducts surveillance for the early identification and detection of public health risks and prevention of public health emergencies. The implementation of the project wills synergies these activities.
Increase in skilled workforce in the country	√	√	√	The construction of the project will enhance the skill of construction workers as it requires enhanced facility design in addition to conventional practices. BSL-3 requires also operational controls and special practices that require comprehensive training program for laboratory workers animal facility workers and maintenance workers. All these will increase the skill of the workers at the facility.
Regional Integration		√		Encourage cross-border collaboration in centers of excellence among the countries participating in the project and beyond.
Air, water and soil pollution	√	√	√	Air, water and soil pollution is expected during the construction, operation and decommissioning phases.
Noise and vibration	√	√	√	Some noise pollution is expected from this project during the construction, operation and decommissioning phases.
Solid waste impacts	√	√	√	Significant amount of solid waste will be generated during construction, operation (hazardous and infectious) and decommission phase
Liquid wastes (hazardous and infectious)	√	√	√	Wastewater is expected to generate during the construction and operation of the project.
Impact on plant, soil	√	√	√	The construction of the project will clear

and animal biodiversity				limited plants on the project site. Soil biodiversity will be affected during site clearing and foundation preparation. In addition, many laboratory animals have been used for research purposes and will have an impact on animal biodiversity. Decommissioning of the facility will also have an impact on plant and animal biodiversity
Impacts on Historical Building	√	√		deep excavations and/or the use of heavy vibrating equipment may damage Historical Buildings and other buildings near the project site
Impacts on utility	√	√		Influx of workers to the project site during the construction phase may increase utility demand. High utility requirement of BSL 3 will have an impact on water and electricity from the city administration.
Risk of Social Conflict and Crime	√	√		Conflicts may arise between the local community and the construction workers, which may be related to religious, cultural or ethnic differences, or based on competition for local resources. An influx of workers to the construction site result increased rates of illicit behavior and crime. Inappropriate waste management practices during the operation phase will also cause a risk of social conflict.
Gender based violence	√	√	√	A large influx of male labor may lead to an increase in exploitative sexual relationships and human trafficking whereby women and girls (working at the institute) are forced into sex work during the construction phase.
Impact on traffic and public safety	√	√	√	Use of construction machineries and dump trucks will have an impact on traffic and public

				safety considering the high traffic load of the access road.
Risk of communicable disease,	√	√		Influx of workers during construction, handling, transportation and treatment of hazardous and infectious wastes result in communicable disease for workers and the community
Risk related to slip, trip and falls	√		√	construction slips, trips and falls include uneven surfaces, obstacles, trailing cables, wet or slippery surfaces, and changes in level will be expected during construction
Risk related to electricity	√	√	√	Use of poorly maintained electrical equipment, contact with underground power cables during excavation work or horizontal boring or drilling, fires started by poor electrical installations and faulty electrical appliances, untested worksite distribution boards and defective residual-current-operated protective devices
Risk related to fire and explosion	√	√	√	welding or abrasive cutting techniques used in places not specially prepared for such works, the use of solvents and ignition by sparks, explosive atmospheres in sewers, damage to pipes containing explosive gases may result in fire and explosion risks
Increased Burden on and Competition for Public Service Provision and Accommodation	√	√		Influx of service finders may increase demand and competition for local social and health services, as well as for goods and services, which can lead to price hikes and crowding out of local consumers.
Child right violation impacts	√			Children experience insidious forms of violence, exploitation and abuse during construction
Impacts on	√	√	√	Occupational health and safety impacts are

Occupational Health and Safety				expected during the construction, operation, and decommissioning of the project.
Impact due to Improper Waste Management		√		Health-care activities lead to the production of waste that may lead to adverse health effects. Poorly managed sharp wastes could expose the healthcare workers, waste handlers and the community to infections.
Risk associated with final waste disposal		√		The disposal and storage of healthcare wastes without treatment leads to contamination of surface and groundwater through long term leachate accumulation from the disposal sites and ultimately disturbs the ecological and environmental balance
Impacts of Improper wastewater treatment at EPHI BSL 3 NRL Complex		√		Inadequate tank volume, geometry and compartmentalization, the use of substandard construction materials can reduce the efficiency of the septic tank treatment system Retention). In addition, a faulty designing can result also in cracking of the tank, leakage (ground infiltration), may result physical ,biological and social environment impacts.
Impacts of incineration of solid wastes		√		Waste incinerators have been a major source of emissions of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs, other persistent organic pollutants (POPs) and some heavy metals such as cadmium and mercury. Human health risks due to dioxin and furan exposure have been reported
Impacts associated with off-site transport of waste		√		Off-site transportation of wastewater to the treatment plant will be a linkage or spillage of the waste from the vehicle due to poor packaging of the waste and/ car accident. This may cause physical ,biological and social

				environment impacts.

10.2 Impact Analysis

Once all the important impacts have been identified, their potential size and characteristics were predicted and evaluated systematically by the environmental and social specialists based on physical, biological, socio-economic and cultural data to estimate the likely characteristics and parameters of impacts (e.g. magnitude, spatial occurrence, etc.). For this analysis weighted matrix was used to assist the total impact estimation (as well as assign values). The result analysis is displayed in the table 20. Only impacts with moderate and above impact significant will be further described and mitigation measures will be developed for these impacts.

Table 20: Total impact analysis of the proposed project

Identified Impacts	**Character (C)**	**Significance (S)**	**Disturbance (D)**	**Occurrence (O)**	**Extension (E)**	**Duration (D*)**	**Reversibility (R)**	**Total Impact (TI)**	**Remark**
Construction Phase Impacts									
Employment opportunities	+	3	2	3	2	2	1	(+13)	Moderate
Increase in skilled workforce	+	2	2	2	2	1	2	(+11)	Moderate
Income Generation and Economic Activity	+	2	2	3	1	1	2	(+9)	Moderate
Air pollution	-	2	2	3	1	2	1	(-11)	Moderate
Water pollution	-	2	2	2	1	1	1	(-9)	Moderate
Soil pollution and erosion	-	2	1	3	1	1	2	(-10)	Moderate
Noise and vibration impacts	-	3	1	3	1	1	2	(-11)	Moderate
Solid Waste Impacts	-	3	1	3	2	1	2	(-12)	Moderate
Traffic and Public safety impacts	-	3	3	3	1	1	2	(-13)	Moderate
Public Health Impacts	-	3	2	2	2	2	2	(-13)	Moderate
Liquid Waste Impacts	-	2	1	3	2	1	2	(-11)	Moderate
Impact on plant, soil and animal biodiversity	-	1	1	2	2	1	2	(9)	Moderate

Identified Impacts	Character (C)	Significance (S)	Disturbance (D)	Occurrence (O)	Extension (E)	Duration (D*)	Reversibility (R)	Total Impact (TI)	Remark
Impacts on Historical Building	-	2	2	2	2	2	2	(-13)	Moderate
Impacts on utility	-	2	1	3	1	1	2	(-10)	Moderate
Risk of Social Conflict and Crime	-	2	2	2	1	1	2	(-10)	Moderate
Gender-based violence	-	2	2	2	1	1	3	(-11)	Moderate
Child right violation impacts	-	2	2	2	2	1	2	(-11)	Moderate
Increase Burden on Public Service	-	2	2	3	1	1	2	(-12)	Moderate
Occupational health and safety Risks									
Risk of communicable of disease	-	2	2	2	1	1	2	(-10)	Moderate
Risk related to slip, trip, and falls	-	2	2	2	2	2	1	(-11)	Moderate
Risk Related fire and explosion	-	2	1	2	1	2	1	(-9)	Moderate
Physical injury	-	3	2	2	2	2	2	(-13)	Moderate
Lung injury	-	2	2	2	1	2	2	(-11)	Moderate
Eye injury	-	2	1	2	1	2	2	(-10)	Moderate
Electrical hazard	-	2	2	2	1	2	2	(-11)	Moderate
Ergonomic hazard	-	2	1	2	1	2	2	(-10)	Moderate
Biological hazard	-	2	2	2	1	2	2	(-11)	Moderate
Muscle Skeletal disturbance	-	2	1	2	1	2	2	(-10)	Moderate
Risk of traffic accident	-	2	1	2	1	2	2	(-10)	Moderate
Operation Phase Impacts									
Protect and Promote the Health of the community	+	3	3	3	3	3	2	(+17)	High
Creation of employment opportunities	+	2	2	3	3	3	2	(+15)	High
Research and community services	+	3	3	3	3	3	2	(+17)	High
Increase in skilled workforce in the country	+	3	2	3	3	3	2	(+16)	High
Regional Integration	+	3	2	3	3	3	2	(+16)	High
Income generation and economic activity	+	3	3	3	3	3	2	(+17)	High

Identified Impacts	Character (C)	Significance (S)	Disturbance (D)	Occurrence (O)	Extension (E)	Duration (D*)	Reversibility (R)	Total Impact (TI)	Remark
Air pollution	-	3	3	3	2	3	2	(-16)	Severe
Water pollution	-	3	2	3	2	3	3	(-16)	Severe
Soil pollution	-	2	2	3	2	3	2	(-14)	Moderate
Noise and vibration	-	2	1	3	1	3	2	(-12)	Moderate
Solid waste impacts (Hazardous and infectious)	-	3	3	3	1	3	3	(-16)	Severe
Liquid wastes (Hazardous and infectious)	-	3	2	3	2	3	3	(-16)	Severe
Impacts on plant, soil and animal biodiversity	-	1	2	2	2	1	1	(-9)	Moderate
Impacts on utility	-	2	2	3	2	2	2	(-11)	Moderate
Risk of Social Conflict and Crime	-	2	2	2	2	3	2	(-13)	Moderate
Gender based violence	-	2	1	2	1	3	2	(-11)	Moderate
Impact on traffic and Public safety	-	2	1	2	1	3	2	(-11)	Moderate
Public Health Impacts	-	3	2	2	2	3	2	-(14)	Moderate
Increase Burden on Public Service	-	2	1	2	1	3	2	(-11)	Moderate
Occupational Health and Safety Risks									
Risk of infection	-	3	2	2	2	2	3	(-14)	Moderate
Risk of chemical hazard	-	2	2	2	2	2	2	(-12)	Moderate
Risk of burn	-	2	2	2	2	2	2	(-12)	Moderate
Ergonomic hazard	-	2	2	1	2	2	1	(-10)	Moderate
Injury and accident	-	2	2	2	2	2	2	(-12)	Moderate
Risk related to electricity (electric shock)	-	2	2	2	1	2	2	(-11)	Moderate
Risk related to fire and explosion	-	2	2	2	1	2	2	(-11)	Moderate
Impacts Related to Waste Management									
Improper Waste Managemen	-	3	3	3	2	3	2	(-16)	Severe
Risk associated with final waste disposal	-	3	2	2	2	3	2	(-14)	Moderat

Identified Impacts	Character (C)	Significance (S)	Disturbance (D)	Occurrence (O)	Extension (E)	Duration (D*)	Reversibility (R)	Total Impact (TI)	Remark
Impacts of Improper wastewater treatment at EPHI BSL 3 NRL Complex	-	3	3	3	2	3	2	(-16)	Severe
Impacts of incineration of solid wastes	-	3	3	3	2	3	2	(-16)	Severe
Impacts associated with off-site transport of waste	-	3	3	3	3	3	3	(-18)	Severe
Decommissioning Phase									
Impact on soil quality	-	1	1	2	2	1	1	(-8)	Low
Impact on water resource	-	1	1	2	1	1	1	(-7)	Low
Impact on air quality	-	2	1	3	1	1	1	(-9)	Moderate
Impact on noise Environment	-	2	1	3	1	1	1	(-9)	Moderate
Solid waste generation	-	2	2	2	2	1	1	(-10)	Moderate
Liquid waste generation	-	1	1	1	1	1	1	-(6)	Low
Impact on plant, soil and animal biodiversity	-	1	1	2	1	1	1	(-7)	Low
Impact on traffic and public safety	-	2	1	2	2	1	1	(-8)	Moderate
Occupational Health and safety Risk									
Risk related to slip, trip, and falls	-	2	2	2	1	2	1	(-10)	Moderate
Risk of injury	-	2	2	1	2	2	1	(-10)	Moderate
Risk related to electricity	-	2	2	2	1	2	1	(-10)	Moderate
Positive Impacts									
Income generation	+	2	1	1	1	1	1	(+7)	Low
Creation of employment	+	2	1	2	2	1	1	(+9)	Low
Increase economic activities	+	2	1	2	2	1	1	(+9)	Low

Where, C=Characteristics, S=Significance, D=Disturbance, O=Occurrence, E =Extension, D*=Duration, R=Reversibility

10.3 Beneficial Impact (Positive Impact)

10.3.1 Employment Opportunities

The proposed project is expected to provide direct and indirect employment to several workers during the pre-construction, construction and operation phases. The construction phase is expected to create job opportunities for 100 citizens. These range from unskilled casual workers, semi-skilled and skilled employees such as designers, supervisors, contractors, local material suppliers, masons, daily laborers, dwellers, merchants, security guards, cleaners, gardeners, drivers, wood-workers, metal workers, plumbers, consultants, etc.

During the operational phase of the proposed project create additional job opportunities for the local people. These include administrative staff, HVAC technicians, electrical technicians, equipment and instrument maintenance technicians (Biomedical engineers) technical staff, incinerator operators, supportive staff, cleaners, and security personnel.

Enhancement measures: Hiring local professionals and service providers at all levels where possible enhance the national benefit. There is also a need to recruit locally available labor for positions that do not demand special skills and experts that fulfill the requirements. This enhances the benefits of local communities and project sustainability. Outsourcing some activities such as greenery and cleaning services for local enterprises found in Gulele Sub-City Woreda 09 is important for project sustainability.

10.3.2 Increase Skilled Workforce and Center of Excellence

Africa CDC program will train new staff and build the skills of existing staff at EPHI to ensure the public health workforce is prepared to protect every community across the country and east Africa in general. Professionals will be assigned to Africa CDC programs and public health partner organizations, where they receive training and mentoring, strengthen applied public health and data science skills, and provide public health service project implementation. The project will also increase workforce skills during the construction and decommissioning phases.

Enhancement measures: Provide training for researchers, technical and supportive staff about the BSL 3 technology installed in the institute, waste handling, transport and disposal.

10.3.3 Income Generation and Economic Activity

Implementations of the BSL 3 NRL project will entail civil works requiring materials such as gravel, bricks, lumber and cement. In addition to the construction materials to be procured locally, the development of the BSL 3 NRL project will require supplies from abroad. It is a positive but short-term impact. Moreover, the people who are involved in these businesses supply and value chains will benefit from the employment creation. Additionally, the project will create business opportunities for the people who are involved in quarrying and brick production, furniture and carpentry, glass production, plant and gardening, tarmac, building contractors, equipment supply and maintenance, electric fittings, plumbing fittings and water infrastructure and food and drinking establishment service. During the operation phase, this project will also create business opportunities for the local people and increase the economy of the country through income tax. EPHI has been acting as a training center for both itself and clients outside. Attending training courses in community development can introduce many benefits to individuals, groups, organisations, and the community itself through the development and supply of training materials and refreshments for trainees. People who are in good health are more efficient economically. The improvement of public health will promote the improvement of people's work efficiency and the extension of working hours, which will promote economic growth and form a virtuous circle (Su *et at*., 2021).

Enhancement Measures: Where possible the construction contractor will be advised through contractual means to maximize the application and use of locally produced construction material supplies. This will increase the quantity of materials to be procured from the various local suppliers and hence it will enhance the income generation capacity of local suppliers. On the other hand earth materials needed for construction, for example, aggregate (stones and sand) are obtained from quarry operations. However, conscious or unwitting purchase of these materials from unlicensed operations indirectly promotes environmental degradation at illegal quarry sites and can cause moderate- to long-term negative impacts. Therefore, there will be a contractual obligation for contractors to procure construction materials from quarries legitimately licensed by Government. PPHI should also provide the first opportunity to the local people to procure training materials and get catering services. All technical and supportive staff should get adequate training to make the institute center of excellence. The contractor should give the priority to locally available materials.

10.3.4 Protect and Promote Community Health

The EPHI has been undertaking research, based on the national public health research agenda, on priority health and nutrition problems, and generate, absorb and disseminate scientific and technological knowledge to improve the health of the general public. It has been conducting surveillance for the early identification and detection of public health risks and prevents public health emergencies through adequate preparedness; and alert, warn and dispatch timely information during a public health emergency, responding effectively and timely and ensuring rapid recovery of the affected population from the impact of the public health emergency. The institute has been striving to strengthen its laboratories with trained manpower and technology to undertake problem-solving research provide an effective responses to public health emergencies, carry out referral diagnostic and analytical tests; and support the capacity building of health and food science laboratories at the national level to enable them to provide quality laboratory services.

Therefore, the implementation of BSL 3 NRL EPHI will transform the above services and objectives of the institute through the development of adequate laboratory infrastructures, which enable the institute to have effective public health emergency management; establish quality laboratory system; and train public health researchers and practitioners for best public health interventions.

Enhancement Measures: The facility should construct as per WHO standards and hiring the right construction agency for the construction of the BSL3 lab at EPHI are the key step for the success of the project. The EPHI BSL-3 lab would be operated according to all guidelines and requirements established by the CDC and NIH (CDC 1999), WHO, 2004, and BMBL (2005).

10.3.5 Regional Integration

A regional approach to developing the BSL-3 project can have several benefits, including facilitating the mobility of people and skilled labour, promoting peer learning among countries and institutions and sharing good policies and practices, and targeting employment toward regional economic corridors. The regional integration facilitates the flow of human capital and ideas and promotes medical tourism in the region.

Enhancement measures: The EPHI should promote the mobility of people and skilled labour. EPHI should identify skills gaps and develop cross-border skills enhancement programs. In simple terms, the extent to which countries and regions will benefit from

regional and global value chains depends on the skills of their populations: more precisely, on how well workers' competencies match the technology and research capacities of today and tomorrow.

10.3.6 Research and Community Services

The health problem in Ethiopia is wide and diverse with complex challenges. To address this, public health research plays an important role by generating and disseminating evidence based information to improve the health of the general public. The implementation of the project will capacitate the institutions to bring high-quality research that addresses community health problems effectively and efficiently in terms of quality, cost, and time and customer satisfaction.

Enhancement measures: EPHI is expected to use new and innovative methodologies that are responsive to today's complex and evolving public health challenges.

10.4 Potential Adverse Impacts (Negative Impact)

10.4.1 Physical Impacts

10.4.1.1 Impact on Air Quality

Pre-construction and Construction Phase: During site preparation and construction of the proposed BSL 3 NRL project, the use of heavy equipment would generate combustive-engine exhausts that would contribute to air pollution. However, since there would be very few of these pieces of equipment and their use would be limited in time, the potential effect on ambient air quality would be temporary and localized. During construction activities, there would be a temporary increase in particulate emissions. The operation of construction vehicles such as dump trucks, cranes, and those involved to transport building materials and waste would generate emissions of SO_2, CO_2, CO, NO_x and particulate matter. However, the potential effect of these emissions on ambient air quality would be localized and have an impact for a short duration only during clearance preparation and construction activities. In addition, a group of GHGs might be emitted from the burning of wastes generated during the pre-construction and construction phases. The emission of these gases contributes to air pollution and results in climate change.The demolition of the existing built environment that will take place during site clearing will lead to considerable levels of indoor cement dust which can affect workers and patients. The deteriorated air quality will be of critical effect to especially asthmatic construction workers, patients and laboratory workers with either minor or severe health impacts depending on the level and duration of exposure.

The EPHI is located close to the main highway which is a relatively high-traffic road that gives rise to gaseous emissions and dust. However, the emission from the vehicles during the pre-construction and construction activities of the BSL 3 NRL project will not contribute to the deterioration of air quality as compared to high traffic movement in the area.

Operation Phase: The emissions of compounds such as volatile organic compounds (VOCs), sulphur dioxide, hydrogen chloride and particulate matter (PM) from waste incineration are unlikely to contribute significantly to total emissions. However, waste incinerators have been a major source of emissions of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs, other persistent organic pollutants (POPs) and some heavy metals such as cadmium and mercury. Inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and in the generation of ash residue. Incinerated materials containing or treated with chlorine can generate dioxins and furans, which are human carcinogens and have been associated with a range of adverse health effects. Air quality effects during the operation of the incinerator generate emissions of SO2, CO2, CO, NOx, particulates and other toxic substances. The International Agency for Research on Cancer classifies 2,3,7,8 tetra-chlorinated dioxin as a known human carcinogen based on evidence from animal experiments and enough evidence on human studies (Ange *et al.,* 2012). Short-term (called acute) exposures may result in skin lesions and altered liver function. The composition of dioxins in the flue gases exiting the combustion chamber of incinerators ranges from 1 to 500 ng TEQ Nm^3. Therefore, it is important to treat the flue gas to reduce its concentration to an acceptable limit (0.1 ng TEQ Nm^3) before releasing it to the environment (Kulkarni *et al*., 2008). In that context, ambient air monitoring is an essential issue to estimate pollutant emissions such as dioxins. The temporary storage of municipal wastes to the southeast of the institute causes a bad odour to nearby residents due to the anaerobic decomposition of solid matter. Furthermore, GHGs including hydrofluorocarbon and chlorofluorocarbons would be emitted from refrigerators and air conditioners. These ozone-deleting substances might contribute to the risk of climate change.

Decommission phase: Most air pollution emissions from platform decommissioning will stem from the combustion of fuel by diesel engines, which are used in virtually all phases and activities of the decommissioning process. Dusts will be also produced during site clearing and leveling of the campus as per the design. In addition, demolishing the existing/old incinerators at the EPHI campus will result in the generation of air pollutants mainly

particulates and solid and solid wastes comprising of brick, concrete rubble, metal and others. These wastes may lead to health deterioration and environmental degradation unless proper mitigation measures are implemented.

10.4.1.2 Water Pollution Impacts

Construction phase: Site runoff and drainage may contain increased loads of suspended solids and contaminants. Potential sources of pollution from site drainage include runoff and erosion from exposed soil surfaces, earth working areas and stockpiles; release of grouting and cement materials with rain wash; wash water from dust suppression sprays; and fuel and lubricants from maintenance of construction vehicles and mechanical equipment. Domestic sewage would be generated from the workforce during the construction phase which may cause water pollution if appropriate actions are taken.

Water Quality could also be affected by construction activities through soil erosion, The impact of soil erosion can be very significant not only in reducing soil productivity but also in deteriorating water quality by increasing the levels of nitrogen (N) and phosphorus (P) in surface waters are also leading contributors to reduced water quality. One of the many problems that are commonly associated with soil erosion and sediment is the impact of P- and N-rich sediment in causing eutrophication, or significant growth of algae and other aquatic plants in nutrient-enriched waters that lower dissolved oxygen levels. As these algae and other plants die and decompose, the result is fish kills, and increased turbidity.

Inappropriate dumping of excavated soil will also result in the deposition of soil to the river which will change the physicochemical characteristics of water during the rainy season. In almost all cases the effect damages individual species, populations of species, and also causes harm to the natural biological communities. Surface water and groundwater are interrelated. Surface water seeps through the soil and becomes groundwater. Conversely, groundwater can also feed surface water sources.

Operation phase: The disposal of untreated health care wastes in landfills can lead to the contamination of the surface, and ground waters if those landfills are not properly constructed. The treatment of healthcare wastes with chemical disinfectants (perchlorate or chlorine) can result in the release of chemical substances into the environment if those substances are not handled, stored and disposed of in an environmentally sound manner. Incineration of waste results in the generation of ash residue which contains heavy metals.

Disposal of these ashes in an open environment results in leachates of heavy metals that can cause water pollution.

10.4.1.3 Soil Pollution

Construction Phase: Land clearing during site preparation and construction, there would be a very minor/negligible effect upon geology, soils, or seismicity. Liquid wastes from concrete batching plants, plastic bottles, PVC, rubber wastes, empty cans from oil and grease, used oils from machineries and trucks, and thermal insulation wastes may be the main cause of soil pollution. These wastes will alter the soil physiology such as soil pH, and affect the plant biodiversity in the institute. Non-biodegradable plastic wastes block the nutrient uptake by the plant. Accidental leakage of fuel, oil, or chemicals from vehicles stored within the area causes direct contamination of the soil which may degrade lower layers of soil depending on the number of spills. Excavation of the area for foundations may result in soil erosion.

Operation Phase: Infectious and hazardous wastes will be generated from the institute during operation. Incineration of heavy metals or materials with high metal content (in particular lead, mercury and cadmium) can lead to the spread of toxic metals in the environment. The ash formed after the incinerator will be expected to reach in heavy metals. Liquid wastes from public health research institutes are saturated with a variety of chemicals, infectious agents, detergents, solvents, and laboratory chemicals. When laboratory effluent containing these pollutants is allowed to flow in the fields, it clogs the pores of the soil resulting in a loss of soil productivity. The texture of the soil gets hardened and penetration of roots is prevented. These chemicals could also affect the microorganisms and in turn negatively affect the soil texture and fertility.

10.4.1.4 Noise and Vibration Impacts

Pre-construction and Construction Phase: Pre-construction phase will involve site clearance activity for the development of the access road and the project. Clearance of the site will involve the removal of vegetation and land leveling activities by using machineries which leads to the generation of noise. The removal of the old building also may cause sound pollution. The noise generated during this phase will be site-specific and for a short duration.

Operation of different machineries and equipment for construction activities, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people. Considerable levels of noise and vibrations will mainly result from the use of heavy construction equipment, running of heavy load traffic for construction materials

transportation, and regular traffic movement may generate noise during the construction period. The produced noise may have an impact on existing residents near to the project site and construction workers.

Operation Phase: The major sources of noise is highway traffic from the Swaziland Street and the operation of a generator during a power interruption. This source of continuous and disturbing noise and vibration during the operational phase is from the main road that comes from Piazza to Wingate. Generators and boilers will be installed within the facility and can be additional sources of sound. Also, there will be occasional noise due to ambulances and vehicles movement, and maintenance machinery.

Decommission phase: There will be a considerable increase in noise owing to the demolition process. This will be a short-term impact and will be felt throughout the demolition process. The main sources of noise will include: cars and trucks; the civil works of pulling down the project's built structures (especially of explosives used), and mechanized equipment that will be used in the processes involved in this project phase

10.4.1.5 Solid Waste Generation

Preconstruction and construction phase: The project will use a mat foundation where a continuous thick concrete slab on the soil will be applied that extends the entire footprint of the building. Building foundation works will involve the excavation of at least 1 m of existing material from the area under the building footprint (plus 0.8 m beyond the building footprint). The majority of this material will be taken off-site for disposal and new imported material used for the engineered backfilling. If appropriate action is not taken, discharge of sediment–laden stormwater runoff will be generated and high deposition of sediment will take place to the receiving river (Akaki river). The construction phase will also lead to the generation of construction wastes from the civil works and operations on the materials involved in the processes. These wastes include plastics, metal shavings, wood shavings, food wastes, plants, gases (Carbon, Nitrous and Sulphurous Oxides), fumes (from glues and other hydrocarbons), stone shavings, ceramics, bricks, glass, cardboard, soil, cement, asphalt, sand, concrete, paper, paints, sealants, adhesives, fasteners, construction effluent (grey water).

This type of waste poses risks to both human and environmental health. Some environmental impacts would include soil contamination, and water and air pollution, whereas health risks include: breathing complications and respiratory diseases, cancer, skin disorders, poisoning, etc.

Operation Phase Impacts: The major type of solid waste expected from the operation stage are contaminated primary packaging, dead animal body, cultures and stocks of infectious agents from laboratory work (e.g. waste from autopsies and infected animals from laboratories), or waste from patients with infections (e.g. swabs, bandages and disposable medical devices); Sharps wastes such as syringes, needles, disposable scalpels and blades; Pharmaceutical waste like expired, unused and contaminated drugs and vaccines; products contaminated by radionuclides including radioactive diagnostic material or radiotherapeutic materials used for diagnosis and research. It is expected that the operation of BSL 3 NRL will generate 39.87 ton/year of hazardous solid wastes. In addition, the existing facility has been generating 87.6 ton of solid waste. All these wastes are hazardous, infectious and cytotoxic if appropriate measures are taken. Ashes formed from incinerators have heavy metals or materials with high metal content (in particular lead, mercury and cadmium) can lead to the spread of toxic metals in the environment. Burial and random dumping on uncontrolled sites can have a direct impact on the environment in terms of soil and water pollution. A person who experiences one needle stick injury from a needle used on an infected source patient has risks of 30%, 1.8%, and 0.3% respectively of becoming infected with HBV, HCV and HIV (WHO, 2018).

Plastic bottles will be also generated during social events, training and annual conferences. Most Solid waste impacts are expected to be minor but their impact may be significant in the absence of a proper waste management plan i.e. improper disposal of waste may have adverse environmental effects such as air, water, public health, occupational health and safety and others.

Decommission phase: Waste in form of debris and pieces of metal and wood will arise. The decommissioning phase of the project will create demolition wastes which share similar characteristics with construction wastes and therefore similar risks.

The key environmental impacts are associated with the residual ash remaining in the incinerator unit and ash collector. The decommissioning and disposal of the incinerators will be limited to internal areas, therefore, the potential impacts are considered to be moderate and cause impacts on water and air quality.

10.4.1.6 Generation of Waste Water

Pre-construction and Construction phase: liquid wastes will be generated from the concrete batching plant during construction. Liquid wastes will be also generated from toilet

and washing facilities of construction workers. Hazardous materials stored on-site for vehicle and equipment maintenance would include petroleum fluids (lubricating oils, hydraulic fluid, and fuels), coolants, and battery electrolytes.

Operation Phase: It is expected that 131.4 M^3/year of hazardous and infectious liquid waste (i.e., contaminated syringes, needles, sharps, blood-soaked gauze and alike) will be generated from the proposed BSL 3 NRL. Since BSL 3 laboratory is a place where highly infectious agents are handled and manipulated, it may have potential risks resulting life-threatening for personnel working in the BSL 3 laboratory, the community and the environment in general. The agents may cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community.

In the BSL 3 laboratory there would be a generation of highly infectious agents due to laboratory activities (e.g., diagnosis process or culture in the PTPC and biobank. If these wastes are not properly managed, there would be a possibility that infectious agents escape from BSL-3 containment and cause deleterious effects on workers at EPHI as well as the community at large.

Potential means for infectious agents to leave the BSL-3 containment and possibly cause human health impacts would include five pathways. These are direct transmission, vector-borne transmission, vehicle-borne transmission, airborne transmission, and water-borne transmission.

Sanitary sewage also called domestic sewage contains human wastes and wash water from offices and laboratory facilities, administrative buildings and other facilities, waste from the kitchen, barn, bathroom, laundry, etc. A total of 149.65 M^3/year of sanitary liquid waste will be generated from BSL 3 NRL. The improper disposal of wastewater plays a role in the contamination of surface water, groundwater, and soil. Liquid waste (grey and black water) will be generated from the kitchen, toilet, shower, bathing and recreational area and this will lead to water pollution, thermal pollution and soil contamination to the receiving environment if it is not properly handled and treating as they contain chemicals and contaminated pathogenic microorganisms.

10.4.2 Biological Impacts

10.4.2.1 Impacts on Plant and Soil Biodiversity

Pre-construction and Construction Phase: The operation of the proposed BSL-3 lab would have moderate effects on biodiversity. The EPHI BSL3 National reference laboratory

Building will be constructed at the existing EPHI compound and hence will have a reduced impact on threatened or endangered species habitats or buffer areas. A small portion of vegetation and native trees like *Podocarpus falcatus, Dracaena fragrans, Acacia abyissinica, Enset edule, Juniperus procera, Dovyalis caffra and Vemonia amygdalina* and exotic trees like *Gravilie rubusta,Pinus patula, Delonix ragia, Acacia melanoxylon and Cupressus pyramidalis* would be removed under foundation footings and other parts of the building's base. The extent of this impact could have temporary effects on vegetation and trees in the immediate site location area. Land-use changes related to site clearing, excavation and construction activities have no significant impacts on soil biodiversity.

Operation Phase: There are no threatened or endangered species habitats or buffer areas affected by the operations of the proposed BSL 3 NRL. Inappropriate management of the wastes within the EPHI compound may affect the plant biodiversity of EPHI.

10.4.2.2 Impacts on Animal Biodiversity

Operation Phase: The EPHI BSL3 NRL building will be constructed at the existing EPHI compound and hence will have a low impact on threatened or endangered species habitat. Laboratory animals like Mouse, Rabbits, guinea pigs and sheep are used for research purpose and has impacts on these animal biodiversities.

10.4.3 Socio-Economic Impacts

10.4.3.1 Traffic and Public Safety Impacts

Pre-construction and Construction phase: Construction activities may result in a significant increase in the number of vehicles during the transport of construction materials and equipment, which will lead to an increased risk of traffic-related accidents or injuries to workers and EPHI community. But traffic movement in EPHI will have a separate route from other internal activities of EPHI staff. The main road (Swaziland Street) is characterized by heavy traffic and the construction activity may also cause an additional impact on the safety and traffic of the areas. Heavy trucks do not have the risk of causing accidents due to their limited maneuverability but also place added pressure on the roads and can lead to failure (cracks and potholes).

Operation Phase: The operations of BSL 3 NRL will create additional job opportunities for 45 citizens. There will be an increase in traffic flow resulting from the transport for staff and patients and the introduction of new cars from the employees. This may lead to increased traffic jams and hazards in the area especially if the roads in the region are not upgraded to

cater to this demand. The area will also experience an increase in traffic albeit intermittent, and this will increase the risk of traffic hazards since the probability of occurrence of the hazards will be increased by having more cars on the roads. Additionally, the BSL-3 project may put the employees at risk for the spread of diseases including COVID-19, Tuberculosis, and alike.

Decommission Phase: For the processes of this phase materials from the buildings and equipment will have to be ferried to and from the site through the use of trucks and tractors/bulldozers and these will increase the amount of heavy traffic in the area. Although it is expected that at the time when the project will be decommissioned there will be substantial developments in infrastructure (transport), the trucks with limited maneuverability will pose a risk to the general public and other vehicles/drivers on top of placing extra pressure on the roads.

10.4.3.2 Gender-Based Violence

Construction Phase: There will be plenty of younger workers during the construction of BSL-3 so the potential risks emanating from the new social environment related to illegal and non-voluntary sexual relations. This situation will be exacerbated if the large influx of young male workers leads to an increase in exploitative sexual relationships and human trafficking whereby women and girls (working at the institute) are forced into sex work during the construction phase. Besides, the risk of GBV may be driven by the newly merging life of workers with the host community.

There is a potential risk of project workers engaging in illegal sexual relations with minor girls and high school students around the project site, leading to HIV infection, teenage pregnancy, illegal and risky abortions, school dropout, etc.

Operation Phase: The operational activities of the proposed BSL 3 NRL laboratory will have limited interactions with members of the public who will come to deliver samples or collect results. The assessment revealed that the occurrence of GBV cases in connection with services provided by the EPHI laboratories to the public is hardly present. This is expected to continue due to the reason that the same pattern of services is going to be delivered by the BSL 3 NRL to the public. On the other side, the occurrence of GBV cases within the EPHI staff itself is moderate.

10.4.3.3 Risk of Social Conflict and Crime

Construction Phase: A dispute may arise between the contractor and workers due to various reasons. Workers will develop non-harmonious relations among themselves and between the labourers and the contractor. In addition, there may be a conflict with the existing community dwellers due to the new way of life arising from the entry of construction-related behaviors such as prostitution, sexual assault and illegal drugs. As well, the frequency of grievances will be raised from workers related to working hours, access to essential materials for construction and wage limitation. Complaints may bay also arise from the local community if the contractor exclude them from temporary job opportunities, which consequently will lead to conflict and develop non-harmonious relation. Furthermore, a dispute as a result of religion and cultural needs may appear, since a lot of individuals will come to the area for tentative or permanent work.

Operation Phase: Workers who have different political and religious interns may be employed by this project, which will in turn lead to distrust, suspicion and lack of tolerance among workers. Such ethnocentric attitude to be emanated from some workers may disseminate to others and disturb the function of the institution

10.4.3.4 Increase Burden on Public Service

Construction Phase: As the project will be operated in Addis Abeba city, there is an existing problem with public services in various aspects. So, the burden will appear in transportation, house rent price, electricity, market places and other public service centers. Since, the Influx of construction workers may increase demand and competition for local social and health services, as well as for goods and services, which can lead to price hikes and crowding out of the local consumer.

The problem will also appear in health and security protection services because individuals who have not previously known at the area may be a cause of insecurity and physical attack. This directly affects the surrounding health centers and policies in addition to normal activities.

Operation Phase: The arrival of newly employed workers would rise demand and competition for local social and health services, as well as for goods and services, which can lead to price hikes and crowding out of the local consumer. The implementation of this project will add pressure in waste management of the existing people, electricity, access to clean water, traffic management and fire disasters.

Since laboratory services will continue to be provided during the construction period, patients seeking to give or deliver samples to the present sample collection rooms found next to the site will be urged to cross through the construction area. Frequent changes of designated safe pathways across the construction site to the sample collection area will entail moving patients. This may cause inconveniences and temporary disruption in the delivery of sample collection services to patients

10.4.3.5 Child Right Violation Impacts

Construction Phase: During the construction stage, children may be exposed to permanently distorted or disabled bodies when they carry heavy loads or are forced to adopt unnatural positions at work for long hours. In addition, materials to be used for construction purposes would affect children playing in the surrounding area. Children are less resistant to diseases and suffer more readily from chemical hazards and radiation than adults.

In extreme situations, the rise in the number of young workers in the project area may lead children to be forced into sexual exploitation or recruitment by construction workers and Foreman, with no means to seek protection or justice. Children who have lost the care of their parents may also find it impossible to access essential services and lead to sexual abuse. Therefore, children of the surrounding community may experience insidious forms of violence, exploitation and abuse during construction.

10.4.3.6 Utility Impacts (Water and Energy)

Construction phase: Concrete batching plant, construction and watering of the building requires a significant amount of water during construction. This may lead to additional pressure on the water demand of the city administration. The main form of energy for the construction in the project area is hydropower from the national grid. The anticipated increase in industries as an industrial zone will inadvertently mean a corresponding increase in energy demand.

Operation Phase: Use of HAVAC system, deep freezer, steam sterilizer, autoclave and other laboratory equipment, installation of new incinerator requires additional energy demand and creates pressure on local energy requirements. In addition, water will be also required for sanitation and drinking during the operation phase.

10.4.3.7 Public Health Impacts

Construction Phase: The influx of construction workers to the project place will cause for the spread of communicable diseases to the community where the project is hosted. For instance there are some diseases such as sexually transmitted diseases (STDs), COVID-19, and other epidemic viruses that would be a threat to the project surrounding dwellers. Besides, there are informal economic sectors directly operated in relation to the enhancement of construction workers like coffee, shops with cigarette and chat and food suppliers that might be exposed to the transmission of disease which in turn would be disseminated at the mass of local people.

Operation Phase: The new influx of people due to the operation of this project may bring health problems to the people of the host community including COVID-19 and HIV/AIDS which transmits during physical contact and blood insertion respectively. This means an increase in labor influx in the project site: may induce sex work and potential sexual relations between migrant workers and women and girls in the community. This may lead to an increase in the risk of acquiring sexually transmitted diseases, such as HIV/AIDS, etc. In turn, workers, individually and collectively, will be susceptible to the coronavirus as construction works normally require teamwork. Increase in risk of sexually transmitted diseases, such as HIV/AIDS, etc. due to labor influx-induced sex work and potential sexual relations between migrant workers and women and girls in the community.

In the BSL 3 laboratory and facilities such as PTPC and biobank, there would be highly infectious agents in storage, diagnosis process or culture. So, there would be a possibility to escape infectious agents BSL-3 Containment. Potential means for infectious agents to leave the BSL-3 containment and possibly cause human health impacts to the surrounding community and workers.

10.4.3.8 Impacts on Historical Buildings

Pre-construction and Construction Phase: Dr. Thomas Lambie buildings at EPHI are registered historical buildings which are situated about 50 meters to the north of the project site. The all-stone building which is gracefully landing in the spacious campus of EPHI was built in 1930 by an American missionary named Dr. Thomas Lambie. Various activities that commonly form part of construction can influence the values of archaeological buildings. The activity that will affect the building includes not limited are disturbance by digging, disturbance by piling, compression- degradation through changes in the burial environment-

Soil colour change affecting the visibility of soil features through changes in the burial environment- Non-physical effects like inaccessibility for monitoring and visual inspection.

During construction, holes are dug and boreholes drilled, both of which cause a physical disturbance, but can also increase oxygen ingress to previously undisturbed layers, potentially increasing decay and corrosion. De-watering of sites can have very serious impacts both on the site and also adjacent areas. It can lead to deposits drying out and cracking, allowing oxygen to enter, and stimulating biodegradation. Excavation of the basement will obviously reduce the amount of material that can be preserved *in situ*. Although shallow foundations, such as strips or pads, do not penetrate deeply into the ground, they do usually require the excavation of large areas of the site, and even if the most significant archaeology is still buried, excavation of the soil will reduce the amount of protection for the deposit. The imposition of heavy loads on these footings could reduce water flow through the deposit, and also cause deformation or breakage of fragile artifacts.

In addition, during the pre-construction and construction phases of the project infrastructure which involves excavations, it is possible that chance finds will be encountered. These may include the following:

- An archaeological heritage which has remained unnoticed in the past,
- An encounter with a grave containing human remains which the local residents may have not mentioned at the survey stage and
- An encounter with a sacred site which was not mentioned at the survey stage.

10.4.3.9 Occupational Health and Safety (OHS) Impacts

Pre-construction and Construction Phase: During this phase, several OHS risks may occur due to exposure to occupational hazards such as physical hazards, at the project site. Several OHS risks as a result of the important activities, processes, materials and equipment carried out during the pre-construction and construction phases of the project are listed as given below:

- **Risk of Communicable disease:** labour influx in the project site may induce sex work and potential sexual relations between migrant workers and women and girls in the community. This may increase in the risk of sexually transmitted diseases, such as **HIV/AIDS,** etc. due to labour influx-induced sex work and potential sexual relations between migrant workers and women and girls in the community. Workers, individually and collectively, will be susceptible to the coronavirus as construction

works normally require teamwork (Pasco *et al*., 2020). It was estimated that allowing unrestricted construction work would be associated with an increase in the COVID-19 hospitalization rate from 0.38 per 1000 residents to 1.5 per 1000 residents overall. EPHI laboratory has highly infectious agents in storage, diagnosis process or culture. So, that there would be a possibility to escape infectious agents from the containment. Potential means for infectious agents to leave the existing containment and possibly cause human health impacts including construction workers by direct transmission, vector-born transmission, vehicle-borne transmission, air-born transmission and water-born transmission.

- **Risk related to slips, trips, and falls:** Working at heights, Spills, ice, snow, rain, loose mats, rugs, and stepladders are some of the common causes of slips, trips, and falls during construction.
- **Fire and explosion hazards**: portable gasoline containers for generators and other gasoline-powered equipment, fuel transfers for onsite heavy equipment operation, ignition of flammable materials during hot works, welding operations that creative spark, risk of electrocution;
- **Physical injuries** or hazards from materials and equipment from moving parts of equipment such as saws, tractors, grinders, moving heavy materials, open foundation pits, raised building materials and equipments (e.g. bricks, saws, hammers, steel pipes & fittings, sharp edges of nails, knives, saws and glass), the collapse of excavation sides, Persons falling into excavations, plant and materials falling into excavations, Work at height, the collapse of formwork, falling materials or debris, risk from lifting operations, cuts and abrasions, weakening of adjacent structures (if any), striking existing services/utilities (if any)), risk of confined space entry, lift heavy objects using inappropriate body posture, driving equipment with improper brake system, lack of concentration while working and exposure to hazardous wastes such as paints, cement, adhesives and cleaning solvents, all may cause physical injuries to construction workers.
- **Lung injury:** Concrete and masonry products contain silica sand and rock containing silica from inhalation of dust, inhalation of Volatile Organic Carbons (VOCs). When workers inhale crystalline silica, the lung tissue reacts by developing fibrotic nodules and scarring around the trapped silica particle. This fibrotic condition of the lung is

called silicosis. If the nodules grow too large, breathing becomes difficult and death may result.

- **Eye injury and damage:** bright lights from welding operations, UV radiation given off by electric arc welding, Eye injury due to flying debris, Eye irritation due to Volatile Organic Carbons (VOCs), struck by moving objects/equipment,
- **Electrical hazards**: Most of the construction equipment uses gasoline so they would be gasoline containers at risk of explosives. All equipment need electric power, without provisions for electrical safety, there is a risk of an electric hazard in the site. Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers.
- **Ergonomic hazards** (poor working design, working at heights, frequent lifting, vibration)
- **Biological hazards are rare**: (e.g., bacteria, viruses or parasites) and mosquitoes carrying disease-causing agents).
- **Muscle skeletal disorder:** due to manual handling**,**
- **Traffic accident impacts:** Construction activities may result in a significant increase in a number of vehicles during the transport of construction materials and equipment, which will lead to an increasing risk of traffic-related accidents or injuries to workers and the EPHI community.

Operation Phase Impacts:

The proposed facility will have attributes of most laboratories in that it would have identified physical, electrical, biological and chemical hazards. The potential for injuries and illnesses involving routine laboratory operations presents a greater health risk to workers than does the potential for injury and illnesses associated with handling infectious substances at the proposed BSL 3 laboratory would hand highly infectious agents.

- **Risk of Infection:** Surveillance of laboratory-acquired infection (LAI) is, therefore, an efficient marker to evaluate the effectiveness of biosafety and to optimize the risk assessment in BSL 3 laboratories. It was reported that 85% of LAI were caused by *Mycobacterium tuberculosis*, *Coxiellaburnetii*, hantaviruses, arboviruses, hepatitis B and C viruses, *Brucella* spp., *Salmonella* spp., *Shigella*spp., and *Cryptosporidium* spp. (Wurtz *et al.*, 2016). Operation of PTPC and biobank

involves handling infectious organisms. As the BSL 3 laboratory is expected to perform diagnosis for highly infectious agents, during specimens' collection, handling, transportation and storage, there will be a risk of exposure for the specimen. If the specimen has highly infectious agents, it may cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community. PTPC and Biobank centre is also expected to hand and store infectious agents, during specimens' collection, handling, transportation and storage, there will be a risk of exposure for the specimen. If the specimen has an infectious agent, it may cause human disease, present a hazard to workers, and may present a risk of spreading to the community. Patients seeking laboratory service and staff as well as visitors may be exposed to health risks mainly due to improper management of hazardous wastes during the operational phase of the proposed BSL 3 NRL. There is a high risk for rabies exposure and infection including veterinarians, animal control workers, rabies diagnostic lab workers, during the removal and handling of dogs at the EPHI lab.

- **Chemical Hazards:** Some chemicals adversely affect the health of those who handle them or inhale their vapours. Chemical disinfectants (such as sodium hypochlorite or potassium hypochlorite) and biologic stabilizers (phenol). Chemicals such as paraformaldehyde are used for fumigation. Apart from overt poisons, several chemicals are known to have various toxic effects on workers. The respiratory system, blood, liver, kidneys and gastrointestinal system, as well as other organs and tissues may be adversely affected or seriously damaged. Some chemicals are known to be carcinogenic or teratogenic.

- **Risk of burn:** Different combustible materials such as flammable liquids, solid materials and loose electrical connections, etc could cause serious fire incidents in the BSL 3 NRL complex facility, PTPC, biobank Centre, and central warehouse. Flammable liquids are volatile in nature and liberate vapours at ambient or elevated temperatures that can ignite in presence of sparks, hot plates, naked flames or other hot surfaces. This incidence may cause serious injury to the workers even may be life treating.

- **Ergonomic hazards:** Laboratory workers are at risk for repetitive motion injuries during routine laboratory procedures such as pipetting, working at microscopes, operating microtomes, using cell counters and keyboarding at computer and working

on BSC workstations. Standing and working in awkward positions in front of laboratory hoods/biological safety cabinets can also present ergonomic problems

- **Injury/accident:** Studies have shown personnel dealing with medical waste are by the biological, physical and chemical hazards such as needle sticks, cuts, falls, strains, sprains, burns, eye and back injuries during collection, handling and transportation. Several injuries such as hand-cut due to handling broken glass occurred due to exposure to medical wastes inside and outside hospital premises (Bokhoree *et al.*, 2014). During transporting/handling of wastes, the laboratory and ancillary staff as well as the sanitary labourers can be injured if the waste has not been packed safely. In that respect, sharps are considered one of the most dangerous categories of waste. Many injuries occur because syringe needles or other sharps have not been collected in safety boxes or because these have been overfilled.

Decommission phase: The decommissioning phase will have several OSH risks from the civil works involved, equipment, materials and processes.

Risk related to slip, trip, and falls: sloppy area and unstable area during decommission may result in an increasing likelihood of slip, trip, or fall occurring which result in serious injuries

Risk of injury: Injuries or injurious substances, materials and equipment from:

- Falling debris
- Moving parts of equipment such as mechanized saws and other cutting equipment

Risk of Fire: Heat from gas cutters, friction from abrasive processes, fuel, electricity and electrical equipment

10.4.3.10 Risks Related to Improper Waste Management

The WHO confirms the risks associated to infectious waste and sharps that health professional are exposed to during healthcare delivery and also exposed to such risks during waste collection, storage, transport, treatment and disposal. Similarly, the final disposal of hazardous waste that is incineration, involves health risks to which the operators are exposed to medical waste incinerators emit of toxic gases such as Dioxin which are detrimental to health. Incinerators that operated at temperatures below 800 degrees Celsius may lead to the production of dioxins, furans or other toxic pollutants as emissions and/or in bottom/fly ash. Transport to centralised disposal facilities may also produce hazards to health-care handlers, if not safely managed. Therefore, risks associated with waste management are expected

during waste collection, storage, transport, treatment and disposal. Generation of hazardous and infectious waste from BSL 3 laboratory will cause potential risks resulting life-threatening for personnel working in the BSL 3 laboratory, the community and the environment in general if approapriate measures are not taken. The agents may cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community.

10.4.3.11 Risk Associated with Final Waste Disposal

The wastes generated from different processes are of complex characteristics and composition and hence, their safe management and disposal is also complex. The disposal and storage of these wastes without treatment leads to contamination of surface and groundwater through long term leachate accumulation from the disposal sites and ultimately disturbs the ecological and environmental balance. The characteristic of these waste are that they are enriched with heavy metals, and the large amount of Zn and Cr in MW may come from syringes, waste plastics, rubber, and medical adhesive plaster. Heavy metals in the waste usually present as metal oxides, metal elements, volatile metallic chlorides, and sulphates. Most heavy metals migrate or concentrate in the fly ash and bottom ash; depending on the formed compounds of heavy metals and their physicochemical properties during incineration.

In the BSL 3 laboratory there would be a generation of highly infectious agents due to laboratory activities (e.g., diagnosis process or culture in the PTPC and biobank. If these wastes are not properly managed, there would be a possibility that infectious agents escape from BSL-3 containment and cause deleterious effects on workers at EPHI as well as the community at large..

10.4.3.12 Impacts of Improper Wastewater Treatment

Several risk factors can reduce the efficiency of the septic tank. The risk can be imparted during designing or operation phase. During designing phase if risks such as Inadequate tank volume, geometry and compartmentalization, inconsideration of tank access space and plan that involves the use of substandard construction materials are not managed properly it can reduce the efficiency of the septic tank treatment system. In addition, a faulty designing can result also in cracking of the tank, leakage (ground infiltration), tank flotation and inadequate retention time of effluent. Moreover, scums, septage and sludge can clog the septic tank drainage system.

In relation to suspended growth aerobic systems - clarifier operation common operational problems of aeration tank are but not limited to excessive local turbulence in aeration tank, white thick, billowy foam on aeration tank, clumps of rising sludge in clarifier, fine dispersed flocs, and turbid effluent.

Moreover, natural organic matter in the water in the form of particulate matter (such as suspended solids, turbidity or colour) can reduce the performance of UV-irradiation. Compounds that present in the water can also foul the external surfaces of the lamp sleeves and other wetted components of UV reactors.

Faults from designing and operation of the treatment can last for long-term and have high impact on the quality of ground water table, soil and receiving surface water..

10.4.3.13 Impact of Air Pollution due to Waste Incineration

The emissions of compounds such as volatile organic compounds (VOCs), sulphur dioxide, hydrogen chloride and particulate matter (PM) from waste incineration are unlikely to contribute significantly to total emissions. However, waste incinerators have been a major source of emissions of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs, other persistent organic pollutants (POPs) and some heavy metals such as cadmium and mercury. MSW incinerators in many countries now apply extensive abatement techniques and comply with emission limits, and in these cases the contribution of MSW incinerators to total emissions of PCDD/Fs and heavy metals has greatly decreased.

During the operation BSL 3 laboratory, waste are generated and they would be treated using different techniques such as autoclave, chemical disinfectant, incinerators. However, incinerator would contribute to air pollution. So that air quality effects during the operation of the incinerator generate emissions of SO2, CO2, CO, NOx, particulates and other toxic substance. Incineration presents a good option for good disposal and destruction of solid and sharps-wastes. However, concerns such as availability of technical knowhow, maintenance, environmental pollution, etc would be considered. Incineration has the potential for toxic emissions, particularly if the waste stream is not regulated, as is usually the case if the equipment is not properly operated and maintained, and if the emissions management system is inadequate. Large-scale incinerators tend to pollute less than small-scale incinerators because the combustion temperature is higher and combustion efficiency (gas residence time) is better. To avoid the risk associated with incinerator, it is good that treatment in Pyrolytic or Rotary Kiln Incinerator with good emissions management system.

Human health risks due to dioxin and furan exposure have been reported and evidence for dioxin and furan toxicity in humans comes from studies of populations that have been exposed to high concentrations occupationally or in industrial accidents. The International Agency for Research on Cancer classifies 2,3,7,8 tetra-chlorinated dioxin as a known human carcinogen based on evidence on animal experiments and enough evidence on human studies.

10.4.3.14 Risk Associated with Off-site Transport of Waste

The off-site transport of waste from generator facilities to treatment facilities imposes a population health risk associated with potential accidents involving the release of infectious agent and toxic chemicals to the atmosphere. These transports also impose a potential collision health risk to other vehicle drivers and passengers, pedestrians, and the transport truck crew members. However, EPHI would transport bottom and fly ash and treated liquid waste, there is no any potential accidents involving the release of infectious agent. Safe Off-site transportation of waste would be conducted to prevent or minimize spills, releases, and exposures to employees and the public. In addition, if the WHO safe waste management and World Bank Environmental, Health, and Safety Guidelines for Hhealthcare Facilities (2007) would be implemented during transportation of the waste.

Uncontrolled releases of hazardous materials may result from small cumulative events, or from more significant equipment failure associated with events such as manual or mechanical transfer between storage systems or process equipment.

11. IMPACT MITIGATION MEASURES

11.1 Pre-construction and Constriction Phases Impact Mitigation Measures

11.1.1 Physical Impacts Mitigation Measures

11.1.1.1 Air pollution Impact Mitigation Measures

- Construction work should be undertaken by an experienced and duly registered contractor with a verifiable sense of environmental awareness and responsibility,
- Contractors should use dust screens or nets in windows, doorways and ventilators of rooms where demolition or other dusty construction activities are occurring,
- Sprinkling the road with water two times a day (or periodically) when operations are underway to prevent the raising of dust,
- Enclosing the structures under construction with dustproof nets,
- Ensure good housekeeping and clean construction operations where, among other necessary actions, dust should be quickly swept off cement floors and collected in covered containers.
- Regular maintenance of construction machinery as per the Manual,
- Controlling the speed (10 km/hr) and operation of construction vehicles during transportation,
- Use of clean fuels (e.g., unleaded and de-sulphurized fuels) not used fuel from the black market,
- Educate and raise awareness of construction workers on emission reduction techniques.
- Workers will be provided with PPE and the use of PPE shall be enforced.

11.1.1.2 Water Pollution Impact Mitigation Measures

- Landscaping and site management to control runoff and provide basement flood protection, landscaping, providing proper roof drainage and minimizing paved surfaces,
- The contractor should have separate garages for the truck and construction machinery and used oils and other liquid wastes should be stored in a secured area and disposed of as hazardous wastes,

- Excavated soil should be disposed of in designated areas (with local authorities permit) where it will get environmental clearance from the city administration EPA office.
- Minimize the amount of exposed ground and stockpiles of soil on the site,
- Do not discharge or allow water contaminated with silt to enter a watercourse or drain as it can cause pollution and limit the water within the site,
- Protect all surface water drains and watercourses with cut-off ditches or earth bunds. These should be at least 10 meters from the watercourse, and limit all the water runoff from the site, and
- Develop a spill response plan for accidental leakage of oil spills and apply it within 2 hours of spills.

11.1.1.3 Soil Pollution Impact Mitigation Measures

- Minimize disturbance and control erosion by avoiding steep slopes and by minimizing the amount of construction and ground clearing needed for roads, staging areas, and crane pads,
- All plastic tubes left from construction should be sold to recyclers,
- Develop a spill response plan for accidental leakage of oil spills and apply it within 2 hrs spills,
- Used oils such as engine lubrication oil, hydraulic fluids, and gear oils used in cars sold for the recycler,
- Used oil filters, contaminated cans should be placed in a secured area and disposed of as hazardous waste,
- Construct a garage for construction vehicles and machineries,

11.1.1.4 Noise and Vibration Impacts Mitigation Measures

- A contractor will be careful when selecting equipment to avoid the use of old or damaged machinery with high levels of noise emissions that would have a negative impact on the environment.
- Construction activities required outside normal working hours must be approved by the Project Manager, and where necessary, the warning provided to adjacent residents,
- Noise levels exceeding 55 dB (daytime) and 45 dB (nighttime) shall only be permitted where approved and with an appropriate advanced warning to adjacent

residents (minimum of 2 days) being provided,

- Noise that could cause a major disturbance should only be carried out during daylight hours and with warning provided as above,
- Acoustic enclosures should be provided with DG (Diesel generator) sets and machinery to control the noise levels at a construction site,
- Equipment and machinery should routinely be maintained as per the manual,
- Educate and raise awareness of construction workers on noise reduction techniques,
- Provision of PPEs such as earplugs for employees working in noisy conditions or with noisy equipment.

11.1.1.5 Solid Waste Generation Impact Mitigation Measures

- Solid wastes should be collected from the project site at least once in 24 hours to minimize nuisance odour and vermin,
- Solid wastes should be properly segregated to encourage the recycling of some useful waste materials,
- The contractor and EPHI administration should work together to facilitate proper waste handling and disposal from the site. All wastes must be taken to the approved dumpsites,
- Inert portion of construction & demolition material (including inert excavated material), that is, public fill, deemed suitable for re-use on site as far as possible and only the surplus material should be disposed of off-site,
- Excavated soil should be immediately removed from the site and disposed of in an area that gets an environmental clearance certificate from Addis Ababa City Administration
- *Cut-off trench* means an excavation later to be filled with an impervious material to prevent or reduce seepage under the embankment should be employed

11.1.1.6 Liquid Waste Impact Mitigation Measures

- Wastewater from the concrete batching plant should be stored in a protected pond within the site and used for concrete curing and watering of buildings,
- Construct separate safety tanks for latrines and sanitation of construction workers,
- Used oils and other liquid wastes should be stored in a secured area in tanks and disposed of as hazardous wastes

11.1.2 Socio-Economic Impacts

11.1.2.1 Traffic and Public Safety Impacts

- Traffic inside and outside the project site should be directed by flagmen,
- Limit the speed of the truck to 10 km/hr at the project site
- Initiation of a safety program and measures by creating awareness and educational campaigns for drivers, workers and local communities, including observation of speed limits,
- Installation of appropriate road signage, speed signs, and other warning signs at the site and access roads,
- Copies of driver's licenses and insurance policies for the Contractor's drivers and vehicles respectively should be provided to the Supervision Consultant,
- The Contractor's vehicles and equipment must be in proper working condition (roadworthy vehicles) and have registration plates and numbering.
- The Contractor ensures proper driving discipline by its employees, and sanctions those in breach,
- Use only permitted gates and access road which is allowed for construction machineries and trucks,

11.1.2.2 Public Health Impacts Mitigation Measures

- Contracting of an HIV service provider (government health center) to be available on-site every year,
- Implementation of HIV/AIDS and COVID-19 education programs,
- Information campaigns on STDs among the workers and local community,
- Education about the transmission of diseases,
- Vaccinating workers against common and locally prevalent diseases including COVID-19,
- Provision of condoms,
- Awareness raising about public health impacts from labor influx,
- Construction camp to include wastewater disposal and septic systems,
- Identification of authorized water supply sources and prohibition of use from other community sources, and
- Separate service providers for community and workers' camp/construction site

11.1.2.3 Historical Buildings

- Ensure that construction activities with the highest impacts, such as piles or service trenches are positioned to avoid areas with the greatest archaeological sensitivity,
- The design and position of the building should not cover the view of the old building,
- Divert runoff to protect these areas before clearing and grading begins,
- Properly compact the exposed surface area to reduce erosion potential,
- Use crushed aggregate or temporary seeding to reduce erosion,
- Site plans should show the location, slope, cut, fill, and finish elevation of the surfaces to be graded and the auxiliary practices for safe disposal of runoff water, slope stabilization, erosion control, and drainage such as waterways, lined, ditches, diversions, grade stabilization structures, retaining walls, and surface and subsurface drains, and
- Removing basements, or other large areas of intervention from the designs, or relocating them to less critical parts of the development,

In order to avoid potential damage to cultural property discovered during pre-construction and construction phases, the following will apply:

- Workers must be vigilant to any relics found during excavation. In case of discovery during the excavation, workers must immediately report the findings to the foreman,
- The Foreman must stop the work immediately and communicate the findings to the Supervisor,
- The supervisor then communicates the findings to the Contractor Manager,
- The Contractor Manager then notifies EPHI and then Addis Ababa city administration,
- The Department of Museums and Monument of Addis Ababa City Administration will then be notified either via communicating with the Addis Ababa city Administration EPA via telephone or email or based on a site visit within 14 days from the time of discovery.
- Any further excavations or continuation of the infrastructure development at the Site of the discovered heritage will be undertaken only with the approval of the Department of Museums and Monuments in Addis Ababa,

- Should the Conservator of Antiquities from the Department of Museums and Monuments confirm that the discovered resource falls within the heritage resource description, he/she will report the resource to the director of Tourism, Heritage and Antiquities for preservation and protection. Rescue excavation or in-situ conservation will be proposed based on the disturbance likely to be caused by the project or in relation to cost versa via the value of the heritage resource and All chance finds will be recorded.

11.1.2.4 Utility Impact (Water and Energy) Mitigation Measures

- Employ water conservation strategies such as the reuse of water from concrete batching plants for watering the building and toilet flushing,
- Rainwater harvesting during summer
- Using advanced designs and construction techniques that reduce energy consumption

11.1.2.5 Risk of Social Conflict and Crime Mitigation Measures

- During the construction phase of the proposed BSL 3 NRL project, the proponent (FMOH HILEO /EPHI) and the contractor will jointly set up a project-specific grievance handling system with a team comprising of construction supervisor, and delegated officers from the HILEO and PCT who will receive and log, and address any disputes, conflicts or concerns arising from stakeholders that may be aggrieved by the project.
- Grievances will be resolved and status reported back to complainants within a week. If the works supervisor cannot solve the grievance, he will refer it to MOH/EPHI and the contractor through the Supervising Engineer. It is believed all possible grievances can be solved by the joint action of MOH/EPHI and the contractor.
- Early management of disputes and proactive community engagement,
- The contractor should prepare workers influx management action plan,
- The contractor will provide orientation to its staff to respect the culture, religion and ethnic differences of its workers, the EPHI community and the local people,
- Paying salaries into workers‘ bank accounts rather than in cash,
- Sourcing of local workforce as much as possible,

- Give the first opportunity to the local people to supply construction materials such as sand, brick and other locally available materials,
- Cooperation with local law enforcement, and
- Job priority to the local people to develop a sense of ownership

11.1.2.6 Gender-Based Violence Mitigation Measures

- The institution will prepare a GBV prevention action plan and act accordingly,
- Conduct continued sensitization and awareness raising to EPHI staff in general and BSL-3 NRL staff in particular on the prevention of GBV,
- Strengthen the Gender and women office of EPHI to address GBV cases when it occurs,
- The contractor will provide orientation to its staff to respect the culture of the local people and to limit their relationship with the local people,
- Contractor and implementing agency to prepare and implement a GBV Prevention and Response Action Plan to include at a minimum, in conformance with local laws and customs, equal opportunity for employment,
- All workers and nearby communities and stakeholders will be educated on preventing and responding to sexual harassment and GBV ahead of any project-related works,
- Construction areas should be separated by a fence and a separate access gate is used for construction workers,
- Ensure that women are given a mentorship orientation before starting their work.
- Regular sensitization and awareness campaigns (at least two times a year) to workers should be done to promote gender equity in employment during the construction and operation phases,
- Provision of gender-disaggregated data, separate bathing, changing, and sanitation facilities for men and women should be made ready by the contractor, and
- Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project.

SEA/SH Mitigation Measures

- ☛ Clearly define the SEA/SH requirements and expectations in the bidding documents for contractor

- Evaluate the contractors SEA/SH Accountability and Response Framework in Contractor Environmental and Social Management Plan (C-ESMP)

The C-ESMP is the plan prepared by the contractor outlining how it will implement the work activities following the ESMP's requirements and following the contract. The development of an effective C-ESMP is a cornerstone for addressing SEA/SH, and more broadly the ESHS risks, during implementation. Contractually, the contractor must follow the C-ESMP, which is why it is important that the C-ESMP build upon the findings and proposed measures identified in the project ESMP.

The C-ESMP should include:

- **Code of Conduct:** The agreed CoC to address behavior which will be used on the project for the contractor's workers, including sub-contractors and suppliers;
- **Training Plan:** The plan for training workers on SEA/SH;
- **Community Consultation Plan:** The strategy by which in consultation with the MoH/EPHI, the communities adjoining the project will be advised on the project activities, how to make complaints, and what GBV support services are available; and
- **Labor Influx Management:** Should the project involve the influx of labor, how this influx will be managed—particularly to address SEA/SH risks.

To ensure that the SEA/SH risks are managed, it is important that:

- The contractor prepares the C-ESMP in accordance with the requirements of the project ESMP. The C-ESMP should provide a detailed explanation of how the contractor will comply with the project's E & S requirements (embodied in the ESMP) and demonstrate that sufficient funds are budgeted for that purpose.
- The contractor does not carry out any works, including mobilization and/or pre-construction activities (e.g., limited clearance for haul roads, site access and work site establishment, geotechnical investigations or investigations to select ancillary features such as quarries and borrow pits), unless the supervising Engineer is satisfied that appropriate measures are in place to address SEA/SH risks and impacts through the C-ESMP.
- Public consultations are held on the C-ESMP, with the active participation of the contractor and the supervising Engineer's E & S specialist. These consultations must

be well documented and include separate consultations with women and girls. •

The C-ESMP be submitted and approved by MoH.

11.1.2.7 Impact of Traffic and Public Safety Mitigation Measures

- Minimize risk for those around and near the project site as well as those entering or exiting the site by placing signs,
- Identify the times of day truck traffic is expected – heavy truck traffic should be outside peak hours,
- Regularly maintain construction vehicles and machineries as per the manual,
- Identify any works that are likely to be so disruptive to traffic that they may need to be scheduled outside the hours of work permitted,
- Ensure safe passage for those around and near the project site as well as those entering or exiting the site.

11.1.2.8 Child Rights Violation Impacts Mitigation Measures

- Strengthen the social service workforce to identify and respond to potential situations of child labour through case management and social protection services, including early identification, registration and follow-up,
- Improve children‘s access to justice systems that are child-friendly, gender-sensitive and well-resourced to uphold their rights, and
- Zero tolerance of child right violation and the contractor should inform all workers related to child right violation consequences,
- The contractor is responsible to ensure that all workers should be over 18 years old (particularly for hazardous work) to comply with the contractor's obligation to prevent the use of child labor on the project,
- The contractor and his sub-contractors are expected to follow standard occupational health and safety standards during the construction phase of the project.

The following mitigation methods need to be implemented by the contractors/subcontractor to prevent child labour:

- ☛ The contractor should clearly state the minimum age for general work in their hiring policy and job announcements

- ☛ Hiring procedures and processes must include a robust age verification mechanism, which includes checking ID documents (government-issued ID) and in-person interviews

Additionally, the International Labour Organization Supplier Guidance on Preventing, Identifying and Addressing Child Labour Guidelines will be practiced.

11.1.2.9 Increase Burden on Public Service Mitigation Measures

- Use of borehole (existing and a new borehole to be drilled) as an alternative source of water from the EPHI compound,
- Workers‘ camp to include wastewater disposal and septic systems,
- Separate service providers for community and workers‘ camp/construction site,
- Water conservation and recycling of water,
- Provide first aid treatment at campus and recruit health professionals for this purpose,
- Consideration of the use of rainwater where feasible,
- Avoiding contamination of fresh water,
- workers orientation and instruction on water and electricity consumption,

11.1.2.10 Occupational Health and Safety (OHS) Risk Mitigation Measures

i) Risk of Communicable Diseases

- Contracting of an HIV service provider to be available on-site;
- Implementation of HIV/AIDS and COVID-19 education program;
- Information campaigns on STDs among the workers and local community;
- Education about the transmission of diseases;
- Vaccinating workers against common and locally prevalent diseases including COVID-19;
- Provision of condoms;
- Awareness raising about public health impacts from labor influx;
- Workers‘ camp to include wastewater disposal and septic systems;
- Identification of authorized water supply source and prohibition of use from other community sources; and
- Separate service providers for community and workers‘ camp/construction site;

ii) Slips, Trips and Falls Mitigation Measures

- Conducting audits as required to ensure responsibilities are met,
- Ensuring employees receive appropriate training and instructions
- Deal with spills straight away as per the spill response plan
- Consider routine monitoring of areas where spills are a high risk
- Use absorbent material to soak up the spill
- Identify areas at high spill risk and locate absorbent materials nearby
- Where possible avoid using wet cleaning as this may spread the potential danger area
- Consider using spill kits
- Ensure slip-resistant footwear is provided and worn as needed Providing personal protective equipment (e.g. slip-resistant footwear) if required

iii) Fire and Explosion Hazards Mitigation Measures

- Ensure the provision of fire extinguishers at all work locations and at all times.
- All flammable gases, liquids and vapors are removed before the start of any hot work.
- Where appropriate, use spark-resistant tools and make sure all equipment is bonded or grounded properly,
- Ensure provisions of first aid for staff, insurance, and access to ambulance service at all worksites, and arrangement (agreement) to access local hospital/dispensary with qualified medical staff by workers,
- The construction site shall be fenced off to prevent access to members of the public,
- Providing adequate storage for hazardous and flammable substances and controlling access to them.
- Monitoring the movement, handling and management of wastes to ensure they are safely managed and don’t present any EHS risks,
- Establish clinics and equip them with appropriate medical equipment for first aid treatment,

iv) Physical Hazards Mitigation Measures

- Scan the workplace for existing and potential hazards before work begins and take appropriate controls. Be aware that conditions can change constantly,
- Use correct personal protective equipment and apparel, including safety footwear,

- Have training before beginning any task, especially high-risk activities such as working at heights, hazardous energy control (lockout/tag out), or confined space entry,
- Prepare and emergency response plan and be aware of the emergency response plans before work begins,
- Develop evacuation procedures to handle emergency situations.
- Safety glasses/face shield for those working with any chemical or using any mechanical equipment to protect their eyes and face,
- For hand, use the correct gloves for the job for workers at concrete batching plant,
- Placing readable signs alerting people of hazardous such as for slippery floors,
- Insuring against liability for any loss, damage, death or bodily injury which may occur to any physical property or to any person which may arise out of the Contractor's performance of the contract,

v) Lung Injury Mitigation Measures

- Reduction of Ventilator-associated lung injury (VALI) by protective low tidal volume ventilation,
- Do not eat, drink, or use tobacco products in dusty areas,
- Wash hands and face before eating, drinking, or smoking outside dusty areas,
- Shower and change into clean clothes before leaving the worksite,

vi) Eye Injury and Damage Mitigation Measures

- Always to wear personal protective eyewear for workers working on high dust and eye goggles for welders,
- Clean your eyewear several times throughout the day, and always brush yourself off before removing your safety glasses, It's vital to call for medical attention (get treatment) when you notice the following signs in yourself or coworkers such as blood in the clear part of an eye, cut or torn eyelid, one eye doesn't move as well as the other, one eye sticks, pain or trouble seeing, unusual pupil dilation or shape

vii) Electrical Hazards Mitigation Measures

- Inspect portable cord-and-plug connected equipment, extension cords, power bars, and electrical fittings for damage or wear before each use. Repair or replace damaged equipment immediately,
- Always locate all power lines on or near the project sites,

- Perform regular fire risk assessments to identify areas at risk of bad wiring and circuits,
- Maintain proper grounding to eliminate unwanted voltage and reduce the risk of electrocution,
- Verify that all wiring is coming from a properly rated circuit and doesn't exceed the capacity

viii) Ergonomic Hazards Mitigation Measures

- Adjust the height of working surfaces to reduce long reaches and awkward postures,
- Put work supplies and equipment within comfortable reach,
- Provide the right tool handle for the worker,
- Vary tasks for workers (e.g., employ job rotation),
- Encourage short rest breaks,
- The contractor should be responsible for adequate first-aid services are provided to the employees at all times,

ix) Biological Hazards Mitigation Measures

- Construction site should be separated from the main campus by fence and construction workers should be restricted within the site,
- Wasps are attracted by discarded food, so make sure all leftovers go in the garbage and keep it covered. Remove and reduce debris and rubble piles when possible to help keep insects and rodents away
- The contractor should properly screen vaccine, and other biological products so as not to introduce infection to the construction site and the wastes should be autoclaved and incinerated,
- In case of any disease outbreak vaccination should be performed in a construction areas or surroundings to prevent the spread of disease, and
- Workers should cover as much of the body as feasible.

x) Muscle Skeletal Disorder Mitigation Measures

- Using mechanical assist devices to relieve heavy load lifting and carrying tasks or using handles,
- Reducing shift length or limiting the amount of overtime,

- Rotating workers through jobs that are physically tiring,
- PPE generally provides a barrier between the worker and the hazard source,

xi) Traffic Accident Impacts Mitigation Measures

- Limit the speed of the truck to 10 km/hr within the site,
- Initiation of a safety program and measures by creating awareness and educational campaigns for drivers, workers and local communities, including observation of speed limits,
- Sanctions for reckless driving,
- Installation of appropriate road signage, speed signs, and other warning signs at the site and access roads,
- Copies of driver's licenses and insurance policies for the Contractor‘s drivers and vehicles respectively should be provided to the Supervision Consultant,
- All construction machineries and cars should have third-parties insurance,
- Use only permitted gates and access roads which is allowed for construction machineries and trucks,

11.2 Operation Phase Impact Mitigation Measures

11.2.1 Physical Impact Mitigation Measures

11.2.1.1 Air Quality Impact Mitigation Measures

- Waste segregation for wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs plastics would be done and these wastes should never be incinerated these wastes should be cleaned. Disinfected and disposed of with non-hazardous wastes,
- Controlled incineration of medical wastes with a pyrolysis incinerator should be done at an operating temperature of 800 to, 1200°C.
- Regular planned maintenance: replacement of faulty parts, inspection, inventory of spare parts;
- Wet waste must be mixed with drier waste during incineration and sharps containers must be loaded one by one; the incinerator must run for long periods (at least 2 hours); heavy-duty gloves, body protection, and goggles must always be worn as well as a respirator whenever ash is being removed;

- Emissions must not exceed the national limit values and they must comply with the BAT/BEP1817 recommendations outlined in the Stockholm Convention.
- Materials free of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs should be purchased, for minimizing the environmental and health impacts.
- Workers will be provided with PPE and the use of PPE would be enforced.
- Applicable national requirements and internationally recognized standards for incinerator design and operating conditions would be followed, mainly rapid quenching of the flue gas after leaving all combustion chambers and before entering any dry particulate matter air pollution control device but also combustion temperature, residence time, and turbulence,
- Wastes would be introduced into the incinerator only after the optimum temperature is reached in the final combustion chamber.
- The waste charging system would be interlocked with the temperature monitoring and control system to prevent waste additions if the operating temperature falls below the required limits;
- Electronic wastes should not be incinerated at the site,
- Flue gas treatment system would be used for the control of acid gases, particulate matter, and other air pollutants;

11.2.1.2 Water Pollution Impacts Mitigation Measures

- Promoting practices that reduce the volume of wastes generated and ensure proposer waste segregation;
- Developing strategies and systems along with strong oversight and regulation to incrementally improve waste segregation, destruction and disposal practices with the ultimate aim of meeting national and WBG standards;
- Where feasible, favouring the safe and environmentally sound treatment of hazardous health care wastes (e,g, by autoclaving, steam treatment integrated with internal mixing, and chemical treatment) over medical waste incineration;
- Hazardous and chemical liquid wastes should be stored in separate concrete-based safety tanks as recommended and disposed of after treatment,
- Flue and bottom ashes need to be stored in a secured and protected landfill,

- Construction of elevated structures to limit the stormwater within the protected landfill, construction of floodwalls, floodgates, levees, and evacuation routes for rainwater to prevent runoff of ashes;
- Wastewater treatment plant works must comply with the effluent discharge guidelines of the country,
- The bottom of the landfill must be waterproofed and must be equipped with a final cover to prevent rainwater infiltration;
- leachates must be collected to the safety tank and treated on wastewater treatment plant to be constructed by FMoH

11.2.1.3 Soil Pollution Mitigation Measures

- Soils surfaces not covered by the building footprint or not paved would be landscaped to control erosion from stormwater runoff,
- Spill contingency plan will be implemented in case of accidental spills or leaks
- Wastewater generated from BSL 3 NRL activity should be stored in a concrete-based safety tank (100 M^3) and should be disposed of after treatment from the proposed wastewater treatment plant,
- Municipal wastes generated from latrine and sanitary areas should be stored in safety tanks and disposed of in the Kality wastewater treatment plant
- All domestic solids should be landfilled in Repi landfill
- Contaminated primary packaging, hazardous and infectious wastes should be incinerated
- Ash formed from incinerator should be stored in concrete-based landfill within the EPHI compound and need roof covering and protection.

11.2.1.4 Noise and Vibration Impacts Mitigation Measures

- Using equipment with low noise ratings or noise reduction technologies such as generators,
- Diesel generators should be enclosed and should be serviced as per the manual

11.2.1.5 Solid Waste Generation Impact Mitigation Measures

- All wastes should be segregated based on type,

- Initial packaging and storage would take place where HCW is generated.
- Storage of waste will then be moved to a temporary on-site storage location
- Non-hazardous wastes that are generated by the BSL-3 would be segregated and landfilled in the Repi landfill,
- Hazardous and contaminated solid waste generated in the BSL-3 laboratory would leave the laboratories only after decontamination using the laboratory's autoclave,
- Solid or semisolid wastes would be placed in tear-resistant plastic bags judged by their thickness or durability,
- There would be special packaging characteristics for some treatment techniques: incineration requires combustible containers, and steam sterilization requires packaging materials that allow steam penetration and evacuation of air,
- All sharps used in the BSL-3 would be autoclaved prior to incineration,
- Sharps (sharp items or items with sharp corners) would be placed in rigid, puncture-resistant, containers made of glass, metal, rigid plastic, or cardboard,
- Non-risk Health care waste (HCW) would always be stored in a separate location from the infectious/ hazardous HCW to avoid cross-contamination,

11.2.1.6 Liquid Waste Impact Mitigation Measures

- Strictly limit the discharge of hazardous liquids to sewers or sanitary safety tank,
- sewage pipes bringing wastewater from throughout the facility(project) to a central underground location for temporary retention
- construct two separate collection systems such as a sewerage system for wastewater from sanitary and toilet facilities and a hazardous wastes system from the laboratory liquid waste,
- Use of tertiary treatment plant for treatment of hazardous waste to be constructed in vaccine lab project site in Akaki Kaliti Sub-city,
- Sanitary liquid waste will be treated in the Kaliti wastewater treatment plant,
- body-fluids and the contents of suction systems from highly infectious patients (e.g., cholera) should be thermally treated (e.g. in a waste treatment autoclave) and then discharged via the drain to the safety tank for temporary storage and offsite treatment,
- Hazardous pharmaceuticals and chemicals should never be disposed of via the sanitary wastewater and rainwater drainage system,

- Leachate from the fly and bottom ash landfill should be collected to a hazardous wastewater safety tank and treated using an offsite wastewater treatment plant,
- The hazardous liquid waste should fulfill the WB EHS Guideline for healthcare facilities (2007) before discharge to the environment,
- Using engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard;
- Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures,
- Consecute double-chambered septic tank and soaks away pits for onsite retention of liquid wastes until it transfer to the treatment facility,
- Use of dedicated fittings, pipes, and hoses specific to materials in safety tanks and maintaining procedures to prevent addition of hazardous materials to the environment,
- All waste containers designated for off-site shipment would be secured and labelled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards,
- Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfe,
- Prepare written procedures for transfer operations that includes a checklist of measures to follow during filling
- operations and the use of filling operators trained in these procedures,
- Vehicles used for transporting infectious waste shall be disinfected prior to use for any other purpose,
- Provision of automatic fill shutoff valves on storage tanks to prevent overfilling,
- Non-hazardous wastes will be stored in double-chambered septic tank and soaks away pits found witin EPHI compound and further treated using Kaliti Wastewater treatment palnt as usual.

11.2.2 Socio-Economic Impacts

11.2.2.1 Utility Impacts (Water and Energy) Mitigation Measures

- Reduce heating, cooling, and lighting demand through passive strategies such as climate-responsive design, daylighting, and conservation practices;

- Employ renewable energy sources such as solar for road lightening in the future,
- The institute should implement water conservation programs such as Good housekeeping measures, and the use of Automatic Shut-off Valves,
- Use alternative groundwater sources during the operation phase,

11.2.2.2 Risk of Social Conflict and Crime Mitigation Measures

- Transparent local community engagement and participation should begin during initial project decision-making and continue routinely throughout the life of the project,
- Awareness-raising among the local community, contract workers and staff about the cultures and norms of the local community,
- Provision of cultural sensitization training for all staff regarding engagement with the local community,
- Provide awareness creation program about tolerance of diversity and,
- Develop a code of conduct for staff to prevent discrimination and other ethnocentric behaviors

11.2.2.3 Gender-Based Violence Mitigation Measures

- Establish gender mainstreaming and monitoring committee,
- Provide awareness to the newly joined workers about the incidence and impact of domestic violence, sexual assault, and stalking, including reporting requirements and options,
- Conduct continued sensitization and awareness raising to EPHI staff in general and BSL-3 NRL staff on the prevention of GBV,
- Strengthen the gender and women office of EPHI to address GBV cases when it occurs,
- On-going prevention training for staff; and
- Provision of gender-disaggregated data, separate bathing, changing, and sanitation facilities for men and women should be ready by institution and
- Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project

11.2.2.4 Traffic and Public Safety Impacts Mitigation Measures

- Placing visible and readable signs to the main gate where there are risks and arrange designated car parking,
- Apply "Three E" philosophy and be transparent and proactive about all traffic initiatives;
  - **Enforcement** – including duties performed by Addis Ababa Police (Traffic Management Bureau) and Woreda by-law enforcement staff,
  - **Education** – including Speed Management Program and Safety Driven education campaign,
  - **Engineering** – including issues related to road design on existing roads and planning for future projects

11.2.2.5 Public Health Impacts Mitigation Measures

- Laboratory personnel working in BSL 3, PTPC and biobank should receive specific training in handling pathogenic and potentially lethal agents and should be supervised by competent staff in handling infectious agents and associated procedures,

- Laboratory workers would be trained in equipment operating and handling techniques during operation,
- Effective vaccines or therapeutic measures would be available for all risk groups,
- The use of pest control programs would limit the potential for transmission of infectious agents from animals to humans,
- Training should be provided on sample and waste handling, transportation, and storage, and disposal,
- All material would be sterilized by autoclave or chemical disinfection
- Ensure that the facility should be designed to severely limit the potential for possible vector-borne transmission through insects and rodents,
- Ensure that water exiting through the sink drains would be diverted to a retention tank where it would be disinfected before being sent to the sewer system.
- All agents would be contained within the laboratory and a biosecurity system would be in place

- Promote the use of a condom, and implementation of HIV/AIDS education program, and get a vaccine for Covid 19,

- BSCs HEPA filters would be tested annually and replaced as necessary,
- Ensure that the facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents
- PTPC and biobank would be locked always and access restricted for non-authorized personnel,

11.2.2.6 Public Service Burden Mitigation Measures

- The project needs to provide its own transportation for staff,
- In collaboration with concerned sectors, the BSL-3 project should ensure access of additional electric transformers whereby they can keep the existing power utilized by the community,
- Drill a borehole within the project site for the water source.
- Work with the community and city administration to make the access road asphalt smooth during the entrance and leaving of the campus,

11.2.2.7 Occupational Health and Safety Impacts Mitigation Measures

i) Risk of Infection Mitigation Measures

- Laboratory personnel working in BSL 3, PTPC and the Biobank Centre should receive specific training in handling pathogenic and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures,
- All procedures involving the manipulation of infectious materials should be conducted within a BSC or other physical containment devices,
- Persons would wash- their hands after working with potentially hazardous materials and before leaving the laboratory,
- Spills involving infectious materials would be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material.
- Equipment would be decontaminated before repair, maintenance, or removal from the laboratory,
- Workers in the laboratory should wear protective laboratory clothing with a solid front, such as tie-back or wrap-around gowns, scrub suits, or coveralls. Protective clothing will not be worn outside of the laboratory,

- Reusable clothing should be decontaminated before being laundered. Clothing is changed when contaminated,
- Potentially infectious materials should be placed in a durable, leak-proof container during collection, handling, processing, storage, or transport within a facility,
- Gloves should be worn to protect hands from exposure to hazardous materials. Gloves should not be worn outside the laboratory. Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols would be rigorously followed,
- Blood should be collected from patients by trained staff,
- For phlebotomies, conventional needle and syringe systems should be replaced by single-use safety vacuum devices that allow the collection of blood directly into stoppered transport and/or culture tubes, automatically disabling the needle after use.

ii) Chemical Hazards Mitigation Measures

- To avoid accidental leakage or spillage, secondary containers, such as leak-proof boxes, should be used, fitted with racks so that the specimen containers remain upright,
- Respiratory protection should be used when carrying out high-hazard procedures. The choice of respirator will depend on the type of hazard(s) and it is available with interchangeable filters for protection against gases, vapors, particulates and microorganisms
- Volatile solvents should be handled in a chemical hood,
- Material Safety Data Sheets (MSDS) or equivalent should be considered while handling, storing, using, and disposing of hazardous chemicals.
- Only small amounts of chemicals necessary for daily use should be stored in the laboratory,
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid would always be ensured. Appropriately equipped first-aid stations would be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water,
- Either a fully buttoned laboratory coats, gown, coverall, or long-sleeved, back-opening gown or coverall should be used in the BSL-3 laboratory at EPHI. Aprons

may also be worn over laboratory coats or gowns were necessary to give further protection during handling of chemicals, hazardous and infectious materials, and

- Eye and face protection (goggles, mask, face shield or other splash guards) would be used for anticipated splashes or sprays of infectious or other hazardous chemical materials.

iii) Risk of Burn or Fire Mitigation Measures

- Prepare a fire safety plan and the plan should provide employees or building occupants with the instructions they need to leave the building (or respond as appropriate) in the event of a fire,
- Delineating fire and emergency assembly points and creating awareness to ensure all people at the site are aware of them, e.g. through the use of maps on elevators, staircases, etc.
- All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs,
- Combustible materials such as flammable liquids, solid materials should be stored in a lockable cupboard,
- Fire hazard signs such as 'No Smoking' signs will be provided. Directions to exit in case of any fire incidence and emergency contact numbers will be provided. The contact/emergency numbers will be displayed within the laboratory
- First aid treatment facility should be also available,
- Automatic fire alarm system for the entire laboratory will be installed,
- All staff will have training in fire control through regular fire fighting drills.
- Fire extinguishers should be available in an accessible area near fire risk area and ensure that all fire-fighting equipment is regularly maintained and serviced,

iv) Ergonomic Hazards Mitigation Measures

- Training of workers in lifting and materials handling techniques during operation, including the placement of weight limits above which mechanical assists or two-person lifts are necessary,
- Planning work site layout to minimize the need for manual transfer of heavy loads,
- Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user-adjustable work stations,

- Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks.

v) Injury/Accident Mitigation Measures

- Injuries should always be reported to supervisors and victims should get medical attention as soon as possible. Collect broken needles in a secured and safe area and dispose of all based on WHO standards,
- Sharps waste by disposing of it in a sealable container; self-locking and sealable sharps containers are made of plastic so that the sharps cannot easily penetrate through the sides. Such units are designed so that the whole container can be disposed of with other biohazardous waste, with the support of the government
- Hepatitis B Vaccine should be given to all workers working in the laboratory

vi) Risk related to Electricity Mitigation Measures

- All electrical installations and equipment must be inspected and tested regularly, including earthing/grounding systems. Circuit breakers and earth-fault-interrupters should be installed in appropriate laboratory electrical circuits,
- All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs,
- All laboratory electrical equipment and wiring would conform to national electrical safety standards and codes,
- Disconnect equipment attached to high-voltage or high-amperage power sources from the source or provide a lockout device on the breaker box to prevent circuit activation before maintenance is performed,
- Because electrical devices can generate sparks, do not use them near flammable or volatile gases or liquids,
- Never place flammable liquids in a household refrigerator. The spark generated by the door-activated light switch can ignite fumes trapped in the unit, causing an explosion and fire,
- Specialized refrigerators would be used when storing chemicals that have explosion potential

vii) Fire and Explosion Mitigation Measures

- All staff will have training in fire control through regular firefighting drills,
- Fire extinguishers would be available in an accessible area near fire risk area and ensure that all fire-fighting equipment is regularly maintained and serviced,
- Fire emergency telephone numbers would be displayed in communal areas,

- Automatic fire alarm system for the entire laboratory will be installed,
- Fire suppression for the BSL-3 facility would be provided by a standard wet-pipe fire sprinkler system,
- Water flow alarms would be connected to the facilities fire alarm monitoring station so that,
- Designated responders would be notified
- Water hose reels will be installed in the laboratory.

11.2.2.8 Mitigation Measures for Risks related to Improper Waste Management

- Develop and implement a waste management plan for EPHI in general and for the proposed NRL project in particular in accordance with the infection control and waste management plan to guide the daily waste management operations,
- Initial packaging and storage would take place where HCW is generated,
- Storage of waste will then be moved to a temporary on-site storage location
- Waste segregation for wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs plastics would be done and these wastes should never be incinerated these wastes should be cleaned. Disinfected and disposed of with non-hazardous wastes,
- Controlled incineration of medical wastes with a pyrolysis incinerator should be done at an operating temperature of 800 to, 1200°C.
- Electronic wastes should not be incinerated at the site,
- Flue gas treatment system would be used for the control of acid gases, particulate matter, and other air pollutants;
- Hazardous and chemical liquid wastes should be stored in separate concrete-based safety tanks as recommended and disposed of after off-site treatment,
- Wastewater treatment plant works must comply with the effluent discharge guidelines of the country,
- The bottom of the landfill must be waterproofed and must be equipped with a final cover to prevent rainwater infiltration; and
- leachates must be collected to the safety tank and treated on wastewater treatment plant to be constructed by FMoH.

11.2.2.9 Mitigation Measures for Risk associated with Final Waste Disposal

- Personnel working on waste disposable would wear adequate personal protective equipment (PPE) including gloves, closed shoes, overalls and masks,

- Training would be provided to personnel working on waste disposable,
- Bottom ash, fly ash and other flue gas should be stored in secured ash pit in which it has leachate collection system that connects to the hazardous liquid waste safety tank,
- Bottom ash and residuals would be managed based on their classification as hazardous or non-hazardous materials;
- Use of double-walled, composite, or specially coated storage and piping systems for hazardous waste waste onsite storage particularly in the use of underground storage tanks (USTs) and underground piping. If doublewalled systems are used, It should be provided a means of detecting leaks between the two walls,
- Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store, and
- The treated liquid waste should fulfil the national and WBG ESH Guideline befor disposal to the environment.

11.2.2.10 Mitigation Measures related to impacts on Improper Wastewater Treatment

- Considering proper tank volume, geometry and compartmentalization to impart adequate hydraulic residence time for sedimentation,
- Elongated tanks with length-to-width ratios of 3:1 or more is will be used to reduce short-circuiting of the effluent,
- Two compartments will be used to achieve, better suspended solids removal rates,
- Manways 18 to 24 inches in diameter or square will be designed to access the tank for regular monitoring and maintenance,
- tank will be located where it can be accessed easily for septage removal and sited away from drainage swales or depressions where water can collect. Maintaining minimum horizontal setback distances from buildings, property boundaries, wells, water lines, and the like,
- Tank will rest on uniform bearing surface,
- The backfill material will be free flowing and free of stones larger than 3 inches in diameter and debris,
- Joints will be sealed properly, including tank joints,
- Use of appropriate anti-flotation devices,
- Tanks would be pumped when sludge and scum accumulations exceed 30 percent of the tank volume or are encroaching on the inlet and outlet baffle entrances,

- Periodic pumping of septic tanks will be used to ensure proper system performance and reduce the risk of hydraulic failure,
- Pumping and cleaning of Sludge and septage from the septic tank will be outsourced to Addis Ababa water supply and sewerage authority, Kotebe treatment plant,
- To achieve acceptable treatment in the sand/media unit, the wastewater retention time in the filter will be sufficiently long and reaeration of the media will occur to meet the oxygen demand of the applied wastewater. The pore size distribution and continuity of the filter medium, the dose volume, and the dosing frequency will be key design and operating considerations for achieving these conditions,
- Remove and clean or replace the throttle blower as required,
- Check aeration system, aeration tank dissolved oxygen level.
- Increase sludge return rate to decrease sludge retention time in clarifier
- Effective cleaning of UV-lamp sleeves periodically, and
- In order to improve transmittance of UV, the process control will be implemented to obtain a turbidity level of <0.2 NTU in the final water. Where the turbidity levels are above 0.2 NTU and/or TOC levels are in excess of 2-3 mg/litre, sludge or waste water return lines will be constructed for better performance2.

11.2.2.11 Mitigation Strategies for Impact of Air Pollution due to Waste Incineration

- Waste segregation for wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs would be done and these wastes would never be incinerated,
- Materials free of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs would be purchased, for minimizing the environmental and health impacts.
- Workers will be provided with PPE and the use of PPE would be enforced.
- Improve incinerators and infrastructure for healthcare waste treatment and disposal
- New environmentally friendly incinerator would be purchased considering the following features:
- Applicable national requirements and internationally recognized standards for incinerator design and operating conditions would be followed, mainly rapid quenching of the flue gas after leaving all combustion chambers and before entering any dry particulate matter air pollution control device but also combustion temperature, residence time, and turbulence,

- Wastes would be introduced into the incinerator only after the optimum temperature is reached in the final combustion chamber,
- The waste charging system would be interlocked with the temperature monitoring and control system to prevent waste additions if the operating temperature falls below the required limit,
- Minimize the uncontrolled ingress of air into the combustion chamber via waste loading or other routes,
- Optimize and control combustion conditions by the control of air (oxygen) supply, distribution and temperature, including gas and oxidant mixing; the control of combustion temperature level and distribution; and the control of raw gas residence time;
- maintenance and other procedures would be implemented to minimize planned and unplanned shutdowns;
- operating conditions in excess of those that are required for efficient destruction of the waste would be avoided;
- Auxiliary burner(s) would always be used for start-up and shut-down and for maintaining the required operational combustion temperatures (according to the waste concerned) when unburned waste is in the combustion chamber.

11.2.2.12 Mitigation Measures for Risk Associated with Off-Site Transport of Waste

- Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks
- Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer Regular inspection, maintenance and repair of fittings, pipes and hoses
- Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points or other possible overflow points,
- The transportation would be properly documented, and all vehicles will carry a consignment note from the point of collection to the treatment facility,
- Vehicles used for the carriage of waste would be disinfected prior to use for any other purpose,

- The vehicles would be free of sharp edges, easy to load and unload by hand, easy to clean and disinfect, and fully enclosed to prevent any spillage in the facility premises or on the road during transportation, and
- The vehicles would carry adequate supplies of plastic bags, protective clothing, cleaning tools, and disinfectants to clean and disinfect in case of any spillage

11.3 Decommission Phase Mitigation Measures

11.3.1 Air Quality Impact Mitigation Measures

- Using efficient equipment and machines with efficient engines having low emissions,
- Using clean fuels such de-sulphurized diesel and unleaded fuels,
- Water sprinkling on structures and facilities to be demolished if necessary, and
- Removing components with a potential of emitting hazardous gases or particulates separately and under caution to prevent emissions.

11.3.2 Noise and Vibration Impacts Mitigation Measures

- Carrying out the decommissioning works only during the specified time from 8:00 hrs to 17: 00 hrs where permissible levels of noise are high and acceptable,
- Machineries used in decommissioning activities should be maintained regularly to reduce noise resulting from friction as per the Manual,
- Providing workers with Personal Protective Equipment such as earmuffs when operating noisy machinery and when in a noisy environment,
- Provision of billboards at the construction site gates notifying people of the activities and timings,

11.3.3 Gender-Based Violence Mitigation Measures

- The institution will prepare a GBV prevention action plan and act accordingly,
- Conduct continued sensitization and awareness raising to EPHI staff in general and BSL-3 NRL staff in particular on the prevention of GBV,
- Strengthen the Gender and women office of EPHI to address GBV cases when it occurs,
- The contractor will provide orientation to its staff to respect the culture of the local people and to limit their relationship with the local people,

- Contractor and implementing agency to prepare and implement a GBV Prevention and Response Action Plan to include at a minimum, in conformance with local laws and customs, equal opportunity for employment,
- All workers and nearby communities and stakeholders will be educated on preventing and responding to sexual harassment and GBV ahead of any project-related works,
- Construction areas should be separated by a fence and a separate access gate is used for construction workers,
- Ensure that women are given a mentorship orientation before starting their work.
- Regular sensitization and awareness campaigns (at least two times a year) to workers should be done to promote gender equity in employment during the construction and operation phases,
- Provision of gender-disaggregated data, separate bathing, changing, and sanitation facilities for men and women should be made ready by the contractor, and
- Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project.
- In addition, SEA/SH mitigation measures should be practiced (a detailed description on SEA/SH mitigation measures has given in section11.1.3.6).

11.3.4 Traffic Impacts Mitigation Measures

- Placing signs around the site notifying other vehicles about the heavy traffic and setting the speed limit around the site,
- Ensuring all drivers for the project comply to speed regulations, and
- Making sure the construction doesn't occupy the road reserves and complying with traffic and land demarcation obligations.

11.3.5 Solid Waste Generation Impacts Mitigation Measures

- Follow regulations on waste management of the country,
- Employing a waste management plan, which will involve assessing and creating opportunities for Regulation, Reducing, Reusing, Recycling, Recovering, and Renovation,
- Ashes from the old incinerator should be placed in a secured landfill to be constructed within EPHI,

- Removing reusable and recyclable material from the building before demolition to minimize the amount of waste,
- Allocating responsibilities for waste management and identifying all sources of wastes, and ensuring wastes are handled by personnel licensed to do so,
- Making available suitable facilities for the collection, segregation and safe disposal of waste, and
- Ensuring all wastes are dumped in their designated areas and through legally acceptable methods.

Before removal of materials and equipment, the equipment must be checked for contamination and decontaminated if required

Procedures:

- **Hazardous Materials -** Remove chemical, biological, and radiological agents prior to decommissioning. Be aware that numerous restrictions apply to the transfer of hazardous materials that is stated under the waste management section,
- **Chemicals** – Coordinate chemical waste disposal with EH&S Hazardous Waste Management and federal EPA at least 30 days prior to decommissioning. Unopened and uncontaminated chemicals can be returned to departmental stockrooms, transferred to temporary storage,
- **Compressed Gas Cylinders** –transferred to temporary storage by performing leak test,
- **Biologicals** – Dispose of biological wastes, potentially infectious materials, and sharps according to WHO requirements. Liquids can be decontaminated and poured down the drain,

Safe Packaging and Transfer of Materials- Remove all glassware, laboratory research apparatus, empty containers, and other equipment. Storage areas, cabinets, and fume hoods must be completely emptied before decommissioning.

- Ensure that all containers (bottles, jars, etc) are securely closed and that containers are not damaged or leaking. Where necessary laboratory film or secondary containers can be used to assist in this process,
- A risk assessment is generally required when preparing to move large quantities of hazardous substances from one area to another especially if porters or other non-

specialist staff will be involved. An emergency plan and spill control strategy should always be in place before any movement is carried out,

- Biological hazards must be appropriately packaged and safely transported between buildings and local sites in the immediate vicinity,

Clean and Decontaminate – Clean and decontaminate all laboratory surfaces, including those in fume hoods, biosafety cabinets, and chemical storage areas. General cleaning and chemical decontamination can be accomplished by washing with warm, soapy water. Further decontamination may be necessary for:

- **Biologicals** – Areas that may have been exposed to spills can be decontaminated with 1:10 bleach solution or other suitable disinfectants,
- **Equipment** – Decontaminate all accessible surfaces. Affix Equipment Release Form to equipment that will be shipped to temporary areas,
- **Biosafety Cabinets** – Wipe down all accessible surfaces (including the spill pan) with a suitable disinfectant. Some agents may necessitate a formaldehyde gas decon of the filter and inner surfaces;

11.3.6 Gender-Based Violence Mitigation Measures

- The institution will prepare a GBV prevention action plan and act accordingly,
- Conduct continued sensitization and awareness raising to EPHI staff in general and BSL-3 NRL staff in particular on the prevention of GBV,
- Strengthen the Gender and women office of EPHI to address GBV cases when it occurs,
- The contractor will provide orientation to its staff to respect the culture of the local people and to limit their relationship with the local people,
- Contractor and implementing agency to prepare and implement a GBV Prevention and Response Action Plan to include at a minimum, in conformance with local laws and customs, equal opportunity for employment,
- All workers and nearby communities and stakeholders will be educated on preventing and responding to sexual harassment and GBV ahead of any project-related works,
- Construction areas should be separated by a fence and a separate access gate is used for construction workers,
- Ensure that women are given a mentorship orientation before starting their work.

- Regular sensitization and awareness campaigns (at least two times a year) to workers should be done to promote gender equity in employment during the construction and operation pahses,
- Provision of gender-disaggregated data, separate bathing, changing, and sanitation facilities for men and women should be made ready by the contractor, and
- Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project.

11.3.7 Occupational Health and Safety (OHS) Impacts Mitigation Measures

- Employing an OSH plan that will outline all OSH risks and provide a strategy for their management,
- Ensuring all hazards such as movable parts are labeled,
- Raising awareness and educating workers on risks from equipment and ensuring they receive adequate training on the use of the equipment,
- Providing the workers with adequate PPEs and monitoring regularly to ensure they are replaced on time when they wear out,
- Placing visible and readable signs around where there are risks and undertaking the riskier demolition activities first and in isolation,
- All wastes should be removed from the site,
- Ensuring there is security in and around the site to control the movement of people,
- Providing safe and secure storage for the waste and materials in the site,
- Placing visible and readable signs to control the movement of vehicles and notify motorists and pedestrians around them, and workers in the site,
- Providing firefighting equipment and in easily accessible areas as well as ensuring site personnel are well trained to use them as well as maintaining them regularly,
- Labelling chemicals and materials according to the risks they possess,
- Creating safe and adequate fire and emergency assembly points and making sure they are well-labeled, and

- Establishing emergency procedures against hazards and ensuring the workers stay aware/educated on following them and commensurate to the magnitude and type of emergency, by conducting regular drills and involving the neighbors.

12 RISKS RELATED TO DECOMMISSIONING OF OLD INCINERATOR AND CONSTRUCTION OF NEW INCINERATOR

12.1 Risk of Decommissioning of Old Incinerator

The clinical waste incinerators and their associated ductwork are located in the southeast of EPHI approximately 30 meters to the east of the EPHI training centre building. The floor area of the incinerator rooms is approximately 48 m^2 (functional) and 30 m^2 for the old incinerator (non-functional) respectively. The incinerators and associated ductworks are constructed mainly of steel.

As both chimneys are located inside the concrete service duct in the northern corner of Block K with limited access, removal of the chimneys will cause severe disruption to the

EPHI operation, residents and community to the southeast of EPHI campus, etc. if the decommissioning and demolition works are carried out in one single phase. Also, the service duct is considered a a confined space, additional precautions would be required. Furthermore, floor spaces would be needed to be isolated with restricted access for the demolition works and locations of decontamination compartments which would cause further restrictions to the access of wards, treatment rooms, offices and operation theatres. To minimize disruption and disturbance, the decommissioning and demolition works would be best undertake in 2 Phases, i.e. the decommission and demolition of the two incinerator units and associated ductworks within the Incinerator Room in the first phase whilst the vertical flues (chimneys) would be demolished when the blocks are being demolished.

Decommissioning of incinerators and their associated waste induces the environmental release of several contaminants, including organic and inorganic chemical compounds and biological agents, which might adversely affect human health through several pathways of exposure if appropriate mitigation measures are taken.

12.1.1 Hazardous Wastes Risks

A list of substances or chemicals (in any form, quantity and concentration), including asbestos, dioxins, polychlorinated biphenyls (PCBs) and heavy metals (HMs) are expected from the decommissioning and demolition of the incinerators and associated ductworks include residual ash and asbestos-containing materials. The key environmental impacts are associated with the residual ash (bottom ash and fly ash) remaining in the incinerator unit and ash collector. Exposure to organic substances such as dioxins, furans, polychlorinated

biphenyls and polycyclic aromatic hydrocarbons may increase the occurrence of genotoxic, immunologic and endocrine-disrupting effects, even at unexpectedly low concentrations.

Mitigation Measures

- Prior to the commencement of any decommissioning works, the project proponent or its representative shall notify the Federal EPA 28 days in advance of the intended works,
- As ash is deposited inside the combustion chamber as well as attached to its associated walls, and ductworks, the Specialist Contractor shall use a High-Efficiency Particulate Air (HEPA) vacuum to clean these materials, wet wiping before wrap them in polythene and dispose of the ash at the secured and protected landfill to be constructed at EPHI,
- The demolition works will be conducted in 2 Phases to minimize the disruption to the EPHI operation and nearby community,

12.1.2 Water Quality Impact

Incinerator wastes in the form of stack gas, fly ash, bottom ash/slag, scrubber water, scrubber water filter cake,

etc. are deliberately dispersed or otherwise released to the environment, carrying with them a diverse number of pollutants formed or redistributed during incineration. In addition, Soil and water become more acidic due to the emission of gases (SO 2 , NO x) that react in the atmosphere to form acids (H_2 SO_4, HNO_3), leading to acid precipitation.

Mitigation Measures

- Wastewater generated from the decommissioning and demolition works will be limited to general cleaning works, and water used in dust suppression whilst wastewater from the shower unit of the decontamination unit will be collected and discharged into the hazardous waste collection system. Any water will be wiped dry with cloths. The damp cloths shall be stored in appropriate containers such as drums and jerricans for proper incineration and disposal,
- The floor drain in the incinerator room shall be covered with a temporary seal during the decommissioning and demolition works. The top of the chimney should be sealed with polyethylene sheets at least twenty-four (24) hours before the works commence,

- All wastewater arising (if any) from the decommissioning should be collected and discharged to the onsite wastewater collecting safety tank and treated at the recommended offsite wastewater treatment plant,
- The floor drain in the incinerator room shall be covered with a temporary seal during the decommissioning and demolition works,
- The top of the chimney should be sealed with polyethylene sheets at least twenty-four (24) hours before the works commence,

12.1.3 Air Quality Impact

Pollutants that are emitted into the atmosphere from an incinerator stack as well as fugitive emissions may be deposited on the ground near the incinerator and thus contaminate the local environment. The pollutants, including PM and organic compounds (dioxins), get transported great distances on air currents.

Incinerators, in particular, cement kilns; emit considerable quantities of SO_2 and NO_2. Long-term exposure to these substances is known to have negative impacts on respiratory health.

Mitigation Measures

- The decommissioning and demolition of the incinerator units and associated ductworks in Phase 1 will be carried out in an air-tight condition under negative pressure, and hand-held tools and small electric equipment will be used for the decommissioning works,
- The demolition of the chimneys in Phase 2 will be carried out in a fully enclosed structure, and hand-held tools and small electric equipment will be used for the decommissioning works,
- Decommissioning and demolition work will be carried out in full containment; a Specialist contractor will be employed with adequate health and safety protection measures in place,
- Wet wiping of the surface to minimize airborne dust,

12.1.4 Risk of Accident

Accidents may occur during decommissioning works which are associated with disconnecting the town gas supply.

- Falls from ladders, stairs and elevated platforms while decommissioning the incinerator,

- Slips and falls on the level, particularly on floors that are slippery or covered with spilled fuel, debris,
- Struck by flying ashes and debris, incl. penetration into eyes,

Mitigation Measures

- Wear safety shoes with non-skid soles,
- Technicians who have operated the incinerator shall be part of the decommissioning activity,
- Wear long-sleeved shirts and protect hands with metal-mesh or other protective gloves,
- Wear appropriate eye protection; consult a safety supervisor or a supplier

12.2 Risk of Construction of New Incinerator

12.2.1 Risks of Trauma and Infection

Wastes from EPHI laboratory are a source of potentially dangerous micro-organisms that can infect EPHI workers, waste handlers, incinerator operators, and the general public. There are many different exposure routes: through injury (cut, prick), through contact with the skin or mucous membranes, through inhalation or ingestion. Sharps and pathogenic cultures are regarded as the most hazardous medical waste.

Mitigation Measures

- Organizational prevention: such as assigning duties and responsibilities to all involved, management (sorting, packaging, labeling, storage, transport), best practices (such as refraining from putting the caps back on syringes), training,
- Individual prevention: personal protective equipment, vaccination, washing hands,
- Provide body protection such as aprons, protective suits for staff involved in collecting, transporting and treating wastes,
- Provide also heavy-duty protective gloves for staff involved in transporting and treating wastes,
- Staff handling wastes must be appropriately protected by vaccination, including vaccination against hepatitis A and B and tetanus.

12.2.2 Accident Hazards

Accident hazards may occur when;

- Falls from ladders, stairs and elevated platforms while operating and maintaining the incinerator equipment, esp. hopper,
- Slips and falls on the level, particularly on floors that are slippery or covered with spilled fuel, debris, etc.
- Falls of trash containers and other heavy loads on legs,
- Struck by flying ashes and debris, incl. penetration into eyes,
- Burns caused by contact with hot surfaces of furnaces, by back-fire while igniting burners, or by flying hot ashes and debris,
- Acute poisoning by carbon monoxide or by other combustion products in the air, particularly in the case of faulty ventilation or inadequate air supply to the burners,
- Acute poisoning (primarily using inhalation) is caused by hazardous components of refuse and its combustion products,
- Punctures and cuts while using a stoking hoe, spade, scrap iron and other tools,
- Fires and explosions caused by flammable or explosive components of refuse, or by fuel (particularly from fuel leaks)

Mitigation Measures

- Wear safety shoes with non-skid soles,
- Wear long-sleeved shirts and protect hands with metal-mesh or other protective gloves,
- Wear appropriate eye protection; consult a safety supervisor or a supplier,
- Install effective exhaust ventilation to prevent air contamination; add local exhaust ventilation if necessary,
- Arrange for periodic inspection of incinerator vessel integrity, to detect metal cracking, etc.

12.2.3 Physical Hazards

Physical hazard is associated with exposure to high levels of noise, exposure to heat while continuously working near furnaces, esp. when their doors are open, and exposure to abrupt changes from heat to cold and vise versa while entering and exiting the incinerator room in cold weather.

Mitigation Measures

- Wear hearing protection appropriate for the noise levels and type of noise -consult an expert,
- Wear long-sleeved shirts and protect hands with metal-mesh or other protective gloves,

12.2.4 Chemical Hazards

- Chronic exposure, by inhalation, skin and eye contact and digestion, to hazardous components of the waste prior to incineration, during transportation, loading, spreading, etc,
- Chronic exposure, primarily using inhalation, to hazardous products of thermal degradation of the waste,

Mitigation Measures

- Wear respiratory protection during maintenance or other work in which dust and noxious gases may be released into the atmosphere,
- Read material safety data,
- Provide the training and information necessary for the employees to work safely and healthily,
- Ensure all personal protective equipment (PPE) is in good working condition
- Follow safe work instructions and procedures given by your supervisor,

12.2.5 Ergonomic Hazard

Ergonomic hazards associated with the operation of the incinerator are back pains and other musculoskeletal problems (including lesions of intervertebral discs) resulting from overexertion and awkward postures, during operations of loading, unloading, spreading, agitating, repair of linings, etc; exposure to obnoxious (sometimes offensive) odors of refuse and its combustion products, and general tiredness as a result of heavy physical work in a hot, noisy and filthy environment.

Mitigation Measures

- Learn and use safe lifting and moving techniques for heavy or awkward loads; use mechanical aids to assist in lifting,

- Wear respiratory protection during maintenance or other work in which dust and noxious gases may be released into the atmosphere

12.2.6 Risk of Fire or Explosion

Incinerators usually require storage of flammable or combustible fuels (e.g. kerosene, waste fuels). Hazards associated with flammable/combustible fuels include the potential for an on-site spill or release of material. The release may cause worker exposure to the vapors generated or a fire hazard may exist if the material is ignited. Soils saturated with flammable or combustible materials may be ignited by sparks generated when the blade of the dozer or crawler contacts rocks or other objects.

Mitigation measures

- Fuel system installation/storage and testing must comply with the applicable requirements,
- Fire extinguisher should be installed and periodically checked for its functionality, and
- Wetting of the soil before and during crushing may help prevent ignition. The soil handling equipment may also be equipped with non-sparking buckets or blades
- Temperature safety control systems should be included to protect people and equipment,
- The design of the systems should also consider the handling of materials exiting the system,
- Safety barriers can be included to isolate critical sections of the equipment, and
- Signs should be posted warning of high temperatures.

12.2.7 Electrocution Hazards

Since incinerators operate electrical systems outdoors, workers may be exposed to electrocution hazards.

Mitigation Measures

- All controls, wiring, and equipment, including adequate ground-fault protection, should be in conformance with the requirements

12.2.8 Risk of Facility Damage or Failure

Improperly designed systems can corrode or dissolve to a point of failure and cause damage to the facilities or exposure to workers.

Mitigation Measures

- All transfer equipment (conveyors, piping, process units and instruments) in contact with contaminated materials should be fabricated from materials that are chemical-resistant to that chemical,
- Where liquids may separate from solid materials or when incinerating liquids, containment drip pans or receivers should be included in the design, and
- Spill and/or leak detection instruments can be installed to monitor for leaks or spills and set off alarms when appropriate.

12.2.9 Risk of Air Pollution

Air pollution arises as a result of the release of particulate matter during medical waste incineration activities. Inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and in the generation of ash residue. Incinerated materials containing or treated with chlorine can generate dioxins and furans, which are human carcinogens and have been associated with a range of adverse health effects.

Mitigation measures

- Weekly: clean heat recovery boiler tubes, blower intakes, burner flame rods and sensors, heat recovery induced draft fan; lubricate latches, hinges, hopper door pins, etc,
- Only modern incinerators operating at 850-1200 °C and fitted with special gas-cleaning equipment can comply with the national and international emission standards for dioxins and furans,
- Daily: check opacity, oxygen and temperature monitors; clean underfire airports, ash pit and sump; inspect limit switches and door seals,
- Always Operation by trained, qualified personnel,
- Introduction of waste at 850ºC or higher; automation to avoid introducing waste below 850ºC,
- Minimum residence time of 2 seconds at 1200ºC in the secondary chamber after the last addition of air and 6% O2 by volume (for waste with >1% halogenated substances)

12.2.10 Water and Soil Pollution

Bottom Ash generally contains dioxins/furans, other organics and leachable metals. Bottom ash from medical waste incinerators often contains hazardous constituents and has to be treated as hazardous waste before disposal to the environment.

Mitigation Measures

- Ash should be handled, transported (using covered hauling) and disposed of in an environmentally friendly manner,
- Disposal or landfilling in double-walled concrete-based landfill to be constructed in EPHI,
- the leachate collection system should be connected to a hazardous liquid waste safety tank for further treatment,
- surface water drainage system should be constructed to prevent the entrance of rainwater,
- Vegetation should be planted along the sides of the secured landfill, and
- The landfill should be protected from any access.

13 IMPACTS ASSOCIATED WITH THE OPERATION OF BSL 3 NRL, PTPC AND BIOBANK

13.1 Impact of escaping Infectious Agents from BSL-3 Containment

In the BSL 3 laboratory, there would be highly infectious agents in storage, diagnosis process or culture. So, there would be a possibility to escape infectious agents BSL-3 Containment. Potential means for infectious agents to leave the BSL-3 containment and possibly cause human health impacts would include five pathways. These are direct transmission, vector-borne transmission, vehicle-borne transmission, airborne transmission, and water-borne transmission.

Direct Transmission: would first require a worker to be exposed to an infectious agent. The likelihood of a worker inhaling or otherwise becoming exposed (for example, through cuts in the skin or ingestion) to an infectious agent would be extremely remote. While it would be very unlikely that a worker would be exposed, if exposed with a sufficient dose, it would be possible for them to be carriers for those agents and through direct transmission expose others. This potential is further reduced through the intervention of effective vaccines or therapeutic measures (CDC 1999).

Vector-borne Transmission: Vector-borne transmission can include mechanical or biological transmission of infectious agents. Mechanical transmission includes carriage by crawling or flying insects through soiling of feet or proboscis or by the passage of organisms through the gastrointestinal tract, it does not require multiplication or development of the organism. The biological transmission includes propagation (multiplication), cyclic development, or a combination of these. The facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents.

Vehicle-borne Transmission: The primary concern for vehicle-borne transmission would be by the workers' clothing or skin and hair, as all other materials leaving the BSL-3 would go through sterilization by autoclave or chemical disinfection. The guidelines established by the CDC and NIH, which would be followed within the proposed BSL-3 facility, are designed to reduce this potential method of transmission. This would substantially reduce any potential for a worker to unknowingly transport infectious microbes from the facility.

Water-borne Transmission. Potable water would not be affected by the implementation of the proposed Action. Facility design features, such as backflow preventers would prevent microbes within the facility from migrating back through the water supply piping to the

public. Water exiting through the sink drains would be diverted to a retention tank where it would be disinfected before being sent to the sewer system.

Airborne Transmission: All air leaving the BSL-3 laboratory during normal conditions would exit through ductwork that is HEPA-filtered before emission through stacks on the building roof. HEPA filters are rated as 99.97 percent efficient at a most-penetrating "design point" of 0.3 microns diameter as tested by dioctyl phthalate (DOP) particles (NSC 1996). This means that HEPA filters are designed to remove at least 99.97 percent of all the particulates that hit the filters, even in the most-penetrating sizes of 0.1 to 0.4 microns. The remaining particles (less than 0.03 percent) can penetrate or pass through the filters. The number of viable vegetative microorganisms after HEPA filtration would be negligible. Because HEPA filters have fiber diameters ranging from 0.65 to 6.5 microns in three diameter groupings. The process of aerosol filtration does not simply rely on the size of the opening between fibers but uses several physical properties of air movement around fibers to capture the particles.

Since in BSL 3 laboratory highly infectious agents are escaped from BSL-3 Containment, it may have potential risks resulting in life-threatening for personnel working in BSL 3 laboratory and community. The agents may cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community. Duration of the impact would be *long-term/* throughout the entire life of the affected person or short-term depending on the hazard exposed to. The intensity of the impact would be *low* when ''facility design'' and HEPA filters proposed in WHO & World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007) are adopted. In relation to this, workers at the EPHI facility would always wear PPE while working in BSL-3. The institute would also benefit from long term practices and experience in performing similar procedures in the existing mobile BSL 3 laboratory through its established system.

Mitigation Strategies

The following mitigation strategies would be implemented to prevent infectious agents from escaping BSL-3 containment

- Laboratory personnel working in BSL 3 would receive specific training in handling pathogenic and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures.
- Laboratory workers would be trained in equipment operating and handling techniques during operation,

- Equipment would be periodically maintained and calibrated according to manufacturer recommendation
- HEPA filters at the EPHI BSL-3 facility (including those in the BSCs) would be tested annually and replaced as necessary.

Additionally, the potential impact would further be reduced through the following intervention:

- Effective vaccines or therapeutic measures would be available for all risk groups
- The use of pest control programs would limit the potential for the transmission of infectious agents from animals to humans.
- Trainings would be provided on sample and waste handling, transportation, and storage
- All material would be sterilized by autoclave or chemical disinfection
- Ensure that the facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents.
- Ensure that water exiting through the sink drains would be diverted to a retention tank where it would be disinfected before being sent to the sewer system.
- All agents would be contained within the laboratory and a biosecurity system would be in place.

13.2 Impact of Handling and Storage of Infectious and Hazardous Materials in BSL 3 NRL

As BSL 3 laboratory is expected to perform diagnosis for highly infectious agents, during specimens' collection, handling, transportation and storage, there will be a risk of exposure for the specimen. If the specimen has highly infectious agents, it may cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community.

Mitigation Measures

The following strategies would be implemented to mitigate the potential risks associated with BSL 3 laboratory regarding specimen handling.

- Specimen containers would be robust and would not leak when the cap or stopper

is correctly applied. No material would remain on the outside of the container. Containers would be correctly labeled to facilitate identification. Specimen requests or specification forms would not be wrapped around the containers but placed in separate, preferably waterproof envelopes.

- To avoid accidental leakage or spillage, secondary containers, such as boxes, would be used, fitted with racks so that the specimen containers remain upright. The secondary containers may be of metal or plastic, would be autoclavable or resistant to the action of chemical disinfectants, and the seal would preferably have a gasket. They would be regularly decontaminated. Laboratories that receive large numbers of specimens would designate a room or area for this purpose.

Moreover, regarding the collection, labeling and transport of specimens, the following will also be considered:

- Standard precautions would always be followed; gloves would be worn for all procedures.
- Blood would be collected from patients by trained staff.
- For phlebotomies, conventional needle and syringe systems would be replaced by single-use safety vacuum devices that allow the collection of blood directly into stoppered transport and/or culture tubes, automatically disabling the needle after use.
- The tubes would be placed in adequate containers for transport to the laboratory and within the laboratory facility.
- Request forms would be placed in separate waterproof bags or envelopes.
- Reception staff would not open these bags.

Opening Packages: personnel who receive and unpack specimens would be aware of the potential health hazards involved, and would be trained to adopt standard precautions, particularly when dealing with broken or leaking containers. Primary specimen containers would be opened in a biological safety cabinet. Disinfectants would be available.

Avoiding the dispersal of infectious materials: To avoid the premature shedding of their loads, microbiological transfer loops would have a diameter of 2–3 mm and be completely

closed. The shanks would not be more than 6 cm in length to minimize vibration. Working areas would be decontaminated with a suitable disinfectant at the end of each work period.

Avoiding ingestion of infectious materials and contact with skin and eyes: Large particles and droplets (> 5 □m in diameter) released during microorganism manipulations settle rapidly on bench surfaces and on the hands of the operator. Disposable gloves would be worn. Laboratory workers would avoid touching their mouths, eyes and face. Food and drink would not be consumed or stored in the laboratory. The face, eyes and mouth would be shielded or otherwise protected during any operation that may result in the splashing of potentially infectious materials.

Avoiding injection of infectious materials: Accidental inoculation resulting from injury with broken or chipped glassware would be avoided through careful practices and procedures. Glassware would be replaced with plastic ware whenever possible. Accidental injection may also result from sharps injuries and workers at the BSL-3 facility in EPHI would implement the following when possible:

- Needle-stick injuries can be reduced by: (a) minimizing the use of syringes and needles (e.g. simple devices are available for opening septum-stoppered bottles so that pipettes can be used instead of syringes and needles; or (b) using engineered sharp safety devices when syringes and needles are necessary.
- Needles would never be recapped. Disposable articles would be discarded into puncture-proof/puncture-resistant containers fitted with covers.

Opening of ampoules containing lyophilized infectious materials: Care would be taken when ampoules of freeze-dried materials are opened, as the contents may be under reduced pressure and the sudden inrush of air may disperse some of the materials into the atmosphere. Ampoules would always be opened in a biological safety cabinet. The following procedures would be implemented while opening ampoules.

- First the outer surface of the ampoule would be decontaminated.
- A file mark would be made on the tube near the middle of the cotton or cellulose plug, when present.
- The ampoule would be held in alcohol-soaked cotton to protect hands before breaking it at a file scratch.
- The top would be removed gently and treated as contaminated material.

- The plug would be removed with sterile forceps when it is still above the contents of the ampoule.
- Liquid would be added for resuspension slowly to the ampoule to avoid frothing.

Storage of ampoules containing infectious materials: Ampoules containing infectious materials would never be immersed in liquid nitrogen because cracked or imperfectly sealed ampoules may break or explode on removal. If very low temperatures are required, ampoules would be stored only in the gaseous phase above the liquid nitrogen. Otherwise, infectious materials would be stored in mechanical deep-freeze cabinets or on dry ice. Laboratory workers would wear eye and hand protection when removing ampoules from cold storage. The outer surfaces of ampoules stored in these ways would be disinfected when the ampoules are removed from storage.

Standard precautions with blood and other body fluids, tissues and excreta: Standard precautions (which include "universal precautions" would be designed to reduce the risk of transmission of microorganisms from both recognized and unrecognized sources of infection.

Opening specimen tubes and sampling contents: Specimen tubes would be opened in a biological safety cabinet.

- Gloves would be worn. Eye and mucous membrane protection would also be used (goggles or face shields).
- Protective clothing would be supplemented with a plastic apron.
- The stopper would be grasped through a piece of paper or gauze to prevent splashing.

13.3 Potential Impact During the Operation of Central Warehouse

Although the quantities of hazardous chemicals stored in the facility of PTPC and biobank would be at a few chemicals, the central warehouse would be a large amount. However, there would be no radioactive substance stored at the central house as well as at the EPHI level. Nearly all industries, including laboratory facilities, use chemicals in variable amounts and must therefore store them, as well as the produced chemical waste before disposal. Acting as a warehouse, the storage facility also shelters the chemicals: it protects the personnel and the environment from the effects of a spill, or an aerosol or gas emission.

Chemical emissions: Toxicological, chemical and physical properties define the hazards of a chemical. However, in a chemical storage facility, further factors add on: quantity, storage

form, the proximity of various chemicals, activities carried out in the facility, etc. The following example illustrates this hazard increase: hydrochloric acid and iron fillings, stored separately, are not flammable, yet when they come in contact, their reaction releases hydrogen, an extremely flammable gas, which may cause fire or explosion. But the hazard first materializes, when chemicals are spilled, e.g. out of containers. Among numerous causes for a chemical leak are:

- Mechanical damage to the container (bumped during transportation, tilted over after it was placed on an unstable ground or rack...);
- Container aging (plastic becoming brittle with time or under the effect of light or low temperatures, plastic softening through heat, metal corrosion, the interaction between the container and its filling);
- Expansion of the filling (vapour pressure build-up with heat, crystallization at low temperature, chemical decomposition with time or induced by light exposure);
- Sampling and transfer of chemicals.

This chemical dispersion can have serious consequences for the health of the staff community and environment as follow:

Damage to health: A leaked chemical, especially when it is volatile or gas at room temperature can cause intoxication. The risk of intoxication is particularly insidious, when the spilled chemical on its own does not have any severe toxicological properties but releases a toxic substance when it reacts with the environment or other chemicals stored in the same room (for instance, gaseous chlorine forms, when liquid bleach comes in contact with an acidic solution). Besides these acute effects, a wide range of chronic effects can also occur (such as impaired organ function, allergies and cancers. Contrary to acute effects, the occurrence of those chronic effects does not necessarily depend on the level of exposure: allergies, for example, can be triggered by exposure to very low concentrations of a sensitizing agent. Moreover, among all chemical categories, liquefied gases constitute a specific hazard. Contact with liquefied gases causes severe frostbites and, even if not toxic, once released, their rapid expansion can locally reduce the oxygen concentration to dangerously low levels and therefore cause asphyxia.

Damage to the environment and facilities: Apart from the hazards they represent for workers' health, stored chemicals may induce hazards for facilities, fauna and flora, and the general public off-site. When they are spilled, chemicals can irreversibly alter soils, streams

and ground waters, thus affecting surrounding communities. The nature of the environmental damage caused by a chemical spill depends on its toxicological, physical and chemical properties (form, reactivity, solubility, persistence, bioaccumulation, etc.) and those of the polluted site (permeation properties, etc.), but pollution risk increases with the number of stored chemicals.

Stored chemicals can also cause accidental fire or explosions. account for few occupational accidents each year, however, when they happen, they often claim lives and have dramatic environmental and economic consequences. Hostile fire is an uncontrolled oxidation reaction between combustible matter and an oxidant. Large amounts of both elements can often be found in a storage facility. Oxygen is the usual oxidant involved in a fire, while stored goods (organic chemicals like solvents or polymer pellets), packaging materials (plastic bags or containers) or pallets act as combustible matter. Various sources of energy can start a fire, e.g. a spark, heat, or an explosion. Accidental explosions can be either “physical” or “chemical”. A physical explosion can happen when, for example, pressure builds up inside a chemical container. Chemical explosions result from chemical reactions: a decomposition (storage of explosive materials) or the inflammation of an explosive atmosphere (storage of flammable chemicals, of oxidizing metal dust, etc.). In some cases, the chemical reaction is essentially combustion. Many dusts of combustible materials as diverse as flour and coal, can lead to a risk of explosion at critical concentrations in the air.

Risks associated with warehouse may result from the handling of chemicals. The proposed central warehouse project operators would have a procedure to prevent chemical and materials hazards. These control measures would be designed and implemented accordingly, and the institute would continue providing training on the appropriate usage, handling and storage of chemicals and hazardous. Chemical hazards can most effectively be prevented through a hierarchical approach that includes designing a chemical storage facility.

As a research institute and reference laboratory, EPHI uses a large amount of chemical and hazardous materials for different purposes. Professional has extensive experience in handling chemicals and hazardous materials and takes regular training in chemical handling and storage. Chemical hazards represent the potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. They also represent a risk of uncontrolled reaction, including the risk of fire and explosion, if incompatible chemicals are inadvertently mixed. However, accidents due to

chemical and hazardous materials have never been reported in the institution. Thus, the risk of accidents due to chemical and hazardous materials would be low at a central warehouse.

Mitigation measures

According to World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007) and Laboratory Biosafety Manual 3rd edition, the following mitigation strategies will be implemented:

- Replacement of the hazardous substance with a less hazardous substitute
- Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid would always be ensured. Appropriately equipped first-aid stations would be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers would be provided close to all workstations where the recommended first-aid response is immediate flushing with water
- Keeping the number of employees exposed, or likely to become exposed, to a minimum
- Communicating chemical hazards to workers through labeling and marking according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety
- Material Safety Data Sheets (MSDS) or equivalent. Any means of written communication would be in an easily understood language and be readily available to exposed workers and first-aid personnel
- Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE
- The procedure would be followed in the event of a significant chemical spill

Besides, the OSHA recommends following these guidelines for safe chemical storage and all personnel handling the hazardous materials at the warehouse as well as at the laboratory would

- Read chemical labels and MSDSs for specific storage instructions.

- Store chemicals in a well-ventilated area; however, do not store chemicals in a fume hood.
- Maintain an inventory of all chemicals in storage.
- Return chemical containers to their proper storage location after use.
- Store glass chemical containers so that they are unlikely to be broken.
- Store all hazardous chemicals below eye level.
- Never store hazardous chemicals in a public area or corridor.
- Separate acids from bases. Store these chemicals near the floor level.
- Isolate perchloric acid from organic materials. Do not store perchloric acid on a wooden shelf.
- Separate highly toxic chemicals and carcinogens from all other chemicals. This storage location should have a warning label and should be locked.
- Separate acids from flammables.
- Not keep peroxide-forming chemicals longer than twelve months.
- Not allow picric acid to dry out.
- If flammables need to be chilled, store them in a laboratory-safe refrigerator, not in a standard refrigerator.
- Flammables would be stored in a flammable storage cabinet.
- Store reactive materials separate from corrosives or flammables.
- Store Nitric acid (reactive and corrosive) separately from other acids and flammables.
- Storage location would clearly indicate which group/code is stored in that location. Each shelf or cabinet should indicate the colour.
- Groups would always be separated by a vertical divider, not a horizontal divider. (see diagrams below)
- Each chemical container would be clearly labeled by its storage colour
- Ideally liquids would be isolated by secondary containment.

13.4 Impact of Improper Use of Equipment in the BSL 3 Laboratory

Laboratory workers are at risk for repetitive use of laboratory equipment such as pipetting, centrifuge, BSC homogenizers, shakers, blenders, sonicators, freezers, autoclaves and other equipment. Certain items of equipment may create hazards when they are used, and the common hazards related to laboratory equipment are Aerosols, splashing and tube breakage rotors and impaired ultrasonic hearing, dermatitis, burning, splash and spillage. In addition, due to improper use, equipment-related accidents might occur.

Mitigation strategies

EPHI would implement the following mitigation measures**:**

- Training of workers in equipment operating and handling techniques during operation.
- Periodic maintenance and calibration of equipment according to manufacturer recommendation.
- Operation of equipment according to the manufacturer's instructions.

In addition, the following measures would be taken from the WHO laboratory biosafety manual and World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007) would be implemented for the prevention and control of risks emanating from equipment utilization in the BSL-3 laboratory:

Safety during the use of biological safety cabinets (BSC)

The use and limitations of biological safety cabinets would be explained to all potential users, with reference to national standards and relevant literature. Written protocols or safety or operations manuals would be issued to staff. It would be made clear that the cabinet will not protect the operator from spillage, breakage or poor technique.

- The cabinet would not be used unless it is working properly.
- The glass viewing panel would not be opened when the cabinet is in use.
- Apparatus and materials in the cabinet would be kept to a minimum. Air circulation at the rear plenum would not be blocked.
- Bunsen burners would not be used in the cabinet. The heat produced will distort the airflow and may damage the filters.
- All work would be carried out in the middle or rear part of the working surface and be visible through the viewing panel.

- Traffic behind the operator would be minimized.
- The operator would not disturb the airflow by repeated removal and reintroduction of his or her arms.
- Air grills would not be blocked with notes, pipettes or other materials, as this will disrupt the airflow causing potential contamination of the material and exposure of the operator.
- The surface of the biological safety cabinet would be wiped using an appropriate disinfectant after work is completed and at the end of the day.
- The cabinet fan would be run for at least 5 min before beginning work and after completion of work in the cabinet.
- Paperwork would never be placed inside biological safety cabinets.

Safety during the use of pipettes and pipetting aids

- A pipetting aid would always be used. Pipetting by mouth would be prohibited.
- All pipettes would have cotton plugs to reduce contamination of pipetting devices.
- Air would never be blown through a liquid containing infectious agents.
- Infectious materials would not be mixed by alternate suction and expulsion through a pipette.
- Liquids would not be forcibly expelled from pipettes.
- Contaminated pipettes would be completely submerged in a suitable disinfectant contained in an unbreakable container. They would be left in the disinfectant for the appropriate length of time before disposal.
- A discarded container for pipettes would be placed within the biological safety cabinet, not outside it.
- Syringes fitted with hypodermic needles would not be used for pipetting.
- Devices for opening septum-capped bottles that allow pipettes to be used and avoid the use of hypodermic needles and syringes would be used.
- To avoid dispersion of infectious material dropped from a pipette, an absorbent material would be placed on the working surface; this would be disposed of as infectious waste after use.

Safety during the use of centrifuges

- Centrifuges would be operated according to the manufacturer's instructions.

- Centrifuges would be placed at such a level that workers can see into the bowl to place trunnions and buckets correctly.
- Tubes and specimen containers would always be securely capped for centrifugation.
- The buckets would be loaded, equilibrated, sealed and opened in a biological safety cabinet.
- Buckets and trunnions would be paired by weight and, with tubes in place, correctly balanced.
- The amount of space that would be left between the level of the fluid and the rim of the centrifuge tube would be given in the manufacturer's instructions.
- Distilled water or alcohol (propanol, 70%) would be used for balancing empty buckets. Saline or hypochlorite solutions would not be used as they corrode metals.
- Sealable centrifuge buckets (safety cups) would be used for microorganisms in Risk Groups 3 and.
- When using angle-head centrifuge rotors, care would be taken to ensure that the tube is not overloaded as it might leak.
- The interior of the centrifuge bowl would be inspected daily for staining or soiling at the level of the rotor. If staining or soiling is evident then the centrifugation protocols would be re-evaluated.
- Centrifuge rotors and buckets would be inspected daily for signs of corrosion and for hair-line cracks.
- Buckets, rotors and centrifuge bowls would be decontaminated after each use.
- After use, buckets would be stored in an inverted position to drain the balancing fluid.

Infectious airborne particles may be ejected when centrifuges are used. These particles travel at speeds too high to be retained by the cabinet airflow if the centrifuge is placed in a traditional open-fronted Class I or Class II biological safety Cabinet. Enclosing centrifuges in Class III safety cabinets prevents emitted aerosols from dispersing widely. However, good centrifuge technique and securely capped tubes offer adequate protection against infectious aerosols and dispersed particles.

Safety during the use of homogenizers, shakers, blenders and sonicators

- Caps and cups or bottles would be in good condition and free from flaws or distortion. Caps would be well-fitting, and gaskets would be in good condition.
- Pressure builds up in the vessel during the operation of homogenizers, shakers

and sonicators. Aerosols containing infectious materials may escape from between the cap and the vessel. Plastic, in particular, polytetrafluoroethylene (PTFE) vessels would preferably be used over glass. Glass may break, releasing infectious material and possibly wounding the operator.

- When in use, homogenizers, shakers and sonicators would be covered by a strong transparent plastic casing. This would be disinfected after use. Where possible, these machines would be operated, under their plastic covers, in a biological safety cabinet.
- At the end of the operation, the containers would be opened in a biological safety cabinet.
- Hearing protection would be provided for people using sonicators.

Safety during the use of autoclaves

An autoclave is common laboratory equipment that uses high-pressure steam to sterilize laboratory equipment/items. During the use of an autoclave, there may be hazards such as burns from steam and hot parts of the autoclave, and the following measure would be taken with the use of autoclaves:

- Autoclave would be operated according to the manufacturer's instructions and by trained personnel only.
- Manual handling, when lifting items in/out of the autoclave.
- Never operate autoclaves unless you are trained and authorized to do so.
- Never autoclave flammable or toxic materials
- Personnel would wear a lab coat, goggles and heat-resistant gloves, keeping their sleeves tucked into the gloves to stop steam from going up their sleeves.
- Personnel would make sure the chamber pressure has returned to zero before opening the door. Stand away from the door and open it slowly to avoid a rush of steam and wait 5 minutes after opening the door before removing liquids so they don't burn you.
- If there is something wrong with the autoclave, stop using it, place a sign on it to ensure others don't use it and report it immediately to your supervisor

Safety during the use of refrigerators and freezers

- Refrigerators, deep-freezers and solid carbon dioxide (dry-ice) chests would be defrosted and cleaned periodically, and any ampoules, tubes, etc. that have broken during storage removed. Face protection and heavy-duty rubber gloves would be worn during cleaning. After cleaning, the inner surfaces of the cabinet would be disinfected.
- All containers stored in refrigerators, etc. would be clearly labeled with the scientific name of the contents, the date stored and the name of the individual who stored them. Unlabelled and obsolete materials would be autoclaved and discarded.
- An inventory would be maintained of the freezer's contents.
- Flammable solutions would not be stored in a refrigerator unless it is explosion-proof. Notices to this effect would be placed on refrigerator doors.

13.5 Impact of Contamination of the BSL 3 NRL and PTPC and Biobank Facilities

BSL 3 laboratory perform several types of analysis for specimens collected from human so that during the activities performed, laboratory space, furniture and equipment will be contaminated by different type of hazardous materials including highly infectious agents and chemicals. In addition, PTPC and Biobank facilities also perform several types of activities such as specimen analysis, handling allocation, and storage, so that during the activities performed, working space, furniture and equipment will be contaminated by different types of hazardous materials including infectious agents and chemicals. The contamination of the laboratory facilities, furniture and equipment may result from laboratory procedures: performing and handling of culture, specimens and chemicals. If the contamination is due to highly infectious agents, it may cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community.

Mitigation strategies

The following mitigation strategies would also be implemented:

- Workers would be trained on the evacuation of the contaminated area
- Workers would also be trained on
  - Decontamination or disinfection,

- Rinsing, and wiping dry the spillage area with an absorbent cloth by personnel wearing adequate protective clothing and
- Decontamination or disinfection of the protective clothing if necessary.
- Handling and managing spill and splash

- Administration (policy, purpose, distribution, definitions, etc) and organization of emergency areas (command Centres, medical stations, etc) would be available.

In addition, the following mitigation strategies that are more detailed in WHO Laboratory Biosafety Manual 3rd edition, and CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL) will also be implemented in EPHI:

Laboratory environmental decontamination

Decontamination of the laboratory space, its furniture and its equipment require a combination of liquid and gaseous disinfectants. Surfaces would be decontaminated using a solution of sodium hypochlorite (NaOCl); a solution containing 1 g/l of available chlorine would also be applied for general environmental sanitation, but stronger solutions (5 g/l) would be used when dealing with high-risk situations. For environmental decontamination, formulated solutions containing 3% hydrogen peroxide (H_2O_2) would make suitable substitutes for bleach solutions. Rooms and equipment would be decontaminated by fumigation with formaldehyde gas generated by heating paraformaldehyde or boiling formalin. A specially trained will be carried out for personnel involved in the fumigation process. All openings in the room (i.e. windows, doors, etc.) would be sealed with masking tape or similar before the gas is generated. Fumigation would be conducted at an ambient temperature of at least 21°C and a relative humidity of 70%.

After fumigation, the area would be ventilated thoroughly before personnel is allowed to enter. Appropriate respirators would be worn by anyone entering the room before it has been ventilated. Gaseous ammonium bicarbonate would be used to neutralize the formaldehyde. Fumigation of smaller spaces with hydrogen peroxide vapor is also effective but requires specialized equipment to generate the vapor.

The proposed laboratory would not use radioactive materials, propellants, or high explosive materials, and the quantities of hazardous chemicals stored in the facility at any time would be just a little volume for each chemical disinfectant (such as sodium hypochlorite or potassium hypochlorite) and biologic stabilizers (phenol). Chemicals such as paraformaldehyde would

not be stored in the facility but brought in only when required for fumigation (the facility has a minimal amount of storage space). The hazardous chemicals used and stored would be tracked using a chemical inventory system) and handled according to the MSDS and EPHI Safety manual.

Biological safety cabinet decontamination

To decontaminate Class I and Class II cabinets, equipment that independently generates circulates and neutralizes formaldehyde gas is available. Alternatively, the appropriate amount of paraformaldehyde (final concentration of 0.8% paraformaldehyde in the air) would be placed in a frying pan on an electric hot plate using the WHO laboratory biosafety manual. Another frying pan, containing 10% more ammonium bicarbonate than paraformaldehyde, on a second hot plate would also be placed inside the cabinet. The hot plate leads would be plugged in outside the cabinet, so that the operation of the pans would be controlled from the outside by plugging and unplugging the hot plates as necessary. If the relative humidity is below 70%, an open container of hot water would also be placed inside the cabinet before the front closure is sealed in place with strong tape (e.g. duct tape). Heavy gauge plastic sheeting is taped over the front opening and exhaust port to make sure that the gas cannot seep into the room. Penetration of the electric leads passing through the front closure would also be sealed with duct tape. The plate for the paraformaldehyde pan would be plugged in. It is unplugged when all the paraformaldehyde has vaporized. The cabinet would be left undisturbed for at least 6 h. The plate for the second pan would then be plugged in and the ammonium bicarbonate can vaporize. This plate would then be unplugged, and the cabinet blower would be switched on for two intervals of approximately 2 seconds each to allow the ammonium bicarbonate gas to circulate. The cabinet would be left undisturbed for 30 min before the front closure (or plastic sheeting) and the exhaust port sheeting would be removed. The cabinet surfaces would be wiped down to remove residues before use.

14 ENVIRONMENTAL AND SOCIAL IMPACT MANAGEMENT PLAN

This ESMP is developed with the aim to outline actions necessary to prevent, mitigate and control possible negative impacts or disadvantages during the different phases of the project on the environment and to analyze steps that could be taken with respect to this. In addition, the ESMP assigns responsibilities for actions to various actors and provides a timeframe within which mitigation measures and monitoring can be done. The purpose of this management plan is not only to ensure that the project complies with the relevant legislation and guidelines but also that it avoids (where possible), reduces or minimizes its risks. Together with the actions proposed in ESMP of this report, this management plan will synergistically enable the project to set environmental performance objectives, goals and targets and achieve them. The ESMP is proactive and will be upgraded if new facilities or modifications of existing facilities, with environmental concerns, come up at a later stage. A comprehensive and effective ESMP has to be prepared and implemented to safeguard environmental concerns. Therefore, ESMP is a vital output of an Environmental and Social Impact Assessment as it provides a checklist for project monitoring and evaluation. The ESMP outlined below will address the identified potential negative impacts and mitigation measures of the proposed project.

Table 21: Environmental and Social Management Plan

Impact Description	Mitigation Measures	Standard	Location	Responsible Body	Time / Implementa Mitigation	Cost (in Birr)/year
Pre-construction and Construction phases						
Air Quality Impact	• Construction work should be undertaken by an experienced and duly registered contractor with a verifiable sense of environmental awareness and responsibility, • Contractors should use dust screens or nets in windows, doorways and ventilators of rooms where demolition or other dusty construction activities are occurring, • Sprinkling the road with water two times a day periodically when operations are underway to prevent the raising of dust, • Enclosing the structures under construction with dustproof nets, • Ensure good housekeeping and clean construction operations where, among other necessary actions, dust should be quickly swept off cement floors and	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site and its surroundin g	Contractor, EPHI, EPHI Project Environmental and safety officer	Every week during construction	40,000

	collected in covered containers. • Regular maintenance of construction machinery as per the Manual, • Controlling the speed (10 km/hr) and operation of construction vehicles during transportation, • Use of clean fuels (e.g., unleaded and de-sulphurized fuels) not used fuel from the black market, • Educate and raise awareness of construction workers on emission reduction techniques. • Workers will be provided with PPE and the use of PPE shall be enforced.					
Impact on Water Resource	• Landscaping and site management to control runoff and provide basement flood protection, landscaping, providing proper roof drainage and minimizing paved surfaces, • The contractor should have separate garages for the truck and construction machinery and used oils and other liquid wastes should be stored in a secured area and disposed as hazardous wastes,	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site and its surrounding	Contractor, EPHI, EPHI Project Environmental and safety off7icer	Every week	50,000

	• Excavated soil should be disposed in designated areas (with local authorities permit) where it will get environmental clearance from the city administration EPA office. • Minimize the amount of exposed ground and stockpiles of soil on the site, • Do not discharge or allow water contaminated with silt to enter a watercourse or drain as it can cause pollution and limit the water within the site, • Protect all surface water drains and watercourses with cut-off ditches or earth bunds. These should be at least 10 meters from the watercourse, and limit all the water runoff from the site, and • Develop a spill response plan for accidental leakage of oil spills and apply it within 2 hours of spills.					
Soil Pollution and Erosion Impact	• Minimize disturbance and control erosion by avoiding steep slopes and by minimizing the amount of construction and ground clearing needed for roads, staging areas, and crane pads, • All plastic tubes left from construction should be	World Bank Environmental, Health, and Safety Guidelines for	Within the project site and its surrounding	• Contractor, • EPHI Project Environmental and safety	Every week,	30,000

	sold to recyclers, • Develop a spill response plan for accidental leakage of oil spills and apply it within 2 hrs spills, • Used oils such as engine lubrication oil, hydraulic fluids, and gear oils used in cars sold for the recycler, • Used oil filters, contaminated cans should be placed in a secured area and disposed as hazardous waste, • Separate garage for construction vehicles and machineries,	Healthcare Facilities (2007), pH not greater than 2 from the baseline, Oils, fats, and grease value less than 15 mg/lit		officer		
Noise and Vibration Impacts	• Contractor will be careful when selecting equipment to avoid the use of old or damaged machinery with high levels of noise emissions that would have a negative impact on the environment. • Construction activities required outside normal working hours must be approved by the Project Manager, and where necessary, the advance warning provided to adjacent residents, • Noise levels exceeding 85 dB shall only be permitted where approved and with an appropriate	For commercial areas 70 dBA for daytime and 70 dBA for nighttime; For residential areas, 55 dBA for daytime and 45dBA for nighttime	Construction area, entrance and leaving the road	• Contractor • EPHI • Project Environmental and safety officer	Every three month	40,000

	advanced warning to adjacent residents (minimum of 2 days) being provided, • Noise that could cause a major disturbance should only be carried out during daylight hours and with advance warning provided as above, • Acoustic enclosures should be provided with DG (Diesel generator) sets and machinery to control the noise levels at a construction site, • Equipment and machinery should routinely be maintained as per the manual, • Educate and raise awareness of construction workers on noise reduction techniques, • Provision of PPEs such as earplugs for employees working in noisy conditions or with noisy equipment					
Solid Waste Generation Impacts	• Solid wastes should be collected from the project site at least once in 24 hours to minimize nuisance odour and vermin, • Solid wastes should be properly segregated to encourage the recycling of some useful waste materials,	Solid Waste Management Standard,	Project site	• Contractor • EPHI • Project Environmental and safety	Every three month	20,000

	• The contractor and EPHI administration should work together to facilitate proper waste handling and disposal from the site. All wastes must be taken to the approved dumpsites, • Inert portion of construction & demolition material (including inert excavated material), that is, public fill, deemed suitable for re-use on site as far as possible and only the surplus material should be disposed of off-site, • Excavated soil should be immediately removed from the site and disposed of in an area that gets an environmental clearance certificate from Addis Ababa City Administration • *Cut-off trench*‖ means an excavation later to be filled with an impervious material to prevent or reduce seepage under the embankment should be employed			officer		
Liquid Waste Impacts	• Wastewater from the concrete batching plant should be stored in a protected pond within the site and used for concrete curing and watering of buildings,	World Bank Environmental, Health, and Safety Guidelines for	Project site	• Contractor • EPHI • Project Environme	Every three month	30,000

	• Construct separate safety tank for latrines and sanitation of construction workers, • Used oils and other liquid wastes should be stored in a secured area in tanks and disposed as hazardous wastes	Healthcare Facilities (2007), Standard for Effluent discharges limit value to inland waters (e.g. COD, BOD, pH etc)		ntal and safety officer		
Traffic and Public Safety Impacts	• Use only access gate of the construction site only, • Limit the speed of the truck to 10 km/hr on the project site • Initiation of a safety program and measures by creating awareness and educational campaigns for drivers, workers and local communities, including observation of speed limits, • Installation of appropriate road signage, speed signs, and other warning signs at the site and access roads, • Copies of driver's licenses and insurance policies for the Contractor's drivers and vehicles	• Speed limit standard, • Occupation health and safety standards	Access road within the project site and outside the project site,	• Contractor • EPHI	Every week	40,000

	respectively should be provided to the Supervision Consultant, • The Contractor's vehicles and equipment must be in proper working condition (roadworthy vehicles) and have registration plates and numbering. • The Contractor ensures proper driving discipline by its employees, and sanctions those in breach, • Use only permitted gates and access road which is allowed for construction machineries and trucks,					
Public Health Impacts	• Contracting of an HIV service provider (government health center) to be available on-site every year, • Implementation of HIV/AIDS and COVID-19 education programs, • Information campaigns on STDs among the workers and local community, • Education about the transmission of diseases, • Vaccinating workers against common and locally prevalent diseases including COVID-19, • Provision of condoms, • Awareness raising about public health impacts	• ILO Occupational health safety, COVID-19 Guidelines and Protocols,	Within and around the project site	• Contractor • EPHI • Project Environmental and safety officer	Every week during construction	40,000

	from labor influx, • Construction camp to include wastewater disposal and septic systems, • Identification of authorized water supply sources and prohibition of use from other community sources, and • Separate service providers for community and workers' camp/construction site					
Historical Buildings Impact	• The design and position of the building should not cover the view of the old building, • Divert runoff to protect these areas before clearing and grading begins, • Properly compact the exposed surface area to reduce erosion potential, • Use crushed aggregate or temporary seeding to reduce erosion, • Site plans should show the location, slope, cut, fill, and finish elevation of the surfaces to be graded and the auxiliary practices for safe disposal of runoff water, slope stabilization, erosion control, and drainages such as waterways, lined, ditches,	• Availability of permit letter from Addis Ababa Cultural and Tourism Bureau, engagement of cultural heritage specialist	Within and around the project site	• Contractor • EPHI • Addis Ababa Cultural and Tourism Bureau	Every three month	40,000

	diversions, grade stabilization structures, retaining walls, and surface and subsurface drains, and • Removing basements, or other large areas of intervention from the designs, or relocating them to less critical parts of the development,					
Impact on utility	• Employ water conservation strategies such as the reuse of water from concrete batching plants for watering of the building and toilet flushing, • Rainwater harvesting during summer • Using advanced designs and construction techniques that reduce energy consumption	• Presence of holding tank for water harvesting, use of new machineries	Construction site	• Contractor • EPHI	Every week during construction	20,000.00
Risk of Social Conflict and Crime	• During the construction phase of the proposed BSL 3 NRL project, the proponent (FMOH HILEO /EPHI) and the contractor will jointly set up a project specific grievance handling system with a team comprising of construction supervisor, and delegated officers from the HILEO and PCT who will receive and log, and address any disputes, conflicts or concerns arising from stakeholders that may be aggrieved by the project. • Grievances will be resolved and status reported	• Social norms and values, criminal code	Within the institute and around the project site	• Contractor • EPHI	Every three month	15,000

	back to complainants within a week. If the Work supervisor cannot solve the grievance, he will refer it to MOH/EPHI and the contractor through the Supervising Engineer. It is believed all possible grievances can be solved by the joint action of MOH/EPHI and the contractor. • Early management of disputes and proactive community engagement, • The contractor should prepare workers influx management action plan, • The contractor will provide orientation to its staff to respect the culture, religion and ethnic differences of its workers, EPHI community and the local people, • Paying salaries into workers‘ bank accounts rather than in cash, • Sourcing of local workforce as much as possible, • Give the first opportunity to the local people to supply construction materials such as sand, brick and other locally available materials, • Cooperation with local law enforcement, and					

	• Job priority to the local people to develop a sense of ownership					
Gender Based Violence	• The institution will prepare a GBV prevention action plan and act accordingly, • Conduct continued sensitization and awareness raising to EPHI staff in general and BSL-3 NRL staff in particular on the prevention of GBV, • Strengthen the Gender and women office of EPHI to address GBV cases when it occurs, • The contractor will provide orientation to its staff to respect the culture of the local people and to limit their relationship with the local people, • Contractor and implementing agency to prepare and implement a GBV Prevention and Response Action Plan to include at a minimum, in conformance with local laws and customs, equal opportunity for employment, • All workers and nearby communities and stakeholders will be educated on preventing and responding to sexual harassment and GBV ahead of any project-related works,	• National gender mainstreaming manual for health (MoH, 2021),	Within and around the institute	• Contractor • EPHI • EPHI Gender and women office	Every week during construction	40,000

	• Construction areas should be separated by a fence and a separate access gate is used for construction workers, • Ensure that women are given a mentorship orientation before starting their work. • Regular sensitization and awareness campaigns (At least two times a year) to the workers should be done to promote gender equity in employment during the construction works and operation, and • Provision of gender-disaggregated data, separate bathing, changing, sanitation facilities for men and women should be ready by the contractor, and • Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project.					
Traffic and Public Safety Impact	• Minimize risk for those around and near the project site as well as those entering or exiting the site by placing signs, • Identify the times of day truck traffic is expected – heavy truck traffic should be outside peak hours, • Regularly maintain construction vehicles and	• Presence of a traffic management plan	Within the project site, within the city	• EPHI • Contractor • Project Environmental and safety	Every week during construction	25,000.00

	machineries as per the manual, • Identify any works that are likely to be so disruptive to traffic that they may need to be scheduled outside the hours of work permitted, • Ensure safe passage for those around and near the project site as well as those entering or exiting the site.			officer		
Child Right Violation Impacts	• Strengthen the social service workforce to identify and respond to potential situations of child labour through case management and social protection services, including early identification, registration and follow-up, • Improve children's access to justice systems that are child-friendly, gender-sensitive and well-resourced to uphold their rights, and • Zero tolerance of child right violation and the contractor should inform all workers related to child right violation consequences, • The contractor and his sub-contractors are expected to follow standard occupational health and safety standards during the construction phase	• National child policy of Ethiopia, ILO Convention 182	Within and around the institute	• Contractor • EPHI • Project Environmental and safety officer	Every three month	12,000

	of the project.					
Increase Burden on Public Service	• Use of borehole as an alternative source of water from the EPHI compound, • Workers‘ camp to include wastewater disposal and septic systems, • Separate service providers for community and workers‘ camp/construction site, • Water conservation and recycling, • Provide first aid treatment at campus and recruit health professionals for this purpose, • Consideration of the use of rainwater where feasible, • Avoiding contamination of fresh water, • workers orientation and instruction on water and electricity consumption,		Within and around the project site	• EPHI • Contractor • Project Environmental and safety officer	Every three month	30,000
Occupational Health and Safety Risks	**i) Risk of communicable Diseases** • Contracting of an HIV service provider to be available on-site; • Implementation of HIV/AIDS and COVID-19 education program; • Information campaigns on STDs among the	World Bank Environmental, Health, and Safety Guidelines for	Within the project site	• Contractor • EPHI • Project environmental and safety	Every day	20,000

	workers and local community; • Education about the transmission of diseases; • Vaccinating workers against common and locally prevalent diseases including COVID-19; • Provision of condoms; • Awareness raising about public health impacts from labor influx; • Workers‘ camp to include wastewater disposal and septic systems; • Identification of authorized water supply source and prohibition of use from other community sources; and • Separate service providers for community and workers‘ camp/construction site;	Healthcare Facilities (2007)		officer		
	ii) Slip, Trip and Falls Mitigation Measures • Conducting audits as required to ensure responsibilities are met, • Ensuring employees receive appropriate training and instructions • Deal with spills straight away as per the spill	World Bank Environmental, Health, and Safety Guidelines for Healthcare	Within the project site	• Contractor • EPHI • Project environmental and safety	Every day	15,000

	response plan • Consider routine monitoring of areas where spills are a high risk • Use absorbent material to soak up the spill • Identify areas at high spill risk and locate absorbent materials nearby • Where possible avoid using wet cleaning as this may spread the potential danger area • Consider using spill kits • Ensure slip-resistant footwear is provided and worn as needed Providing personal protective equipment (e.g. slip-resistant footwear) if required	Facilities (2007)		officer		
	iii) Fire and Explosion Hazards Mitigation Measures • Ensure the provision of fire extinguishers at all work locations and at all times. • Prepare a fire safety management plan • All flammable gases, liquids and vapors are removed before the start of any hot work. • Where appropriate, use spark-resistant tools	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site	• Contractor • EPHI • Project environmental and safety officer	Every day	10,000

	and make sure all equipment is bonded or grounded properly, • Ensure provisions of first aid for staff, insurance, and access to ambulance service at all worksites, and arrangement (agreement) to access local hospital/dispensary with qualified medical staff by workers, • The construction site shall be fenced off to prevent access to members of the public, • Providing adequate storage for hazardous and flammable substances and controlling access to them. • Monitoring the movement, handling and management of wastes to ensure they are safely managed and don't present any EHS risks, • Establish clinics and equip them with appropriate medical equipment for first aid treatment,					
	iv) Risk of Physical Hazards • Scan the workplace for existing and potential hazards before work begins and take	World Bank Environmental, Health, and	Within the project site	• Contractor • EPHI • Project	Every day	25,000

	appropriate controls. Be aware that conditions can change constantly, • Use correct personal protective equipment and apparel, including safety footwear, • Have training before beginning any task, especially high-risk activities such as working at heights, hazardous energy control (lockout/tag out), or confined space entry, • Prepare and emergency response plan and be aware of the emergency response plans before work begins, • Develop evacuation procedures to handle emergency situations. • Safety glasses/face shield for those working with any chemical or using any mechanical equipment to protect their eyes and face, • For hand, use the correct gloves for the job for workers at concrete batching plant, • Placing readable signs alerting people of hazardous such as slippery floors, • Insuring against liability for any loss, damage,	Safety Guidelines for Healthcare Facilities (2007)		environmental and safety officer		

	death or bodily injury which may occur to any physical property or to any person which may arise out of the Contractor's performance of the contract,					
	v) Lung Injury Mitigation Measures • Reduction of Ventilator-associated lung injury (VALI) by protective low tidal volume ventilation, • Do not eat, drink, or use tobacco products in dusty areas, • Wash hands and face before eating, drinking, or smoking outside dusty areas, • Shower and change into clean clothes before leaving the worksite,	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site	• Contractor • EPHI • Project environmental and safety officer	Every day during construction	10,000
	vi) Eye Injury and Damage Mitigation Measures • Always wear personal protective eyewear for workers working on high dust and eye goggles for welders, • Clean your eyewear several times throughout the day, and always brush yourself off before	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site	• Contractor • EPHI • Project environmental and safety officer	Every day during construction	10,000

	removing your safety glasses, It's vital to call for medical attention (get treatment) when you notice the following signs in yourself or coworkers such as blood in the clear part of an eye, cut or torn eyelid, one eye doesn't move as well as the other, one eye sticks, pain or trouble seeing, unusual pupil dilation or shape					
	vii) Electrical Hazards Mitigation Measures • Inspect portable cord-and-plug connected equipment, extension cords, power bars, and electrical fittings for damage or wear before each use. Repair or replace damaged equipment immediately, • Always locate all power lines on or near the project sites, • Perform regular fire risk assessments to identify areas at risk of bad wiring and circuits, • Maintain proper grounding to eliminate unwanted voltage and reduce the risk of electrocution, • Verify that all wiring is coming from a	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site	• Contractor • EPHI • Project environmental and safety officer	Every day during construction	15,000

	properly rated circuit and doesn't exceed the capacity					
	viii) Ergonomic Hazards Mitigation Measures • Adjust the height of working surfaces to reduce long reaches and awkward postures, • Put work supplies and equipment within comfortable reach, • Provide the right tool handle for the worker, • Vary tasks for workers (e.g., employ job rotation), • Encourage short rest breaks, • The contractor should be responsible for adequate first-aid services provided to the employees at all times,	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site	• Contractor • EPHI • Project environmental and safety officer	Every day during construction	20,000
	ix). Biological Hazards Mitigation Measures • Construction site should be separated from the main campus by fence and construction workers should be restricted within the site, • Wasps are attracted by discarded food, so make sure all leftovers go in the garbage and keep it covered. Remove and reduce debris and	WBG Environmental, Health, and Safety Guidelines	Within the project site	• Contractor • EPHI • Project environmental and safety officer	Every day during construction	20,000

	rubble piles when possible to help keep insects and rodents away • Vaccine, and other biological products should be properly screened so as not to introduce infection to the construction site and the wastes should be autoclaved and incinerated, • In case of any disease outbreak vaccination should be performed in a construction area or surroundings to prevent the spread of disease, and • Workers should cover as much of the body as feasible.					
	x). Traffic Accident Impacts Mitigation Measures • Limit the speed of the truck to 10 km/hr within the site, • Initiation of a safety program and measures by creating awareness and educational campaigns for drivers, workers and local communities, including observation of speed limits, • Sanctions for reckless driving, • Installation of appropriate road signage, speed	WBG Environmental, Health, and Safety Guidelines	Within the project site	• Contractor • EPHI • Project environmental and safety officer	Every day during construction	25,000

	signs, and other warning signs at the site and access roads, • Copies of drivers‘ licenses and insurance policies for the Contractor‘s drivers and vehicles respectively should be provided to the Supervision Consultant, • All construction machineries and cars should have third-parties insurance, • Use only permitted gates and access roads which are allowed for construction machineries and trucks,					
Operation phase						
Air Quality Impact	• Waste segregation for wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs plastics would be done and these wastes should never be incinerated these wastes should be cleaned. Disinfected and disposed of with non-hazardous wastes, • Controlled incineration of medical wastes with a pyrolysis incinerator should be done at an operating temperature of 800 to, 1200°C.	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007),	Around the new incinerator	• EPHI • FMoH	Every week	80,000; not include incinerator cost

	• Regular planned maintenance: replacement of faulty parts, inspection, inventory of spare parts; • Wet waste must be mixed with drier waste during incineration and sharps containers must be loaded one by one; the incinerator must run for long periods (at least 2 hours); heavy-duty gloves, body protection, and goggles must always be worn as well as a respirator whenever ash is being removed; • Emissions must not exceed the national limit values and they must comply with the BAT/BEP1817 recommendations outlined in the Stockholm Convention. • Materials free of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs should be purchased, for minimizing the environmental and health impacts. • Workers will be provided with PPE and the use of PPE would be enforced. • Applicable national requirements and internationally recognized standards for incinerator					

	design and operating conditions would be followed, mainly rapid quenching of the flue gas after leaving all combustion chambers and before entering any dry particulate matter air pollution control device but also combustion temperature, residence time, and turbulence, • Wastes would be introduced into the incinerator only after the optimum temperature is reached in the final combustion chamber. • The waste charging system would be interlocked with the temperature monitoring and control system to prevent waste additions if the operating temperature falls below the required limits; • Electronic wastes should not be incinerated at site, • Flue gas treatment system would be used for control of acid gases, particulate matter, and other air pollutants;					
Water Pollution Impacts	• Promoting practices that reduce the volume of wastes generated and ensure proposer waste segregation; • Developing strategies and systems along with	World Bank Environmental, Health, and Safety Guidelines for	Project site	• EPHI • FMoH	During operation	20,000

	strong oversight and regulation to incrementally improve waste segregation, destruction and disposal practices with the ultimate aim of meeting national and WBG standards; • Where feasible, favouring the safe and environmentally sound treatment of hazardous health care wastes (e,g, by autoclaving, steam treatment integrated with internal mixing, and chemical treatment) over medical waste incineration; • Hazardous and chemical liquid wastes should be stored in separate concrete-based safety tanks as recommended and disposed after treatment, • Flue and bottom ashes need to be stored in a secured and protected landfill, • Construction of elevated structures to limit the stormwater within the protected landfill, construction of floodwalls, floodgates, levees, and evacuation routes for rainwater to prevent runoff of ashes; • Wastewater treatment plants works must comply with the effluent discharge guidelines of the	Healthcare Facilities (2007), effluent discharges to inland waters standard (COD, BOD, pH etc.)				

	country, • The bottom of the landfill must be waterproofed and must be equipped with a final cover to prevent rainwater infiltration; • leachates must be collected to the safety tank and treated on wastewater treatment plan to be constructed by FMoH					
Soil pollution	• Soils surfaces not covered by the building footprint or not paved would be landscaped to control erosion from stormwater runoff, • Spill contingency plan will be implemented in case of accidental spills or leaks • Wastewater generated from BSL 3 NRL activity should be stored in concrete-based safety tank (100 M^3) and should be disposed after treatment from the proposed wastewater treatment plant, • Municipal wastes generated from the latrine and sanitary area should be stored in a safety tank and disposed in the Kality Wastewater Treatment Plant, • All domestic solids should be landfilled in	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site	• EPHI • FMoH	Every week	80,000

	Repi landfill • Contaminated primary packaging, hazardous and infectious wastes should be incinerated • Ash formed from incinerator should be stored in concrete-based landfill within the EPHI compound and needs roof covering and protection					
Noise and Vibration Impacts	• Using equipment with low noise ratings or noise reduction technologies such as generators, • Diesel generators should be enclosed and should be serviced as per the manual	For residential areas, 55 dBA for daytime and 45dBA for nighttime	Around the generator	• EPHI	During the operation of the generator	10,000
Solid Waste Generation Impacts	• All wastes should be segregated based on type, • Initial packaging and storage would take place where HCW is generated. • Storage of waste will then be moved to a temporary on-site storage location • Non-hazardous wastes that are generated by the BSL-3 would be segregated and landfilled in the Repi landfill, • Hazardous and contaminated solid waste generated	Solid waste management standard; World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities	Solid waste temporary site, collection area in different laboratory	• EPHI • FMoH	Every week	30,000

	in the BSL-3 laboratory would leave the laboratories only after decontamination using the laboratory's autoclave, • Solid or semisolid wastes would be placed in tear-resistant plastic bags judged by their thickness or durability, • There would be special packaging characteristics for some treatment techniques: incineration requires combustible containers, and steam sterilization requires packaging materials that allow steam penetration and evacuation of air, • All sharps used in the BSL-3 would be autoclaved prior to incineration, • Sharps (sharp items or items with sharp corners) would be placed in rigid, puncture-resistant, containers made of glass, metal, rigid plastic, or cardboard, • Non-risk Health care waste (HCW) would always be stored in a separate location from the infectious/ hazardous HCW to avoid cross-contamination, • Flue ashes should be stored in a secured area	(2007), WHO standard				

Liquid Waste Impact	• Strictly limit the discharge of hazardous liquids to sewers or sanitary safety tank, • sewage pipes bringing wastewater from throughout the facility(project) to a central underground location for temporary retention • construct two separate collection systems such as a sewage system for wastewater from sanitary and toilet facilities and a hazardous wastes system from the laboratory liquid waste, • Sanitary liquid waste will be treated in the Kaliti wastewater treatment plant, • body-fluids and the contents of suction systems from highly infectious patients (e.g., cholera) should be thermally treated (e.g. in a waste treatment autoclave) and then discharged via the drain to the safety tank for temporary storage and offsite treatment, • Hazardous pharmaceuticals and chemicals should never be disposed of via the sanitary wastewater and rainwater drainage system, • Leachate from the fly and bottom ash landfill	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within EPHI	• EPHI • FMoH	Every week	120,000 excluding the cost of the wastewater treatment plant

	should be collected to a hazardous wastewater safety tank and treated using an offsite wastewater treatment plant. • Workers will be provided with PPE and the use of PPE would be enforced. • Hazardous wastewater Plant will be constructed in collaboration with MoH, EFDA and other stakeholders • Follow the EHS health care waste management guideline for handling and transportation hazardous wastewater to treatment plant and infrastructure for healthcare waste treatment and disposal • Maintain the wastewater treatment treatment plant periodically • The hazardous liquid waste should fulfill the national effluent discharge standard before discharge to the environment					
	• Use of tertiary treatment plant for treatment of hazardous waste to be constructed in vaccine lab	World Bank Environmental	Within vaccine	• EPHI • FMoH	Every week	500, 000

	project site in Akaki Kaliti Sub-city,	, Health, and Safety Guidelines for Healthcare Facilities (2007)	laboratory site in Akaki Kaliti			
Utility Impact (Water and Energy)	• Reduce heating, cooling, and lighting demand through passive strategies such as climate-responsive design, day lighting, and conservation practices; • Employ renewable energy sources such as solar for road lightening in the future, • The college should implement water conservation programs such as good housekeeping measures, and use of automatic shut-off valves, • Use alternative groundwater source during the operation phase,	WHO requirement	Within EPH campus	• EPHI	Every day	20,000
Risk of Social Conflict and Crime	• Transparent local community engagement and participation should begin during initial project decision-making and continue routinely throughout the life of the project,	Social Norms and values, criminal code	Within the institute and around the project site	• EPHI, • Woreda 09 social affair	During operation	20,000

	• Awareness-raising among the local community, contract workers and staff about the cultures and norms of the local community, • Provision of cultural sensitization training for all staff regarding engagement with the local community, • Provide awareness creation program about tolerance of diversity and, • Develop a code of conduct for staff to prevent discrimination and other ethnocentric behaviors,			office		
Gender Based Violence	• Establish a gender mainstreaming and monitoring committee, • Provide awareness to the newly joined workers about the incidence and impact of domestic violence, sexual assault, and stalking, including reporting requirements and options, • Conduct continued sensitization and awareness raising to EPHI staff in general and BSL-3 NRL staff on the prevention of GBV, • Strengthen the Gender and women office of EPHI to address GBV cases when it occurs,	National Standard	Within and around the institute	• EPHI, • EPHI, Gender and women office •	Every three month	20,000

	• On-going prevention training for staff; and • Provision of gender-disaggregated data, separate bathing, changing, sanitation facilities for men and women should be ready by institution and • Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project					
Traffic and Public Safety Impacts	Placing visible and readable signs at the main gate where there are risks and arranging designated car parking, Apply the "Three E" philosophy and be transparent and proactive about all traffic initiatives; ➢ **Enforcement** – including duties performed by Addis Ababa Police (Traffic Management Bureau) and Woreda by-law enforcement staff, ➢ **Education** – including Speed Management Program and Safety Driven education campaign, ➢ **Engineering** – including issues related to road design on existing roads and planning		Around the Project site	• EPHI • AA Traffic Manageme nt Bureau	Every three month	20,000

	for future projects					
Public Health Impacts	➢ Laboratory personnel working in BSL 3, PTPC and Biobank would receive specific training in handling pathogenic and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures, • Laboratory workers would be trained in equipment operating and handling techniques during operation, • Effective vaccines or therapeutic measures would be available for all risk groups, • The use of pest control programs would limit the potential for transmission of infectious agents from animals to humans, • Trainings would be provided on the sample and waste handling, transportation, and storage, and disposal, • All material would be sterilized by autoclave or chemical disinfection • Ensure that the facility would be designed to	WBG Environmental, Health, and Safety Guidelines, COVID-19 guidelines and protocols, hazardous waste management standard	Within EPHI campus	• EPHI, FMoH	Every three month	25,000

	severely limit the potential for possible vector-borne transmission through insects and rodents, • Ensure that water exiting through the sink drains would be diverted to a retention tank where it would be disinfected before being sent to the sewer system. • All agents would be contained within the laboratory and a biosecurity system would be in place • Promote the use of condom, and implementation of HIV/AIDS education program; and get a vaccine for Covid 19, • BSCs HEPA filters would be tested annually and replaced as necessary, • Ensure that the facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents • PTPC and Biobank would be locked always					
Public Service Burden	➢ The project needs to provide its own transportation for staff, ➢ In collaboration with concerned sectors, the	ILO Occupational health safety	project site	• EPHI	During operation	40,000

	BSL-3 project should ensure access to additional electric transformers whereby they can keep the existing power utilized by the community, ➢ Dig out its water pamper within the project place, ➢ Work with the community and city administration to make the access road asphalt-based, and ➢ Implement health education and mentorship within the project.					
Occupational Health and Safety Impacts	**i) Risk of Infection Mitigation Measures** Laboratory personnel working in BSL 3, PTPC and Biobank Centre should receive specific training in handling pathogenic and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures, All procedures involving the manipulation of infectious materials should be conducted within a BSC or other physical containment devices, Persons would wash- their hands after working with	WBG Environmental, Health, and Safety Guidelines, OHS Standard, COVID 19 guidelines and protocols, hazardous waste	Around the Laboratory	• EPHI, • Ministry of Health	During operation	80,000

	potentially hazardous materials and before leaving the laboratory, Spills involving infectious materials would be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material, Equipment would be decontaminated before repair, maintenance, or removal from the laboratory, Workers in the laboratory should wear protective laboratory clothing with a solid front, such as tie-back or wrap-around gowns, scrub suits, or coveralls. Protective clothing will not be worn outside of the laboratory, Reusable clothing should be decontaminated before being laundered. Clothing is changed when contaminated, Potentially infectious materials should be placed in a durable, leak-proof container during collection, handling, processing, storage, or transport within a facility, ➢ Gloves should be worn to protect hands from exposure to hazardous materials. Gloves should	management standard				

	not be worn outside the laboratory. Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols would be rigorously followed, ➢ Blood should be collected from patients by trained staff, For phlebotomies, conventional needle and syringe systems should be replaced by single-use safety vacuum devices that allow the collection of blood directly into stoppered transport and/or culture tubes, automatically disabling the needle after use					
	ii) Chemical Hazards Mitigation Measures ➢ To avoid accidental leakage or spillage, secondary containers, such as leak-proof boxes, should be used, fitted with racks so that the specimen containers remain upright, ➢ Respiratory protection should be used when carrying out high-hazard procedures. The choice of respirator will depend on the type of hazard(s) and it is available with interchangeable filters for protection against gases, vapors, particulates and microorganisms	OHS Standard, WBG Environmental, Health, and Safety Guidelines	Within the lab at EPHI	• EPHI,	During operation	80,000

	➢ Volatile solvents should be handled in a chemical hood, ➢ Material Safety Data Sheets (MSDS) or equivalent should be considered while handling, storing, using, and disposing hazardous chemicals. ➢ Only small amounts of chemicals necessary for daily use should be stored in the laboratory, ➢ Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid would always be ensured. ➢ Either a fully buttoned laboratory coats, gowns, coveralls, or long-sleeved, back-opening gowns or coveralls should be used in the BSL-3 laboratory at EPHI. Aprons may also be worn over laboratory coats or gowns where necessary to give further protection during the handling of chemicals, hazardous and infectious materials, and ➢ Eye and face protection (goggles, mask, face shield or other splash guards) would be used for anticipated splashes or sprays of infectious or other hazardous chemical materials.					
	iii) Risk of Burn or Fire Mitigation Measures	OHS Standard,	Within the	• EPHI,	During	80,000

	➢ Prepare a fire safety plan and the plan should provide employees or building occupants with the instructions they need to leave the building (or respond as appropriate) in the event of a fire, ➢ Delineating fire and emergency assembly points and creating awareness to ensure all people at the site are aware of them, e.g. through the use of maps on elevators, staircases etc. ➢ All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs, ➢ Combustible materials such as flammable liquids, and solid materials should be stored in a lockable cupboard, ➢ Fire hazard signs such as 'No Smoking' signs will be provided. Directions to exit in case of any fire incidence and emergency contact numbers will be provided. The contact/emergency numbers will be displayed within the laboratory ➢ First aid treatment facility should be also available, ➢ Automatic fire alarm system for the entire laboratory will be installed,	WHO Laboratory Biosafety Manuals 3rd edition, World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	lab at EPHI		operation	

	➢ All staff will have training in fire control through regular fire fighting drills. ➢ Fire extinguishers should be available in an accessible area near fire-risk areas and ensure that all fire-fighting equipment is regularly maintained and serviced,					
	iv) Ergonomic Hazards Mitigation Measures ➢ Training of workers in lifting and materials handling techniques during operation, including the placement of weight limits above which mechanical assists or two-person lifts are necessary, ➢ Planning worksite layout to minimize the need for manual transfer of heavy loads, ➢ Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user-adjustable work stations, ➢ Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks.	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007), OHS Standard,	Within the lab at EPHI	• EPHI	During operation	20,000

	v) Injury/Accident Mitigation Measures ➢ Injuries should always be reported to supervisors and victims should get medical attention as soon as possible. Collect broken needles in a secured and safe area and dispose all based on WHO standards, ➢ Sharps waste by disposing of it in a sealable container; self-locking and sealable sharps containers are made of plastic so that the sharps cannot easily penetrate through the sides. Such units are designed so that the whole container can be disposed of with other biohazardous waste, with the support of the government ➢ Hepatitis B Vaccine should be given to all workers in laboratory	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007), OHS Standard, WHO Laboratory Biosafety Manuals 3rd edition,	Within the lab at EPHI	• EPHI	During operation	15,000
	Vi) Risk related to Electricity Mitigation Measures • All electrical installations and equipment must be inspected and tested regularly, including earthing/grounding systems. Circuit breakers and earth-fault-interrupters should be installed in	WHO Laboratory Biosafety Manuals 3rd edition, World Bank	Within the lab at EPHI	• EPHI, • Contractor	During operation	25,000

	appropriate laboratory electrical circuits, • All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs, • All laboratory electrical equipment and wiring would conform to national electrical safety standards and codes, • Disconnect equipment attached to high-voltage or high-amperage power sources from the source or provide a lockout device on the breaker box to prevent circuit activation before maintenance is performed, • Because electrical devices can generate sparks, do not use them near flammable or volatile gases or liquids, • Never place flammable liquids in a household refrigerator. The spark generated by the door-activated light switch can ignite fumes trapped in the unit, causing an explosion and fire, • Specialized refrigerators would be used when storing chemicals that have explosion potential	Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007),				

	vii) Fire and Explosion Mitigation Measures ➢ All staff will have training in fire control through regular firefighting drills, ➢ Fire extinguishers would be available in an accessible area near fire risk area and ensure that all fire-fighting equipment is regularly maintained and serviced, ➢ Fire emergency telephone numbers would be displayed in communal areas, ➢ Automatic fire alarm system for the entire laboratory will be installed, ➢ Fire suppression for the BSL-3 facility would be provided by a standard wet-pipe fire sprinkler system, ➢ Water flow alarms would be connected to the facilities fire alarm monitoring station so that, ➢ Designated responders would be notified ➢ Water hose reels will be installed in the laboratory.	WHO Laboratory Biosafety Manuals 3rd edition, World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the lab at EPHI	• EPHI	During operation	20,000
Risks related to	• Develop and implement a waste management plan for EPHI in general and for the proposed NRL project in particular in accordance with the infection	World Bank Environmental, Health, and	Within the lab at EPHI, Vaccine	• EPHI	During operation	15,000

Improper Waste Management	control and waste management plan to guide the daily waste management operations, • Initial packaging and storage would take place where HCW is generated, • Storage of waste will then be moved to a temporary on-site storage location • Waste segregation for wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs plastics would be done and these wastes should never be incinerated these wastes should be cleaned. Disinfected and disposed of with non-hazardous wastes, • Controlled incineration of medical wastes with a pyrolysis incinerator should be done at an operating temperature of 800 to, 1200°C. • Electronic wastes should not be incinerated at the site, • Flue gas treatment system would be used for the control of acid gases, particulate matter, and other air pollutants; • Hazardous and chemical liquid wastes should be stored in separate concrete-based safety tanks as	Safety Guidelines for Healthcare Facilities (2007)	laboratory site			

	recommended and disposed of after off-site treatment, • Wastewater treatment plant works must comply with the effluent discharge guidelines of the country, • The bottom of the landfill must be waterproofed and must be equipped with a final cover to prevent rainwater infiltration; and • leachates must be collected to the safety tank and treated on wastewater treatment plant to be constructed by FMoH.					
Risk associated with Final Waste Disposal	• Personnel working on waste disposable would wear adequate personal protective equipment (PPE) including gloves, closed shoes, overalls and masks, • Training would be provided to personnel working on waste disposable, • Bottom ash, fly ash and other flue gas should be stored in secured ash pit in which it has leachate collection system that connects to the hazardous liquid waste safety tank, • Bottom ash and residuals would be managed	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007),	Within the lab at EPHI, Vaccine laboratory site	• EPHI • FMOH	During operation	15,000

	based on their classification as hazardous or non-hazardous materials; • Use of double-walled, composite, or specially coated storage and piping systems for hazardous waste waste onsite storage particularly in the use of underground storage tanks (USTs) and underground piping. If doublewalled systems are used, It should be provided a means of detecting leaks between the two walls, • Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store, and • The treated liquid waste should fulfil the national and WBG ESH Guideline befor disposal to the environment.					
Impacts on Improper	• Considering proper tank volume, geometry and compartmentalization to impart adequate hydraulic residence time for sedimentation,	World Bank Environmental, Health, and Safety	Within the lab at EPHI, Vaccine laboratory	• EPHI • FMOH	During operation	20,000

r Wastewater Treatment	• Elongated tanks with length-to-width ratios of 3:1 or more is will be used to reduce short-circuiting of the effluent, • Two compartments will be used to achieve, better suspended solids removal rates, • Manways 18 to 24 inches in diameter or square will be designed to access the tank for regular monitoring and maintenance, • tank will be located where it can be accessed easily for septage removal and sited away from drainage swales or depressions where water can collect. Maintaining minimum horizontal setback distances from buildings, property boundaries, wells, water lines, and the like, • Tank will rest on uniform bearing surface, • The backfill material will be free flowing and free of stones larger than 3 inches in diameter and debris, • Joints will be sealed properly, including tank joints, • Use of appropriate anti-flotation devices,	Guidelines for Healthcare Facilities (2007)	site			

	• Tanks would be pumped when sludge and scum accumulations exceed 30 percent of the tank volume or are encroaching on the inlet and outlet baffle entrances, • Periodic pumping of septic tanks will be used to ensure proper system performance and reduce the risk of hydraulic failure, • Pumping and cleaning of Sludge and septage from the septic tank will be outsourced to Addis Ababa water supply and sewerage authority, Kotebe treatment plant, • To achieve acceptable treatment in the sand/media unit, the wastewater retention time in the filter will be sufficiently long and reaeration of the media will occur to meet the oxygen demand of the applied wastewater. The pore size distribution and continuity of the filter medium, the dose volume, and the dosing frequency will be key design and operating considerations for achieving these conditions, • Remove and clean or replace the throttle blower as required,					

	• Check aeration system, aeration tank dissolved oxygen level. • Increase sludge return rate to decrease sludge retention time in clarifier • Effective cleaning of UV-lamp sleeves periodically, and • In order to improve transmittance of UV, the process control will be implemented to obtain a turbidity level of <0.2 NTU in the final water. Where the turbidity levels are above 0.2 NTU and/or TOC levels are in excess of 2-3 mg/litre, sludge or waste water return lines will be constructed for better performance2.					
Impact of Air Pollution due to Waste Incineration	• Waste segregation for wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs would be done and these wastes would never be incinerated, • Materials free of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs would be purchased, for minimizing	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the lab at EPHI, Vaccine laboratory site	• EPHI	During operation	15,000

	the environmental and health impacts. • Workers will be provided with PPE and the use of PPE would be enforced. • Improve incinerators and infrastructure for healthcare waste treatment and disposal • New environmentally friendly incinerator would be purchased considering the following features: • Applicable national requirements and internationally recognized standards for incinerator design and operating conditions would be followed, mainly rapid quenching of the flue gas after leaving all combustion chambers and before entering any dry particulate matter air pollution control device but also combustion temperature, residence time, and turbulence, • Wastes would be introduced into the incinerator only after the optimum temperature is reached in the final combustion chamber, • The waste charging system would be					

	interlocked with the temperature monitoring and control system to prevent waste additions if the operating temperature falls below the required limit, • Minimize the uncontrolled ingress of air into the combustion chamber via waste loading or other routes, • Optimize and control combustion conditions by the control of air (oxygen) supply, distribution and temperature, including gas and oxidant mixing; the control of combustion temperature level and distribution; and the control of raw gas residence time; • maintenance and other procedures would be implemented to minimize planned and unplanned shutdowns; • operating conditions in excess of those that are required for efficient destruction of the waste would be avoided; • Auxiliary burner(s) would always be used for start-up and shut-down and for maintaining the required operational combustion temperatures					

	(according to the waste concerned) when unburned waste is in the combustion chamber.					
Risk associated with off-site Transport of Waste	• Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks • Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer Regular inspection, maintenance and repair of fittings, pipes and hoses • Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points or other possible overflow points, • The transportation would be properly documented, and all vehicles will carry a consignment note from the point of collection to the treatment facility, • Vehicles used for the carriage of waste would be	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the lab at EPHI, Vaccine laboratory site	• EPHI	During operation	15,000

	disinfected prior to use for any other purpose, • The vehicles would be free of sharp edges, easy to load and unload by hand, easy to clean and disinfect, and fully enclosed to prevent any spillage in the facility premises or on the road during transportation, and • The vehicles would carry adequate supplies of plastic bags, protective clothing, cleaning tools, and disinfectants to clean and disinfect in case of any spillage					
Decommission Phase						
Air Quality Impact	• Using efficient equipment and machines with efficient engines having low emissions, • Using clean fuels such de-sulphurized diesel and unleaded fuels, • Water sprinkling on structures and facilities to be demolished if necessary, and • Removing components with the potential of emitting hazardous gases or particulates separately and under caution to prevent emissions.	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Within the project site and its surrounding	EPHI,contractor	During decommissioning phase	20,000
Noise	• Carrying out the decommissioning works only	Industry area	Demolishi	EPHI,	During	15,000

and Vibration Impacts	during the specified time from 8:00 hrs to 17: 00 hrs where permissible levels of noise are high and acceptable, • Machineries should be maintained regularly to reduce noise resulting from friction as per themanual, • Providing workers with Personal Protective Equipment such as earmuffs when operating noisy machinery and when in a noisy environment, • Provision of billboards at the construction site gates notifying people of the activities and timings	75dBA for daytime and 55 dBA for nighttime; For residential areas, 55 dBA for daytime and 45dBA for nighttime	ng area	contractor	decommissioning phase	
Solid Waste Generation Impacts	• Following regulations on Waste Management in the country, • Employing a waste management plan, which will involve assessing and creating opportunities for Regulation, Reducing, Reusing, Recycling, Recovering, and Renovation, • Ashes from the old incinerator should be placed in a secured landfill to be constructed within EPHI, • Removing reusable and recyclable material from the building before demolition to minimize the amount of	Solid waste management guideline, World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities	Demolishing area	EPHI, contractor	During decommissioning phase	35,000

	waste, • Allocating responsibilities for waste management and identifying all sources of waste, and ensuring wastes are handled by personnel licensed to do so, • Making available suitable facilities for the collection, segregation and safe disposal of the wastes, and • Ensuring all wastes are dumped in their designated areas and through legally acceptable methods.	(2007)				
Occupational Health and Safety (OHS) Impacts	• Employing an OSH plan that will outline all OSH risks and provide a strategy for their management, • Ensuring all hazards such as movable parts are labeled, • Raising awareness and educating workers on risks from equipment and ensuring they receive adequate training on the use of the equipment, • Providing the workers with adequate PPEs and monitoring regularly to ensure they are replaced on time when they wear out, • Placing visible and readable signs around where there are risks and undertaking the riskier demolition activities first and in isolation, • All wastes should be removed from the site,	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Demolishing area	EPHI, contractor	During decommissioning phase	30,000

	• Ensuring there is security in and around the site to control the movement of people, • Providing safe and secure storage for the waste and materials on the site, • Placing visible and readable signs to control the movement of vehicles and notify motorists and pedestrians around them, and workers in the site, • Providing firefighting equipment and in easily accessible areas as well as ensuring site personnel are well trained to use them as well as maintaining them regularly, • Labelling chemicals and materials according to the risks they possess, • Creating safe and adequate fire and emergency assembly points and making sure they are well-labeled, and • Establishing emergency procedures against hazards and ensuring the workers stay aware/educated on following them and commensurate to the magnitude and type of emergency, by conducting regular drills and involving the neighbors.					

TOTAL COST FOR CONSTRUCTION AND DECOMMISSIONG						**1,552,000**

Impact Description	**Mitigation Measures**	**Standard**	**Location**	**Responsible Body**	**Time / Implementa Mitigation**	**Cost (in Birr)/year**
Risk of Decommissioning of Old Incinerator						
Hazardous Wastes Risks	• Prior to the commencement of any decommissioning works, the project proponent or its representative shall notify the Federal EPA 28 days in advance of the intended works, • As the ash is deposited inside the combustion chamber as well as attached to its associated walls, and ductworks, the Specialist Contractor shall use a High-Efficiency Particulate Air (HEPA) vacuum to clean these materials, wet wiping before wrapping them in polythene and dispose of the ash at the secured and protected landfill to be constructed at EPHI, • The demolition works will be conducted in 2 Phases to minimize the disruption to the EPHI	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007), OHS Standard, COVID 19 guidelines and protocols,	Around the old incinerator	• EPHI, • Contractor • Project Environment and safety officer	During Decommissioning	*20,000*

	operation and nearby community,	hazardous waste management standard				
Water Quality Impact	• Wastewater generated from the decommissioning and demolition works will be limited to general cleaning works, and water used in dust suppression whilst wastewater from the shower unit of the decontamination unit will be collected and discharged into the hazardous waste collection system. Any water will be wiped dry with cloths. The damp cloths shall be stored in appropriate containers such as drums and jerricans for proper incineration and disposal, • The floor drain in the incinerator room shall be covered with a temporary seal during the decommissioning and demolition works. The top of the chimney should be sealed with polyethylene sheets at least twenty-four (24) hours before the works commence, • All wastewater arising (if any) from the decommissioning should be collected and	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007),	Around the old incinerator	• EPHI, • Contractor • Project Environment and safety officer	During Decommissioning of the old incinerator	25,000

	discharged to the onsite wastewater collecting safety tank and treated at the recommended offsite wastewater treatment plant, • The floor drain in the incinerator room shall be covered with a temporary seal during the decommissioning and demolition works, • The top of the chimney should be sealed with polyethylene sheets at least twenty-four (24) hours before the works commence,					
Air Quality Impact	• The decommissioning and demolition of the incinerator units and associated ductwork in Phase 1 will be carried out in an air-tight condition under negative pressure, and hand-held tools and small electric equipment will be used for the decommissioning works, • The demolition of the chimneys in Phase 2 will be carried out in a fully enclosed structure, and hand-held tools and small electric equipment will be used for the decommissioning works, • Decommissioning and demolition work will be carried out in full containment; a Specialist	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007)	Around the old incinerator	• EPHI, • Contractor • Project Environment and safety officer	During Decommissioning of the old incinerator	20,000

	contractor will be employed with adequate health and safety protection measures in place, • Wet wiping off the surface to minimize airborne dust,					
Risk of Accident	• Wear safety shoes with non-skid soles, • Technicians who have operated the incinerator shall be part of the decommissioning activity, • Wear long-sleeved shirts and protect hands with metal mesh or other protective gloves, • Wear appropriate eye protection; consult a safety supervisor or a supplier	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007), OHS Standard, ILO standard	Around the old incinerator	• EPHI, • Contractor • Project Environment and safety officer	During Decommissioning of the old incinerator	25,000
Risk of Construction and Operations of New Incinerator						
Risks of Trauma and Infection	• Organizational prevention: such as assigning duties and responsibilities to all involved, management (sorting, packaging, labeling, storage, transport), best practices (such as refraining from putting the caps back on syringes), training, • Individual prevention: personal protective	World Bank Environmental, Health, and Safety Guidelines for	new incinerator site	• EPHI,	During the operation of the new incinerator	30,000

	equipment, vaccination, washing hands, • Provide body protection such as aprons, protective suits for staff involved in collecting, transporting and treating wastes, • Provide also heavy-duty protective gloves for staff involved in transporting and treating wastes, • Staff handling wastes must be appropriately protected by vaccination, including vaccination against hepatitis A and B and tetanus.	Healthcare Facilities (2007), OHS Standard, ILO standard				
Accident Hazards	• Wear safety shoes with non-skid soles, • Wear long-sleeved shirts and protect hands with metal mesh or other protective gloves, • Wear appropriate eye protection; consult a safety supervisor or a supplier, • Install effective exhaust ventilation to prevent air contamination; add local exhaust ventilation if necessary, • Arrange for periodic inspection of incinerator vessel integrity, to detect metal cracking, etc.	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007), HS Standard, ILO standard	new incinerator site	• EPHI,	During the operation of the new incinerator	25,000
Physical Hazards	• Wear hearing protection appropriate for the noise levels and type of noise -consult an expert,	World Bank Environment	new incinerator	• EPHI,	During the operation of	20,000

	• Health insurance for all workers, • Wear long-sleeved shirts and protect hands with metal-mesh or other protective gloves,	al, Health, and Safety Guidelines for Healthcare Facilities (2007), OHS Standard, ILO standard	site		the new incinerator	
Chemical Hazards	• Wear respiratory protection during maintenance or other work in which dust and noxious gases may be released into the atmosphere, • Read material safety data, • Provide the training and information necessary for the employees to work safely and healthily, • Ensure all personal protective equipment (PPE) is in good working condition • Follow safe work instructions and procedures given by your supervisor,	World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007), OHS Standard, ILO standard	new incinerator site	• EPHI,	During operations of the new incinerator	25,000
Ergonomic	• Learn and use safe lifting and moving techniques for heavy or awkward loads; use mechanical aids to	World Bank Environment	new incinerator	• EPHI,	During operations	25,000

Hazard	assist in lifting, • Wear respiratory protection during maintenance or other work in which dust and noxious gases may be released into the atmosphere	al, Health, and Safety Guidelines for Healthcare Facilities (2007), OHS Standard, ILO standard	site		of the new incinerator	
Risk of Fire or Explosion	• Fuel system installation/storage and testing must comply with the applicable requirements, • Fire extinguisher should be installed and periodically checked for its functionality, and • Wetting of the soil before and during crushing may help prevent ignition. The soil handling equipment may also be equipped with non-sparking buckets or blades • Temperature safety control systems should be included to protect people and equipment, • The design of the systems should also consider the handling of materials exiting the system,	*Ethiopian* Building Code *Standard*	new incinerator site	• EPHI,	During operations of the new incinerator	25,000

	• Safety barriers can be included to isolate critical sections of the equipment, and • Signs should be posted warning of high temperatures.					
Electrocution Hazards	• All controls, wiring, and equipment, including adequate ground-fault protection, should be in conformance with the requirements	*Ethiopian* Building Code *Standard*	new incinerator site	• EPHI,	During operations of the new incinerator	25,000
Risk of Facility Damage or Failure	• All transfer equipment (conveyors, piping, process units and instruments) in contact with contaminated materials should be fabricated from materials that are resistant to that chemical, • Where liquids may separate from solid materials or when incinerating liquids, containment drip pans or receivers should be included in the design, and • Spill and/or leak detection instruments can be installed to monitor for leaks or spills and set off alarms when appropriate.	*Ethiopian* Building Code *Standard*	new incinerator site	• EPHI,	During operations of the new incinerator	20,000
Air Pollution	• Weekly: clean heat recovery boiler tubes, blower intakes, burner flame rods and sensors, heat recovery induced draft fan; lubricate latches,	World Bank Environmental, Health,	new incinerator site	• EPHI,	During operations of the new	20,000

	hinges, hopper door pins, etc, • Only modern incinerators operating at 850-1200 °C and fitted with special gas-cleaning equipment can comply with the national and international emission standards for dioxins and furans, • Daily: check opacity, oxygen and temperature monitors; clean underfire airports, ash pit and sump; inspect limit switches and door seals, • Always Operation by trained, qualified personnel, • Introduction of waste at 850ºC or higher; automation to avoid introducing waste below 850ºC, • Minimum residence time of 2 seconds at 1200ºC in the secondary chamber after the last addition of air and 6% O2 by volume (for waste with >1% halogenated substances)	and Safety Guidelines for Healthcare Facilities (2007)			incinerator	
Water and Soil Pollution	• Ash should be handled, transported (using covered hauling) and disposed of in an environmentally friendly manner, • landfilling in concrete-based landfill to be constructed in EPHI,	World Bank Environmental, Health, and Safety Guidelines	new incinerator site and landfill	• EPHI,	During operations of the new incinerator	30,000

	• the leachate collection system should be connected to a hazardous liquid waste safety tank for further treatment, • surface water drainage system should be constructed to prevent the entrance of rainwater, • Vegetation should be planted along the sides of the secured landfill, and • The landfill should be protected from any access	for Healthcare Facilities (2007)				
	Total Management Cost ETB					**3,539,000**

15 CAPACITY DEVELOPMENT AND TRAINING

The development and operation of the proposed BSL 3 National reference laboratory need to have a strong Environment, Health and Safety (EHS) monitoring and inspection capacity that will ensure the installation and observance of all safety features and protocols in the proposed BSL 3 NRL project. In addition, capacity is needed to ensure monitoring of the ESMP implementation both during the construction and operation phases of the proposed project. At present, it appears that both the EPHI and FMOH HILEO directorate lacks a dedicated EHS unit or dedicated personnel responsible for planning and implementing EHS activities. Thus there is a need for capacity development by providing technical support and training in the areas of BSL-3 laboratory safety, workers and community safety, as well as in environmental monitoring for both the EPHI and FMOH HILEO directorate.

The training in the areas of BSL-3 laboratory safety, workers and community safety, as well as in environmental monitoring for implementation monitoring will be provided to relevant staff of FMoH HILEO, EPHI, AAEFCC and AABoLSA to enhance their skills in environmental monitoring during the operational phases of the NRL BSL-3 laboratory. Furthermore, training needs identified for waste management are provided in the Infection Control and Waste Management Plan (ICWMP) for the BSL-3 Lab document. The budget for technical support and capacity building training will be **79, 500.00 USD.** See table 22 for the trainings plan for BSL 3 staff and support staff.

Table 22: Trainings plan for BSL 3 Staff and Support Staff

Capacity Needs	Target Participant	Number of participants	Estimated Cost (Usd)
Training on Infection control and waste management	• Professionals working in BSL 3 NRL Complex (BSL 3 Laboratory, PTPC, biobank Centre, Central Warehouse, and LEMC) • Cleaners, waste transporters and handlers, incinerator operators, liquid waste treatment facility operators and other staff of the BSL 3 laboratory	70 24	6,000.00

Training on OSHA and environmental safety	• Wastewater treatment Plant Operator, Incinerator Operator, Waste handler, Laboratory Director, Laboratory scientist, Laboratory Quality Manager \ Biosafety and biosecurity Officer and other pertinent staff	70	6,000.0
Training on biosafety and biosecurity	• Professionals working in in BSL 3 NRL Complex (BSL 3 Laboratory, PTPC, biobank Centre, Central Warehouse, and LEMC • Cleaners, waste transporters and handlers, incinerator operators, liquid waste treatment facility operators and other staff of the BSL 3 laboratory	70 24	6,000.00
Quality management system	• Professionals working in in BSL 3 NRL Complex (BSL 3 Laboratory, PTPC, biobank Centre, Central Warehouse, LEMC and other staff of the BSL 3 laboratory	70	4,500.00
Specimens management	• Professionals working in in BSL 3 NRL Complex (BSL 3 Laboratory, PTPC, biobank Centre, Central Warehouse • Cleaners, waste transporters and handlers, incinerator operators, liquid waste treatment facility operators and other staff of the BSL 3 laboratory	70 24	6,000.00

Training on emergency preparedness and response	• Professionals working in in BSL 3 NRL Complex (BSL 3 Laboratory, PTPC, biobank Centre, Central Warehouse, and LEMC • Cleaners, waste transporters and handlers, incinerator operators, liquid waste treatment facility operators and other staff of the BSL 3 laboratory	70 24	6,000.00
Specific laboratory technique (microbiology, molecular methods and other related training)	• Professionals working in in BSL 3 NRL Complex (BSL 3 Laboratory, PTPC, and biobank Centre	46	30, 000.00
Training for BSL 3 lab bioengineers and technicians for maintenance team	• Bioengineers	20	5, 000.00
Training on handling pathogenic and potentially lethal agents	• Professional working in PTPC and biobank Centre	16	5,000.00
Training on the use of MSDSs, safe work practices, and appropriate PPE	• Professional working in in BSL 3 NRL Complex (BSL 3 Laboratory, PTPC, biobank Centre, Central Warehouse, and LEMC • Cleaners, waste transporters and handlers, incinerator operators, liquid waste treatment facility operators and other staff of the BSL 3 laboratory	70 24	5,000.00
Total	**79, 500.00**		

16 ENVIRONMENTAL AND SOCIAL MONITORING PROGRAM

Environmental and social monitoring activities should be based on direct or indirect indicators of air pollution, water pollution, sound pollution, solid and liquid waste generation, socio-economic impacts, occupational health and safety practice, visual impacts and resource use applicable to EPHI BSL 3 NRL. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. This kind of monitoring has to be carried out by the environmental safety officer of the project with an environmental officer of the Sub-city in regular bases. The project top management together with affiliated units of Addis Ababa City administration Environmental Protection Authority and representatives of the community should have to carry out an occasional monitoring on the performance of the environmental and social management plan.

The various environmental and social components and pollution sources, which would be monitored under the environmental and social monitoring program, would be mainly solid waste generation, air emission, noise level and occupational health and safety practices.

Table 23: Environmental and social Monitoring plan

Impact Description	**Proposed Mitigation Measures**	**Monitoring Indicators**	**Responsible Parties**	**Monitoring Frequency**	**Budget required/yr, monitoring ETB**
Pre-construction and Construction phases					
Air Quality Impact	• Construction work should be undertaken by an experienced and duly registered contractor with a verifiable sense of environmental awareness and responsibility, • Contractors should use dust screens or nets in windows, doorways and ventilators of rooms where demolition or other dusty construction activities are occurring, • Sprinkling the road with water two times a day periodically when operations are underway to prevent the raising of dust, • Enclosing the structures under construction with dustproof nets, • Ensure good housekeeping and clean	Total Particulate Matter, Total organic carbon, Hydrogen chloride, availability of buffer zone, Hydrogen fluoride (HF), Sulfur dioxide (SO_2), Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer	Every six month	2400

	construction operations where, among other necessary actions, dust should be quickly swept off cement floors and collected in covered containers. • Regular maintenance of construction machinery as per the Manual, • Controlling the speed (10 km/hr) and operation of construction vehicles during transportation, • Use of clean fuels (e.g., unleaded and de-sulphurized fuels) not used fuel from the black market, • Educate and raise awareness of construction workers on emission reduction techniques. • Workers will be provided with PPE and the use of PPE shall be enforced.				
Impact on Water Resource	• Landscaping and site management to control runoff and provide basement flood protection, landscaping, providing proper roof drainage and minimizing paved	Availability of garage, availability of water cut-of	Gulele Sub-city Environmental protection office, EPHI Supervisory	Every week during construction	*28,800*

	surfaces, • The contractor should have separate garages for the truck and construction machinery and used oils and other liquid wastes should be stored in a secured area and disposed as hazardous wastes, • Excavated soil should be disposed in designated areas (with local authorities permit) where it will get environmental clearance from the city administration EPA office. • Minimize the amount of exposed ground and stockpiles of soil on the site, • Do not discharge or allow water contaminated with silt to enter a watercourse or drain as it can cause pollution and limit the water within the site, • Protect all surface water drains and watercourses with cut-off ditches or earth bunds. These should be at least 10 meters from the watercourse, and limit all the	ditches	engineer		

	water runoff from the site, and • Develop a spill response plan for accidental leakage of oil spills and apply it within 2 hours of spills.				
Soil Pollution and Erosion Impacts	• Minimize disturbance and control erosion by avoiding steep slopes and by minimizing the amount of construction and ground clearing needed for roads, staging areas, and crane pads, • All plastic tubes left from construction should be sold for recyclers, • Develop a spill response plan for accidental leakage of oil spills and apply it within 2 hrs spills, • Used oils such as engine lubrication oil, hydraulic fluids, and gear oils used in cars sold for recycler, • Used oil filters, contaminated cans should be placed in secured area and disposed as hazardous waste,	Availability of spill response plan, availability of concrete based landfill for sludge	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer	Every week during construction	*28,800*

	• Separate garage for construction vehicles and machineries,				
Noise and Vibration Impacts	• Contractor will be careful when selecting equipment to avoid the use of old or damaged machinery with high levels of noise emissions that would have a negative impact on the environment. • Construction activities required outside normal working hours must be approved by the Project Manager, and where necessary, the advance warning provided to adjacent residents, • Noise levels exceeding 85 dB shall only be permitted where approved and with an appropriate advanced warning to adjacent residents (minimum of 2 days) being provided, • Noise that could cause a major disturbance should only be carried out during daylight hours and with advance warning provided as above,	For commercial area 70 dBA for day time and 70 dBA for night time; For residential area, 55 dBA for day time and 45dBA for night time	Gulele Sub city Environmental protection office, EPHI Supervisory engineer	Every three month during construction	*5000*

	• Acoustic enclosures should be provided with DG (Diesel generator) sets and machinery to control the noise levels at a construction site, • Equipment and machinery should routinely be maintained as per the manual, • Educate and raise awareness of construction workers on noise reduction techniques, • Provision of PPEs such as ear plugs for employees working in noisy conditions or with noisy equipment				
Solid Waste Generation Impact	• Solid wastes should be collected from the project site at least once in 24 hours to minimize nuisance odour and vermin, • Solid wastes should be properly segregated to encourage recycling of some useful waste materials, • The contractor and EPHI administration should work together to facilitate proper waste handling and disposal from the site.	Volume of excavated soil disposed,	AA Gulele Sub-city EPA, Sub city Environmental protection office, EPHI Supervisory engineer	Every month during construction	*15,000*

	All wastes must be taken to the approved dumpsites, • Inert portion of construction & demolition material (including inert excavated material), that is, public fill, deemed suitable for re-use on site as far as possible and only the surplus material should be disposed of off-sit, • Excavated soil should be immediately removed from the site and disposed of in an area that gets an environmental clearance certificate from Addis Ababa City Administration • *Cut-off trench*‖ means an excavation later to be filled with an impervious material to prevent or reduce seepage under the embankment should be employed				
Liquid Waste Impact	• Waste water from the concrete batching plant should be stored in a protected pond within the site and used for concrete curing and watering of buildings,	availability of separate latrine for construction workers,	Gulele Sub city Environmental protection office, EPHI Supervisory	Every month during construction	11,000

	• Construct separate safety tanks for latrines and sanitation of construction workers, • Used oils and other liquid wastes should be stored in a secured area in tanks and disposed as hazardous wastes	availability of garages for construction vehicles and machineries	engineer		
Plant, Soil and Animal Biodiversity impacts	• Maintaining landscaped gardens, terraces, conservation and management of the grass gardens, • Use dust proofing net to protect the plants around the project site, • Proper management of excavated soil during land clearance and construction activities to mitigate the impact of soil erosion and siltation of the nearby aquatic ecosystems, • Limit the extent of vegetation and tree clearing only in the building foundation and establish green area along the sides of the building, • Buffer areas and restrict the construction activity within the project sites,	The usage of Access roads, maintenance of landscape garden, Proper management of excavated soil	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer	Every month during construction	11,000

	• **Avoid** developing sites, and locations within sites, where existing key habitats, important species, buffer areas and other landscape features				
Traffic and Public Safety Impacts	• Use only access gate of the construction site only, • Limit the speed of the truck to 10 km/hr in project site • Initiation of a safety program and measures by creating awareness and educational campaigns for drivers, workers and local communities, including observation of speed limits, • Installation of appropriate road signage, speed signs, and other warning signs at the site and access roads, • Copies of drivers' licenses and insurance policies for the Contractor's drivers and vehicles respectively should be provided to the Supervision Consultant, • The Contractor's vehicles and equipment	Availability of road signs, availability of maintenance plan for car and machineries, incident report format	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, A.A Traffic management agency	Every month during construction	15,000

	must be in proper working condition (roadworthy vehicles) and have registration plates, and numbering. • The Contractor ensures proper driving discipline by its employees, and sanctions those in breach, • Use only permitted gates and access road which is allowed for construction machineries and trucks, • Regularly maintain construction vehicles and machineries as per the manual, • Identify the times of day truck traffic is expected – heavy truck traffic should be outside peak hours, • Identify any works that are likely to be so disruptive to traffic that they may need to be scheduled outside the hours of work permitted,				
Public Health Impacts	• Contracting of an HIV service provider (government health center) to be available on-site every year,	Provision of Education related to HIV/AIDS,	Gulele Sub-city Environmental protection office,	Every month during construction	15,000

	• Implementation of HIV/AIDS and COVID-19 education program, • Information campaigns on STDs among the workers and local community, • Education about the transmission of diseases, • Vaccinating workers against common and locally prevalent diseases including COVID-19, • Provision of condoms, • Awareness rising about public health impacts from labor influx, • Construction camp to include wastewater disposal and septic systems, • Identification of authorized water supply sources and prohibition of use from other community sources, and • Separate service providers for community and workers' camp/construction site	COVID-19 and transmission of disease Provision of condoms, Availability of waste water and septic system	EPHI Supervisory engineer, Woreda social affairs Bureau		
Historical Buildings	• The design and position of the building should not cover the view of the old	Availability of permit letter from	Gulele Sub-city Environmental	Every three Month During	*5000*

Impact	building, • Divert runoff to protect these areas before clearing and grading begins, • Properly compact the exposed surface area to reduce erosion potential, • Use crushed aggregate or temporary seeding to reduce erosion, • Site plans should show the location, slope, cut, fill, and finish elevation of the surfaces to be graded and the auxiliary practices for safe disposal of runoff water, slope stabilization, erosion control, and drainages such as waterways, lined, ditches, diversions, grade stabilization structures, retaining walls, and surface and subsurface drains, and • Removing basements, or other large areas of intervention from the designs, or relocating them to less critical parts of the development,	Addis Ababa Cultural and tourism Bureau, engagement of cultural heritage specialist	protection office EPHI Supervisory engineer, Addis Ababa Cultural and tourism Bureau	Construction	
Impact on	• Employ water conservation strategies such	KWh and M^3	Gulele Sub-city	Every six	1500

utility	as reuse of water from concrete batching plants for watering the building and toilet flushing, • Rain water harvesting during summer • Using advanced designs and construction techniques that reduce energy consumption		Environmental protection office, EPHI Supervisory	month	
Risk of Social Conflict and Crime	• During the construction phase of the proposed BSL 3 NRL project, the proponent (FMOH HILEO /EPHI) and the contractor will jointly set up a project-specific grievance handling system with a team comprising of construction supervisor, and delegated officers from the HILEO and PCT who will receive and log, and address any disputes, conflicts or concerns arising from stakeholders that may be aggrieved by the project. • Grievances will be resolved and status reported back to complainants within a week. If the Work supervisor cannot solve the grievance, he will refer it to	Numbers of job created for local people Presence of a gender action plan, Availability of fence,	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, Woreda social affairs Bureau	Every Month During Construction	15,000

	MOH/EPHI and the contractor through the Supervising Engineer. It is believed all possible grievances can be solved by the joint action of MOH/EPHI and the contractor. • Early management of disputes and proactive community engagement, • The contractor should prepare workers influx management action plan, • The contractor will provide orientation to its staff to respect the culture, religion and ethnic differences of its workers, the EPHI community and the local people, • Paying salaries into workers‘ bank accounts rather than in cash, • Sourcing of local workforce as much as possible, • Give the first opportunity to the local people to supply construction materials such as sand, brick and other locally available materials,				

	• Cooperation with local law enforcement, and • Job priority to the local people to develop a sense of ownership				
Gender Based Violence	• The institution will prepare a GBV prevention action plan and act accordingly, • Conduct continued sensitization and awareness raising to EPHI staff in general and BSL-3 NRL staff in particular on the prevention of GBV, • Strengthen the Gender and women office of EPHI to address GBV cases when it occurs, • The contractor will provide orientation to its staff to respect the culture of the local people and to limit their relationship with the local people, • Contractor and implementing agency to prepare and implement a GBV Prevention and Response Action Plan to include at a minimum, in conformance with local laws and customs, equal opportunity for	Presence of a gender action plan, Availability of construction limit fense, Percentage of women employed	Gulel Sub-city Environmental protection office, EPHI Supervisory engineer, Woreda social affairs Bureau ,	Every six months during construction	2500

	employment, • All workers and nearby communities and stakeholders will be educated on preventing and responding to sexual harassment and GBV ahead of any project-related works, • Construction areas should be separated by a fence and a separate access gate is used for construction workers, • Ensure that women are given a mentorship orientation before starting their work. • Regular sensitization and awareness campaigns (At least two times a year) to the workers should be done to promote gender equity in employment during the construction works and operation, and • Provision of gender disaggregated data, separate bathing, changing, sanitation facilities for men and women should be ready by contractor, and • Impose zero tolerance on sexual harassment, all forms of gender-based				

	violence and discrimination at all phases of the project.				
Child Right Violation Impacts	• Strengthen the social service workforce to identify and respond to potential situations of child labour through case management and social protection services, including early identification, registration and follow-up, • Improve children's access to justice systems that are child-friendly, gender-sensitive and well-resourced to uphold their rights, and • Zero tolerance of child right violation and the contractor should inform for all workers related to child right violation consequences, • The contractor and his sub-contractors are expected to follow standard occupational health and safety standards during the construction phase of the project.	Availability of registration and identification of employees to identify the age	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, Woreda social affairs Bureau	Every month during construction	15,000
Increase	• Use of borehole as an alternative source of	Availability of	Gulele Sub-city	Every two	7,500

Burden on Public Service	water from the EPHI compound, • Workers‘ camp to include wastewater disposal and septic systems, • Separate service providers for community and workers‘ camp/construction site, • Water conservation and recycling, • Provide first aid treatment at campus and recruit health professionals for this purpose, • Consideration of use of rainwater where feasible, • Avoiding contamination of fresh water, • workers orientation and instruction on water and electricity consumption,	first aid service Availability of workers code of conduct on public service The institute's activities in community development	Environmental protection office, EPHI Supervisory engineer, Woreda social affairs Bureau	months during construction	
Occupational Health and Safety Risks	**i. Risk of communicable diseases** • Contracting of an HIV service provider to be available on-site; • Implementation of HIV/AIDS and COVID-19 education program; • Information campaigns on STDs among the workers and local community;	Availability of OSH plan and emergency plan, Presence of PPE for all workers Availability of Insurance,	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, Gulele Sub-city Social affair	Every day during construction	15,000

	• Education about the transmission of diseases; • Vaccinating workers against common and locally prevalent diseases including COVID-19; • Provision of condoms; • Awareness rising about public health impacts from labor influx; • Workers‘ camp to include wastewater disposal and septic systems; • Identification of authorized water supply source and prohibition of use from other community sources; and • Separate service providers for community and workers‘ camp/construction site;	Availability of buffer zone on both sides of high tension transmitter	office		
	ii. Slip, Trip and Falls Mitigation Measures • Conducting audits as required to ensure	Report, incidence report,	Gulele Sub-city Environmental protection office, EPHI Supervisory	Every day during construction	15,000

	responsibilities are met, • Ensuring employees receive appropriate training and instructions • Deal with spills straight away as per the spill response plan • Consider routine monitoring of areas where spills are a high risk • Use absorbent material to soak up the spill • Identify areas at high spill risk and locate absorbent materials nearby • Where possible avoid using wet cleaning as this may spread the potential danger area • Consider using spill kits • Ensure slip-resistant footwear is provided and worn as needed Providing personal protective equipment (e.g. slip-resistant footwear) if required		engineer, Gulele Sub-city Social affair office		
	iii. Fire and Explosion Hazards	Availability of	Gulele Sub-city	Every month	3600

	Mitigation Measures • Ensure the provision of fire extinguishers at all work locations and at all times. • Prepare a fire safety management plan • All flammable gases, liquids and vapors are removed before the start of any hot work. • Where appropriate, use spark-resistant tools and make sure all equipment is bonded or grounded properly, • Ensure provisions of first aid for staff, insurance, and access to ambulance service at all worksites, and arrangement (agreement) to access local hospital/dispensary with qualified medical staff by workers, • The construction site shall be fenced off to prevent access to members of the public, • Providing adequate storage for	fire extinguisher, availability, fire safety management plan	Environmental protection office, EPHI Supervisory engineer, Gulele Sub-city Social affair office	during construction	

	hazardous and flammable substances and controlling access to them. • Monitoring the movement, handling and management of wastes to ensure they are safely managed and don't present any EHS risks, • Establish clinics and equip them with appropriate medical				
	iv. Risk of Physical Hazards • Scan the workplace for existing and potential hazards before work begins and take appropriate controls. Be aware that conditions can change constantly, • Use correct personal protective equipment and apparel, including safety footwear, • Have training before beginning any task, especially high-risk activities such as working at heights, hazardous energy control (lockout/tag out), or confined	Report, incidence report,	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, Gulele Sub-city Social affair office	Every day during construction	15,000

	space entry, • Prepare and emergency response plan and be aware of the emergency response plans before work begins, • Develop evacuation procedures to handle emergency situations. • Safety glasses/face shield for those working with any chemical or using any mechanical equipment to protect their eyes and face, • For hand, use correct gloves for the job for workers at concrete batching plant, • Placing readable signs alerting people of hazardous such as slippery floors, • Insuring against liability for any loss, damage, death or bodily injury which may occur to any physical property or to any				
	v. Lung Injury Mitigation Measures • Reduction of Ventilator-associated lung	Report, incidence report,	Gulele Sub-city Environmental	Every month during	3600

	injury (VALI) by protective low tidal volume ventilation, • Do not eat, drink, or use tobacco products in dusty areas, • Wash hands and face before eating, drinking, or smoking outside dusty areas, • Shower and change into clean clothes before leaving the worksite,		protection office, EPHI Supervisory engineer, Gulele Sub-city Social affair office	construction	
	vi. Eye Injury and Damage Mitigation Measures • Always to wear personal protective eyewear for workers working on high dust and eye goggles for welders, • Clean your eyewear several times throughout the day, and always brush yourself off before removing your safety glasses, It's vital to call for medical attention (get treatment) when you notice the following signs in	Incidence report	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, Gulele Sub-city Social affair office	Every day during construction	15,000

	yourself or coworkers such as blood in the clear part of an eye, cut or torn eyelid, one eye doesn't move as well as the other, one eye sticks, pain or trouble seeing, unusual pupil dilation or shape				
	vii. Electrical Hazards Mitigation Measures • Inspect portable cord-and-plug connected equipment, extension cords, power bars, and electrical fittings for damage or wear before each use. Repair or replace damaged equipment immediately, • Always locate all power lines on or near the project sites, • Perform regular fire risk assessments to identify areas at risk of bad wiring and circuits, • Maintain proper grounding to eliminate unwanted voltage and reduce the risk of electrocution,	Incidence report	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, Gulele Sub-city Social affair office	Every day during construction	15,000

	• Verify that all wiring is coming from a properly rated circuit and doesn't exceed the capacity				
	viii. Ergonomic Hazards Mitigation Measures • Adjust the height of working surfaces to reduce long reaches and awkward postures, • Put work supplies and equipment within comfortable reach, • Provide the right tool handle for the worker, • Vary tasks for workers (e.g., employ job rotation), • Encourage short rest breaks, • The contractor should be responsible for adequate first-aid services provided to the employees at all times,	Report, physical observation	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, Gulele Sub-city Social affair office	Every day during construction	15,000
	ix. Biological Hazards Mitigation Measures	Incidence report, physical	Gulele Sub-city Environmental	Every day during	15,000

	• Construction site should be separated from the main campus by fence and construction workers should be restricted within the site, • Wasps are attracted by discarded food, so make sure all leftovers go in the garbage, and keep it covered. Remove and reduce debris and rubble piles when possible to help keep insects and rodents away • Vaccines, and other biological products should be properly screened so as not to introduce infection to the construction site and the wastes should be autoclaved and incinerated, • In case of any disease outbreak vaccination should be performed in a construction area or surroundings to prevent the spread of disease, and • Workers should cover as much of the body as feasible.	observation	protection office, EPHI Supervisory engineer, Gulele Sub-city Social affair office	construction	

	x. Muscle Skeletal Disorder Mitigation Measures • Using mechanical assist devices to relieve heavy load lifting and carrying tasks or using handles, • Reducing shift length or limiting the amount of overtime, • Rotating workers through jobs that are physically tiring, • PPE generally provides a barrier between the worker and the hazard source,	Incidence report, physical observations	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer,	Every week during construction	4000
	xi. Traffic Accident Impacts Mitigation Measures • Limit the speed of the truck to 10 km/hr within the site, • Initiation of a safety program and measures by creating awareness and educational campaigns for drivers,	Incidence report,	Gulele Sub-city Environmental protection office, EPHI Supervisory engineer, Gulele sub-city traffic management	Every month	3600

	workers and local communities, including observation of speed limits, • Sanctions for reckless driving, • Installation of appropriate road signage, speed signs, and other warning signs at the site and access roads, • Copies of drivers‘ licenses and insurance policies for the Contractor‘s drivers and vehicles respectively should be provided to the Supervision Consultant, • All construction machineries and cars should have third-parties insurance, • Use only permitted gates and access roads which is allowed for construction machineries and trucks,		office		
Operation Phase					
Air Quality Impact	• Waste segregation for wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs plastics would be done and these wastes	Presence of new incinerator, Availability of a	Gulele Sub-city Environmental protection office,	Every two months during operation	4000

	should never be incinerated these wastes should be cleaned. Disinfected and disposed with non-hazardous wastes, • Controlled incineration of medical wastes with a pyrolysis incinerator should be done at operating temperature of 800 to, 1200°C. • Regular planned maintenance: replacement of faulty parts, inspection, inventory of spare parts; • Wet waste must be mixed with drier waste during incineration and sharps containers must be loaded one by one; the incinerator must run for long periods (at least 2 hours); heavy-duty gloves, a body protection, and goggles must always be worn as well as a respirator whenever ash is being removed; • Emissions must not exceed the national limit values and they must comply with the BAT/BEP1817 recommendations set forth in the Stockholm Convention. • Materials free of polychlorinated dibenzo-	buffer zone,			

	dioxins and polychlorinated dibenzo-furans PCDD/Fs should be purchased, for minimizing the environmental and health impacts. • Workers will be provided with PPE and the use of PPE would be enforced. • Applicable national requirements and internationally recognized standards for incinerator design and operating conditions would be followed, mainly rapid quenching of the flue gas after leaving all combustion chambers and before entering any dry particulate matter air pollution control device but also combustion temperature, residence time, and turbulence, • Wastes would be introduced into the incinerator only after the optimum temperature is reached in the final combustion chamber. • The waste charging system would be interlocked with the temperature				

	monitoring and control system to prevent waste additions if the operating temperature falls below the required limits; • Electronic wastes should not be incinerated at the site, • Flue gas treatment system would be used for the control of acid gases, particulate matter, and other air pollutants;				
Water Pollution Impacts	• Promoting practices that reduce the volume of wastes generated and ensure proposer waste segregation; • Developing strategies and systems along with strong oversight and regulation to incrementally improve waste segregation, destruction and disposal practices with the ultimate aim of meeting national and WBG standards; • Where feasible, favouring the safe and environmentally sound treatment of hazardous health care wastes (e,g, by autoclaving, steam treatment integrated	Availability of concrete-based safety tank, waste management plan	Gulele Sub-city Environmental protection office, Akaki-Kaliti Sub-city Environmental protection office,	Every month during operation	7500

	with internal mixing, and chemical treatment) over medical waste incineration; • Hazardous and chemical liquid wastes should be stored in separate concrete-based safety tanks as recommended and disposed after treatment, • Flue and bottom ashes need to be stored in a secured and protected landfill, • Construction of elevated structures to limit the storm water within the protected landfill, construction of floodwalls, floodgates, levees, and evacuation routes for rain water to prevent runoff of ashes; • Wastewater treatment plants works must comply with effluent discharge guidelines of the country, • The bottom of the landfill must be waterproofed and must be equipped with a final cover to prevent rainwater infiltration; • leachates must be collected to the safety tank and treated waste water treatment plan				

	to be constructed by FMoH				
Soil pollution	• Soils surfaces not covered by the building footprint or not paved would be landscaped to control erosion from storm water runoff, • Spill contingency plan will be implemented in case of accidental spills or leaks • Wastewater generated from BSL 3 NRL activity should be stored in a concrete-based safety tank (100 M^3) and should be disposed after treatment from the proposed wastewater treatment plant, • Municipal wastes generated from latrine and sanitary areas should be stored in safety tanks and disposed in Kality wastewater treatment plant, • All domestic solids should be landfilled in Repi landfill • Contaminated primary packaging, and hazardous and infectious wastes should be incinerated • Ash formed from incinerator should be	Availability of separate safety tank, concrete-based landfill	Gulele Sub-city Environmental protection office,	Every month during operation	7500

	stored in concrete-based landfill within the EPHI compound and need roof covering and protection				
Noise and Vibration Impacts	• Using equipment with low noise ratings or noise reduction technologies such as generators, • Diesel generators should be enclosed and should be serviced as per the manual	Availability of enclosed generator	Gulele Sub-city Environmental protection office,	Every three months during operation	2500
Solid Waste Generation Impacts	• All wastes should be segregated based on type, • Initial packaging and storage would take place where HCW is generated. • Storage of waste will then be moved to a temporary on-site storage location • Non-hazardous wastes that are generated by the BSL-3 would be segregated and landfilled in the Repi landfill, • Hazardous and contaminated solid waste generated in the BSL-3	Availability of temporary damping site, segregation practices and availability of separate collection waste bin	• Gulele Sub-city Environmental protection office, AA city Administration solid waste management agency	• Every month during operation month	15,000

	laboratory would leave the laboratories only after decontamination using the laboratory's autoclave, • Solid or semisolid wastes would be placed in tear-resistant plastic bags judged by their thickness or durability, • There would be special packaging characteristics for some treatment techniques: incineration requires combustible containers, and steam sterilization requires packaging materials that allow steam penetration and evacuation of air, • All sharps used in the BSL-3 would be autoclaved prior to incineration, • Sharps (sharp items or items with sharp corners) would be placed in rigid, puncture-resistant, containers made of glass, metal, rigid plastic, or cardboard, • Non-risk Health care waste (HCW) would always be stored in a separate				

	location from the infectious/ hazardous HCW to avoid cross-contamination, • Flue ashes should be stored in secured area				
Liquid Waste Impact	• Strictly limit the discharge of hazardous liquids to sewers or sanitary safety tanks, • sewage pipes bringing wastewater from throughout the facility(project) to a central underground location for temporary retention • construct two separate collection systems such as a sewerage system for wastewater from sanitary and toilet facilities and hazardous wastes system from the laboratory liquid waste, • Sanitary liquid waste will be treated in Kaliti wastewater treatment plant, • body-fluids and the contents of suction systems from highly infectious patients (e.g., cholera) should be thermally treated (e.g. in a waste treatment autoclave) and	Presence of separate safety tank for hazardous and non- hazardous wastes	• Gulele Sub-city Environmental protection office,	• Every three months during operation	12,200

	then discharged via the drain to the safety tank for temporary storage and offsite treatment, • Hazardous pharmaceuticals and chemicals should never be disposed of via the sanitary wastewater and rainwater drainage system, • Leachate from the fly and bottom ash landfill should be collected to a hazardous wastewater safety tank and treated using an offsite wastewater treatment plant, • Workers will be provided with PPE and the use of PPE would be enforced. • Hazardious wastewater Plant will be constructed in collaboration with MoH, EFDA and other stakeholders at vaccine laboratory site in Akaki Kaliti Sub-City • Follow the EHS health care waste management guideline for handling and transportation hazardous wastewater to treatment plant and infrastructure for healthcare waste treatment and disposal				

	• Maintain the wastewater treatment treatment plant periodically • The hazardous liquid waste should fulfill the national effluent discharge standard before discharge to the environment • Using engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard; • Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures, • Consecute double-chambered septic tank and soaks away pits for onsite retention of liquid wastes until it transfer to the treatment facility, • Use of dedicated fittings, pipes, and hoses specific to materials in safety tanks and maintaining procedures to prevent addition of hazardous materials to the environment,				

	• All waste containers designated for off-site shipment would be secured and labelled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards, • Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfe, • Prepare written procedures for transfer operations that includes a checklist of measures to follow during filling • operations and the use of filling operators trained in these procedures, • Vehicles used for transporting infectious waste shall be disinfected prior to use for any other purpose, • Provision of automatic fill shutoff valves				

	on storage tanks to prevent overfilling, • Non-hazardous wastes will be stored in double-chambered septic tank and soaks away pits found witin EPHI compound and further treated using Kaliti Wastewater treatment palnt as usual.				
	• Use of tertiary treatment plant for treatment of hazardous waste to be constructed in vaccine lab project site in Akaki Kaliti Sub-city,	Presense of off-site wastewater treatment plant	• Federal EPA, Gulele Sub-city Environmental protection office,	• Every six month	12,200
Plant, Animal and soil Biodiversity Impact	• Both solid and wastewater within the EPHI compound should be appropriately managed to prevent their effects on plant, animal and soil biodiversity, • Maintain green area along the sides of the new building and incinerator; • Chemical and hazardous wastes will be stored in a concrete based safety tank	Presence of Rehabilitation strategies, Availability of Guideline for the care and use of laboratory animals, availability of	• Gulele Sub-city Environmental protection office,	• Every three month	2500

	and treated offsite • Properly managed and limited number of laboratory animals used for research purposes, • All animals used for research should be properly sacrificed and incinerated, • Animal care and use program, institutional animal care and use committee (IACUC) functions, and animal facility design and management, • avoidance or minimization of discomfort, distress, and pain, • use of appropriate sedation, analgesia, and anesthesia, and • Conduct of experimentation on living animals exclusively by and/or under the close supervision of qualified and experienced personnel. • All animals used for research should be properly sacrificed and incinerated, • avoidance or minimization of	computer simulations			

	discomfort, distress, and pain, • use of appropriate sedation, analgesia, and anesthesia,				
Utility Impact (Water and Energy)	• Reduce heating, cooling, and lighting demand through passive strategies such as climate-responsive design, day lighting, and conservation practices; • Employ renewable energy sources such as solar for road lightening in the future, • The college should implement water conservation programs such as Good housekeeping measures, and the Use of Automatic Shut-off Valves, • Use alternative groundwater sources during the operation phase,	• Availability of renewable energy source Availability of ground water source	Gulele Sub-city Environmental protection office,	• Every six month	1500
Risk of Social Conflict and	• Transparent local community engagement and participation should begin during initial project decision-making and continue routinely	Number of training given	Gulele Sub-city Environmental protection office, woreda Social	• Every three month during	5000

Crime	throughout the life of the project, • Awareness-raising among the local community, contract workers and staff about the cultures and norms of the local community, • Provision of cultural sensitization training for all staff regarding engagement with the local community, • Provide awareness creation program about tolerance of diversity and, • Develop a code of conduct for staff to prevent discrimination and other ethnocentric behaviours,		affairs bureau	operation	
Gender Based Violence	• Establish a gender mainstreaming and monitoring committee, • Provide awareness to the newly joined workers about the incidence and impact of domestic violence, sexual assault, and stalking, including reporting requirements and options, • Conduct continued sensitization and	• Number of training given Presence of guidelines for gender main streaming	Gulele Sub-city Environmental protection office, Woreda Social affairs bureau	• Every month during operation	5000

	awareness raising to EPHI staff in general and BSL-3 NRL staff on the prevention of GBV, • Strengthen the Gender and women office of EPHI to address GBV cases when it occurs, • On-going prevention training for staff; and • Provision of gender-disaggregated data, separate bathing, changing, sanitation facilities for men and women should be ready by institution and • Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project				
Traffic and Public Safety Impacts	**17** Placing visible and readable signs to the main gate where there are risks and arranging designated car parking, **18** Apply the "Three E" philosophy and to be transparent and proactive about all traffic	Number of accidents that occurred, availability of speed limit	Gulele Sub-city Environmental protection office, A.A traffic management	• Every month	5000

	initiatives; ➢ **Enforcement** – including duties performed by Addis Ababa Police (Traffic Management Bureau) and Woreda by-law enforcement staff, ➢ **Education** – including Speed Management Program and Safety Driven education campaign, ➢ **Engineering** – including issues related to road design on existing roads and planning for future projects		agency		
Public Health Impacts	➢ Laboratory personnel working in BSL 3, PTPC and bio bank would receive specific training in handling pathogenic and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures, • Laboratory workers would be trained in	Availability of all safety measures	Gulele Sub-city Environmental protection office,	• Every month during operation	15,000

	equipment operating and handling techniques during operation, • Effective vaccines or therapeutic measures would be available for all risk groups, • The use of pest control programs would limit the potential for transmission of infectious agents from animals to humans, • Trainings would be provided on sample and waste handling, transportation, and storage, and disposal, • All material would be sterilized by autoclave or chemical disinfection • Ensure that the facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents, • Ensure that water exiting through the sink drains would be diverted to a retention tank where it would be				

	disinfected before being sent to the sewer system. • All agents would be contained within the laboratory and a biosecurity system would be in place • Promote the use of condom, and implementation of HIV/AIDS education program; and get a vaccine for Covid 19, • BSCs HEPA filters would be tested annually and replaced as necessary, • Ensure that the facility would be designed to severely limit the potential for possible vector-borne transmission through insects and rodents • PTPC and bio bank would be locked always				
Public Service Burden	• The project needs to provide its own transportation for staff, • In collaboration with concerned sectors,	• Availability of transport service for	Gulele Sub-city Environmental protection office,	Every three month during operation	5000

	the BSL-3 project should ensure access of additional electric transformers whereby they can keep the existing power utilized by the community, • Drill a borehole within the project site for the water source. Work with the community and city administration to make the access road asphalt-based, and	workers • Availability of borehole for the hospital			
Occupational Health and Safety Impacts	**i. Risk of Infection Mitigation Measures** ➢ Laboratory personnel working in BSL 3, PTPC and biobank Centre should receive specific training in handling pathogenic and potentially lethal agents and would be supervised by competent staff in handling infectious agents and associated procedures, ➢ All procedures involving the manipulation of infectious materials should be conducted within a BSC, or other physical containment devices,	• Availability of infection control waste mgt plan • Availability of cooling fan and first aid treatment, • Availability of clinics, • Presence of fire	Gulele Sub-city Environmental protection office,	every three month	3200

	➢ Persons would wash- their hands after working with potentially hazardous materials and before leaving the laboratory, ➢ Spills involving infectious materials would be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material, ➢ Equipment would be decontaminated before repair, maintenance, or removal from the laboratory, ➢ Workers in the laboratory should wear protective laboratory clothing with a solid-front, such as tie-back or wrap-around gowns, scrub suits, or coveralls. Protective clothing will not be worn outside of the laboratory, ➢ Reusable clothing should be decontaminated before being laundered. Clothing is changed when	extinguishers, • Availability of accident reporting • Availability of material data sheet and also availability and use of PPE and other safety equipment (such as scaffolds) ,availability of safe work procedures			

	contaminated, ➢ Potentially infectious materials should be placed in a durable, leak-proof container during collection, handling, processing, storage, or transport within a facility, ➢ Gloves should be worn to protect hands from exposure to hazardous materials. Gloves should not be worn outside the laboratory. Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols would be rigorously followed, ➢ Blood should be collected from patients by trained staff, ➢ For phlebotomies, conventional needle and syringe systems should be replaced by single-use safety vacuum devices that allow the collection of blood directly into stoppered transport and/or culture tubes, automatically disabling				

	the needle after use				
	ii. Chemical Hazards Mitigation Measures ➢ To avoid accidental leakage or spillage, secondary containers, such as leak-proof boxes, should be used, fitted with racks so that the specimen containers remain upright, ➢ Respiratory protection should be used when carrying out high-hazard procedures. The choice of respirator will depend on the type of hazard(s) and it is available with interchangeable filters for protection against gases, vapors, particulates and microorganisms ➢ Volatile solvents should be handled in a chemical hood, ➢ Material Safety Data Sheets (MSDS) or equivalent should be considered while handling, storing, using, and	• Incidence report,	Gulele Sub-city Environmental protection office,	every three month	3200

	disposing hazardous chemicals. ➢ Only small amounts of chemicals necessary for daily use should be stored in the laboratory, ➢ Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid would always be ensured. ➢ Either fully buttoned laboratory coats, gowns, coveralls, or a long-sleeved, back opening gowns or coveralls should be used in BSL-3 laboratory at EPHI. Aprons may also be worn over laboratory coats or gowns where necessary to give further protection during handling of chemicals, hazardous and infectious materials, and ➢ Eye and face protection (goggles, mask, face shield or other splash guard) would be used for anticipated splashes or sprays of infectious or				

	other hazardous chemical materials.				
	iii. Risk of Burn or Fire Mitigation Measures ➢ Prepare a fire safety plan and the plan should provide employees or building occupants with the instructions they need to leave the building (or respond as appropriate) in the event of a fire, ➢ Delineating fire and emergency assembly points and creating awareness to ensure all people at the site are aware of them, e.g. through the use of maps on elevators, staircases etc. ➢ All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs, ➢ Combustible materials such as flammable liquids, solid materials should be stored in a lockable cupboard, ➢ Fire hazard signs such as 'No Smoking'	• Incidence report, availability of calibrated fire extinguisher	Gulele Sub-city Environmental protection office,	every three month	3200

	signs will be provided. Directions to exit in case of any fire incidence and emergency contact numbers will be provided. The contact/emergency numbers will be displayed within the laboratory ➢ First aid treatment facility should be also available, ➢ Automatic fire alarm system for the entire laboratory will be installed, ➢ All staff will have training in fire control through regular fire fighting drills. ➢ Fire extinguishers should be available in an accessible area near fire risk area and ensure that all fire-fighting equipment is regularly maintained and serviced,				
	iv. Ergonomic Hazards Mitigation Measures ➢ Training of workers in lifting and	• Incidence report,	Gulele Sub-city Environmental protection office,	every three month	3200

	materials handling techniques during operation, including the placement of weight limits above which mechanical assists or two-person lifts are necessary, ➢ Planning work site layout to minimize the need for manual transfer of heavy loads, ➢ Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user-adjustable work stations, ➢ Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks.				
	v. Injury/Accident Mitigation Measures ➢ Injuries should always be reported to	• Incidence report, physical observations	Gulele Sub-city Environmental protection office,	every three month	3200

	supervisors and victims should get medical attention as soon as possible. Collect broken needles in a secured and safe area and dispose all based on WHO standards, ➢ Sharps waste by disposing of it in a sealable container; self-locking and sealable sharps containers are made of plastic so that the sharps cannot easily penetrate through the sides. Such units are designed so that the whole container can be disposed of with other bio hazardous waste, with the support of the government ➢ Hepatitis B Vaccine should be given to all workers in laboratory				
	vi. Risk related to Electricity Mitigation Measures ➢ All electrical installations and equipment must be inspected and tested regularly, including earthen/grounding	• Incidence report	Gulele Sub-city Environmental protection office,	every three month	3200

	systems. Circuit-breakers and earth-fault-interrupters should be installed in appropriate laboratory electrical circuits, ➢ All laboratory electrical equipment would be earthed/grounded, preferably through three-prong plugs, ➢ All laboratory electrical equipment and wiring would conform to national electrical safety standards and codes, ➢ Disconnect equipment attached to high-voltage or high-amperage power sources from the source or provide a lockout device on the breaker box to prevent circuit activation before maintenance is performed, ➢ Because electrical devices can generate sparks, do not use them near flammable or volatile gases or liquids, ➢ Never place flammable liquids in a household refrigerator. The spark				

	generated by the door-activated light switch can ignite fumes trapped in the unit, causing an explosion and fire, ➢ Specialized refrigerators would be used when storing chemicals that have explosion potential				
	vii. Fire and Explosion Mitigation Measures ➢ All staff will have training in fire control through regular fire fighting drills, ➢ Fire extinguishers would be available in an accessible area near fire risk area and ensure that all fire-fighting equipment is regularly maintained and serviced, ➢ Fire emergency telephone numbers would be displayed in communal areas, ➢ Automatic fire alarm system for the entire laboratory will be installed, ➢ Fire suppression for the BSL-3 facility	• Incidence report	Gulele Sub-city Environmental protection office,	every three month	3200

	would be provided by a standard wet-pipe fire sprinkler system, ➢ Water flow alarms would be connected to the facilities fire alarm monitoring station so that, ➢ Designated responders would be notified ➢ Water hose reels will be installed in the laboratory.				
Risks related to Improper Waste Management	• Develop and implement a waste management plan for EPHI in general and for the proposed NRL project in particular in accordance with the infection control and waste management plan to guide the daily waste management operations, • Initial packaging and storage would take place where HCW is generated, • Storage of waste will then be moved to a temporary on-site storage location • Waste segregation for wastes with polychlorinated dibenzo-dioxins and	Availability of ceparate safety tank for hazardous and non-hazardous, wastes concrete-based safety tank, presence of color coded waste bin	Gulele Sub-city Environmental protection office, Akaki-Kaliti Sub-city Environmental protection office,	Evry three month	2400

	polychlorinated dibenzo-furans PCDD/Fs plastics would be done and these wastes should never be incinerated these wastes should be cleaned. Disinfected and disposed of with non-hazardous wastes, • Controlled incineration of medical wastes with a pyrolysis incinerator should be done at an operating temperature of 800 to, 1200°C. • Electronic wastes should not be incinerated at the site, • Flue gas treatment system would be used for the control of acid gases, particulate matter, and other air pollutants; • Hazardous and chemical liquid wastes should be stored in separate concrete-based safety tanks as recommended and disposed of after off-site treatment, • Wastewater treatment plant works must comply with the effluent discharge guidelines of the country,				

	• The bottom of the landfill must be waterproofed and must be equipped with a final cover to prevent rainwater infiltration; and • leachates must be collected to the safety tank and treated on wastewater treatment plant to be constructed by FMoH.				
Risk associated with Final Waste Disposal	• Personnel working on waste disposable would wear adequate personal protective equipment (PPE) including gloves, closed shoes, overalls and masks, • Training would be provided to personnel working on waste disposable, • Bottom ash, fly ash and other flue gas should be stored in secured ash pit in which it has leachate collection system that connects to the hazardous liquid waste safety tank, • Bottom ash and residuals would be managed based on their classification as	Availability of ash pit for hazardous waste, presense of wastewater treatment palnt,	Gulele Sub-city Environmental protection office, Akaki-Kaliti Sub-city Environmental protection office,	Evry three month	2400

	hazardous or non-hazardous materials; • Use of double-walled, composite, or specially coated storage and piping systems for hazardous waste waste onsite storage particularly in the use of underground storage tanks (USTs) and underground piping. If doublewalled systems are used, It should be provided a means of detecting leaks between the two walls, • Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store, and • The treated liquid waste should fulfil the national and WBG ESH Guideline befor disposal to the environment.				
Impacts on Improper Wastewater	• Considering proper tank volume, geometry and compartmentalization to impart adequate hydraulic residence	Availability of ash pit for hazardous waste,	Gulele Sub-city Environmental protection office,	Evry three month	2400

Treatment	time for sedimentation, • Elongated tanks with length-to-width ratios of 3:1 or more is will be used to reduce short-circuiting of the effluent, • Two compartments will be used to achieve, better suspended solids removal rates, • Manways 18 to 24 inches in diameter or square will be designed to access the tank for regular monitoring and maintenance, • tank will be located where it can be accessed easily for septage removal and sited away from drainage swales or depressions where water can collect. Maintaining minimum horizontal setback distances from buildings, property boundaries, wells, water lines, and the like, • Tank will rest on uniform bearing surface,	presense of wastewater treatment palnt,	Akaki-Kaliti Sub-city Environmental protection office,		

	• The backfill material will be free flowing and free of stones larger than 3 inches in diameter and debris, • Joints will be sealed properly, including tank joints, • Use of appropriate anti-flotation devices, • Tanks would be pumped when sludge and scum accumulations exceed 30 percent of the tank volume or are encroaching on the inlet and outlet baffle entrances, • Periodic pumping of septic tanks will be used to ensure proper system performance and reduce the risk of hydraulic failure, • Pumping and cleaning of Sludge and septage from the septic tank will be outsourced to Addis Ababa water supply and sewerage authority, Kotebe treatment plant,				

	• To achieve acceptable treatment in the sand/media unit, the wastewater retention time in the filter will be sufficiently long and reaeration of the media will occur to meet the oxygen demand of the applied wastewater. The pore size distribution and continuity of the filter medium, the dose volume, and the dosing frequency will be key design and operating considerations for achieving these conditions, • Remove and clean or replace the throttle blower as required, • Check aeration system, aeration tank dissolved oxygen level. • Increase sludge return rate to decrease sludge retention time in clarifier • Effective cleaning of UV-lamp sleeves periodically, and • In order to improve transmittance of UV, the process control will be				

	implemented to obtain a turbidity level of <0.2 NTU in the final water. Where the turbidity levels are above 0.2 NTU and/or TOC levels are in excess of 2-3 mg/litre, sludge or waste water return lines will be constructed for better performance2.				
Impact of Air Pollution due to Waste Incineration	• Waste segregation for wastes with polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs would be done and these wastes would never be incinerated, • Materials free of polychlorinated dibenzo-dioxins and polychlorinated dibenzo-furans PCDD/Fs would be purchased, for minimizing the environmental and health impacts. • Workers will be provided with PPE and the use of PPE would be enforced. • Improve incinerators and infrastructure for healthcare waste treatment and	air quality indicators, availability of modern incinerator, presense of concrete based ash pit	Gulele Sub-city Environmental protection office, Akaki-Kaliti Sub-city Environmental protection office,	Evry three month	2400

	disposal • New environmentally friendly incinerator would be purchased considering the following features: • Applicable national requirements and internationally recognized standards for incinerator design and operating conditions would be followed, mainly rapid quenching of the flue gas after leaving all combustion chambers and before entering any dry particulate matter air pollution control device but also combustion temperature, residence time, and turbulence, • Wastes would be introduced into the incinerator only after the optimum temperature is reached in the final combustion chamber, • The waste charging system would be interlocked with the temperature monitoring and control system to				

	prevent waste additions if the operating temperature falls below the required limit, • Minimize the uncontrolled ingress of air into the combustion chamber via waste loading or other routes, • Optimize and control combustion conditions by the control of air (oxygen) supply, distribution and temperature, including gas and oxidant mixing; the control of combustion temperature level and distribution; and the control of raw gas residence time; • maintenance and other procedures would be implemented to minimize planned and unplanned shutdowns; • operating conditions in excess of those that are required for efficient destruction of the waste would be avoided; • Auxiliary burner(s) would always be				

	used for start-up and shut-down and for maintaining the required operational combustion temperatures (according to the waste concerned) when unburned waste is in the combustion chamber.				
Risk associated with off-site Transport of Waste	• Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks • Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer Regular inspection, maintenance and repair of fittings, pipes and hoses • Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points	Presense of vehicles that is suitable for the characteristics of the materials transferred, presense of consignment note from the point of collection to the treatment facility	Addis Ababa City Adminsitration EPA, Gulele Sub-city Environmental protection office, Akaki-Kaliti Sub-city Environmental protection office,	Evry three month	3600

	or other possible overflow points, • The transportation would be properly documented, and all vehicles will carry a consignment note from the point of collection to the treatment facility, • Vehicles used for the carriage of waste would be disinfected prior to use for any other purpose, • The vehicles would be free of sharp edges, easy to load and unload by hand, easy to clean and disinfect, and fully enclosed to prevent any spillage in the facility premises or on the road during transportation, and • The vehicles would carry adequate supplies of plastic bags, protective clothing, cleaning tools, and disinfectants to clean and disinfect in case of any spillage				
Decommission Phase					

Air Quality Impact	• Using efficient equipment and machines with efficient engines having low emissions, • Using clean fuels such de-sulphurized diesel and unleaded fuels, • Water sprinkling on structures and facilities to be demolished if necessary, and • Removing components with a potential of emitting hazardous gases or particulates separately and under caution to prevent emissions.	Unavailability of emissions at a significant level, compliance	Gulele Sub-city Environmental protection Office	During decommissioning phase	5000
Noise and Vibration Impacts	• Carrying out the decommissioning works only during the specified time from 8:00 hrs to 17: 00 hrs where permissible levels of noise are high and acceptable, • Machineries should be maintained regularly to reduce noise resulting from friction as per the manual, • Providing workers with Personal Protective Equipment such as earmuffs when operating noisy machinery and when in a noisy environment, • Provision of bill boards at the construction site gates notifying people of the activities and timings	Availability of PPE for workers, availability of bill board	Gulele Sub-city Environmental protection office	During decommissioning phase	5000

Traffic Impacts	• Placing signs around the site notifying other vehicles about the heavy traffic and setting the speed limit around the site, • Ensuring all drivers for the project comply to speed regulations, and • Making sure the construction doesn't occupy the road reserves and complying with traffic and land demarcation obligations.	Availability of speed regulation, absence of construction materials on the road	Gulele Sub-city Environmental protection office,	During decommissioning phase	5000
Solid Waste Generation Impacts	• Following regulations on Waste Management in the country, • Employing a waste management plan, which will involve assessing and creating opportunities for Regulation, Reducing, Reusing, Recycling, Recovering, and Renovation, • Ashes from the old incinerator should be placed in a secured landfill to be constructed within EPHI, • Removing reusable and recyclable material from the building before demolition to minimize the amount of waste, • Allocating responsibilities for waste management and identifying all sources of waste, and ensuring wastes are handled by personnel licensed to do so,	Absence of solid wastes and overburden materials, presence of secured landfill	Gulele Sub-city Environmental protection office	During decommissioning phase	5000

	• Making available suitable facilities for the collection, segregation and safe disposal of the wastes, and • Ensuring all wastes are dumped in their designated areas and through legally acceptable methods. Before removal of materials and equipment, the equipment must be checked for contamination and decontaminated if required Procedures: • **Hazardous Materials** - Remove chemical, biological, and radiological agents prior to decommissioning. Be aware that numerous restrictions apply to the transfer of hazardous materials that is stated under the waste management section, • **Chemicals** – Coordinate chemical waste disposal with EH&S Hazardous Waste Management and federal EPA at least 30 days prior to decommissioning. Unopened and uncontaminated chemicals can be returned to departmental stockrooms, transferred to temporary storage, • **Compressed Gas Cylinders** –transferred to temporary storage by performing leak test, • **Biologicals** – Dispose of biological wastes, potentially				

	infectious materials, and sharps according to WHO requirements. Liquids can be decontaminated and poured down the drain, **Safe Packaging and Transfer of Materials**- Remove all glassware, laboratory research apparatus, empty containers, and other equipment. Storage areas, cabinets, and fume hoods must be completely emptied prior to decommissioning. • Ensure that all containers (bottles, jars, etc) are securely closed and that containers are not damaged or leaking. Where necessary laboratory film or secondary containers can be used to assist in this process, • A risk assessment is generally required when preparing to move large quantities of hazardous substances form one area to another especially if porters or other non-specialist staff will be involved. An emergency plan and spill control strategy should always be in place before any movement is carried out, • Biological hazards must be appropriately packaged and safely transported between buildings and local sites in the immediate vicinity, **Clean and Decontaminate** – Clean and decontaminate all				

	laboratory surfaces, including those in fume hoods, biosafety cabinets, and chemical storage areas. General cleaning and chemical decontamination can be accomplished by washing with warm, soapy water. Further decontamination may be necessary for: • **Biologicals** – Areas that may have been exposed to spills can be decontaminated with 1:10 bleach solution or other suitable disinfectants, • **Equipment** – Decontaminate all accessible surfaces. Affix Equipment Release Form to equipment that will be shipped to temporary areas, • **Biosafety Cabinets** – Wipe down all accessible surfaces (including the spill pan) with a suitable disinfectant. Some agents may necessitate a formaldehyde gas decon of the filter and inner surfaces;				
Gender Based Violence	• The institution will prepare a GBV prevention action plan and act accordingly, • Conduct continued sensitization and awareness raising to EPHI staff in general and BSL-3 NRL staff in particular on the prevention of GBV,	Incidence report	Gulele Sub-city Environmental protection office, Gulele sub-city social	During decommissioning phase	5000

	• Strengthen the Gender and women office of EPHI to address GBV cases when it occurs, • The contractor will provide orientation to its staffs to respect the culture of the local people and to limit their relationship with the local people, • Contractor and implementing agency to prepare and implement a GBV Prevention and Response Action Plan to include at a minimum, in conformance with local laws and customs, equal opportunity for employment, • All workers and nearby communities and stakeholders will be educated on preventing and responding to sexual harassment and GBV ahead of any project-related works, • Construction areas should be separated by a fence and a separate access gate is used for construction workers, • Ensure that women are given a mentorship orientation before starting their work. • Regular sensitization and awareness campaigns (at least two times a year) to workers should be done to promote gender equity in employment during the construction works and operation, and		affairs office		

	• Provision of gender-disaggregated data, separate bathing, changing, sanitation facilities for men and women should be made ready by the contractor, and • Impose zero tolerance on sexual harassment, all forms of gender-based violence and discrimination at all phases of the project.				
Occupational Health and Safety (OHS) Impacts	• Employing an OSH plan that will outline all OSH risks and provide a strategy for their management, • Ensuring all hazards such as movable parts is labeled, • Raising awareness and educating workers on risks from equipment and ensuring they receive adequate training on the use of the equipment, • Providing the workers with adequate PPEs and monitoring regularly to ensure they are replaced on time when they wear out, • Placing visible and readable signs around where there are risks and undertaking the riskier demolition activities first and in isolation, • All wastes should be removed from the site, • Ensuring there is security in and around the site to control the movement of people,	• Availability OSH plan, • Availability of PPE	Gulele Sub-city Environmental protection office,	During decommissioning phase	5000

	• Providing safe and secure storage for the waste and materials on the site, • Placing visible and readable signs to control the movement of vehicles and notify motorists and pedestrians around the, and workers in the site, • Providing firefighting equipment and in easily accessible areas as well as ensuring site personnel are well trained to use them as well as maintaining them regularly, • Labelling chemicals and materials according to the risks they possess, • Creating safe and adequate fire and emergency assembly points and making sure they are well-labeled, and • Establishing emergency procedures against hazards and ensuring the workers stay aware/educated on following them and commensurate to the magnitude and type of emergency, by conducting regular drills and involving the neighbors.				

Impacts	**Proposed Mitigation Measures**	**Monitoring Indicators**	**Responsible Parties**	**Monitoring Frequency**	**Budget required/yr,**

					monitoring ETB
Risk of Decommissioning of Old Incinerator					
Hazardous Wastes Risks	• Prior to the commencement of any decommissioning works, the project proponent or its representative shall notify the Federal EPA 28 days in advance of the intended works, • As ash deposited inside the combustion chamber as well as attached to its associated walls, and ductwork, • the Specialist Contractor shall use a High-Efficiency Particulate Air (HEPA) vacuum to clean these materials, wet wiping before wrapping them in polythene and dispose of the ash at a secured and protected landfill to be constructed at EPHI, • The demolition works will be conducted in 2 Phases to minimize the disruption to the EPHI operation and nearby community,	Notification letter, compliant	Federal EPA, Gulele Sub-City EPA	Every day during decommissioning	3000
Water Quality Impact	• Wastewater generated from the decommissioning and demolition works will be limited to general cleaning works, and water used in dust suppression whilst wastewater from the shower unit of the	Compliant, absence of wastewater spill,	Federal EPA, Gulele Sub-City EPA	Every day during decommissioning	3000

	decontamination unit will be collected and discharged into the hazardous waste collection system. Any water will be wiped dry with cloths. The damp cloths shall be stored in appropriate containers such as drums and jerricans for proper incineration and disposal, • The floor drain in the incinerator room shall be covered with a temporary seal during the decommissioning and demolition works. The top of the chimney should be sealed with polyethylene sheets at least twenty-four (24) hours before the works commence, • All wastewater generated (if any) from the decommissioning should be collected and discharged to the onsite wastewater collecting safety tank and treated at the recommended offsite wastewater treatment plant, • The floor drain in the incinerator room shall be covered with a temporary seal during the decommissioning and demolition works, • The top of the chimney should be sealed with polyethylene sheets at least twenty-four (24) hours before the works commence,	availability of temporary seal			
Air Quality	• The decommissioning and demolition of the incinerator	Compliant,	Federal EPA,	Every day during	3000

Impact	units and associated ductwork in Phase 1 will be carried out in an air-tight condition under negative pressure, and hand-held tools and small electric equipment will be used for the decommissioning works, • The demolition of the chimneys in Phase 2 will be carried out in a fully enclosed structure, and hand-held tools and small electric equipment will be used for the decommissioning works, • Decommissioning and demolition work will be carried out in full containment; a Specialist contractor will be employed with adequate health and safety protection measures in place, • Wet wiping of the surface to minimize airborne dust,	absence of dust	Gulele Sub-City EPA	decommissioning	
Risk of Accident	• Wear safety shoes with non-skid soles, • Technicians who have operated the incinerator shall be part of the decommissioning activity, • Wear long-sleeve shirts and protect hands with metal-mesh or other protective gloves, • Wear appropriate eye protection; consult a safety supervisor or a supplier	Compliant, availability of safety shoes, gloves, goggles	Federal EPA, Gulele Sub-City EPA	Every day during decommissioning	3000
Risk of Construction and Operations of New Incinerator					

Risks of Trauma and Infection	• Organizational prevention: such as assigning duties and responsibilities to all involved, management (sorting, packaging, labelling, storage, transport), best practices (such as refraining from putting the caps back on syringes), training, • Individual prevention: personal protective equipment, vaccination, washing hands, • Provide body protection such as aprons, protective suits for staff involved in collecting, transporting and treating wastes, • Provide also heavy-duty protective gloves for staff involved in transporting and treating wastes, • Staff handling wastes must be appropriately protected by vaccination, including vaccination against hepatitis A and B and tetanus.	Vaccination of employees, training, presence of PPE	Federal EPA, Gulele Sub-City EPA	Every three month	3200
Accident Hazards	• Wear safety shoes with non-skid soles, • Wear long-sleeve shirts and protect hands with metal-mesh or other protective gloves, • Wear appropriate eye protection; consult a safety supervisor or a supplier, • Install effective exhaust ventilation to prevent air	Training, presence of PPE, maintenance record	Federal EPA, Gulele Sub-City EPA	Every three month	3200

	contamination; add local exhaust ventilation if necessary, • Arrange for periodic inspection of incinerator vessel integrity, to detect metal cracking, etc.				
Physical Hazards	• Wear hearing protection appropriate for the noise levels and type of noise -consult an expert, • Health insurance for all workers, • Wear long-sleeve shirts and protect hands with metal-mesh or other protective gloves,	Training, presence of PPE, availability of health insurance	Federal EPA, Gulele Sub-City EPA	Every three month	3200
Chemical Hazards	• Wear respiratory protection during maintenance or other work in which dust and noxious gases may be released into the atmosphere, • Read material safety data, • Provide the training and information necessary for the employees to work safely and healthily, • Ensure all personal protective equipment (PPE) is in good working condition • Follow safe work instructions and procedures given by your supervisor,	Training, presence of PPE , availability of material safety data	Federal EPA, Gulele Sub-City EPA	Every three month	3200
Ergonomic	• Learn and use safe lifting and moving techniques for	Training,	Federal EPA,	Every three	3200

Hazard	heavy or awkward loads; use mechanical aids to assist in lifting, • Wear respiratory protection during maintenance or other work in which dust and noxious gases may be released into the atmosphere	presence of PPE, availability of material safety data	Gulele Sub-City EPA	month	
Risk of Fire or Explosion	• Fuel system installation/storage and testing must comply with the applicable requirements, • Fire extinguisher should be installed and periodically checked for its functionality, and • Wetting of the soil before and during crushing may help prevent ignition. The soil handling equipment may also be equipped with non-sparking buckets or blades • Temperature safety control systems should be included to protect people and equipment, • The design of the systems should also consider the handling of materials exiting the system, • Safety barriers can be included to isolate critical sections of the equipment, and • Signs should be posted warning of high temperatures.	Training, presence of PPE, availability of fire extinguisher	Federal EPA, Gulele Sub-City EPA	Every three month	3200
Electrocution Hazards	• All controls, wiring, and equipment, including adequate ground-fault protection, should be in conformance with	Compliant, adequate	Federal EPA, Gulele Sub-	Every six month	1200

	the requirements	grounding	City EPA		
Risk of Facility Damage or Failure	• All transfer equipment (conveyors, piping, process units and instruments) in contact with contaminated materials should be fabricated from materials that are chemically-resistant to that chemical, • Where liquids may separate from solid materials or when incinerating liquids, containment drip pans or receivers should be included in the design, and • Spill and/or leak detection instruments can be installed to monitor for leaks or spills and set off alarms when appropriate.	Availability of leak detection system,	Federal EPA, Gulele Sub-City EPA	Every six month	1200
Air Pollution	• Weekly: clean heat recovery boiler tubes, blower intakes, burner flame rods and sensors, heat recovery induced draft fan; lubricate latches, hinges, hopper door pins, etc, • Only modern incinerators operating at 850-1200 °C and fitted with special gas-cleaning equipment can comply with the national and international emission standards for dioxins and furans, • Daily: check opacity, oxygen and temperature monitors; clean underfire air ports, ash pit and sump; inspect limit	Availability of maintenance records, compliance	Federal EPA, Gulele Sub-City EPA	Every six month	1200

	switches and door seals, • Always Operation by trained, qualified personnel, • Introduction of waste at 850ºC or higher; automation to avoid introducing waste below 850ºC, • Minimum residence time of 2 seconds at 1200ºC in the secondary chamber after the last addition of air and 6% O2 by volume (for waste with >1% halogenated substances)				
Water and Soil Pollution	• Ash should be handled, transported (using covered hauling) and disposed of in an environmentally friendly manner, • Disposal or landfilling in double-walled concrete-based landfill to be constructed in EPHI, • the leachate collection system should be connected to a hazardous liquid waste safety tank for further treatment, • surface water drainage system should be constructed to prevent the entrance of rainwater, • Vegetation should be planted along the sides of the secured landfill, and • The landfill should be protected from any access	Availability of secured landfill, availability of leachate collection system, surface water drainage system	Federal EPA, Gulele Sub-City EPA	Every six month	1200
	Total Monitoring Cost ETB				**868,900.00**

17 EMERGENCY PREPAREDNESS AND RESPONSE AT BSL 3 NRL

An emergency is an unexpected event when the BSL 3 laboratory operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe work practices for frequent upsets or events that are covered by occupational health and safety. An emergency scenario usually negative events such as spillage, personnel exposures or contamination (puncture wounds, cuts and abrasions, ingestion of potentially infectious material, potentially infectious aerosol release, broken containers and spilled infectious substances), breakage of tubes containing potentially infectious material in centrifuges, contamination of equipment and facilities, release to the environment (air, water, soil), equipment failure and natural disasters, are having the potential to actually increase risk on infectious agents releases from the proposed BSL-3 laboratory. The result of these emergencies would be affected the staff, community and environment.

Accident scenarios usually catastrophic events such as earthquakes, fire, explosions and airplane crashes, normally considered as initiating events are having the potential to increase the risk of microbiological material releases. Emergency Preparedness and Response plan could help to address potential risks/emergencies related to transportation accidents, Accidents of an incinerator, accident of waste management (central waste storage), etc.

Therefore, the BSL 3 facility emergency preparedness and response plan would be commensurate with the risks of the facility and that includes the following basic elements:

Administration (policy, purpose, distribution, definitions, etc)

- Organization of emergency areas (command centers, medical stations, etc)
- Roles and responsibilities,
- Communication systems,
- Emergency response procedures,
- Emergency resources,
- Training and updating,
- Checklists (role and action list and equipment checklist),

In addition, an Emergency Preparedness and Response Plan, incorporated into and consistent with, the facility's overall ES/OHS would be prepared to cover the following:

- **Emergency Equipment:** Procedures would be prepared for using, inspecting, testing, and maintaining the emergency response equipment,
- **Training:** Employees would be trained on emergency response procedures,
- Include emergency response training details in the comprehensive site work plan,
- Ensure that personal protective equipment (PPE) and other equipment for emergency response in the emergency response plan are identified,
- Site-specific emergency response procedures would be shared with relevant personnel
- Regularly rehearse and training would be provided to employees as part of the overall training program for site operations

Regarding mitigation to the emergency case, the following mitigation measures are tailored specifically to the emergency case or an accident scenario as follow:

17.1 Mitigation for Spillage

The WHO Laboratory Biosafety Manual and World Bank Environmental, Health, and Safety Guidelines for Healthcare Facilities (2007) would be followed for accidents and spillage. So that all staff members will be properly trained and prepared for emergency response including procedures for the treatment of injuries, clean-up of the contaminated area, and prompt reporting of all incidents of accidents. All personnel would wear Personal Protective Equipment (PPE), during clean-up or decontamination spill and notify the supervisor immediately of any spills that have the potential for serious health or safety implications.

- Evacuation of personnel from the contaminated area if required,
- Decontamination or disinfection, rinsing, and wiping dry of the spillage area with an absorbent cloth by personnel wearing adequate protective clothing,
- Decontamination or disinfection of the protective clothing if necessary,
- Accident will be reported to the infection control officer/staff or the HCWM committee if available,
- All cases will be registered by the management team of the HCF and annually reported to the district health authorities,

- Maintain a written procedure accessible to staff that includes procedures for each type of spill that could be expected in the facility to help guide appropriate response,

17.2 Mitigation for Accidental Injury

- All personnel would perform blood tests following such an injury to ensure that the injured staff has not been contaminated by pathogens like HIV, HBV, and HCV according to Ethiopia post-exposure prophylaxis (PEP) policy and guidelines,
- The BSL 3 laboratory would maintain a written procedure accessible to staff that includes procedures for each type of spill that could be expected in the facility to help guide appropriate response,
- The affected individual would remove protective clothing, wash the hands and any affected area(s), apply an appropriate skin disinfectant, and seek medical attention as necessary. The cause of the wound and the organisms involved would be reported, and appropriate and complete medical records kept.

17.3 Mitigation for Personnel Exposures or Contamination

- Remove the exposed or contaminated personnel from the contaminated area, unless it is unsafe to do so due to the medical condition of the victim or potential hazard to the rescuer,
- If the incident occurs during normal working hours, notify Medical Centre,
- Administer first aid as appropriate,
- Remove any contaminated clothing,
- Proceed to the nearest emergency eyewash/shower to flush contamination from the eyes and skin,
- Stand by to provide emergency information.

17.4 Ingestion of Potentially Infectious Material Mitigation

- Protective clothing would be removed, and medical attention sought,
- Identification of the material ingested, and circumstances of the incident would be reported, and appropriate and complete medical records kept

17.5 Potentially Infectious Aerosol Release Mitigation

- All persons would immediately vacate the affected area and any exposed persons would be referred for medical advice,
- The laboratory supervisor and the biosafety officer would be informed at once. No one would enter the room for an appropriate amount of time (e.g. 1 h), to allow aerosols to be carried away and heavier particles to settle,
- If the laboratory does not have a central air exhaust system, the entrance would be delayed (e.g. for 24 h). Signs would be posted indicating that entry is forbidden,
- After the appropriate time, decontamination would proceed, supervised by the biosafety officer, and
- Appropriate protective clothing and respiratory protection would be worn.

17.6 Broken Containers, Tubes and Spilled Infectious Substances Mitigation

- Broken containers contaminated with infectious substances and spilled infectious substances would be covered with a cloth or paper towels,
- The cloth or paper towels and the broken material can then be cleared away;
- Glass fragments would be handled with forceps,
- The contaminated area would then be swabbed with disinfectant,
- If dustpans are used to clear away the broken material, they would be autoclaved or placed in an effective disinfectant.
- If laboratory forms or other printed or written matter are contaminated, the information would be copied onto another form and the original discarded into the contaminated-waste container.

17.7 Mitigation for Contamination of Equipment and Facilities

- Do not attempt any clean-up or decontamination procedures alone or without wearing PPE, including respiratory protection if respiratory pathogens may be present. Unless the spill is minor and well defined do not clean up the material without approval,

- Avoid spreading contamination by limiting access to the contaminated equipment or area only to individuals who are properly protected and trained to respond to all types of hazards that exist (e.g., biological, radioactive, and chemical),
- Report details of the incident and request assistance,
- If the spill involves a liquid, place absorbent material on the spill and decontaminate with an approved disinfectant for a minimum of a 30-minute contact time,
- If sharps are involved, pickup using mechanical means, such as tongs, forceps, or dustpan and broom. Do not use your hands to pick up any sharp items, even if gloves are worn,
- Decontaminate the equipment and area using appropriate methods,
- Stand by to provide emergency information and assistance to Emergency Response Personnel,

17.8 Mitigation for Release to the Environment (air, water, soil)

- Stop the release, if safe to do so,
- Follow the procedures described above mitigation for of contamination of equipment and facility,
- Make immediate notifications.

17.9 Mitigation for Equipment Failure

- If the autoclave equipment fails, medical waste would be handled by one of the following methods,
- If there is another option, the medical waste can be autoclaved/decontaminated by other methods,
- Medical waste can be stored at temperatures greater than 32 °F (0°C) for up to 7 days prior to treatment,
- The medical waste may also be stored frozen for up to 90 days. Attempts will be made to complete a repair within this time,

17.10 Mitigation for Natural Disasters

In the event of a natural disaster, all generating medical waste will be suspended until adequate medical waste treatment becomes available. In the event of a spill, the medical material will be disinfected using a 10% bleach solution or another approved disinfectant for a 30-minute contact

time and cleaned. Response to significant spills or releases of medical agents will be coordinated with the safety officer. Personnel performing disinfection procedures shall be equipped with the appropriate PPE for the situation, but at a minimum shall wear chemical eye protection and latex gloves. Protective clothing, shoes, and a face shield may be required for large quantities of medical materials.

18 STAKEHOLDER AND PUBLIC CONSULTATION

As this project is Schedule I type, stakeholder and public consultation for BSL 3 NRL lab ESIA project were conducted three times; twice in the previous study (initial and disclosure consultations) and once during the update of the ESIA report. During the consultation in the update, there were no complaints raised from stakeholders and public. The only concern from the public is the implementations of the project as it has significant positive impacts to the community, the country and the region at large. The public also raised the issue of implementations during consultations (05, April, 2023) that conducted for environmental and social audit of BSL 2 NRL. Disclosure will be also done after the approval of the report by WBG. The public and all stakeholders are welcome to the project but still asking the immediate implementations of the project to benefit the community throughout the project life cycle.

During the first ESIA report preparation, the first was carried out during the data collection stage on January 22, 2019, at the EPHI meeting hall with participants drawn from elders, representatives of religious institution and with members of the different sector offices from woreda 09 in Gulele Sub City; and also, participants from the EPHI. The objective of the public consultation was to solicit the views and opinions of the participants regarding the construction of the BSL 3 laboratory. A total of 22 (13 males and 9 females) participants attended the public consultation and 15 of the participants were from the Woreda sector offices and representatives of elders and religious institutions, and the other 7 participants were from the EPHI. Moreover, other two public and stakeholders consultation were held with 29 particpants (20 males and 9 females) during ESIA report disclosure. A total of 33 males and 18 females were participated in 2019 during first ESIA report preparation.

In addition, during updating of the ESIA study on the proposed BSL 3 NRL complex building, public consultation has conducted on 27/07/2022 G.C at the EPHI training hall during the data collection stage. The participants of the public consultation were carefully mapped in consultation with local authorities by a team of experts to make it representative. More than seven affected and interested groups were finally identified and communicated for participation. Accordingly, the consultation was conducted with participants drawn from community Representatives, EPA Representatives from Gulele Sub-City, Gulele Sub-City Woreda 09 Social Affairs Representative, Woreda 09 Administrators, EPHI management bodies, Project

management units, Basal Consulting Representatives and Experts and senior officials. A total of 27 participants were presented during the public consultation. Therefore, representatives from different age groups and sex (11 male and 16 female) were consulted at the EPHI compound.

Representatives from EPHI raised the issue of what the intended project means to the community and the large public throughout the project phases. He further elaborated the need to build a national reference laboratory which would scale-up the competency and standard of the historic EPHI. Finally, he winded down stating the need to implement the public health policy frameworks and precautionary safety measures while constructing and operating the project activities.

The second participant tried to figure out the likely positive and negative impacts and risks potentially created by the intended project. With this, the possible issues and concerns right at the project design stage are the lack of consideration for greenery areas, sound and noise pollution and engineering specifications aligned with international-local standards. Similarly, the pre-construction stage activities such as demolishing the old buildings and offices together with facility infrastructures shall well be underlined and, should be put in place following the design and layout of the intended project. Remarking on these two stage impacts and risks, he ended his concerns and views by underlining the need to work with communities so that the project is sustainable by ensuring a sense of ownership and trust about the intended project. Furthermore, at the construction stage, the likely concerns are occupational health and safety (OHS), sound pollution and work at height and waste debris removed and dumped. In this regard, precautionary and safety measures along with proper waste dumping places shall well be done. In addition, appropriation of the old sewerage lines and waste management and control schemes, i.e., incinerators and waste burying pits and other constructed facilities, shall well be redesigned and fit to standards. The operation stage concerns from the intended project are more likely to have a positive impact than an adverse effect on the community and environment. But, this does not mean that the operational activities are out of adverse effects and risks. Thus, being a national reference laboratory building project it will serve the community through the creation of jobs for the youth and women on one hand, and it will increase the health distribution coverage of the health sector. Also, the research and health prevention priority of the country shall partly be addressed through the implementation of modern and innovative technologies, e.g., electrical incinerator and full sewage waste treatment and control within the EPHI compound. Otherwise,

as are clinical and laboratory wastes dangerous by nature and type of inputs and chemical uses there would be a higher risk for the environment as well as the community.

The third and fourth participants forwarded the project and its benefits in terms of job creation for youth and women, local economic transactions and, technology and skill/knowledge transfer. However, looking at the current practices of EPHI such as the waste burning practice and its risk to the atmosphere (air pollution) and associated health risks to the local community was an in-depth concern raised. Apparently, the EPHI PMU representatives had well recognized their concern and reflected their views on how the intended BSL-3 NRL Building and facilities would mean to the raised concerns.

The social affair representative reflected his views on the project concerning gender equality, social safety and precautionary measures, and rights and responsibilities of the EPHI-BSL-3 NRL project management unit and the nearby local communities through the lifecycle period. As a result, the project should be a mutually benefitting and model for community-based health care facility.

The last views and concerns raised by participants were concerning the old building which registered by Addis Ababa Culture and Tourism Bureau. The participant raised their concern about the effects of construction activity and the design of the new building on the historic buildings and artifacts found within the EPHI compound including the main gates. Therefore, the design and all construction activity should consider this and any activity should not affect the appearance of the historical building and the position of the new building should not cover the existing historical building.

Meanwhile, Mr. Gonfa a senior expert gave a brief explanation about the intended project since its initial steps took in to consideration of historic buildings and artifacts found within the EPHI.

All concerns and recommendations raised during the previous public and stakeholder consultations were included during the update of the ESIA report. The major concerns of the community during the previous ESIA study are presented as follows;

- The effects of solid and liquid waste release and disposal,
- The impact of the construction activities on traffic flow in their neighborhood by blocking roads,

- the growing impact of high-rise tower building's glass reflection effects on members of the community in Addis Ababa City,

Based on previous stakeholder and public consultation and the consultation that has been conducted recently during updating the ESIA study on the proposed BSLE NRL, the main positive and negative issues and opinions raised by the participants are summarized as follows:

- The participant stated their agreement that the proposed laboratory will enable diagnosing of some chronic and critical health problems and diseases that affect mothers and children in particular. Thus, the construction of the laboratory is expected to contribute to providing high level medical service and the community is highly positive about its construction and is waiting anxiously. They urged to speed up all the studies that will allow the starting of the construction of the laboratory on planned time without wasting time.
- The project is expected to create employment opportunities to the local unemployed youth during its construction phase. In its operation phase, the laboratory will also employ highly skilled and trained professionals and is expected to adopt new and improved technologies.
- Many participants in the community consultation aired their concerns about the effects of the solid and liquid waste release and disposal. The participants stated that, about disposing waste materials during the construction and operation phase, they were advised to dispose both solid and liquid waste without affecting the community in the neighbourhood and the environment by applying recognized standard methods.
- Participants of the consultation meeting also expressed their concern on the impact of the construction activities on traffic flow in their neighbourhood by blocking roads. Participants from the community advised that, during construction work, the contractor should avoid storing construction materials, and parking construction machineries and trucks on vehicular and pedestrian walkways.
- Participants of the community consultation also raised their concern about the growing impact of high-rise tower building's glass reflection effects on members of the community in Addis Ababa City. The participants requested to ensure that the installation of glasses on windows and other parts of the building does not have a negative impact on the community and environment. The glasses to be installed should be

as per the standard of the country if it exists.

- Participants also stated that during the construction phase of the laboratory, the main contractor and his sub-contractors should follow national laws and regulations in the employment of construction workers, ensuring labour standards on occupational health and safety, on-time settling of payments, etc. to avoid inconveniences to be created by workers mishandling. Applying such measures will allow the contractor and his sub-contractors to have a peaceful working environment.

Finally, participants agreed on the importance of the project and the proposed waste management system for the BSL 3 NRL complex and the woreda administration representative and the sector offices under the woreda jurisdiction are willing to work with EPHI and MOH for the effectiveness of the BSL 3 laboratory function.

In order to address the public concerns the following BSL 3 NRL complex design consideration has been taken into account as follows:

- The BSL3 laboratory would have design and safety requirements consisting of an **anteroom** and laboratory rooms and it would have gas-impermeable walls, ceilings and floors. Air gaps under doors would be acceptable for directional airflow. If door gaps are sealed, the laboratory would not leak gaseous decontamination materials.

- The BSL3 laboratory would be designed for ease of maintenance, so that access to critical mechanical equipment (ventilation ducts, fans, piping, etc.) is outside containment. The laboratory would consist of high-quality room construction with special consideration given to joints, finishes and penetrations.

There would be a room for large equipment decontamination. The room would be capable of being sealed for decontamination with gaseous paraformaldehyde and would have a connection to the HVAC exhaust system. All shutoffs (steam, water, natural gas) would be external to containment.

- All tall and/or heavy fixtures and equipment (e.g. BSC, autoclaves, freezers, incubators, etc.) would be fitted with a seismic anchoring system/device engineered to withstand earthquake stresses equal to 7.0 on the Richter scale.

- Work surfaces, floors, walls and ceilings would be designed, constructed and

finished to facilitate easy cleaning and decontamination. The laboratory would be located away from public areas and corridors used by laboratory personnel who do not work in the BSL-3 laboratory. The BSL3 would pass third-party inspection and tests to verify that design and operational parameters have been met.

19 GRIEVANCE REDRESS MECHANISM (GRM)

For projects with environmental and social impacts, grievances are a fact of life. Having a good overall community engagement process in place and providing access to information regularly can substantially help to prevent grievances from arising in the first place, or from escalating to a level that can potentially undermine project performance. Thus, from a basic risk-management perspective, spending the time and effort upfront to develop a well-functioning process is a good investment.

One of the main requirements of the ESIA is to implement an effective mechanism to be recorded and shared in environmental and social issues. The basic principles of effective communication methods with the Grievance Mechanism are as follows:

- Accurate recording and protection of all information obtained during the implementation of the ESIA and ESMP
- Sharing the information about the progress and monitoring of the project with stakeholders and all interest groups, evaluating the information for the preparation of periodic reports.
- Sharing information on the functioning of the Grievance Mechanism with affected communities as part of stakeholder engagement activities.

It is anticipated that the construction and operational phase activities of the proposed BSL 3 NRL project may arise certain types of complaints by the neighborhood community concerning construction activities (traffic & noise), waste management (both construction & operational waste), and other unpredicted sources of complaint. This section describes the procedures, roles and responsibilities for addressing such grievances and resolving disputes. Every aggrieved person shall be able to trigger this mechanism to quickly resolve their complaints.

The objectives of the grievance process are:

- 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 the EPHI will be fed from three main sources:

- Community residents, patients or health workers.
- Supervising engineer works supervisor or contractor.
- Monitoring team who will forward issues/concerns identified in the field.

According to the GRM A Guide for Implementers of Africa CDC projects in Ethiopia, Grievances of the project may also be anticipated from:

- Flaws in the consultation process
- Noise and pollution
- Roads and traffic
- Access to project benefits (no or insufficient job created for local communities)
- Gender-Based Violence (GBV)
- Labor-related risks

During construction people may complain about construction-related inconveniences and construction impacts on their daily lives (noise, dust), lands (drainage problems), roads (damage), and vibrations of houses (cracks in walls). Allegations of corruption might also be raised.

19.1 Grievance Prevention

Grievances cannot be avoided entirely, but much can be done to reduce them to manageable numbers and reduce their impacts. MOH/EPHI should be aware and accept that grievances do occur, that dealing with them is part of the work, and that they should be considered in a work plan. MOH/EPHI should do the following to prevent grievances:

- *Provide sufficient and timely information to communities.* Many grievances arise because of misunderstandings; lack of information; or delayed, inconsistent, or insufficient information. Accurate and adequate information about a project and its activities, plus an approximate implementation schedule, should be communicated to the communities, especially APs, regularly. Appropriate communication channels and means of communication should be used to ensure that relevant information (whether positive or negative) about social and environmental safeguard issues is made available in a timely

manner, in an accessible place, and in a form and language(s) understandable to affected peoples.

- *Conduct meaningful community consultations*. MOH/EPHI should continue the process of consultation and dialogue throughout the implementation of a project. Sharing information, reporting on project progress, providing community members with an opportunity to express their concerns, clarifying and responding to their issues, eliciting communities' views, and receiving feedback on interventions will benefit the communities and the project management.
- *Build capacity for project staff, particularly community facilitators and other field-level staff*. The community-level facilitators and field-level staff of the implementing agencies should be provided with adequate information on the project such as project design, activities, implementing schedules, and institutional arrangements as well as enhanced skills in effective communication, understanding community dynamics and processes, negotiation and conflict resolution, and empathizing with communities and their needs. Building trust and maintaining good rapport with the communities by providing relevant information on the project and responding effectively to the needs and concerns of the community members will help solve issues before they even become grievances. It is also important that community facilitators and field-level staff provide regular feedback on their interactions with the communities to the higher levels of the implementing agencies.
- Overall, good management of a project will also contribute to minimizing complaints

19.2 Steps of GRM procedure

The grievance process steps outlined below and in Figure 16 will be used to manage all the grievances. This GRM will have an accountability mechanism for handling issues, disputes, and complaints. It will be accessible so that individuals, workers, communities, and/or civil society organizations that are being aggrieved by any activities of the BSL 3NRL operation can use it.

The steps of the grievance process are described below. A flow chart outlining the main actions and decision points is shown in Figure 16.

Step 1: Receipt of complaint

A verbal or written complaint from a complainant will be received by the head of the complaint hearing office and recorded in a complaints log. 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 date the grievance was closed. Grievances should be lodged at work hours, directly to the complaint hearing office.

The process for complaining is outlined below:

- Complaint hearing officer receives the complaint (s) from the complainant and records it in the log.
- Complaint hearing officer reads the recorded complaint to confirm correct detail of complaint has been documented.
- Complainant signs the log to confirm grievance was accurately recorded.

The head of the complaint hearing office will be the focal person for the GRM process and he/she will be the first point of contact to trigger the mechanism.

Contact information will be provided via the Project website, through public information meetings, consultation meetings and Project brochures to raise awareness and offer transparency of how stakeholders can voice their grievances. Various channels for stakeholders to vocalize their grievances formally include:

- Face to face (Stakeholders can voice their grievance to assigned personnel of Contractor and/or EPHI/ESD at site office)
- Complaint register form (Stakeholders can fill the forms that will be distributed to them in advance to voice their grievances)
- Telephone (Stakeholders can call EPHI at *(+251 11 2133499/11 2751522)* and call MOH (+251-11 551 7011) to request to speak to the contact person)
- Email (Grievances can be sent to ephi@ethionet.et or moh@moh.gov.et)
- Online contact address of EPHI is www.ephi.gov.et or the online application for the World Bank (Stakeholders can fill out the forms online at the http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service)

Having received and registered a complaint, the next step in the complaint handling process is for the focal points to establish the eligibility of the complaint received. Based on a guide document for GRM implementers for Africa CDC project, the following criteria can be used to assess and verify eligibility:

- The complainant is identifiable and has provided a name and contact details.
- The complainant is affected by the project.
- The complaint has a direct relationship to the project.
- The issues rose in the complaint fall within the scope of the issues that the GRM is mandated to address.

If the complaint is not eligible, the complainant should be informed of the reasons.

If the initial assessment establishes the eligibility of the complaint to be pursued, a further assessment is recommended of the seriousness of the complaint classified in terms of high, medium or low and its impact on both the complainant and the project. Assessing the seriousness of a complaint is not easy, as it could be subject to biases. Criteria should be established and could include the following:

- Severity of the problem.
- Potential impact on the well-being of an individual or group.
- Potential impact on the project, and
- Public profile of the issue.

Assessing the severity of a complaint will require additional data collection through field visits to the sites, discussions and interviews with complainants and other relevant persons or groups in the community, and cross-checking the information already provided.

Step 2: Formulation of response and determination of corrective action

Having completed the complaint assessment, a response can be formulated on how to proceed with the complaint. This response should be communicated to the complainant. The response should include the following elements:

- Acceptance or rejection of the complaint.
- Reasons for acceptance or rejection.
- Next steps; where to forward the complaint.
- A time frame; and

- ☛ Further documents or evidence required. e.g., field Investigations.

A grievance can be solved at this stage; the complaint hearing office will determine a corrective action in consultation with the aggrieved person. Remedial action(s) and a timeframe within which they must be accomplished has been described and the party responsible for implementing them will be recorded in the complaint log. Grievances will be resolved and status reported back to complainants within a week. 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 1 month from lodging a grievance. The grievance beyond the capacity of the project supervisors or BSL 3 laboratory (operational phase) heads are communicated to a higher level as indicated on the diagram of grievance management mechanism indicated above. Complainants who feel their grievance has not been fairly handled may seek justice in a court of law as it is his or her legal right.

Step 3: Meeting with the complainant

The proposed corrective action and the timeframe in which it is to be implemented will be discussed with the complainant within a week of receipt of the grievance. The maximum duration for the Consent to proceed with the corrective action will be sought from the complainant.

Step 4: Implementation of corrective action

Agreed corrective action will be undertaken by the project or its contractor within the agreed timeframe. The date of the completed action will be recorded in the log against the complainant's grievance.

Once a response has been determined for a complaint, the Grievance Focal Person should log this in the GRM log sheet, they should mark the complaint resolved, and they should draft a response letter to the complainant based on the standard letters. A copy of the letter should be kept in the records with the original complaint form.

Response letters should be delivered back to complainants in a timely fashion. Each case should be dealt with individually, and response provided as per standard number of days for feedback as indicated. Response letters can be delivered by the Grievance Focal Persons.

When complaints are referred to other offices, the GRM team should send a letter back to the complainant explaining that the complaint was referred and including contact information for the person to who the complaint was referred.

For complaints where there is a contact phone number, a phone call may be used to deliver the initial response on the complaint (if there is phone call available).

The following are important aspects to be considered in the implementation of a project based GRM:

- Creating a conducive environment for the APs to relate their grievances without fear and intimidation;
- Allowing the APs (if necessary) to be accompanied by a third party, e.g., a family member or a fellow villager with whom they feel comfortable to present their grievances;
- Undertaking field inspections (if necessary) to assess and verify the grievances reported;
- Referring the complaints for technical assessments (if necessary) to validate and establish the real causes of the grievances.
- Minimizing investigative processes and unnecessary referrals to other parties;
- Avoiding delays,
- Referring to the relevant laws, rules, and regulations that bind the decision-making processes,
- Inviting other relevant agencies or persons, e.g., EPA, MoWSA, etc to provide additional information required;
- Creating opportunities for negotiation and exchange;
- Setting clear and objective criteria for decision making, e.g., different compensation rates for people living in different evacuation zones.
- Assuring the APs that decision-making processes are independent and fair.
- Documenting the grievance redress process and its outcome; and
- Communicating the grievance redress outcome to the AP and the relevant agencies.

Step 5: Verification of corrective action

To verify satisfaction, the aggrieved person will be asked to return if not satisfied with the corrective action. If the Complainant is still dissatisfied with the outcome, they may be referred to

proceed with the formal legal process available at any stage to the Complainant. However, courts should be the last avenue for addressing grievances.

Step 6: Action by MOH and project contractors

If the Work supervisor cannot solve the grievance, he will refer it to MOH/EPHI and the contractor through the Supervising Engineer. It is believed all possible grievances can be solved at this level.

Project-based GRMs may propose a variety of strategies to settle grievances, including;

- Requesting the relevant agencies responsible for the grievance to take appropriate measures to remove the cause of grievance, e.g., contractors to clear access roads or provide alternative roads, clear canals and other drainage systems, de-silt paddy fields, and/or remove garbage, manage noise and dust.

- Determining reasonable compensation for property damage, loss of livelihood, temporary evacuations, etc. either from the project executing agency (i.e. MOH/EPHI) or from contractors;
- Signing agreements between APs and the project for solutions mutually agreed upon;
- Ensuring that contractors solved the Aps grievances at the end of completing the project related work, e.g., paying compensation and the assurance letters are issued by the contractors or the project executing agency in local language.
- Initiating a monitoring process (after addressing the causes of the problem or paying compensation) to assess any further impacts of project-related work on the properties and livelihoods of the APs.

19.3 GBV Related Grievance Redress

When Gender-Based Violence (GBV) related grievances are received at any level of the GRM or through any channel, the complaint should be kept confidential by the person or persons receiving the complaints. The complaints shall be reported to the PIU coordinator / focal person at the project and immediate actions should be taken that are consistent with the wishes and choices, rights, and dignity of the complainant. The complainant should be given information in simple and clear terms on the steps for filing complaints and the possible outcomes, the timelines, and the types of support available to be able to make informed decisions. For GBV

cases, it is important to ensure that access to the complaints processes is as easy, confidential, and as safe as possible for the complainant survivor. The recording of incidence should be limited to the nature of the complaint put exactly in the words of the complainant, the age of the survivor and if to the best of their knowledge, the perpetrator associated with the project. The complainant should decide on whether they would like to be referred to the grievance committee and the complainant should give consent to share basic monitoring data.

Safety & Well-Being: The safety of the survivor shall be at all times ensured including during reporting, investigation, and the provision of victim assistance. Those involved in the management of complaints will need to consider potential dangers and risks to all parties (including the survivor, the complainant if different, the subject of the complaint, and the organizations involved), and streamline ways to prevent additional harm in all the complaint handling process. The survivor is never to blame for reporting an act of GBV and should never be made feel investigated. On the contrary, it is important that she/he feels that her story is heard, believed, and valued. The actions and responses of the complaint mechanism will be guided by respect for the choices, needs, rights, and dignity of the survivor.

Confidentiality: The confidentiality of complainants, survivors, and other relevant parties must be always respected. All GBV-related information must be kept confidential, identities must be protected, and the personal information on survivors should be collected and shared only with the informed consent of the person concerned and on a strict need-to-know basis.

Survivor-Centered Approach: All prevention and responses action will need to balance the respect for due process with the requirements of a survivor-centered approach in which the survivor's choices, needs, safety, and wellbeing remain at the center in all matters and procedures. As such, all actions taken should be guided by respect for choices, needs, rights, and dignity of the survivor, whose agency and resilience must be fostered through the complaint process.

Accessibility and non-discrimination: The mechanism must be accessible to all potential complainants and sufficient information must be given on how to access it, making the complaints process accessible to the largest possible number of people. This includes identifying and instituting various entry points that are both gender and context-sensitive. To facilitate

incident reporting and avoid stigmatization reports from third parties (witnesses, people suspicious or aware of an incident, etc.) must also follow accountability protocols.

19.4 Labor Related GRM

Workers engaged in BSL 3 NRL, individual contractors and labours working with contractors who are involved in the project implementation should have a right to have their complaints, issues or grievances addressed expeditiously and justly. The project will only involve Ethiopian workers, the majority which is expected to be existing government civil servants, who will remain subject to the terms and conditions of their existing sector employment. Additional staff who may be directly engaged to support the project will need to be contracted in line with the requirements of the labor-management procedures included in the ESMF prepared for the Project. According to the ESMF, the anticipated Labor-related risks are OHS, community and health and safety, GBV due to contact among project or subproject workers, discrimination, and/or unequal opportunities.

Some of the potential labour-related grievances that may be reported are listed in the table below.

Area	**Potential Grievances**
General	Discrimination in advertisements, during interviews, on appointment terms and conditions and during the period of employment based on language, race, colour, age, sex/gender, religion, political opinion, national extraction or social origin
Children	Child labour
Terms and conditions	Wages below the minimum, long hours of work without breaks; denial of, or less weekly rest and leave
Unfair labour practices	Threatening retaliation, or retaliation against, penalizing or dismissal of, those who complain or report grievances; disrespectful, abusive or other unfair treatment
Occupational safety and health	Non-availability or inadequate sitting, or sanitation or storage facilities, space, ventilation, light, water and protective fencing and other protective equipment
Termination of employment	Wrongful or unfair dismissal; non-payment or payment of less terminal dues

Gender	Sexual harassment (SH) and sexual exploitation and abuse (SEA) at the point of or during employment; gender-based violence (GBV); lack of or inadequate separate and private sanitation and storage facilities for either gender

The project also recognizes the vulnerability of the target communities by the labor influx, beneficiaries, and the different types of workers to be involved or people affected by the project activities. The Grievance Redress Mechanism for addressing and managing workplace and employment-related conflicts or complaints as well as Gender-Based Violence (GBV) is crucial for the project. Project worker with any complaint or grievance has the right to present it and obtain proper redress through the Grievance Redress Mechanism established by the project. This GRM will provide service to all the direct and contracted workers, their complaints can also be accepted through the anonymous column in the digital complaint management system or through the physical options accessible, the suggestion box, being anonymous. The redress process for labor related GRM will follow similar procedures as the above grievances or complaints are managed and in a transparent and understandable way and provide timely feedback with the language they can understand without any retribution and will operate in an independent and objective manner.

19.5 World Bank's Corporate Grievance Redress Service (GRS)

Project-affected communities and individuals can submit their complaints to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB's non-compliance with its policies and procedures. Complaints can be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been allowed to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org

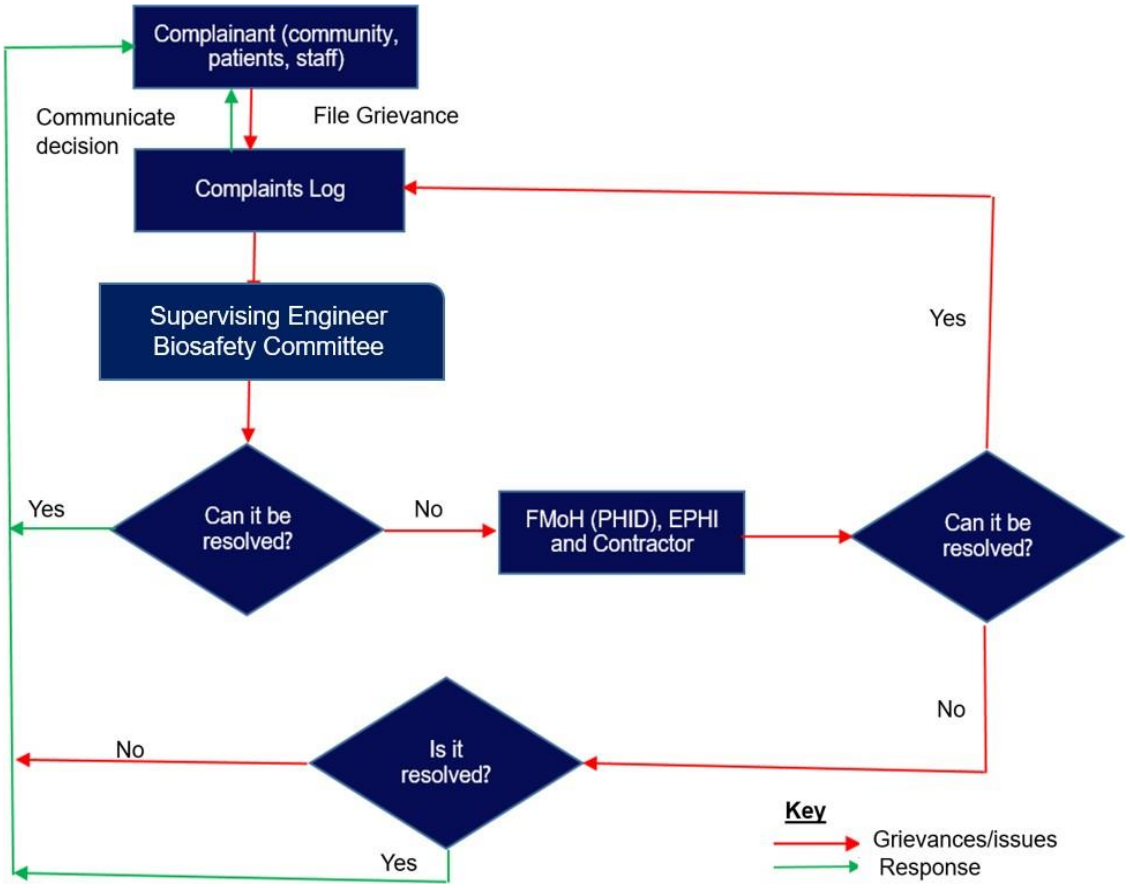


Figure 16: Grievance Management Mechanism

During the construction phase of the proposed project, the proponent (ESD/EPHI) and the contractor will jointly set up a project-specific GRM with a team comprising of the construction supervisor, and delegated officers from the ESD and PIU who will receive and log, and address any disputes, conflicts or concerns arising from stakeholders that may be aggrieved by the project.

19.6 Monitoring and Reporting GRM

The project Environmental Safeguards and/or Social Specialist/s will prepare the yearly plan on the anticipated grievances to be received with a mitigation plan to reduce the occurrences and identify possible stakeholders for the implementation of the mitigation measures and prepare Quarterly Reports on the Grievance Redress issues of the project. The Grievance Redressal Committee may review the nature of grievances that have been represented and if grievances are repeated, recommend suitable changes in implementation procedures, and forward these to the Complaint hearing officer for implementation.

The monitoring time frame shall be after one year of project implementation and the methods for monitoring may include:

- Consultations with the complainant and other stakeholders;
- Review of documents;
- Obtaining expert opinions; and
- Site visits.

The following indicators could be used as monitoring purposes:

- Number of active project complaints and appeals recorded and reported in each institution,
- Percentage of grievance redressed claims settled within the specified period,
- Percentage of unresolved complaints or disputes during the monitoring period,
- Comments received by government authorities, women & youth, family, community leaders and other parties and passed to the Project

When the GRM monitors the implementation of agreements it will do so in consultation with the relevant parties involved. Unless the Complaint hearing officer or GRM Committee specifies a different timeline, the Monitoring and Evaluations team will submit monitoring reports to the GRM

Committee annually and shall make these public through the website within five (5) calendar days post submission to the Committee. The GRM will make a draft of the monitoring report available to the parties to the agreement, giving them a reasonable time to provide comments, prior to submitting monitoring report for publishing to the head of the GRM Committee.

19.7 Evaluating a Grievance Redress Mechanism

The evaluation of grievance redress mechanism should cover the design and Implementation stage to address the issues that are at the heart of project-related grievances. For each of the institutions that are expected to deal with these issues, there will be a credibility assessment. The following should be considered during evaluation of GRM;

19.7.1 Design Stage

Can be assessed by surveying actual and potential users to assess their level of awareness and understanding of the GRM; It can be assessed by asking the following question;

- Why did you include a Grievance Redress Mechanism (GRM) in your project?
- Where/how did you locate the GRM?
- How did you determine it would be effective?
- Was the GRM designed with participation from the communities it is intended to serve?

19.7.2 Implmentations Stage

i) **Organizational Commitment**: The organizational commitment can be assessed by asking the following questions**;**

- Do the project's management and staff recognize and value the GRM process as a means of improving public administration and enhancing accountability and transparency?
- Is grievance redress integrated into the project's core activities?
- Is grievance redress integrated into staff job descriptions and responsibilities?
- Is it appropriately resourced and monitored?

ii) **Legitimacy:** can be assessed through a combination of institutional assessment (e.g. clarifying the level of independence of the GRM staff from agency line managers who may be directly involved in grievances), and stakeholder surveys and interviews, to clarify the range of stakeholder views of the GRM's independence, credibility as a vehicle for grievance resolution, fairness of process and outcomes, and consistency of outcomes with applicable nationally and internationally recognized standards. Can be assessed using the following questions;

- Does the GRM operate independently of interested parties?
- Is the GRM widely-perceived as independent?

iii) **Accessibility:** can be assessed by surveying potential stakeholders and reviewing the history of decisions on its design and operation. This can be assessed by asking the following questions;

- Is the GRM accessible to all stakeholders, irrespective of their remoteness, language, education or income level?

- Are procedures to file grievances and seek action easily understood by project beneficiaries?
- Can grievances be filed anonymously?
- Are there a range of contact options?
- Is the GRM appropriately advertised and communicated to project-affected people?

iv) **Predictability:** can be assessed by surveying actual and potential users to assess their level of awareness and understanding of the GRM. This can be assessed by asking the following questions;

- Is the GRM responsive to the needs of all complainants?
- Does the GRM offer a clear procedure with time frames for each stage and clarity on the types of results it can (and cannot) deliver?

v) **Fairness and Rights Compatibility:** can be assessed through a combination of institutional assessment (e.g. clarifying the level of independence of the GRM staff from agency line managers who may be directly involved in grievances), and stakeholder surveys and interviews, to clarify the range of stakeholder views of the GRM's independence, credibility as a vehicle for grievance resolution, fairness of process and outcomes, and consistency of outcomes with applicable nationally and internationally recognized standards. Can be assessed by the following questions:

- Are grievances treated confidentially, assessed impartially, and handled transparently?
- Are the GRM's outcomes consistent with applicable national and international standards?
- Does it restrict access to other redress mechanisms?

vi) **Transparency**

- Are the GRM's procedures and outcomes transparent enough to meet the public interest concerns at stake?

vii) **Capability**

- Do GRM officials have the necessary technical, human and financial resources, means and powers to investigate grievances

viii) Staff

- Are there dedicated and trained staff available to handle the GRM?
- Are they given learning opportunities and do they receive any systematic reviews of their performance

ix) Processes

- Is there a system to categorize, assign priority, and route grievances to the appropriate entity?
- Are complaints acknowledged in writing?
- Does the acknowledgement outline the GRM process, provide contact details and indicate how long it is likely to take to resolve the grievance?
- Are there clear timetables that are publicly available?
- Are complaints acknowledged in writing?
- Does the acknowledgement outline the GRM process, provide contact details and indicate how long it is likely to take to resolve the grievance?
- Are there clear timetables that are publicly available?
- Is the merit of each grievance judged objectively against clearly defined standards?
- Are investigators neutral or do they have a stake in the outcome?
- Is action taken on every grievance?
- Is there a process to track grievances and assess progress being made to resolve grievances?
- Are there indicators to measure grievance monitoring and resolution?
- If there is data being collected, is this data used to make policy and/or process changes to minimize similar grievances in the future?
- Does a user survey exist to get feedback on the credibility of the process?
- Is such feedback publicly available?
- Is there right to appeal? If yes, are GRM users informed about this right?
- Is there a process to analyze the effectiveness of the GRM?
- Is there a timeframe?

19.8 Update of Grievance Redress Mechanisms

The need of updating of GRM can be assessed by reviewing the history of decisions on its design and operation, seeking evidence that data and analysis about the actual operation of the GRM influenced decision making. Evidence can also be gathered about the extent to which there is ongoing management review of data and records, and the extent to which that review influences current production of new guidance and assessments. Interviews with current and former GRM leadership to explore how they learned from operational experience and how that learning led to changes over time in GRM's goals and/or operations can also inform the assessment of organizational learning capacity.

Based on the contextual assessment, and the assessment of current GRM strengths and gaps, the GRM will be updated and if a new GRM must be set up, this type of risk/capacity mapping should drive the process of defining the GRM's goals, institutional form, structure, and performance measures. The process of establishing a new GRM should involve government and international partner representatives, representatives of potential GRM users, and representatives of any civil society, business, or other groups with a stake in the GRM's design and operation.

20 CONCLUSIONS AND RECOMMENDATION

20.1 Conclusion

The design, construction, equipping and furnishing and maintenance of a Biosafety Level 3 (BSL-3) national reference laboratory (NRL) including a laboratory medical equipment maintenance Centre; establishment of a Proficiency Testing System and panel production for standard quality assurance, biobank Centre for reference materials of all sorts, central warehouse to serve as a logistics supply hub for Africa CDC and the East Africa RCC countries.

The project has significant positive impacts through employment generation, income generation, and business opportunity; improve community health, and increased skilled workforce in a different phase of the project.

Despite its benefits at local, national and regional levels, the project could also result in several negative impacts from its pre-construction, construction, operation and decommission phase activities. The major negative impact expected during the pre-construction, construction and operation phases are related to impact on air quality, water pollution, soil pollution, noise and vibration impacts, solid and liquid waste generation impacts, traffic and public safety impacts, gender-based violence, risk of social conflict and crime, increase the burden on public service, child right violation impacts, utility impacts, public health impacts, historical buildings impacts, and occupational health and safety (OHS) impacts,

Adverse impacts with moderate impact significance during the construction phase are air pollution, soil pollution and erosion, noise and vibration impacts, impacts on landscape and visual receptors, traffic and public safety impacts, waste water generation impacts, solid waste generation impacts, impacts on cultural heritage/archaeological interest/existing ecologically sensitive areas, risk of social conflict and crime, gender-based violence, increased burden on public service provision and accommodations and child right violation impacts. Impacts with severe impact significance during the construction and operation phase are impacts on occupational health and safety.

Negative impacts with moderate impact significance during the operation phase are soil pollution, noise and vibration, impacts on utility, risk of social conflict and crime, gender-based

violence, impact on traffic and Public safety, increased burden on and competition for public service provision and accommodation.

Impacts with severe impact significance during the operation phase are air pollution, water pollution, solid waste impacts (hazardous and infectious), liquid wastes (hazardous and infectious), OHS Impacts and Risk of communicable disease, waste handling and transportation, escaping of infectious disease, fire accident. Construction impacts are short-term and can be mitigated. Proper construction procedures, waste management and occupational health and safety procedures would minimize the impacts.

Based on public consultation, almost all residents welcome the project. In order to enhance local employment and business opportunities, the mitigation measures listed in the report should be implemented.

As can be noted from the impact assessment, impacts with severe impact significance are anticipated to take place during the construction and operation phase because the analysis indicated that all impacts are within the range from compatible to severe impact significance that can be mitigated to the acceptable level. The main mitigation and monitoring measures to minimize or reduce the environmental and social impacts, especially for those with moderate level impacts will be implemented based on the company's mitigation and management plans. Similarly, implementation of the mitigation measures will be verified through environmental social monitoring plan using the specified budget.

20.2 Recommendation

This opinion is based on the nature and extent of the proposed project, the local level of disturbance predicted because of the construction and operation of the BSL 3 NRL project, the findings of this ESIA and the understanding of the level of significance of potential impacts. Finally, it is important to point out some of the critical recommendations which the project management unit should follow. Implement environmental and social monitoring during the construction and operation and decommission phases of the proposed project, Implement an environmental and social management system which ensures environmental and social responsibility at all levels, Waste segregation activities should be implemented at the facility level; Maximum safety and health procedures should be followed during construction and

operation phases, Oversee the most important environmental and social impacts (especially those with moderate and severe impact significance) which are stated in this ESIA report;

Construction of a new incinerator that fulfill the WHO standard, use of separate safety tank for hazardous and infectious liquid wastes treatment and storage, offsite treatment of hazardous wastes, utilize environmentally friendly technologies, reliable information system and a mechanism for labeling, handling, and stocking of dangerous substances and Maintain safety equipment and participate the local communities in different stages of the project are important for the sustainability of the project.

There is no appropriate treatment infrastructure in the vicinity and Addis Ababa City administration for hazardous and infectious liquid waste and ash formed from hospital and clinical facility incinerators. Therefore, it is the responsibility of the EPHI, Ministry of Health, Addis Ababa City Administration and Federal EPA to construct a clinical wastewater treatment plan and secured landfill for all health facility wastes in Addis Ababa.

The contractor should also identify area for backfill material quarrying after conducting an environmental and social impact assessment study and the excavated materials should be also disposed of in the area where the environmental and social impact assessment is conducted. In addition, the contractors should prepare C-ESMP for sub-projects.

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ANNEX I: PUBLIC CONSULTATION VIEWS AND CONCERNS

የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዩት BSL-3NRL የአካባቢ እና የማበረሰብ ተጽእኖ ግምገማ የማበረሰብ ምክክር ቃለ ጉባኤ

- የመሰብሰቢያ ቀን: 27/10/2014
- ስአት: 3:00 እስከ 5:00
- ቦታ: የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዩት ግቢ ዉስጥ

አጀንዳ፡-

1. ስብሰባዉን በአማካሪ ድርጅቱ ተምካይ አላማዉን በመንገር ማስጀመር (የባዛል አማካሪ ድርጅት ተምካይ)
2. ስለፕሮጀክቱ ባህሪ ለተሰብሳቢዊ የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዩት ተምካይ ለተሰብሳቢዉ ማሳምቅ
3. የማህበረሰብ ምክክር

3.1የፕሮጀክቱ አምንታዊ ተጽእኖዎች ላይ አስተያየት እንዲሰጡ የማበረሰብ ተምካዮችን መጋበዝ

3.2የማህበረሰቡ ተምካዮች ያላቸዉን ማንኛዉም ስጋት እንዲገልጹ መጋበዝ

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5. የጉለሌ ክፍለከተማ የጤና ቢሮ ተምካይ አስተያየት እንዲሰጡ መጋዝ፣
6. የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዩት ተምካይ ማህበረሰቡ ባነሳቸዉ ጉዳዮች ላይ የማጠቃለያ ሀሳብ እንዲሰጥ መጋበዝ፡፡
7. የጉለሌ ክፍለከተማ የአካባቢ ጥበቃ ተምካይ ሀሳብ ለተዉ ስብሰባዉን እንዲዘጉት መጋበዝ

2. ዉይይት

2.1ስብሰባዉን በአማካሪ ድርጅቱ ተምካይ አላማዉን በመንገር ማስጀመር (የባዛል አማካሪ ድርጅት ተምካይ)

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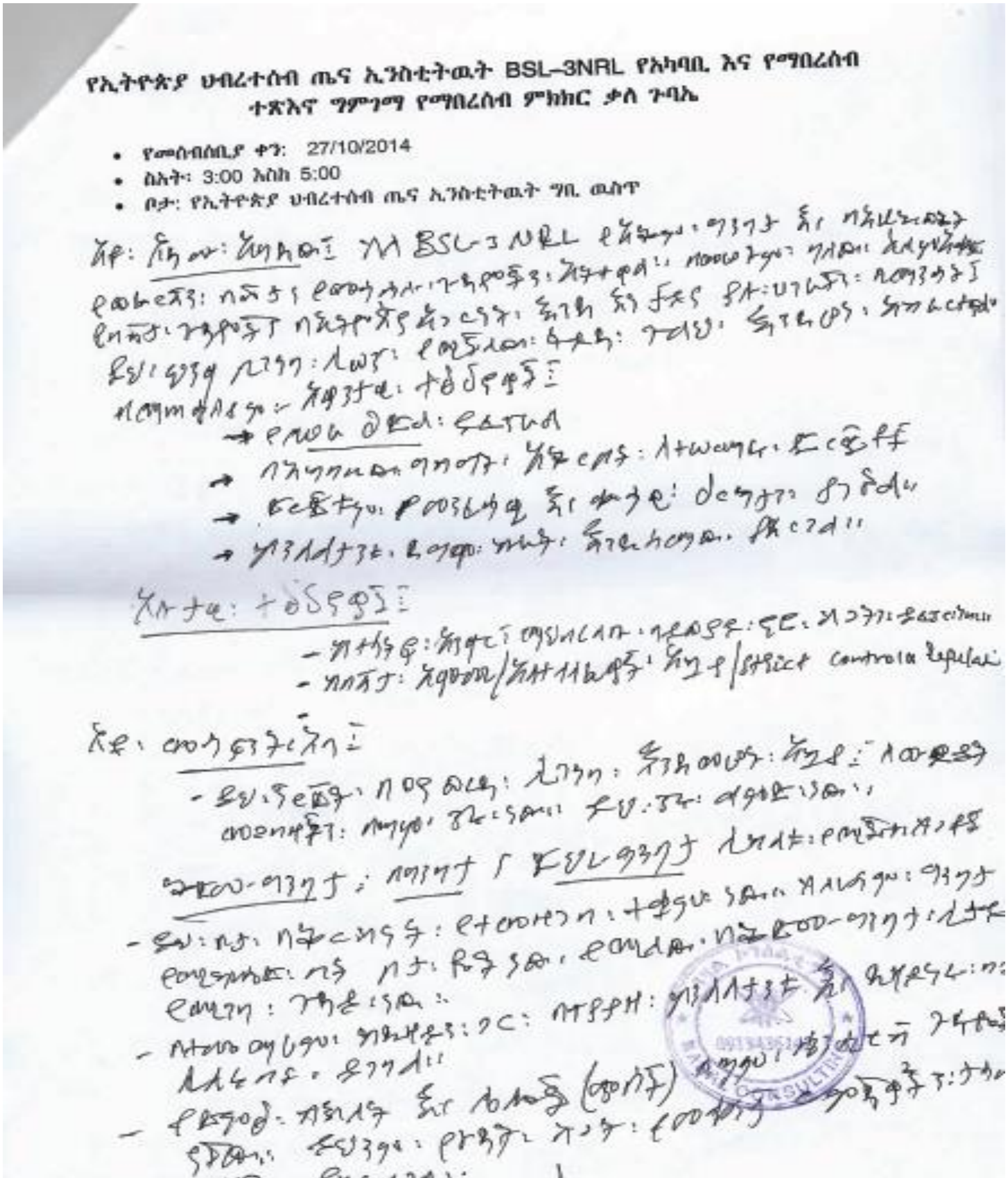

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- የገህዳና ተዛማጅ ንጥሎች — ችግሮች፣ ፈተናዎች ደንግለ
- ዕቅዶች: የመፈፀም ዓላማዎች፣ የተጎዱ.
- ነገር-ግን የመፈፀሙ: ህንፃዎች፣ ስልኮች፣ ንጥሎች፣ ...

ማንገታ - ወቅት:

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- የእውቅና ሂስፔታል: ከዚህ: ቃለ ጉባኤ: ከመሣሪያ ጎ፣ ከህዝብ ተቃዉሞ ዉርስ ከተለ። ለለመነ ይህ ተቃዉሞ: ማንገታ፣ ወቅት ትግበራ ደለለ: ደገገለ።
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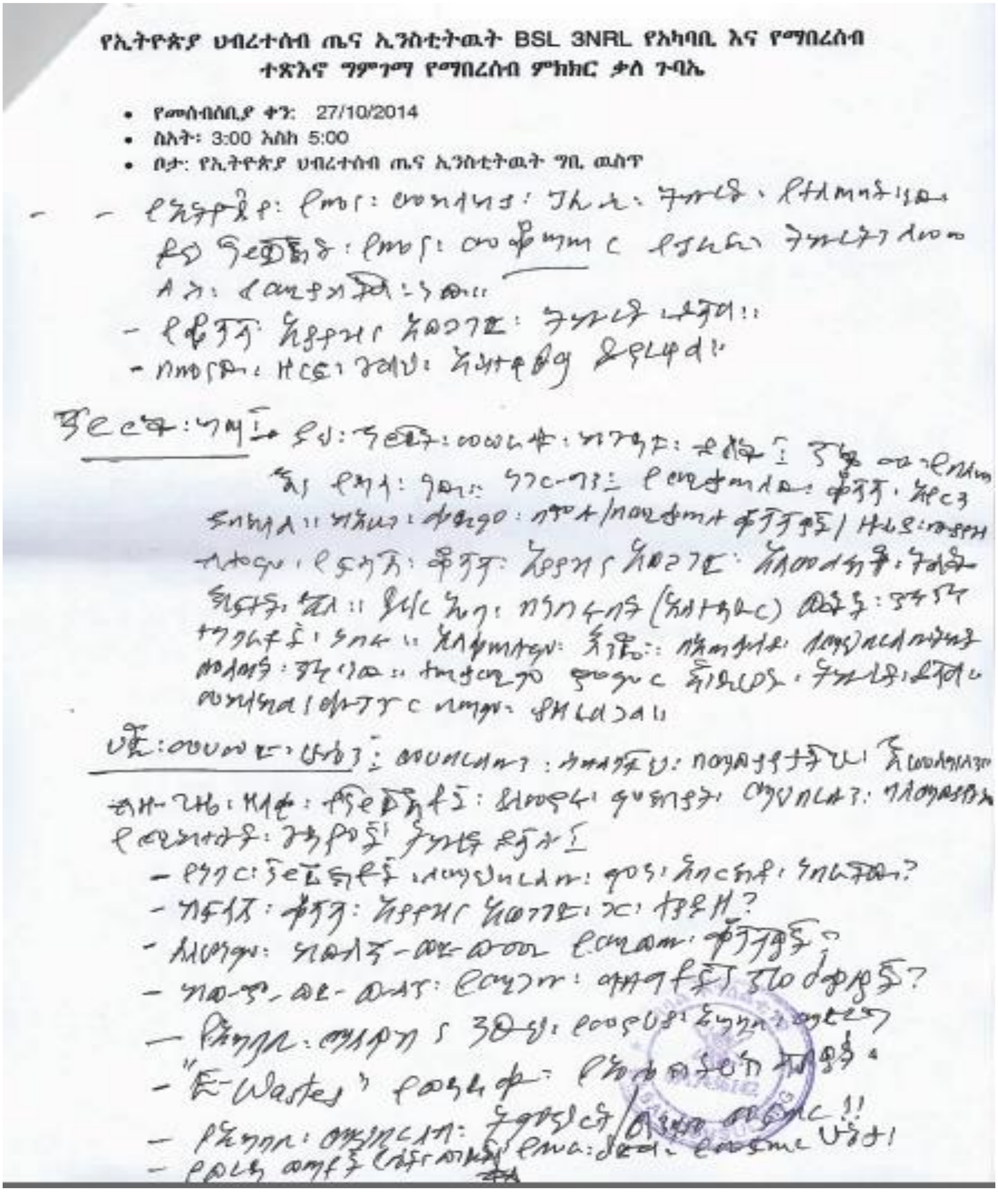

የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዉት BSL 3NRL የአካባቢ እና የማበረሰብ ተጽእኖ ግምገማ የማበረሰብ ምክክር ቃለ ጉባኤ

- የመሰብሰቢያ ቀን: 27/10/2014
- ሰአት፡ 3:00 እስከ 5:00
- ቦታ: የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዉት ግቢ ዉስጥ

የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዩት BSL 3NRL የአካባቢ እና የማበረሰብ ተጽእኖ ግምገማ የማበረሰብ ምክክር ቃለ ጉባኤ

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- ሀይ ቀናለዉም!
  - ከመቀጣለ 150, ሰዉ, ሰዉ. ~ ቁጥሩ / 50% ከጣር፡ የሚገኝ ነዉ)...
ስለመኖሩ: መኖሩ ጥሩ ነዉ: የደንብ: ስለሚያንጽ: ብቻ ሳይሆን መሠርተ ልማት ስለሆነ::
- በአመታት. ህዝቡ: የጎላ ችግር: አማት. ተወስዶ ከተቋሙ ጋር ተቀምጦ: ሊወሰን ይገባል::
- ስለመሬቱ ባንኮች ናይ ክፍያ: ሊወሰኑ ወይ ትግግሩ ሊገባ ይገባል::

አቶ: ሽህለዉ ደ ከመስ ዘዴ!

- ህብረተሰቡ: ከተቋሙ: ምን ጠብቅ: ይጎላል:: ወጣት: ሴቶች: ስራ ፈጠሩ ከመሬ ናይ ክፍያ: ለማህበረሰቡ ገቢ: መቀማት: ስለ ወ/ይ ያስረዳል::
- ጉዳዩ ሚስጥራዊ ይሆ: ስሜት (ውጥ) ምክንያት: ማህበረሰቡ ተሳ ሊያ ሊሆ ይገባ::
- የተቋሙ: ሰራ: ያመነ የተቀበ ሊሆ: ይገባ::
- የመጣ ስሜት ክንግ ይካሄ ሂደ: ማህበረሰቡ ተገቢ: ነዉ::
- ይሚመለከ ችግ: አገት: መመ ያ: ጉዳ: ነዉ::

ከአከባቢ ደ: ማህበረሰቡ ገጠ ያ ጠ ገ ወ ገ: ሰዉ ከ

- የቆ ይ ሰ: ገ ጠ ያ ሊ ተ ስ ገ ት: ይገባ::
- አ ሳ ገ: ገ ጠ ተ ያ
- የ ስ ቆ ያ: ተ ገ ት ሊ ደ: የ ዐ ዐ ሚ ሠ ት: ገ ጠ ያ ያ

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የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዩት BSL 3NRL የአካባቢ እና የማበረሰብ ተጽእኖ ግምገማ የማበረሰብ ምክክር ቃለ ጉባኤ

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ስለፕሮጀክቱ ገለፃ ተደርጓል

- ወረቀት ወይ ጽሑፍ አላከፋፈልም ተብሏል::
- የሰጣ ፈቃደኝነት መሰጠት ይኖርበታል ተብሎ ተገልጿል

የውይይት ርዕሰ ጉዳዮች

- ስራ ሲሰራ እንዳይጎዳ ፕሮጀክቱ ለአካባቢ ማህበረሰብ ከሚፈጥራቸዉ ችግሮች መከላከል እንዴት ይቻላል ተብሎ ተጠይቀዋል ለአካባቢ ጉዳዮችም ተገቢዉ ክፍያ ተከፍሎ ስራ ይሰራ ተብሏል::
- የወባ ትንኝ ማጥፊያ ለአካባቢ ማህበረሰብ ከሚሰጠዉ ጥቅም ስለ ክትትል ስለ ክፍያ ስለ ስራ ሰአት ገለፃ ተሰጥቷል::
- የአየር ብክለት ያጋጠሉ ችግሮች - - - - - ስለሆነም ከፍተኛ ትኩረት ተሰጥቶ ጋር ስትገናኝ መሬት ስትቆፍር እንዳሉ ነገሮ
- የአየር ንብረት (የፀሃይ ብርሃን) ስለመሆኑ ፕሮጀክቱ ከሚፈጥራቸዉ ችግሮ የሚሆኑ (Pollutants) ከ ሲሚንቶ (cement factor) ጋ ተገልጿል::

የኢትዮጵያ ህብረተሰብ ጤና ኢንስቲትዩት BSL 3NRL የአካባቢ እና የማበረሰብ ተጽእኖ ግምገማ የማበረሰብ ምክክር ቃለ ጉባኤ

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ሃሳቦ: ትንተና :- Senior የፕሮጀክት / Coordinator ተሳትፎ

- የፕሮጀክቱ ዓላማ ለአከባቢ፡ ለህዝብ ጉዳት፡ አለዉ ብለዉ ያስባሉ
- የአሰራሮችን፡ ግልፅነት፡ የገንዘብ፡ ድጋፍ፡ አደርጋለሁ
- ለአለማቀፍ፡ የ 150,000,000 ~ ይከፍላ (50%)
- ስለ ክብደት፡ ወስ 100 ግመት፡ ስናገኝ ፡ ስለ ተመዘገበ
- የሚከፍሉት ሰዎች ተለይተ፡ ዉድቅ ያደረጉ ሰዎች ማብራሪያ ተሰጥቶ
- የአካባቢ፡ ማህበረሰብ፡ የስራ፡ ድርጅት፡ አለ ብለ ያስባሉ
- ሽፍታ፡ ስለሆነ፡ የሚሰሩ ሰዎች ወጣቶ ስለ ሆኑ ስራ ያገኛሉ
- የአሁኑ፡ ደንና፡ የደረቅ፡ የጉገት፡ ለጎጂ ሚሳቸዉ ናቸዉ
- የአከባቢ፡ ፕሮጀክት ከሚሰሩ፡ ከተለያዩ ክፍሎች ያሳተፉ ጉዳዮች ተሳትፎ ማድረግ ያለባቸዉ ስለ ሆነ ሁሉ ያሳትፉ ብለዉ ያስባሉ
- ስለዚህ፡ ትክክለኛ ፡ ካሳ ክፍያ ፡ ተቋዉን ፡ ስለማስተላለፍ ፡ ለመተግበር ጉዳይ ይሰጣል
- ስራ ፡ ማቆሚያ ፡ ወጪ ፡ 50,000,000 ~ ይሆናል
- ደርጅቱ፡ የሀገልጋዮች ፡ ገቢታ ፡ ይቀጥላል
- የገንዘብ ፡ ሚኒስትር ፡ ገንዘቡን ፡ የለቀቃ ይሆናል
- ግንባታ ፡ ስለሚቀጠሉ ፡ ሰዎች ፡ ስለ ሚፈጠሩ ፡ ስጋቶ ፡ የገቢ ፡ ስታቅ ፡ ናቸዉ ፡ የምሰሩ ሰዎ

Public Consultation participants of EPHI BSL 3 NRL, ESIA Update

- Meeting date: 04/07/2022
- Time: 9:00 AM to 11:00 AM

Place: EPHI , Woreda 09, Gulele Sub-city, Addis Ababa, Ethiopia

	Name of participant	Organization/Position	E-mail address	Tel./Fax	Signature
1	[illegible]	[illegible]		[illegible]	
2	[illegible]	[illegible]		[illegible]	
3	[illegible]	[illegible]		[illegible]	
4	[illegible]	[illegible]		[illegible]	
5	[illegible]	[illegible]		[illegible]	
6	[illegible]	[illegible]		[illegible]	
7	[illegible]	[illegible]		[illegible]	
8	[illegible]	[illegible]		[illegible]	
9	[illegible]	[illegible]		[illegible]	
10	[illegible]	[illegible]		[illegible]	
11	[illegible]	[illegible]		[illegible]	
12	[illegible]	[illegible]		[illegible]	
13	[illegible]	[illegible]		[illegible]	
14	[illegible]	[illegible]		[illegible]	
15	[illegible]	[illegible]		[illegible]	
16	[illegible]	[illegible]		[illegible]	
17	[illegible]	[illegible]		[illegible]	
18	[illegible]	[illegible]		[illegible]	
19	[illegible]	[illegible]		[illegible]	
20	[illegible]	[illegible]		[illegible]	
21	[illegible]	[illegible]		[illegible]	
22	[illegible]	[illegible]		[illegible]	
23	[illegible]	[illegible]		[illegible]	
24	[illegible]	[illegible]		[illegible]	
25	[illegible]	[illegible]		[illegible]	
26	[illegible]	[illegible]		[illegible]	
27	[illegible]	[illegible]		[illegible]	
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Minutes of Community Consultation (First Round)

Minutes of Community and Stakeholder Consultation

(Translated from Amharic Language)

Stakeholder and public consultation was conducted on January 22, 2019 at the Ethiopian Pubic Health Institute meeting hall with participants drawn from elders, representatives of religious institution and with members of the different sector offices from woreda 09 in Gulele Sub City; and also participants from the EPHI. The objective of the public consultation was to solicit the views and opinions of the participants towards the construction of the BSL 3 laboratory.

A total of 22 people attended the public consultation and 15 of the participants were from the woreda sector offices and representatives of elders and religious institutions; and the other 7 participants were from the Ethiopian Public Health Institute.

Background to the Project: During the consultation, the participants were briefed on the objectives and purpose of the BSL 3 laboratory construction by the National Laboratory Capacity Building Directorate Director Ato Addisu Kebede and by the Project coordinator Dr. Eyob Abera.

Benefits of the proposed project for the country

The construction of BSL 3 laboratory if developedwill be the biggest laboratory in the country and envisaged to provide its service to other African countries as well. It will contribute in providing high level laboratory service and is expected to resolve and reduce issues that are related to both health and social problems. When it becomes operational in future the number of tests that used to be sent outside of the country is expected to reduce drastically.

Positive impacts due to the project

Participants of the consultation meeting have raised the following positive impacts and the measures that contribute to strengthen it.

1. The construction of the laboratory is expected to contribute in providing high level medical service and the community is highly positive about its construction and is waiting anxiously.

2. The project is expected to create employment opportunity to the local unemployed youth during its construction phase.
3. In its operation phase the laboratory will employ highly skilled and trained professionals and is expected to adopt new and improved technologies.
4. It will allow conducting laboratory tests of highly infectious and chronic disease and is expected to reduce the sending of sample for test outside of the country.
5. The construction of the laboratory will enable diagnosing some chronic and critical health problems and diseases that affect mothers and children in particular.

Measures to strengthen the positive impacts

1. To speed up all the studies that will allow the starting of the construction of the laboratory on planned time without wasting time.
2. The woreda administration and the sector offices under the woreda jurisdiction are willing to provide all required assistance and support from them.

Potential Negative Impacts on the community and Environment

1. Labour issues: During the construction phase of the laboratory, either the main contractor or his sub contractors should follow FDRE laws and regulation in the employment of construction workers, ensuring labour standards, on time settling of payments and the like. To follow such measures allows the contractor and his sub-contractors to have peaceful working environment.
2. Occupational health and safety: The contractor and his sub contractors are expected to follow standard occupational health and safety standards during the construction phase of the project.
3. Disposing waste materials: During construction and operation phase it is advised to dispose both solid and liquid waste with affecting the community and the environment in recognized standards.
4. Blocking roads: During construction work, the contractor should avoid storing construction materials, parking of construction machineries and trucks on vehicular and pedestrian walkways.

5. Ensure that installation of glasses on windows and other parts of the building do not have negative impact on the community and environment. The glasses to be installed should be as per the standard of the country.
6. Financial management: All financial issues that are related with the project should follow standard financial management procedures and guidelines and be free from corruption and embezzlement.

Mitigation measures to minimize the negative impacts

1. Establish mechanisms that will allow woreda sector office professionals to carry out follow up and monitoring of the project activities.
2. Ensure that the contractor carries out the construction works as per the rules, regulations and standards of the Environmental Protection Agency.
3. Ensure that the contractor follows occupational, health and safety standards; and labour regulations in employment of his workforce.
4. Monitor the contractor adopts Environmental protection guidelines and procedures
5. Monitor that the financial management system is established as per the law.

Impacts on historical and religious and cultural heritages

According to FDRE proclamation on historical, cultural and religious heritages there are not any recognized and registered historical, cultural and religious heritages site in the project area.

List of participants of the stakeholders and Public consultation

S.N	Name	Sex	Organization	Responsibility
1	Bekalu Tamir	M	Office for regulating law & order	Supervising Officer
2	Fire Hailu	F	Office for regulating law & order	Supervising Officer
3	Nuralah Imam	F	Labour and Social Affairs office	Expert
4	Meri Bela	F	Labour and Social Affairs office	Expert
5	Meri Bela	F	Environmental Protection Authority	Expert
6	Aster Keneni	F	Women’s Affair Office	Expert
7	Senait Sedom	F	Women’s Affair Office	Expert
8	Sewagegne Desalegne	M	Health Office	Expert

9	Alemu Minlargilih	M	Health Office	Expert
10	Mahider Gebeyehu	F	Culture & Tourism Offic	Certification
11	Alem Teklu	F	Culture & Tourism Offic	Supervisor
12	Daniel T/Mariam	M	Elders representative	Elder
13	Bekure Fisseha	M	Rufael Church representative	Supervisor
14	Bekalu Hawaz	M	Rufael Church representative	Supervisor
15	Kirubel Tesfaye	M	EPHI	Researcher
16	Melaku Gizaw	M	EPHI	Researcher
17	Mesay Getachew	M	EPHI	Researcher
18	Daniel Abera	M	EPHI	Researcher
19	Jemanesh Kumera	F	Woreda 09 Administration	Chie Executive
20	Yeabkal Daniel	M	EPHI	Researcher
21	Eyob Abera	M	EPHI	Researcher
22	Ahmed Mohammed	M	EPHI	Researcher

BSL 3 ላቦራቶሪ ግንባታ ዙርያ ከወረዳ 9 ማህበረሰብ ጋር የሚደረግ ውይይት

አጀንዳ

1. ስለግንባታው ፕሮጀክቱ ገለፃ ማድረግ
2. የግንባታውን ፕሮጀክት ለአካባቢ እና ማህበረሰቡ ያለው ጠቀሜታ ገለፃ ማድረግ
3. የፕሮጀክቱ ግንባታው በአካባቢ ላይ የሚያስከትለው ተፅዕኖና የመፍትሄ አቅጣጫ
4. የፕሮጀክቱ ግንባታው በአካባቢ ላይ የሚያስከትለው ተፅዕኖና የመፍትሄ አቅጣጫ
5. ግንባታው በሚካሄድበት ዙሪያ ልዩ ትኩረት የሚሹ ቦታዎች (ታሪካዊ፣ ሀይማኖታዊ) ካሉ የመፍትሄ አቅጣጫ

የስብሰባ ቦታ: ኢ. ህ. ጤ. ኢ. የስብሰባ አዳራሽ **ቀን: ጥር 14/2011 ዓ.ም**

ስለግንባታው ፕሮጀክቱ የተደረገ ውይይት

1. ስለግንባታው ፕሮጀክቱ ገለፃ ማድረግ

የፕሮጀክቱን ግንባታን በመመለከት የፕሮጀክቱ አስተባባሪ ዶ/ር ኡይብ አቡሁፋ አቶ አደሉ ከበደ የብሔሬዳ ካቡሁፋ ደኢ ደሬክተር የአንቀው ግንባታው ሰምን አንዳለፈ ገለፃ አድርገዋል ይህ ካቡሁፋ G+6 አንፃ ሲሆን በኢትዮጵያ ትልቁ ካቡሁፋ ይሆናል አንቀው ሥጠቀቅ ካቡሁፋው በአገሪቱ ሰፊ ስፍ በመሆኑ አገልግሎት ይሰጣል

2. የግንባታውን ፕሮጀክት ለአካባቢ እና ማህበረሰቡ ያለው ጠቀሜታ ገለፃ ማድረግ

የካቡሁፋው ግንባታ በኢትዮጵያ ትልቁ የጤና ካቡሁፋ ፍ አንደዚሁም አስፍሊጎት አገሪት ሙሙር አገልግሎት የሚሰጥ በመሆኑ ያለው ጠቀሜታ አጅግ ሰፊና ከፍተኛ ነው ግንባታው ሲጠናቀቅ በከፍተኛ ደረጃ ቀ ካቡሁፋ አገልግሎት አስመጪ ማሄድበት የአገሪቱን የጤና አገልግሎትና አንደዚሁም ከጤና ጋር ተያይዞ የሆኑትን ማህበራዊ ቁዉሰት ሰመቀነስ ከፍተኛ ድርሻ ይኖረዋል በተመሳሳይም ከኢትዮጵያ ውጭ የሚገኙትን የተከናደ ሙርመራዎችን በዚህ መልኩ በመገነባው ካቡሁፋ አመማ ሄድ ያስችላል

(1)

3. የፕሮጀክቱ ግንባታው በአካባቢ ላይ የሚያስከትለው ተፅዕኖና የመፍትሄ አቅጣጫ?

3.1 የፕሮጀክቱ ግንባታው በአካባቢ ላይ የሚያስከትለው አዎንታዊ ተፅዕኖና

የአካባቢው፡ ተፅእኖዎች፡ የሚከተሉት፡ ዋና፡ዋና፡ ነገሮች፡ ~~ፕ~~ፕሮጀክቱ፡ አዎንታዊ፡ ተፅዕኖ፡ እንደሚያመጣ፡ ገልፀዋል።

1. የ~~ቅ~~ [illegible]፡ መንገድ፡ ከአገልግሎት፡ [illegible]፡ [illegible]፡ የጠና፡ [illegible]፡ ከመስጠት፡ የሚያስፈልገን፡ በመሆኑ፡ [illegible]፡ በጉዳት፡ እንደሚጠቀሙ፡ ገልፀዋል።
2. ለአካባቢው፡ ከሚገኙ፡ ሥራ፡ አጥ፡ ወጣቶች፡ በግንባታ፡ ወቅት፡ የሥራ፡ ዕድል፡ ይፈጥራል
3. ግንባታው፡ ሲጠናቀቅ፡ በልዩ፡ ልዩ፡ ሙያ፡ የሰለጠኑ፡ ሙያተኞች፡ ይቀጠራሉ።
4. በአሁኑ፡ ወቅት፡ ከፍተኛ፡ የጠና፡ [illegible]፡ የሆኑ፡ በአቅራቢያ፡ [illegible]፡ [illegible] በ[illegible]፡ ወላጆች፡ እንደ [illegible]፡ ይስተናገዳሉ። ወደፊትም፡ የሚገነባው፡ [illegible]፡ [illegible]፡ [illegible]
5. የ[illegible]፡ መንገድ፡ በተለይ፡ ከ[illegible]፡ [illegible]፡ [illegible]፡ የሚከተሉ፡ በአቅራቢያ፡ ከመንግስት፡ ከመጠጥ፡ ውሃ፡ (ይለያል)።

3.2 የመፍትሄ አቅጣጫው

1. ግንባታው፡ በተቀመጠለት፡ የጊዜ፡ ገደብ፡ እንዲከናወን፡ ~~[illegible]~~ አስፈላጊው፡ ትኩረት፡ በአስቸኳይ፡ ተጠናቆ፡ ወደ፡ሥራ፡ እንዲገባ፡ ይደረጋል።
2. የወረዳው፡ መስተዳድር፡ የኮንትራት፡ መሠረት፡ [illegible]፡ ለፕሮጀክቱ፡ ግንባታ፡ [illegible]፡ የሚያስፈልጉትን፡ ድጋፍ፡ ከማድረግ፡ ተከታትሎ፡ [illegible]።

4. የፕሮጀክቱ ግንባታው በማህበረሰቡ ላይ የሚያስከትለው ተፅዕኖና የመፍትሄ አቅጣጫ?

4.1 የፕሮጀክቱ ግንባታው በአካባቢ ላይ የሚያስከትለው አሉታዊ ተፅዕኖና

1. በግንባታ ወቅት ከንጥረነገሮች ብክለት የሚመጣ ደንብ የሚፈጠሩ ቆሻሻዎች የአገልግሎት ደንብና ጫጫታ ተከትሎ መፈጠር ይኖርበታል። ይህም አሉታዊ ንጥረነገሮች ማቃጠል ያለመፍጠር የሚፈልጉን መለየት ደህንነት ክንዲያ ወቅት መደረግ። የአካባቢውን ሠራተኞች ጥንቃቄ ማድረግ።

2. በሥራ አካባቢ የሚደረግ ጥንቃቄና ሃላፊነት (occupational health & safety) በትክክለኛው አሠራር ደንቦችን ተከትሎ ማከናወን።

3. በግንባታ ወቅት ከግንባታው የሚወጡ ደረቅ ፍሳሽ ቆሻሻ በንጥቃቄ የአካባቢ ብክለት ሳያስከትሉ ክንዲወገዱ መደረግ።

4. የግንባታ ቁሳቁሶችና አገልግሎቶችን ክንደተሟሉ ተከትሎ ማስከፈሉ መንገድ አይዘጉ ክንዲከናወኑ መደረግ ይኖርበታል።

5. ግንባታው ተጠናቆ ከአካባቢ የሚገጠሙ መስኮቶችና መስተዋቶች አካባቢውን የማይረብሹና የቤና ጠንቅ ክንዲሆኑ ከፍተኛ ጥንቃቄ ክንዲደረግ።

6. የገንዘብ አጠቃቀምና አያያዝ ከመጨመ በፀጋ መሠረት በሒደትንስ ደንብና መሠረት ክንዲከናወን።

4.2 የመፍትሄ አቅጣጫው

1. ግንባታው ከሚከናወንበት ወቅት የወረዳው ኤክተር መ/ቤቶች መቆፈ አለፍንጋው ቆፍጥና ክትትል የሚያደርጉበት አሠራር ክንዲፈጠር ያስፈልጋል።

2. ግንባታውን የሚያካሂደው ከንትራክተር ሠራውን በአካባቢ ንጠቀና ከአካባቢ ደንብ መሠረት ክንዲያከናውን የከንትራክቱ ውስ በደንብ ክንዲተሠር ይሆን።

3. ከንትራክተሩ የሠራተኞ ቆፍር በሚፈልጉበት ወቅት በአከባቢ በደንብ መሠረት ሆኖ የሠራ አካባቢ ደህንነትና የሠራተኞ ደህንነት ደንቦችና መመሪያዎችን ክንዲያከብር ውስ ደተሠር።

4. የአካባቢ ንጥቃና አከባቢ ክንዲተሠሩ መመሪያ ከንትራክ ክንዲተገኙ ይደረግ።

5. መስኖን ከመቆጣጠር በሒደትንስ አከባቢ ደንብ መሠረት ክንዲሆ ክንዲከናወኑ አለፍንጋው ክትትል ክንዲደረግ።

(3)

5. ግንባታው በሚካሄድበት ዙሪያ ልዩ ትኩረት የሚሹ በታዎች (ሪካዊ፣ ህይማኖታዊ)

ካሉ የመፍትሄ አቅጣጫ?

በአትዮጵያ ፡ የታሪክና ፡ ቅርስና ፡ ሙዝገባ ፡ ይንብና ፡ ስጋ ፡ መሠረት
በአካባቢው ፡ በታሪካዊ ና ፡ ሃይማኖታዊ ፡ ቅርስነት ፡ ተመዝግቦ ፡
የወደፊት ፡ ሙፍሁ ፡ አከባቢ ፡ የካበሁ ፡ ቦሌ ፡ ግንባታ ፡
የወደአተጋ ፡ ና ፡ ያዊደናቅፍ ፡ ጋይ ፡ አይኖርም ፡፡

Community and Stakeholders Consultations Attendance Sheet for Environmental and Social Assessment for Construction of BSL 3 Reference Laboratory at Ethiopian Public Health Institute (EPHI)

Federal Democratic Republic of Ethiopia Ministry of Health

Regions Addis Ababa Sub City Gullele Woreda 9

Date of Consultation January 22, 2018

S.N/ ተ.ቁ	Name of Participants/ የተሳታፊ ስም	Sex ፆታ	Organization/የሚሰሩበት መስርያ ቤት	Position/ የስራ ድርሻ	Phone No./ ስልክ ቁጥር	Signature/ ፊርማ
1	[illegible]	M	[illegible]	[illegible]	0921063123	[illegible]
2	[illegible]	M	[illegible]	[illegible]	0940287[illegible]	[illegible]
3	[illegible]	M	[illegible]	[illegible]	0926736635	[illegible]
4	[illegible]	M	[illegible]	[illegible]	0910013607	[illegible]
5	[illegible]	M	[illegible]	[illegible]	0917694440	[illegible]
6	[illegible]	M	[illegible]	[illegible]	0913378601	[illegible]
7	[illegible]	>>	>> >>	[illegible]	0926198409	[illegible]
8	[illegible]	M	[illegible]	[illegible]	0909387227	[illegible]
9	[illegible]	M	"	[illegible]	0911712125	[illegible]
10	[illegible]	M	[illegible]	[illegible]	0938999326	[illegible]
11	[illegible]	M	" "	[illegible]	0912383394	[illegible]
12	[illegible]	M	[illegible]	[illegible]	0913255704	[illegible]
13	[illegible]	M	[illegible]	[illegible]	0911917873	[illegible]
14	[illegible]	M	EPHI	[illegible]	0911001318	[illegible]
15	[illegible]	M	EPHI	[illegible]	0913089015	[illegible]
16	[illegible]	M	>>	>>	0922995553	[illegible]
17	[illegible]	M	>>	>>	0911790416	[illegible]
18	[illegible]	M	[illegible]	[illegible]	0972563284	[illegible]
19	[illegible]	M	[illegible]	[illegible]	0912150808	[illegible]
20	[illegible]	M	[illegible]	[illegible]	0911637513	[illegible]
21	[illegible]	M	>>	>>	0911910058	[illegible]
22	[illegible]	M	[illegible]	[illegible]	0930012583	[illegible]

Minutes 2 for of Community and Stakeholder Consultation for discloser of BSL 3 NRL ESIA

Minutes of Community and Stakeholder Consultation

(Translated from Amharic Language)

Stakeholder and public consultation was conducted on February 28, 2019 at the Ethiopian Pubic Health Institute meeting hall with participants drawn from elders, representatives of religious institution and with members of the different sector offices from woreda 09 in Gulele Sub City; and also participants from the EPHI. A total of 16 people attended the public consultation and 12 of the participants were from the woreda sector offices and representatives of elders and religious institutions; and the other 4 participants were from the Ethiopian Public Health Institute. The objective of the public consultation was to solicit the views and opinions of the participants towards the prepared ESIA report for construction of the BSL 3 laboratory at EPHI.

Project Background: During the consultation, the participants were briefed on the objectives and purpose of the BSL 3 laboratory construction by the National Laboratory Capacity Building Directorate Director Ato Addisu Kebede and by the Project coordinator Dr. Eyob Abera. The presentation was focused on potential impacts of the project and proposedmitigation measures the impacts of during construction and operation phases and the presentation was as follow:

Positive Impacts of the project

The operation of BSL 3 laboratory will contribute a lot for public health emergency management in providing high level laboratory service resulting, improving community health at large.

The proposed project has a positive impact on:

- Employment, Gender and Labor Influx
- Improved medical surveillance services
- Employment opportunities:

Negative Impacts during Construction Phase

- Impacts on Ecological Resources and Biodiversity
- Impact on Geology/Soils
- Impact due to improper construction and demolition waste management
- Impacts on the health and safety of construction workers' and community health(physical, electrical, and Explosive Hazards

- Traffic accident impacts
- Impact on Air Quality
- Impact of Noise and Vibration
- Impact on social service through disruption of laboratory/ sample collection services
- Analysis of Abnormal Events and Accident Scenarios

Negative Impacts during Operation Phase

Negative Impacts during Operation Phase were

- Impacts on Ecological Resources and Biodiversity
- Impacts on Geology/Soils
- Occupational Health and Safety and Community Health Concerns
- Impact of escaping of Infectious Agents from BSL-3 Containment
- Impact of escaping of Infectious Agents from BSL 2 labs, PTPC and biobank centres
- Potential Occupational Health and safety impacts associated with BSL 3 Laboratory operation
- Mitigation Strategies for Potential Occupational Health and safety impacts associated with BSL 3 Laboratory operation
- Potential impacts associated with operation of BSL 2 laboratories, PTPC and biobank
- Impact of handling of infectious materials and specimens in the proposed BSL 3 laboratory
- Risk associated with handling and storage of infectious materials and specimens in the proposed BSL 2 laboratories, PTPC and Biobank
- Impact of improper use of equipment in the BSL 3 laboratory
- Impact of improper use of equipment in the BSL 2 labs, PTPC and Biobank
- Impact of contamination of the BSL 3 laboratory, BSL 2 laboratories, PTPC and Biobank Facilities
- Potential impact during the operation of Central Warehouse
- Impact of fire outbreak
- Chemical hazard in the BSL 3 NRL complex building
- Electrical and explosive hazards in the BSL 3 NRL complex building
- Impact of air pollution due to waste incineration

- Impact due to Improper Waste Management
- Risk associated with collection/handling and storage of waste at BSL 3 NRL complex building
- Analysis of Abnormal Events and Accidents for NRL BSL 3 Facility Operation
- Emergency Preparedness and Response

Moreover, detail presentation was done on the proposed mitigation measures for each impacts for

participants.

Finally, after presentation, participants acknowledged the preparation of the ESIA report and pparticipants of the consultation meeting have raised the following censers:

1. **Implementation issues:** during the construction the contractor should be monitored whether the contractors adhere the proposed mitigation and ensuring occupational safety and health.
2. Similarly, during the operation phase of the laboratory EPHI/MOH, should implement the proposed mitigation accordingly and monitor periodically for effectiveness of the proposed mitigation.
3. Occupational health and safety: The contractor is expected to follow standard occupational health and safety standards during the construction phase of the project.
4. Hazardous waste disposal: especially during the operation phase the waste should be treated and disposed according to the proposed plan and mitigation measures.

The proposed action points

- Establish mechanisms that will allow woreda sector offices to carry out follow up and monitoring of the project activities (discussion will made after the project approved by WB for arrangement)
- Ensure that the contractor carries out the construction works as per the rules, regulations and standards of the Environmental Protection Agency.
- Ensure that the NRL BSL 3 laboratory perform the laboratoryworks as per the standard BSL 3 laboratory procedure and waste management procedures (CDC & WHO manuals)

- Ensure that the contractor follows occupational, health and safety standards; and labour regulations in employment of his workforce.

Finally, the woreda administration representative and the sector offices under the woreda jurisdiction are willing to provide all required assistance and work with EPHI and MOH for successful implementation of this project.

List of participants of the stakeholders and Public consultation

S.N	Name	Sex	Organization	Responsibility
1	Hassen Mohamed	M	Office for regulating law & order	Supervising Officer
2	Endalkachew Midker	M	Office for regulating law & order	Supervising Officer
3	Haji Siraje Mohamed	M	Community Representative	
4	Miheret fikadu	F	Labour and Social Affairs office	Expert
5	Mery Bela	F	Environmental Protection Authority	Expert
6	Hana Chekale	F	Women's Affair Office	Expert
7	Jemanesh Kumera	F	Women's Affair Office	Expert
8	Tomas Mesfin	M	Culture & Tourism Office	Expert
9	Beletu Alemu	M	Health Office	Head
10	Tsegaye Ketema	M	Community representative	
11	Hagos Hafis	M	Community representative	
12	Melaku Gizaw	M	EPHI	Researcher
13	Yeabkal Daniel	M	EPHI	Researcher
14	Dr. Eyob Abera	M	EPHI	Biosafety Advisor
15	Ahmed Mohammed	M	EPHI	Researcher

Minute of Second Community and stakeholder Consultation to disclose the BSL 3 NRL ESIA (February 28, 2019)

በኢትዮጵያ ሕብረተሰብ ጤና ኢንስቲትዩት ስለሚገነባው BSL 3 NRL ላብራቶሪ ከአካባቢው ማህበረሰብ እና ከባለደርሻ አካላት ጋር የተደገ ውይይት

አጀንዳ

በኢትዮጵያ ሕብረተሰብ ጤና ኢንስቲትዩት ስለሚገነባው BSL 3 NRL ላብራቶሪ ከአካባቢው ማህበረሰብ እና ከባለደርሻ አካላት መወያየት

ቀን፡ በየካቲት 21 ቀን 2011 ቦ ፡ በኢትዮጵያ ሕብረተሰብ ጤና ኢንስቲትዩት

በየካቲት 21 ቀን 2011 ዓ.ም በኢትዮጵያ ሕብረተሰብ ጤና ኢንስቲትዩት (ኢ.ሕ.ጤ.ኢ) በተደረገው ውይይት ላይ የተሳተፉት አካላት የተውጣጡት ከአገር ሽማግሌዎች፣ የህይማኖት አባቶች፣ከጎላለ ከ ከተተማ ወረዳ 9 የተውጣጣ ጽ/ቤቶች እንዲሁም ኢ.ሕ.ጤ.ኢ ባለሙያዎች ይገኙበታል፡ ከተሳተፉት 15 ሰዎች ውስጥ 4ቱ ከኢ.ሕ.ጤ.ኢ ሲሆኑ የተቀሩት 11ከወረዳ 9ከአገር ሽማግሌዎች እና ከሀይማኖት አባቶች ነበሩ፡፡

የስብሰባው አላማ በማኅበረሰቡ ግዜ እና ላብራቶሪው አገልግሎት በማስጀመት ግዜ ሊከሰቱ ስለሚችሉ አስከሊዊና ማህበራዊ ተፅዕኖዎች ላይ ያላቸውን ህሀብና አስተያየት እንዲያስረክቡ ነበር፡፡

አቶ አዲስ ከበደ ከሀ/ሳ/ኢ/ማ/ጽ እንዲሁም ዶ/ር እሸጋ አስራ የፕሮጀክቱ አስተባባሪ ስለማኅበረሰቡ አለማና ግቦም ለተሰብሳቢዎች ገለፃ አድርገዋል፡ገለፃው ያተኮረው በማኅበረሰቡ ወቅት ሊከሰቱ ስለሚችሉ ጉዳቶች እና መከላከያ መንገዶች ላይ ነበር፡፡

የፕሮጀክቱ አዎንታዊ ጥቅሞች

ላብራቶሪው ስራ በሚጀምርበት ወቅት ለሕብረተሰቡ ከሚሰጣቸው ጥቅሞች መካከል፡-

- የስራ ዕድል ይፈጥራል
- ለገበያዎችን ቁጥጥር ያመቻራል
- ደረጃውን የጠበቀ የላብራቶሪ አገልግሎት በመስጠት የሕብረተሰቡን የህክምና አገልግሎት ያሻሽላል

የፕሮጀክቱ አሉታዊ ጎኖች

- በአካባቢ ዕፅዋቶችና አፈር ላይ
- የአቧር ብክለት
- የድምፅ ብክለት
- በማኅበረሰቡ ስራተኞችና በአከባቢው ነዋሪዎች ላይ
- የመጢና አደጋ
- የላብራቶሪ አገልግሎት መስተዓጎል

ግንባታው ተጠናቅቆ ላብራቶሪው አገልግሎት በማስጀመራት ወቅት የሚከሰቱ አሉታዊ ጎኖች

- በአካባቢ ዕፅዋቶችና አፈር ላይ
- የስራ ላይ ደህንነት
- ከላብራቶሪ ኢምፕሉስ በሚኖሩ አደጋዎች
- በየምና አደጋዎና አመማጣት ላይ
- የላብራቶሪ ፅዳቶች አገባባበ መጠቀም
- የአለት አደጋ
- ጥሬግዛል አደጋ
- ኬሚደትረስ አደጋ
- ከቆሻሻ ማቃጠያ በማወጣ የአየር ብክለት
- ተገኒ የሰራን ተቆጥሮ ስለጋገደ

ለሁሉም አሉታዊ ነገሮ መከላከያ መንገዶች ላይ ስፊ ማብራሪያዎች ለተሳተፊዎች ተሰጥተዋል፡፡

በመጨረሻም ተሳታፊዎቹ የሚከተሉትን ጥያቄዎች አንስተዋል፡፡

1. በማኅበሩ ጽረ፡- በማኅበሩው ወቅት ንጉዳይ ከተፈጠሩ የተቀመጡትን ከመከላከያ መንገዶች ማተግበሩና ከላራቶሪዎ ጤና እና ደህንነት ማጠናቀር ማረጋገጥ
2. በተመሳሳይ ኢ.ሕ.ጤ.ኢ እና የከተሜ ማኅበተር የመጣለከያ መንገዶች ማተግበራቸውን በተወቱ ማስታዎቅ
3. ከላራቶሪ ጎና እና ደህንነት-ከገጽታ ተሩ ያለ ደህንነት ማተግበሩ ማረጋገጥ
4. በከፊ ቆሻሻ አወጋገድ-ላብራቶሪው አገልግሎት በማስጀመት ወቅት ቆሻሻ ነ ከተቀመጠው መመሪያ ማሟላት ማስገባቱ

የታቀደው የድርጊት መርሀ ግብር

- የጉረቃው ጽ/ቤቶች ንጉትፊ የሚያደርጉትን መገገደ ማጠረት
- ከገጽታ ተሩ ስራው በአካባቢ ጎጋቶ ኢጀገ ህግ ማሳት ማተግበሩን ማረጋገጥ
- ከገጽታ ተሩ ስራ ላይ ደህንነት መመሪያዎች እና ህጎች መገለፅንና ማተግበሩን ማረጋገጥ
- ላብራቶሪው CCDC & WHO ማሳት ስራዎቹን መስራቱን ማረጋገጥ

በመጨረሻም የጉረቃ አስተዳደር ተወካዮችና ጽ/ቤት ሀላፊዎች ከኢ.ሕ.ጤ.ኢ እና የከተሜ ማኅበተር ጋር በመሆን የፕሮጀክቱን ትግበራ ላይ አስፈላጊውን ትብብር እንደሚያደርጉ ገልጸዋል፡፡

Community and Stakeholders Consultations Attendance Sheet for Environmental and Social Assessment for Construction of BSL 3 Reference Laboratory at EHNRI(Ethiopian Public Health Institute (EPHI)
Federal Democratic Republic of Ethiopia Ministry of Health

Region ____ Sub City Gulele Woreda ____
Date of Consultation 28/2/2019

S.N ተ.ቁ	Name of Participants የተሳታፊ ስም	Sex ፆታ	Organization/ የሚሰሩበት ቦታ	Position የስራ ድርሻ	Phone No/ ስልክ ቁጥር	Signature ፊርማ
1	[illegible]	M	[illegible]	[illegible]	[illegible]	
2	[illegible]	M	[illegible]	[illegible]	[illegible]	
3	[illegible]	M	[illegible]	[illegible]	[illegible]	
4	[illegible]	M	[illegible]	[illegible]	[illegible]	
5	[illegible]	M	[illegible]	[illegible]	[illegible]	
6	[illegible]	M	[illegible]	[illegible]	[illegible]	
7	[illegible]	M	[illegible]	[illegible]	[illegible]	
8	[illegible]	M	[illegible]	[illegible]	[illegible]	
9	[illegible]	M	[illegible]	[illegible]	[illegible]	
10	[illegible]	M	[illegible]	[illegible]	[illegible]	
11	[illegible]	M	[illegible]	[illegible]	[illegible]	
12	[illegible]	M	[illegible]	[illegible]	[illegible]	
13	[illegible]	M	[illegible]	[illegible]	[illegible]	
14	[illegible]	M	[illegible]	[illegible]	[illegible]	
15	[illegible]	M	[illegible]	[illegible]	[illegible]	

Minutes 3 for Community and Stakeholder Consultation for disclosure of BSL 3 ESIA

Minutes of Community and Stakeholder Consultation

(Translated from Amharic Language)

Minutes of Community and Stakeholder Consultation on waste management

Mr Adisu Kebede and Mr Gonfa Ayana from national laboratories capacity building directorate started the discussion by explaining the construction of the project in detail. The complex will have a world class BSL-3 Lab, which will be the first of its kind in the country. In addition it also has an equipment maintenance unit, a biobank and also a proficiency test preparation center. The complex is intended to serve not only Ethiopia but also for the neighboring countries. They also discuss with the participants the documents prepared (ESIA &ICWMP) that have detail information about the expected impacts and their mitigation strategies need during the construction and operation of the project.

Ahmed Mohamed, the project team, give detail presentation on the type of waste expected during the operation of the laboratory and their treatment and disposal system .The waste generated will be:-

- Hazardous solid waste
- Non-hazardous solid waste
- Chemicals and other wastewater

The expected waste treatment and disposal techniques are:-

- Incinerator
- Septic tank with treatment plant
- Wastewater transportation to final disposal site

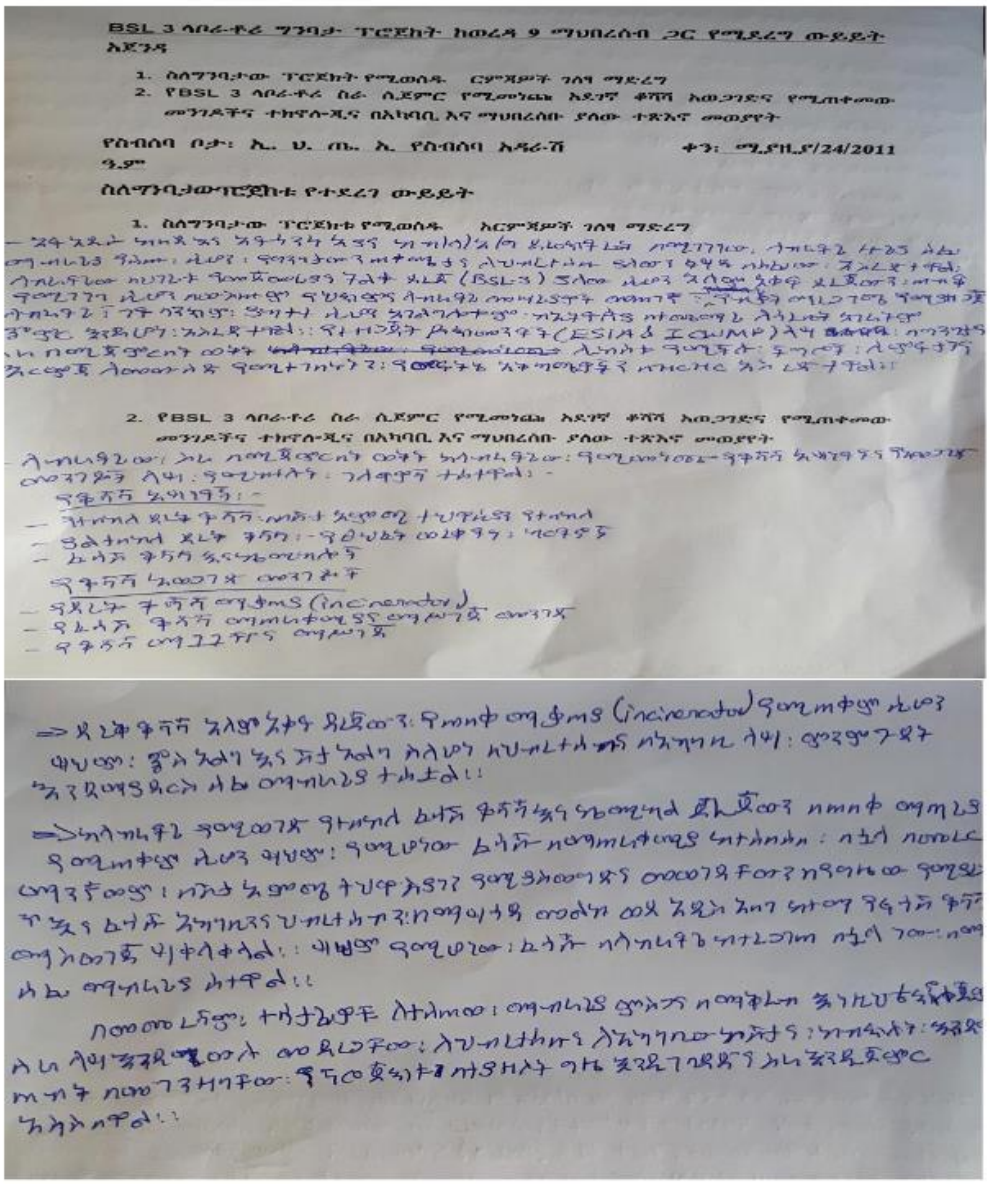
For the disposal of solid waste an efficient incinerator, which is odorless and smokeless will be used. The new incinerator will not have any harm on the community and the surrounding environment. The incinerate waste (ash) will be treated and disposed at Kotebe solidwaste disposal site.

Wastewater generated during the operation phase will be directed into a septic tank for storage and treatment. It is equipped with UV system for the treatment of waste. In addition a regular laboratory tests will be performed to check the effectiveness of the treatment process. The treated waste will not have any negative effect on the environment as well as the community. Finally the treated waste will be connected to the city's sewer system for final disposal.

- The participants of the community consultation raised their concerns about the effectiveness of the technology of incinerator.
- Participants meeting also recommended that during the operation phase of the BSL 3 laboratory EPHI/MOH, should implement the proposed technology of incinerator and liquid waste treatment plan.
- Participants also stated that there should be a monitoring system for waste treatment and disposal.

At the end the participants had a clear picture on the type of waste and the technologies used for the treatment and disposal of the waste from EPHI and also they understand that by using these technologies there will not be any harm on the communi ty and the environment. The participants recognize the value of the project and want to provide anything expected from them for the implementation of the projected.

Minute of Third Community and stakeholder Consultation to disclose the BSL 3 NRL ESIA (May 5, 2019)



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2. የBSL 3 ላቦራቶሪ ስራ ሲጀምር የሚመነጩ አደገኛ ቆሻሻ አወጋገድና የሚጠቀሙት መንገዶችና ተከናዋኝና በአካባቢ እና ማህበረሰቡ ያለው ተጽእኖ መወያየት

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Attendance Sheet for

Stakeholders and Communities Consultations on Environmental and Social Impact Assessment for Construction of BSL 3 National Reference Laboratory at Ethiopian Public Health Institute (EPHI)

Federal Democratic Republic of Ethiopia Ministry of Health

Regions: Addis Ababa Sub City: Gullele Woreda: 09

Date of Consultation: 2/05/2019

S.N/ ተ.ቁ	Name of Participants/ የተሳታፊ ስም	Sex ፆታ	Organization/የሚሰሩበት መስርያ ቤት	Position/ የስራ ድርሻ	Phone No./ ስልክ ቁጥር	Signature/ ፊርማ
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9.	ሙሉ ደስ ሰጪ	W	ማኅበረሰብ ልማት	ክትትል	0913259704	
10.	ደስታዬ ይ	♀	ፖሊስ/ፖሊስ ወ9	ፖሊስ/ፖሊስ/ሰላማዊ	0910013604	
11.	Marder Gebeyehu	F	ባህል ቱሪዝም	ጎብኚ/ኤክስፖርት	0935999723	
12.	Mesay Bekele	M	Community representative	-	0911652549	
13.	Lidiya Tikru	F	[illegible]	-	0915032889	
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ANNEX II: STANDARD GRIEVANCE APPLICATION FORMAT

Date:_____

Woreda _____ Kebele_____ Forest block/zone _____

Name of applicant/s:_____,_____,_____

Issue_____
_____
_____
_____
_____

Evidences

Person:_____,_____,_____

Material or other evidence
_____
_____
_____
_____
_____

Applicant Name_____

I, the undersigned applicant, confirm that my application and evidences are true and understand that inclusion of fraudulent issues and evidence result in automatic rejection of my application.

Signature_____

Date_____

ANNEX III: GUIDELINE FOR GOOD LABORATORY PRACTICES, SAFETY AND DESIGN FOR BSL 3 LABORATORY

The containment laboratory – Biosafety Level 3 is designed and provided for work with Risk Group 3 microorganisms and with large volumes or high concentrations of Risk Group 2 microorganisms that pose an increased risk of aerosol spread. Biosafety Level 3 containment requires the strengthening of the operational and safety programmes over and above those for basic laboratories – Biosafety Levels 1 and 2. The guidelines given in this section are presented in the form of additions to those for basic laboratories – Biosafety Levels 1 and 2, which would therefore be applied before those specific for the containment laboratory – Biosafety Level 3. The major additions and changes are in:

a. Code of practice

b. Laboratory design and facilities

c. Health and medical surveillance.

Laboratories in this category would be registered or listed with the national or other appropriate health authorities.

i) Code of practice for the proposed BSL3 lab

a. The international biohazard warning symbol and sign biohazard must be displayed on the doors of the rooms where microorganisms of Risk Group 2 or higher risk groups are handled.
b. Only authorized persons should be allowed to enter the laboratory working areas.
c. Laboratory doors should be kept closed.
d. Children should not be authorized or allowed to enter laboratory working areas.
e. No animals should be admitted other than those involved in the work of the laboratory.
f. The international biohazard warning symbol and sign displayed on laboratory access doors will identify the biosafety level and the name of the laboratory supervisor who controls access, and indicate any special conditions for entry into the area, e.g. immunization.
g. Laboratory protective clothing will be of the type with solid-front or wrap-around

gowns, scrub suits, coveralls, head covering and, where appropriate, shoe covers or dedicated shoes. Front-buttoned standard laboratory coats are unsuitable, as are sleeves that do not fully cover the forearms. Laboratory protective clothing will not be worn outside the laboratory, and it would be decontaminated before it is laundered. The removal of street clothing and change into dedicated laboratory clothing may be warranted when working with certain agents (e.g. agricultural or zoonotic agents).

h. Open manipulations of all potentially infectious material would be conducted within a biological safety cabinet or other primary containment device.
i. Respiratory protective equipment may be necessary for some laboratory procedures or working with animals infected with certain pathogens.

ii) Laboratory design and facilities for the proposed BSL3 lab

The laboratory design and facilities for basic laboratories – Biosafety Levels 1 and 2 apply except where modified as follows:

j. The laboratory will be separated from the areas that are open to unrestricted traffic flow within the building. Additional separation may be achieved by placing the laboratory at the blind end of a corridor, or constructing a partition and door or access through an anteroom (e.g. a double-door entry or basic laboratory – Biosafety Level 2), describing a specific area designed to maintain the pressure differential between the laboratory and its adjacent space. The anteroom would have facilities for separating clean and dirty clothing and a shower may also be necessary.
k. Anteroom doors may be self-closing and interlocking so that only one door is open at a time. A break-through panel may be provided for emergency exit use.
l. Surfaces of walls, floors and ceilings would be water-resistant and easy to clean. Openings through these surfaces (e.g. for service pipes) would be sealed to facilitate decontamination of the room(s).
m. The laboratory room will be sealable for decontamination. Air-ducting systems will be constructed to permit gaseous decontamination.
n. Windows will be closed, sealed and break-resistant.
o. A hand-washing station with hands-free controls would be provided near each exit door.
p. There would be a controlled ventilation system that maintains a directional airflow into

the laboratory room. A visual monitoring device with or without alarm(s) would be installed so that staff can at all times ensure that proper directional airflow into the laboratory room is maintained.

q. The building ventilation system would be so constructed that air from the containment laboratory – Biosafety Level 3 is not recirculated to other areas within the building. Air may be high-efficiency particulate air (HEPA) filtered, reconditioned and recirculated within that laboratory. When exhaust air from the laboratory (other than from biological safety cabinets) is discharged to the outside of the building, it would be dispersed away from occupied buildings and air intakes. Depending on the agents in use, this air may be discharged through HEPA filters. A heating, ventilation and air-conditioning (HVAC) control system may be installed to prevent sustained positive pressurization of the laboratory. Consideration would be given to the installation of audible or clearly visible alarms to notify personnel of HVAC system failure.

r. All HEPA filters would be installed in a manner that permits gaseous decontamination and testing.

s. Biological safety cabinets would be sited away from walking areas and out of crosscurrents from doors and ventilation systems.

t. The exhaust air from Class I or Class II biological safety cabinets, which will have been passed through HEPA filters, would be discharged in such a way as to avoid interference with the air balance of the cabinet or the building exhaust system.

u. An autoclave for the decontamination of contaminated waste material would be available in the containment laboratory. If infectious waste has to be removed from the containment laboratory for decontamination and disposal, it would be transported in sealed, unbreakable and leak proof containers according to national or international regulations, as appropriate.

v. Backflow-precaution devices would be fitted to the water supply. Vacuum lines would be protected with liquid disinfectant traps and HEPA filters, or their equivalent. Alternative vacuum pumps would also be properly protected with traps and filters.

w. The containment laboratory – Biosafety Level 3 facility design and operational procedures would be documented.

iii) Laboratory equipment

The principles for the selection of laboratory equipment, including biological safety cabinets are the same as for the basic laboratory – Biosafety Level 2. However, at Biosafety Level 3,

Manipulation of all potentially infectious material would be conducted within a biological safety cabinet or other primary containment device. Consideration would be given to equipment such as centrifuges, which will need additional containment accessories, for example, safety buckets or containment rotors. Some centrifuges and other equipment, such as cell-sorting instruments for use with infected cells, may need additional local exhaust ventilation with HEPA filtration for efficient containment.

iv) Health and medical surveillance

The objectives of health and medical surveillance programmes for basic laboratories – Biosafety Levels 1 and 2 also apply to containment laboratories – Biosafety Level 3, except where modified as follows:

x. Medical examination of all laboratory personnel who work in containment laboratories – Biosafety Level 3 is mandatory. This would include recording of a detailed medical history and an occupationally-targeted physical examination.
y. After a satisfactory clinical assessment, the examinee may be provided with a medical contact card stating that he or she is employed in a facility with a containment laboratory – Biosafety Level 3.

ANNEX IV: EPHI SPECIFICATION REQUIREMENT FOR INCINERATOR

Type	Pyrolytic- Hot Medical Waste Disposing Machine
Technology	Pyrolytic
Operation Condition	8-16 Hr /day
Controls	Built in data recording
Incinerator /Primary Combustion Chamber	**Type:** continuous loading
	Capacity/Burn rate per hour 50 kg/hr
	Temperature: $\geq$900 ^{o}C
	Material: **External-** 3 layers **Internal lining:** a fire proof material of pre-fired refractory bricks with Aluminium lining, resistant to corrosive waste or gas and to thermal shock
Secondary Combustion Chamber	**Type:** horizontal/vertical
	Temperature: $\geq$1200 ^{o}C
	Residence time of gases : $\geq$2 seconds
	Material **External-** Low thermal mass insulation 14-30 ^{o}C **Internal lining**: a fire proof material of pre-fired refractory bricks with Aluminium nettle lining, resistant to corrosive waste or gas and to thermal shock.
Burner system	auxiliary burners (for start-up and close-down operations), High turbulence of exhaust gases and reduction of air excess: e.g. injection of secondary air or recirculated flue gas, preheating of the air streams, regulated air inflow
Ash Handling System	Both Automatic and manual removal of Ash. Must ensure removal/treatment of hazardous remnants of ash.
Flue gas treatment system	Capable of treating the flow of flue gas as the incinerator is operating at its maximum capacity
	Auxiliary device: Water level gauge, pressure sensor, PH sensor..etc

	Auxiliary device: Fuel cutoff device
Waste feeding mechanism	Automatic pneumatic/hydraulic waste loading system or conveyor belt , capacity > 650L at a time
Chimney (Stack)	**Type:** Vertical type
	height:≥12 meter
	Material: Fireproof cast, stainless steel
Wet scrubbing system	Vertical sprat tower with baffles or packing inside
Gas emission	Reduction of Pollutant gas SO2, HCL, HF and line particulate that meet WBG/EU requirement including the other emissions
Emission control device	The emission reduction device control (Fabric filter coated with catalyst) made from PTFE, with parallel dedusting, lower contamination of filter dusts to PCDD/PCDF destruction at the catalytic surface that have high efficiency reduction of dioxin upto<0.1 ng TEQ/m3
OUTPUT	ASH -Max ≤5% of original waste size
	GAS- SMOKELESS,ODORLESS
Emission standard (all emission standards will also meet both WB and EU requirements).	WB emission standards as follow: Total Particulate Matter (PM) 10 mg/Nm^3 Total organic carbon (TOC)10 mg/Nm^3 Hydrogen chloride (HCl) 10 mg/Nm^3 Hydrogen fluoride (HF) 1mg/Nm^3 Sulfur dioxide (SO2) 50 mg/Nm^3 Carbon monoxide (CO) 50 mg/Nm^3 NO_X 200 mg/Nm^3 Mercury (Hg) 0.05 mg/Nm^3 Cadmium + Thallium (Cd + Tl) 0.05 mg/Nm^3
	Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V 0.5 mg/Nm^3 Polychlorinated dibenzodioxin and dibenzofuran (PCDD/F) 0.1 Ng/Nm^3 TEQ

	Notes: Oxygen level for incinerators is 7 percent
Test report for emission testing	Must be provided
Additional Requirement	- Local agent or branch in Ethiopia - Training for users as well as for EPHI maintenance staff on preventive maintenance - Fuel tanker with a minimum capacity of 2500 litre (material type need to be specified) - The bidder should be willing to sign at least a five years' service and maintenance agreement with the client (EPHI)

Description: Incinerator should be smokeless, odourless combustion and it should be made by high-quality cast, insulation, and steel plate as well as minimum generation of dust. All emission standards will also meet both WB and EU requirements.

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ANNEX V: ENVIRONMENTAL AND SOCIAL CLAUSES

(BSL 3 National Reference Laboratory Project, Africa CDC Regional Investment Financing Program)

1. General

a) The Contractor shall comply with the specific Environmental and Social Management Plan (ESMP) for the works he is responsible for. The Contractor shall prepare its own ESMP and plan to fully take into account relevant provisions of that ESMP.

The Contractor shall prepare method statements indicating that during construction phase all significant adverse impacts arising from each activity has been appropriately addressed.

The Contractor shall adhere to the proposed activity implementation schedule and the monitoring plan / strategy to ensure effective feedback of monitoring information to project management so that impact management can be implemented properly, and if necessary, adapt to changing and unforeseen conditions.

c) Besides the regular inspection of the sites by the Supervising Engineer (SE) for adherence to the contract conditions and specifications, the Owner may appoint an inspector to oversee the compliance with these environmental and social conditions and any proposed mitigation measures. Environmental Protection Authority (EPA), regional environmental authority or other relevant stake holders may carry out similar inspection duties. In all cases, as directed by the SE, the Contractor shall comply with directives from such inspectors to implement measures required to ensure the adequacy of rehabilitation measures carried out on the bio-physical environment and compensation for socio-economic disruption resulting from implementation of all works.

d) The Contractor shall implement all measures necessary to avoid undesirable adverse environmental and social impacts wherever possible, restore work sites to acceptable standards, and abide by any environmental performance requirements specified in an ESMP.

e) If the Contractor fails to implement the approved ESMP after written instruction by the Supervising Engineer (SE) to fulfill his obligation within the requested time, the Owner reserves the right to arrange through the SE for execution of the missing action by a third party on account of the Contractor.

2. Dust abatement

a) The contractor shall minimize the effect of dust on the surrounding environment resulting from earth moving sites, heavy truck movement, vibrating equipment, temporary access roads, etc. to ensure safety, health and the protection of workers and communities living in the vicinity dust producing activities.

b) During the performance of the work and any operations appurtenant there to, the contractor shall carry out proper and efficient measures, such as sprinkling with water or other means, whenever necessary to reduce the dust nuisance, and to prevent dust which has originated from his operations from damaging crops, cultivated fields, and dwellings or causing a nuisance to persons. The contractor will be held liable for any damage resulting from dust originating from his operations.

3. Noise due to Construction Activities

The contractor shall ensure the noise levels emanating from machinery, vehicles and noisy construction activities (e.g. excavation, blasting) are kept at a minimum for the safety, health and protection of workers within the vicinity of high noise levels and nearby communities.

The national noise limit standard for the residential area in day time is 55 dB while at night is 45 dB.

4. Protection of Archeological and Historical Sites

a) Upon discovery of ancient heritage, relics or anything that might or believed to be of archeological or historical importance during the execution of works, immediately suspend and report such findings to the SE so that the appropriate authorities may be expeditiously contacted for fulfilment of the measures aimed at protecting such historical or archaeological resources.

b) The contractor shall take the necessary measures for preventing that any person or equipment may damage the article or things and shall provide barricades, fences, and signals and, if necessary, protect against atmospheric agents, as directed by the engineer. Also guard service may be required by the engineer.

c) The supervising engineer shall take the following measures:

- Notify the relevant department of antiquities,
- Request for representative to make site inspection,
- Secession of work in the vicinity of the find until the visit of representative; and

- Decision by the department of antiquities on possible salvage or excavation within 48-72 hours of notification

5. **Vegetation and Wildlife**

a) The contractor shall care, in planning, constructing, maintaining and operating temporary works such as camps, roads, spoil, stockpile and construction facilities areas, to avoid unnecessary damage to areas of particular environmental interest, such as patches of valuable trees and erosion sensitive areas, as well as areas in which the presence of wildlife has been noted.

b) In case some part of forest or single trees has to be removed, or where erosion problems that may affect some portion of the permanent or temporary works are expected, and in any case where in the engineer's opinion it is beneficial for the land conservation, landscaping, seeding and planting of trees, as well as executing drainages and water control works may be required to the contractor, who shall carry out the work according to the prescriptions contained in the pertinent sections of these specifications.

c) No valuable trees hall be damaged or removed by the contractor during the execution of the works without the prior consent of the engineer.

6. Use of Material

The contractor, in as much as possible, shall use local materials to avoid importation of foreign material and long distance transportation.

7. **Worksite/Camp Site Waste Management**

a) All vessels (drums, containers, bags, etc.) containing oil/fuel/surfacing materials and other hazardous chemicals shall be banded in order to contain spillage. Used oil and hydraulic fluid generated on the construction sites must be collected in a closed container and stored temporarily in a safe place and sent to an authorized recycling depot.

b) All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before being discharged into the drainage system in line with applicable government water pollution control regulations.

c) The contractor shall take all possible steps to prevent pollution of streams, rivers, and other water supplies, at or in the vicinity of the site and shall comply with applicable laws, orders and regulations in force in the country of the works concerning the control and abatement of water pollution.

d) Entry of runoff to the site shall be restricted by constructing diversion channels or holding structures such as banks, drains, dams, etc. to reduce the potential of soil erosion and water pollution.
e) Construction waste shall not be left in stockpiles along the road, but removed and reused or disposed of on a daily basis and should be also restricted within the project site.
f) If disposal sites for clean spoil are necessary, they shall be located in areas, approved by the SE, for landfill and where they will not result in material being easily washed into drainage channels. Whenever possible, spoil materials should be placed in low-lying areas and should be compacted and dressed with top soil and then planted with species indigenous to the locality.
g) The contractor shall provide all sanitary facilities (e.g. garbage collection and disposal, safety tank, drinking water facilities, etc.) are provided in construction workers camps.

8. **Rehabilitation and Soil Erosion Prevention**

a) To the extent practicable, the Contractor shall rehabilitate the site progressively so that the rate of rehabilitation is similar to the rate of construction.
b) Always remove and retain topsoil for subsequent rehabilitation. Soils shall not be stripped when they are wet as this can lead to soil compaction and loss of structure.
c) Topsoil shall not be stored in large heaps. Low mounds of no more than 1 to 2m high are recommended.
d) Re-vegetate the stockpiles with recommended grass species to protect the soil from erosion, discourage weeds and maintain an active population of beneficial soil microbes.
e) Locate stockpiles where they will not be disturbed by future construction activities.
f) The contractor shall reinstate natural drainage patterns where they have been altered or impaired.
g) The contractor shall collect toxic materials from construction areas and keep protect in designated sites until proper disposal. Backfill excavated areas with soils or overburden that is free of foreign material that could pollute groundwater and soil.
h) Identify potentially toxic overburden and screen with suitable material to prevent mobilization of toxins.
i) Ensure reshaped land is formed so as to be inherently stable, adequately drained and suitable for the desired long-term land use, and allow natural regeneration of vegetation.
j) Minimize the long-term visual impact by creating landforms that are compatible with the adjacent landscape.

k) Minimize erosion by wind and water both during and after the process of reinstatement.

l) Compacted surfaces shall be deep ripped to relieve compaction unless subsurface conditions dictate otherwise.

m) Re-vegetate with plant species that will control erosion, provide vegetative diversity and, through succession, contribute to a resilient ecosystem. The choice of plant species for rehabilitation shall be done in consultation with local research institutions, forest department and the local people.

9. Water Resources Management

a) The Contractor shall at all costs avoid conflicting with water demands of local communities.

b) Abstraction of both surface and underground water shall only be done with the consultation of the local community and after obtaining a permit from the relevant Water Authority.

c) Abstraction of water from wetlands shall be avoided. Where necessary, permission has to be obtained from relevant authorities.

d) No construction water containing spoils or site effluent, especially cement and oil, shall be allowed to flow into natural water drainage courses.

e) Wash water from washing out of equipment shall not be discharged into water courses without pretreated.

f) Site spoils and temporary stockpiles shall be located away from the drainage system, and surface runoff shall be directed away from stockpiles to prevent erosion.

10. Traffic Management

a) Location of access roads shall be done in consultation with the local community especially in important or sensitive environments. Access roads shall not traverse wetland areas.

b) Upon the completion of civil works, all access roads shall be ripped and rehabilitated

c) Access roads shall be watered regularly to suppress dust emission.

11. Disposal of Unusable Elements

a) Unusable materials and construction elements such as electro-mechanical equipment, pipes, accessories and demolished structures will be disposed of in a manner approved by the SE. The Contractor has to agree with the SE which elements are to be surrendered to the Client's premises, which will be recycled or reused, and which will be disposed of at approved landfill sites.

b) Unsuitable and demolished elements shall be dismantled to a size fitting on ordinary trucks for transport.

12. Repair of Private Property

a) Should the Contractor, deliberately or accidentally, damage private property, he shall repair the property to the owner's satisfaction and at his own cost. For each repair, the Contractor shall obtain from the owner a certificate that the damage has been made good satisfactorily in order to indemnify the Client from subsequent claims.

b) In cases where compensation for inconveniences, damage of crops etc. are claimed by the owner, the Client has to be informed by the Contractor through the SE. This compensation is in general settled under the responsibility of the Client before signing the Contract. In unforeseeable cases, the respective administrative entities of the Client will take care of compensation.

13. Contractor's Environment, Health and Safety Management Plan (EHS- MP)

Within 6 weeks of signing the Contract, the Contractor shall prepare an EHS-MP to ensure the adequate management of the health, safety, environmental and social aspects of the works, including implementation of the requirements of these general conditions and any specific requirements of an ESMP for the works.

The Contractor's EHS-MP will serve two main purposes:-

a) For the Contractor, for internal purposes, to ensure that all measures are in place for adequate EHS management, and as an operational manual for his staff, and,

b) For the Client, supported where necessary by SE, to ensure that the Contractor is fully prepared for the adequate management of the EHS aspects of the project, and as a basis for monitoring of the Contractor's EHS performance.

The Contractor's EHS-MP shall provide at least:-

- a description of procedures and methods for complying with these general environmental and social management conditions, and any specific conditions specified in an ESMP;
- a description of specific mitigation measures that will be implemented in order to minimize adverse impacts;
- a description of all planned monitoring activities (e.g. sediment discharges from borrow areas) and the reporting thereof; and
- The internal organizational, management and reporting mechanisms put in place for such.

The Contractor's EHS-MP will be reviewed and approved by the Client before start of the works. This review should demonstrate if the Contractor's EHS-MP covers all of the identified impacts, and has defined appropriate measures to counteract any potential impacts.

13.1 Health and Safety

a) The contractor shall ensure that the project adheres to the Environmental, Health and Safety Guidelines in the ESMP.
b) In advance of the construction work, the Contractor shall mount an awareness and hygiene campaign. Workers and local residents shall be sensitized on health risks particularly of HIV/AIDS.
c) Adequate road signs to warn pedestrians and motorists of construction activities, diversions, etc. shall be provided at appropriate points.
d) Construction vehicles shall not exceed maximum speed limit of 40km per hour.

13.2 Traffic Safety

a) Ensure public safety, and meet traffic safety requirements for the operation of work to avoid accidents.
b) The contractor shall be responsible for the safety along the roads related to the site, and he shall take all necessary precautions for the protection of the work and the safety of the public on the roads affected by his activities.
c) Roads subject to interference by the work shall be kept open or suitable detours shall be provided and maintained by the contractor, who shall provide, erect, and maintain all necessary barricades, suitable and sufficient flashlights, flagmen, danger signals, and signs.
d) The contractor shall submit his weekly activities schedule and the locations of his work along the existing public roads to the authorities concerned, and obtain all necessary approvals prior to commencement of the respective work.
e) At the road crossings or in heavy traffic locations, the contractor shall carry out the work within the working hours as directed by the engineer, and after the completion of the work he shall immediately make the necessary backfill and pavement at the crossings.
f) The contractor shall provide temporary passes and bridges to give an access to the existing villages, houses, etc., to the satisfaction of the engineer and the authorities concerned whenever he disturbs such existing way during the execution of the works.

14. Workers and contractors Code of Conduct

- Construction Managers should be guided in all their relationships by the highest standards of integrity and honesty.
- Construction Managers and workers should conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation and value of the profession.
- Construction Managers and workers should avoid conduct or practices that deceive the public or represent a real or perceived conflict of interest.
- Construction Managers should respect the rights of others and should not discriminate on the basis of race, color, gender, marital status, religion, national origin, age, disability, or sexual orientation nor knowingly violate any law, statute, or regulation in the performance of professional services. Construction managers should strive to create a diverse workforce.
- Construction Managers should have a zero-tolerance policy for any form of harassment including sexual harassment and bullying,
- Contractors must not engage in the exploitation of child labour*4* and contractors must take the necessary steps to prevent the employment of child labour,
- Contractors, their staff, sub-contractors and any other personnel engaged by the contractor, must not exploit the vulnerability of any target group in the context of development, humanitarian and advocacy work, especially women and children, or allow any person/s to be put into compromising situations. Never abuse a position to withhold development or humanitarian assistance, or give preferential treatment; in order to solicit sexual favours, gifts, payments of any kind, or advantage
- The use of physical abuse, disciplinary punishment, sexual abuse, the threat of sexual and physical abuse, and other forms of intimidation may never be practiced by contractors and workers,

15. Reporting

The Contractor shall prepare monthly progress reports to the SE on compliance with these general conditions, the project ESMP if any, and his own EHS-MP. It is expected that the Contractor's reports will include information on:-

- EHS management actions/measures taken, including approvals sought from local or national authorities;
- Problems encountered in relation to EHS aspects (incidents, including delays, cost consequences, etc., as a result thereof);

- Lack of compliance with contract requirements on the part of the Contractor;
- Changes of assumptions, conditions, measures, designs and actual works in relation to EHS aspects; and
- Observations, concerns raised and/or decisions taken with regard to EHS management during site meetings.

It is advisable that reporting of significant EHS incidents be done "as soon as practicable". Such incident reporting shall therefore be done individually. Also, it is advisable that the Contractor keeps his own records on health, safety and welfare of persons, and damage to property. It is advisable to include such records, as well as copies of incident reports, as appendixes to the bi-weekly reports. Example formats for an incident notification and detailed report are given below. Details of EHS performance will be reported to the Client through the SE's reports to the Client.

16. Training of Contractor's Personnel

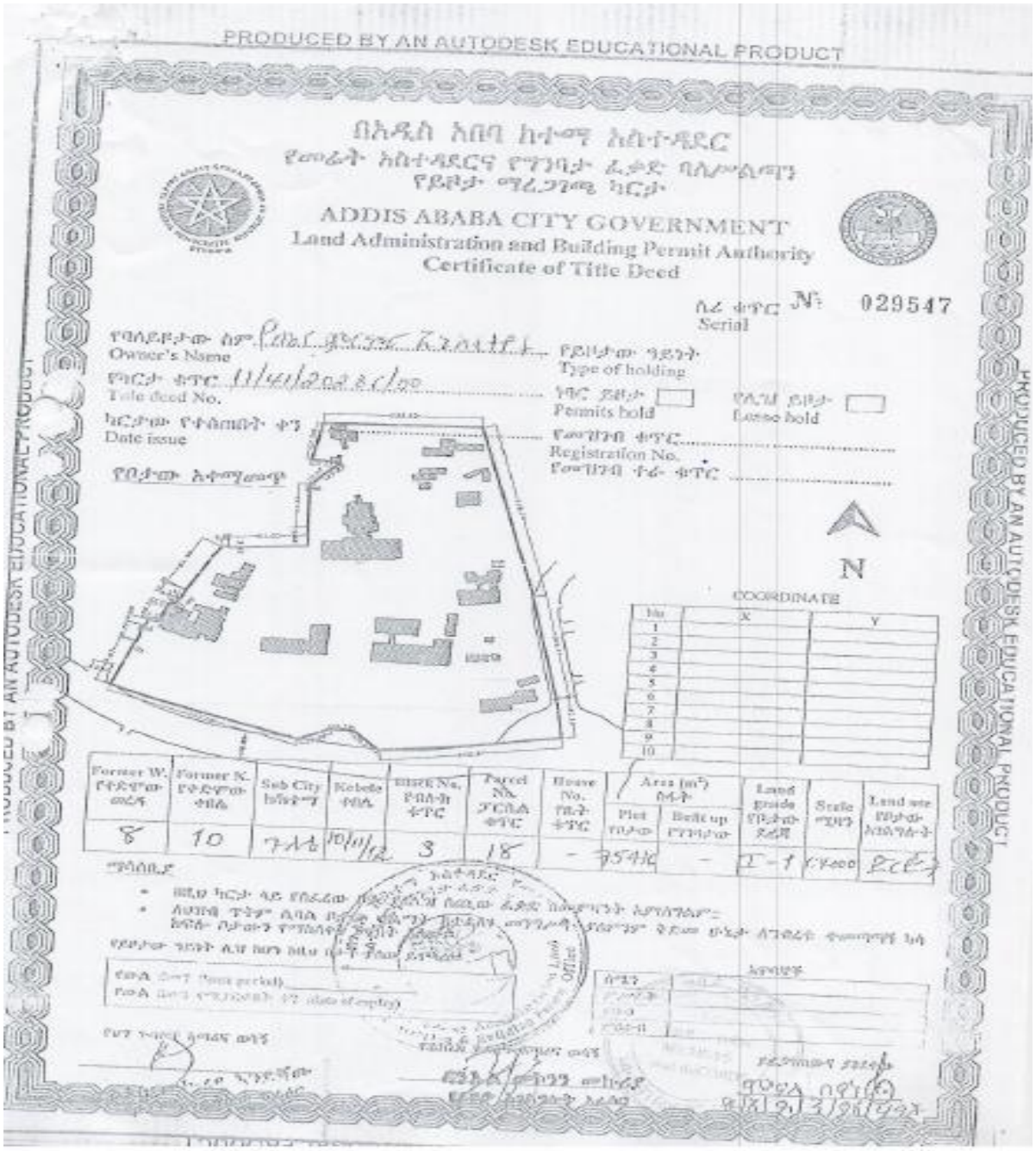
The Contractor shall provide sufficient training to his own personnel to ensure that they are all aware of the relevant aspects of these general conditions, any project EMP, and his own EHS-MP, and are able to fulfill their expected roles and functions. Specific training should be provided to those employees that have particular responsibilities associated with the implementation of the EHS-MP. General topics should be:-

- EHS in general (working procedures);
- Emergency procedures; and
- Social and cultural aspects (awareness creation)

17. Cost of Compliance

It is expected that compliance with these conditions is already part of standard good workmanship and state of art as generally required under this Contract. The item "Compliance with Environmental and Social Management Conditions" in the Bill of Quantities covers these costs. No other payments will be made to the Contractor for compliance with any request to avoid and/or mitigate an avoidable EHS impact.

ANNEX VI: ETHIOPIAN PUBLIC HEALTH CERTIFICATE OF TITLED DEED (LAND OWNERSHIP CERTEFICATE)



PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

በአዲስ አበባ ከተማ አስተዳደር
የመሬት አስተዳደርና የግንባታ ፈቃድ ባለሥልጣን
የይዞታ ማረጋገጫ ካርታ

ADDIS ABABA CITY GOVERNMENT
Land Administration and Building Permit Authority
Certificate of Title Deed

ሰሪ ቁጥር № 029547
Serial

የባለይዞታው ስም Owner's Name
የካርታ ቁጥር Title deed No.
ካርታው የተሰጠበት ቀን Date issue
የይዞታ አቀማመጥ
የይዞታው ዓይነት Type of holding
ፍቃድ ይዞታ Permits hold
የሊዝ ይዞታ Lease hold
የመዝገብ ቁጥር Registration No.
የመዝገብ ተራ ቁጥር

N

COORDINATE

No	X	Y
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Former W.	Former K.	Sub City	Kebele	HHRE No.	Parcel No.	House No.	Area (m²) Plot	Area (m²) Built up	Land Grade	Scale	Land use
8	10	ጎሎሬ	10/11/12	3	18	-	75416	-	I-1	1:1000	ያረፈ

ማስጠንቀቂያ

- ...
- ...

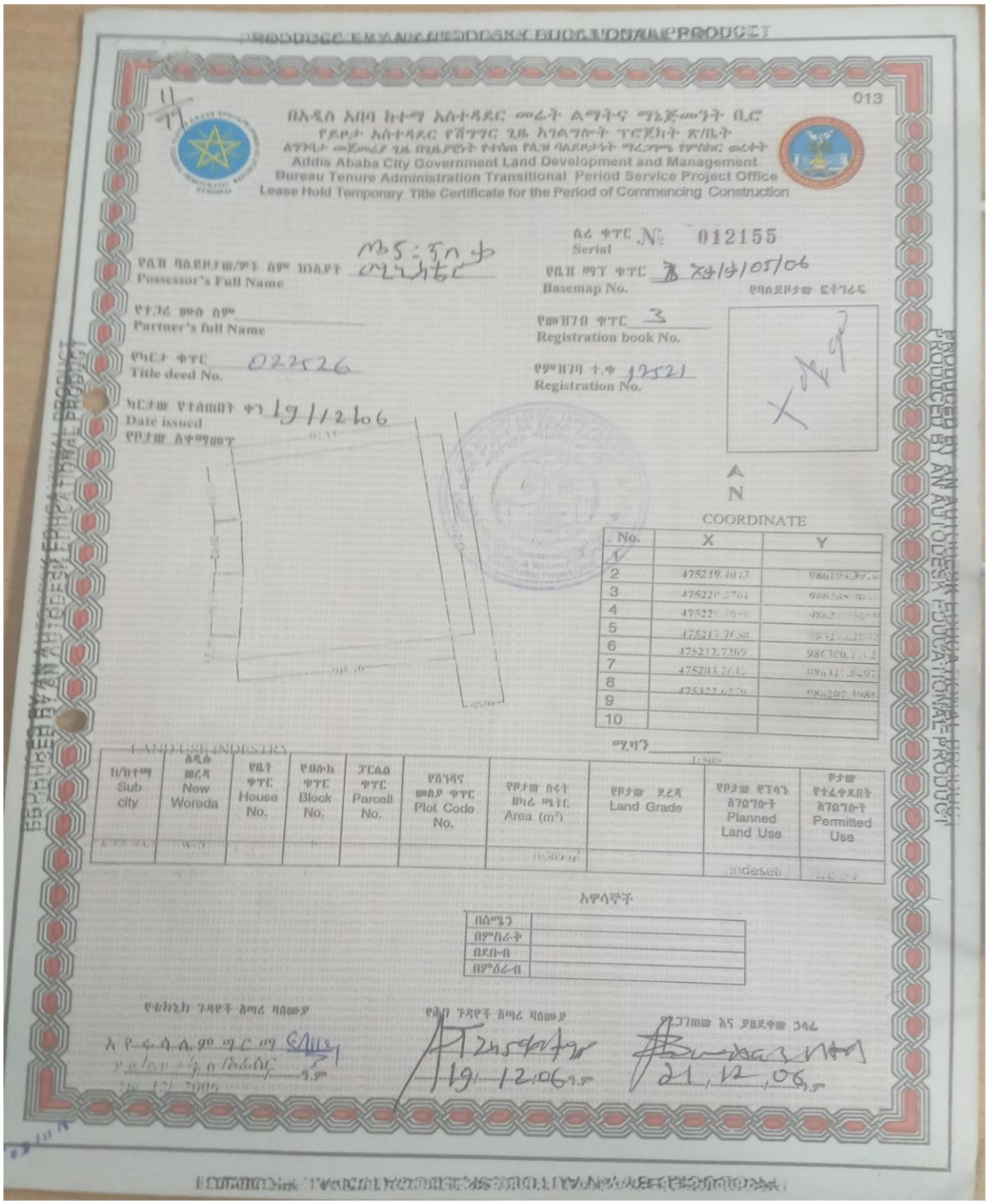
የመሬት ዝውውር ሲኖር ከሆነ ከዚህ ...

የመሬት ... ስም ...

ስለ ... ...

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

ANNEX VII: MINISTRY OF HEALTH – ETHIOPIA CERTIFICATE OF TITLED DEED (LAND OWNERSHIP CERTEFICATE) FOR VACCINE LAB COMPLEX INCULDING WASTEWATER TREATMENT PLANT



PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

013

በአዲስ አበባ ከተማ አስተዳደር መሬት ልማትና ማኔጅመንት ቢሮ
የይዞታ አስተዳደር የሽግግር ጊዜ አገልግሎት ፕሮጀክት ጽ/ቤት
ለማኅሁ መጀመሪያ ጊዜ በሚያሟሉት የተሰጡ የሊዝ ባለይዞታነት ማረጋገጫ የምስክር ወረቀት
Addis Ababa City Government Land Development and Management
Bureau Tenure Administration Transitional Period Service Project Office
Lease Hold Temporary Title Certificate for the Period of Commencing Construction

ሰሪ ቁጥር № 012155
Serial

የቤዝ ማፕ ቁጥር 3 ጽ/ከ/ከ/05/06
Basemap No.

የባለይዞታው ፎቶግራፍ

የዘመዝገብ ቁጥር 3
Registration book No.

የምዝገባ ተ.ቁ 12521
Registration No.

የቤዝ ባለይዞታው/ዎች ስም ከነአያት ሙሉ ስም ገ/ሕይወት
Possessor's Full Name

የተጋሪ ሙሉ ስም
Partner's full Name

የካርታ ቁጥር 022526
Title deed No.

ካርታው የተሰጠበት ቀን 19/12/06
Date issued

የቦታው አቀማመጥ

N

COORDINATE

No.	X	Y
1		
2	475219.4013	[illegible]
3	475220.2764	[illegible]
4	[illegible]	[illegible]
5	475217.7038	[illegible]
6	475212.7369	980300.7712
7	475203.2042	[illegible]
8	[illegible]	980207.4986
9		
10		

ሚዛን 1:500

ክፍለከተማ Sub city	አዲስ ወረዳ New Woreda	የቤት ቁጥር House No.	የብሎክ ቁጥር Block No.	ፓርሴል ቁጥር Parcell No.	የፕላኖ መለያ ቁጥር Plot Code No.	የቦታው በሩን በካሬ ሜትር Area (m²)	የቦታው ደረጃ Land Grade	የቦታው የፕላን አገልግሎት Planned Land Use	የቦታው የተፈቀደበት አገልግሎት Permitted Use
[illegible]	[illegible]	[illegible]	[illegible]			10,500 m²		Indesed	[illegible]

አዋሳኞች

በሰሜን	
በምስራቅ	
በደቡብ	
በምዕራብ	

የቴክኒክ ጉዳዮች አማሪ ባለሙያ
አ የ ሩ ሳ ሌ ም ማ ር ሀ ሳ ሌ ም
ሃ ይ ሌ ሚ ካ ኤ ል ከ ከ ሌ ሌ ሳ ሌ ም
ዓ.ም

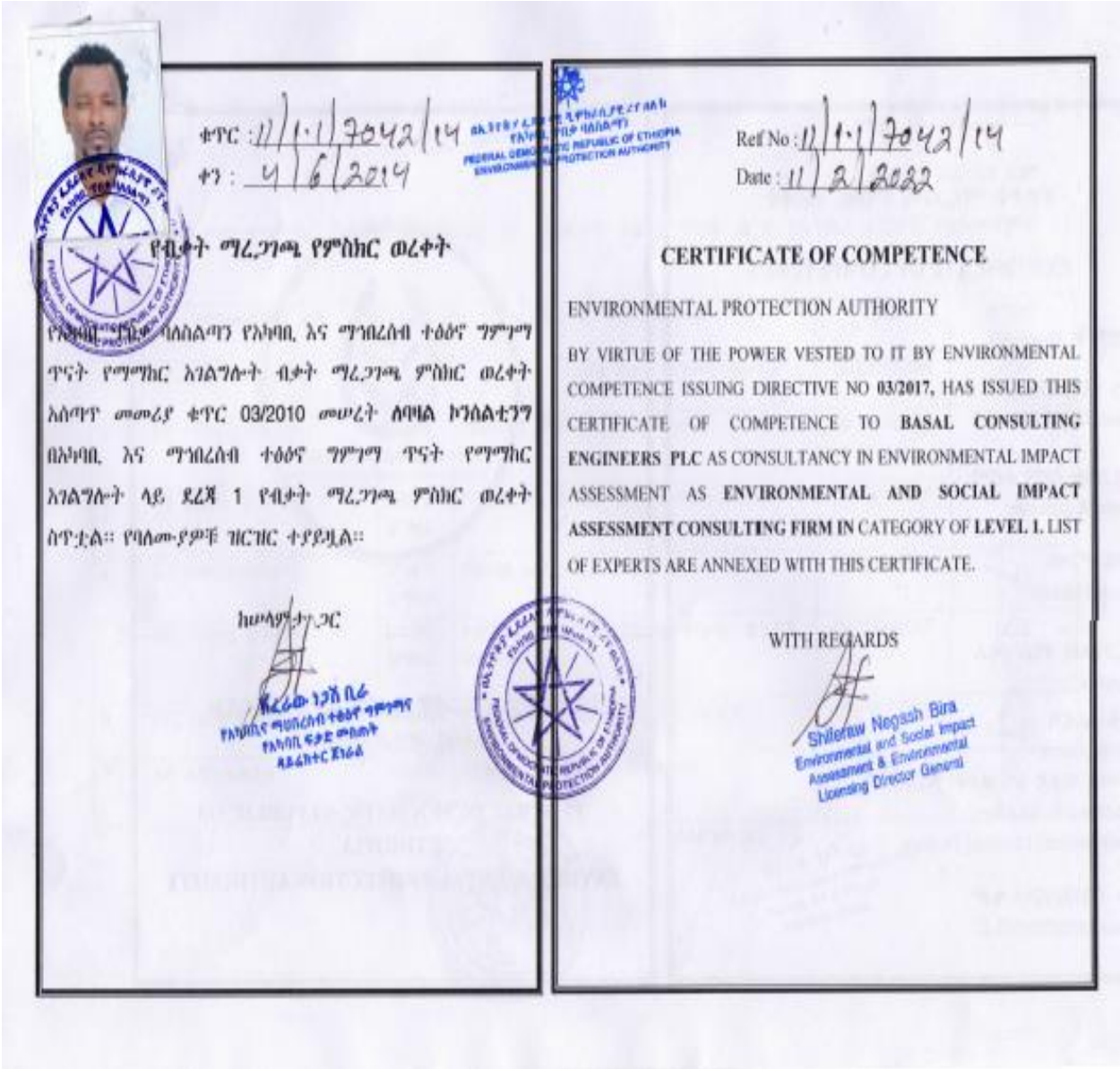
የሕግ ጉዳዮች አማሪ ባለሙያ
19/12/06 ዓ.ም

የተጋገለው እና ያፀደቀው ኃላፊ
21/12/06 ዓ.ም

ANNEX VIII: LABORATORY FACILITY DECOMMISSIONING CHECKLIST

Building number		**Room Number:**
Acceptance Check	**Comment**	**Pass (Yes/no)**
Inform the departments the intended decommissioning of the LAB building before three month		
Decontaminate the room(s) and all exposed facilities of all the hazards?		
Will the lab matariales (s) be disposed or re-used for other purposes?		
Will the room(s) be disposed or re-used for other purposes?		

ANNEX IX: LEGAL DOCUMENTS OF THE CONSULTANT



ቁጥር : 11/1.1/7042/14
ቀን : 4/6/2014

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ ጥበቃ ባለስልጣን የአካባቢ እና ማኅበረሰብ ተፅዕኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለባሳል ኮንሰልቲንግ በአካባቢ እና ማኅበረሰብ ተፅዕኖ ግምገማ ጥናት የማማከር አገልግሎት ላይ ደረጃ 1 የብቃት ማረጋገጫ ምስክር ወረቀት ሰጥቷል። የባለሙያዎቹ ዝርዝር ተያይዟል።

ከሠላምታ ጋር

ሽፈራው ነጋሽ ቢራ
የአካባቢና ማህበረሰብ ተፅዕኖ ግምገማና
የአካባቢ ፍቃድ መስጠት
ዳይሬክተር ጀነራል

Ref No : 11/1.1/7042/14
Date : 11/2/2022

CERTIFICATE OF COMPETENCE

ENVIRONMENTAL PROTECTION AUTHORITY

BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO **03/2017**, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **BASAL CONSULTING ENGINEERS PLC** AS CONSULTANCY IN ENVIRONMENTAL IMPACT ASSESSMENT AS **ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT CONSULTING FIRM IN** CATEGORY OF **LEVEL 1.** LIST OF EXPERTS ARE ANNEXED WITH THIS CERTIFICATE.

WITH REGARDS

Shiferaw Negash Bira
Environmental and Social Impact Assessment & Environmental Licensing Director General

የብቃት ማረጋገጫ ምስክር ወረቀት

CERTIFICATE OF COMPETENCE

ዕድሣት (Renewal)

ቀን : 02/06/2017 ዓ.ም
Date: 09/02/2025G.C

ያዘጋጀው ስምና ፊርማ
Name & Signature

አየለ ምንዳዩ
Ayele Mindaye

ያረጋገጠው የስራ ኃላፊ
Checked by

ጎንፋ አራርሳ
Gonfa Ararsa
የአካባቢ ፍቃድ እና ብቃት ማረጋገጫ
ዳይሬክቶሬት ዳይሬክተር
Environmental Licensing Director

ቀን :03/06/2014 ዓ.ም
Date:10/02/2022G.C

የኢትዮጵያ የአካባቢ ጥበቃ ባለስልጣን
Ethiopian Environmental Protection Authority

በኢትዮጵያ ፌዴራላዊ ዲሞክራሲያዊ ሪፐብሊክ
የአካባቢ ጥበቃ ባለስልጣን

FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ENVIRONMENTAL PROTECTION AUTHORITY

የኢትዮጵያ ፌዴራላዊ ዲሞክራሲያዊ ሪፐብሊክ
የአካባቢ ጥበቃ ባለስልጣን
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ENVIRONMENTAL PROTECTION AUTHORITY

ቁጥር: 11/1/7042/14

ቀን: 03/06/2014 ዓ.ም

ለባዛል ኮንሰልቲንግ የማማከር አገልግሎት በአካባቢ እና ማህበራዊ ተፅዕኖ ጥናት ዘርፍ የአማካሪ ድርጅት የባለሙያዎች ዝርዝር

ተ/ቁ	የባለሙያዎች ስም	ደረጃ	የሚያማክሩበት ሙያ	ስልክ	ፊሚነት
1	አቶ ሀብታሙ ማስረሻ	ከፍተኛ አማካሪ	የሙቀት አማቂ ጋዝ ልቀት ተንታኝ ባለሙያ	0930285738	ሥራ አስኪያጅ
2	አቶ ማስረሻ ቆየ ሰው	ከፍተኛ አማካሪ	የኢኮኖሚ ጉዳዮች ተንታኝ ባለሙያ	0911549357	
3	አቶ የሽዋስ ጥጋቡ	ከፍተኛ አማካሪ	የማህበራዊ ጉዳዮች ተንታኝ ባለሙያ	0920215788	✓
4	አቶ መኮንን ጌታሁን	ከፍተኛ አማካሪ	የአካባቢ ጤና ተንታኝ ባለሙያ	0912021016	
5	ዶ/ር ግዛህኝ ጌታቸው	ከፍተኛ አማካሪ	የብዝሐ ሕይወት እና የስርዓተ-ምህዳር ተንታኝ ባለሙያ	0912865113	
6	ዶ/ር አሰፋ ተክሌ	መካከለኛ አማካሪ	የውሃ ሀብት አጠቃቀም አጥኚ ባለሙያ	0921529218	
7	አቶ ሶሪ ጫልቺሳ	ከፍተኛ አማካሪ	የአካባቢ ብክለት ተንታኝ ባለሙያ	0912830933	

ከሰላምታ ጋር

ፈረሁ ነጋሽ ቢራ
የአካባቢና ማህበረሰብ ተፅዕኖ ግምገማና
የአካባቢ ፍቃድ መስጠት
ዳይሬክተር ጄነራል

የንግድ ስም ምሥክር ወረቀት ቁጥር 0042863148

የንግድ ምዝገባ ቁጥር 10-3141/2007

የንግድ ሥራ ፈቃድ ቁጥር 10-16/2008

በአማራ ብሔራዊ ክልላዊ መንግስት

የንግድና ትራንስፖርት ቢሮ

የንግድ ስም ምዝገባ ምስክር ወረቀት

በንግድ ሥራ ምዝገባና ፈቃድ አዋጅ ቁጥር 686/2002 መሠረት የተሰጠ

1 ሥም ኢሳያው ኢሳያስ ቢያጸጋ

2. የንግድ ዋና ጽርፍ መደብ ደቡብ ጎንደር ጎጃምመጠቅ

3 የፈቃድ መስጫ መደብ 88222

4 የንግድ ሥራው አድራሻ

ክልል አማራ ዞንስተማ አስተዳደር ዳባት ወረዳ ዳባት ከተማ ደንገዝ ቀበሌ 10 ፖቤት ቁጥር ፸B41-43

ስልክ ቁጥር 0930285738 ፖ.ሣ.ቁ ---------- ፋክስ ----------

5 የንግድ ስም "ባዛል ካንሰልቲንግ" / BASAL CONSULTING

6 ከላይ የተሰጠው የንግድ ስም በአዋጅ ቁጥር 686/2002 አንቀጽ 24 መሠረት የአመልካቹ/ዎች የንግድ ስም ተደርጎ የተመዘገበ መሆኑን እናረጋግጣለን።

ይህ የምዝገባና የምስክር ወረቀት ዛሬ 05/05 ቀን 200 8 ዓ/ም በ ጋንጋሊ ከተማ ተሰጠ

የንግድ ምዝገባና ፅድሳት ኦፊሰር ስም ኢሳያስ ወንጌሳ ፊርማ

ማሳሰቢያ፣ በንግድ ስሙ ላይ ማናቸውም መሻሻል በሚደረግበት ጊዜ በሁለት ወር ጊዜ ውስጥ መስተካከል አለበት።

1390

በአማራ ብሔራዊ ክልላዊ መንግስት
ንግድ ቢሮ

Amhara National Regional State
Trade Bureau

ሲሪ ቁ./Serial № 0948379

የግብር ከፋይ መለያ ቁ. /TIN	0042865148
የንግድ ምዝገባ ቁ. Principal Registration No.	AM/DES/BW/1/0000049/2008
የቀደሞው ንግድ ፈቃድ ቁጥር Previous License No.	016/07
የንግድ ሥራ ፈቃድ ቁጥር Business License No.	AM/DES/BW/03/137/5945047/2008
ቀድሞ ተሰጠበት ቀን Previous Date of issuance	27/9/2007
የተሰጠበት ቀን Date of issuance	3/2/2008
የታደሰበት ቀን Renewal Date	26/1/2014

የንግድ ሥራ ፈቃድ

በንግድ ምዝገባና ፈቃድ አዋጅ ቁጥር 980/2008 መሰረት ተሰጠ

Business License

Issued Under Commercial Registration and Business license proc.No 980/2016

1. የግለሰቡ/ድርጅቱ ስም	ሰማዉ አስማረ ቢያድጌ
2. ዜግነት	ኢትዮጵያዊ
3. የንግድ ስም	
4. ሥራ አስኪያጅ ስም	አቶ ሰማዉ አስማረ ቢያዴጌ
5. የንግድ ድርጅቱ አድራሻ	
ክልል	አማራ
ዞን/ክፍለ ከተማ	ደቡብ ወሎ
ወረዳ	ደሴ
ቀበሌ	KEBELE 10
የጌጦ ቁጥር	tb41-43
ስልክ ቁጥር	0913436142
ፋክስ	----
ኢ-ሜይል	----
6. የንግድ ሥራ መስክ	(86312)በአካባቢ ኦዲትና አጠባበቅ የማማከር አገልግሎት (86311)በጤና የማማከር አገልግሎት
7. ካፒታል በኢት ብር	558,586.00
ይህ የንግድ ፈቃድ ዘሬ	26/1/2014 በ አማራ
የሃላፊ ስም/Name of Official	
ፊርማ/Signature	

1. Owner/Company Name	SEMAW ASMARE BIYADGIE
2. Nationality	Ethiopian
3. Trade Name	
4. General Manager Name	Mr. SEMAW ASMARE BIYADGIE
5. Business Address	
Region	Amhara
Zone/Sub City	SOUTH WELLO
Woreda	DESSIE
Kebele	KEBELE 10
House No.	tb41-43
Tel.No	0913436142
Fax	----
E-mail	----
6. Field of Business	(86312)Environmental auditing and environmental protection consultancy service (86311)Health consultancy service
7. Capital in ETB	558,586.00
This Business License is issued in	Amhara
on day	10/6/2021

ለ2014 ታድሷል

ማስሳቢያ- 1. ይህ የንግድ ፍቃድ በዓዋጅ ፈቃድ ቁጥር 980/2008 መሠረት እንደ የበጀት ዓመቱ ገልዎ በተቀመጠው ጣገረት መታደስ አለበት።
N.B. This License Shall be renewed in accordance with Proclamation No. 980/2008 as per the fiscal year.

2. ይህ የንግድ ፈቃድ የምስክር ወረቀት በመስተላለፍ ወይም በሌላ ሊያዝ አይችልም።
The holder of this License is forbidden for surrendering or debt

የኢትዮጵያ ፌደራላዊ ዲሞክራሲያዊ ሪፐብሊክ
የአማራ ብሔራዊ ክልላዊ መንግስት ዝቢዎች ባለስልጣን
Federal Democratic Republic of Ethiopia
AMHARA NATIONAL REGIONAL STATE REVENUE AUTHORITY

የግብር ከፋይ ምዝገባ ሰርተፊኬት
TAXPAYER REGISTRATION CERTIFICATE

የግብ ከፋይ መለያ ቁጥር: Taxpayer Identification Number:	0042863148
የድርጅት/የግለሰብ ሥም: Name of Business/Individuel:	ሰማው አስማረ ቢያድጌ SEMAW ASMARE BIYADGIE
የተመዝገበ አድራሻ/Registered Address:	
ክልል: Region:	አማራ AMAHARA
ዞን/ቅ.አተማ: Zone/Sub City:	ደቡብ ወሎ ዞን SOUTH WOLLO
ወረዳ: Woreda:	ደሴ ከተማ DESSIE KETEMA
ቀበሌ /በአማርኛ/: Kebele/Farmer's Assoc.:	010 010
የቤት ቁጥር: House No.:	new
የንግዱ ዓይነት: Nature of Business:	LEGAL SERVICES
የሰጠው ተቋም: Issuing Authority:	የአማራ ብሔራዊ ክልላዊ መንግስት ዝቢዎች ባለስልጣን AMHARA NATIONAL REGIONAL STATE REVENUE AUTHORITY
የተሰጠበት ቀን: Date of Issuance:	26 GINBOT 2007 03-JUN-15

ይህ የምስክር ወረቀት የግብር ከፋይነን ብቸኛ የግብር ከፋይነት ምዝገባ ሲሆን ከዚህ ቀደም የነበሩ የግብር ከፋይነት ምዝገባ ሰነዶች ካሉ በዚህ ሰነድ የተተኩ መሆናቸውን ነው።
እባክዎ በተጠቀሰው መሠረት ማንኛውም አይነት ለውጥ ቢደረግ ግብር ከፋዩ ለሚመለከተው የግብር ሰብሳቢ ጽ/ቤት የማሳወቅ ኃላፊነት አለበት።

This certificate represents the sole and only registration as a taxpayer and supersedes all prior registration documentation.
The taxpayer is responsible for notifying the appropriate Tax Office of any changes to the above information.

የሰርተፊኬት ቁ.: Certificate No.: 1138657810013

1138657810013

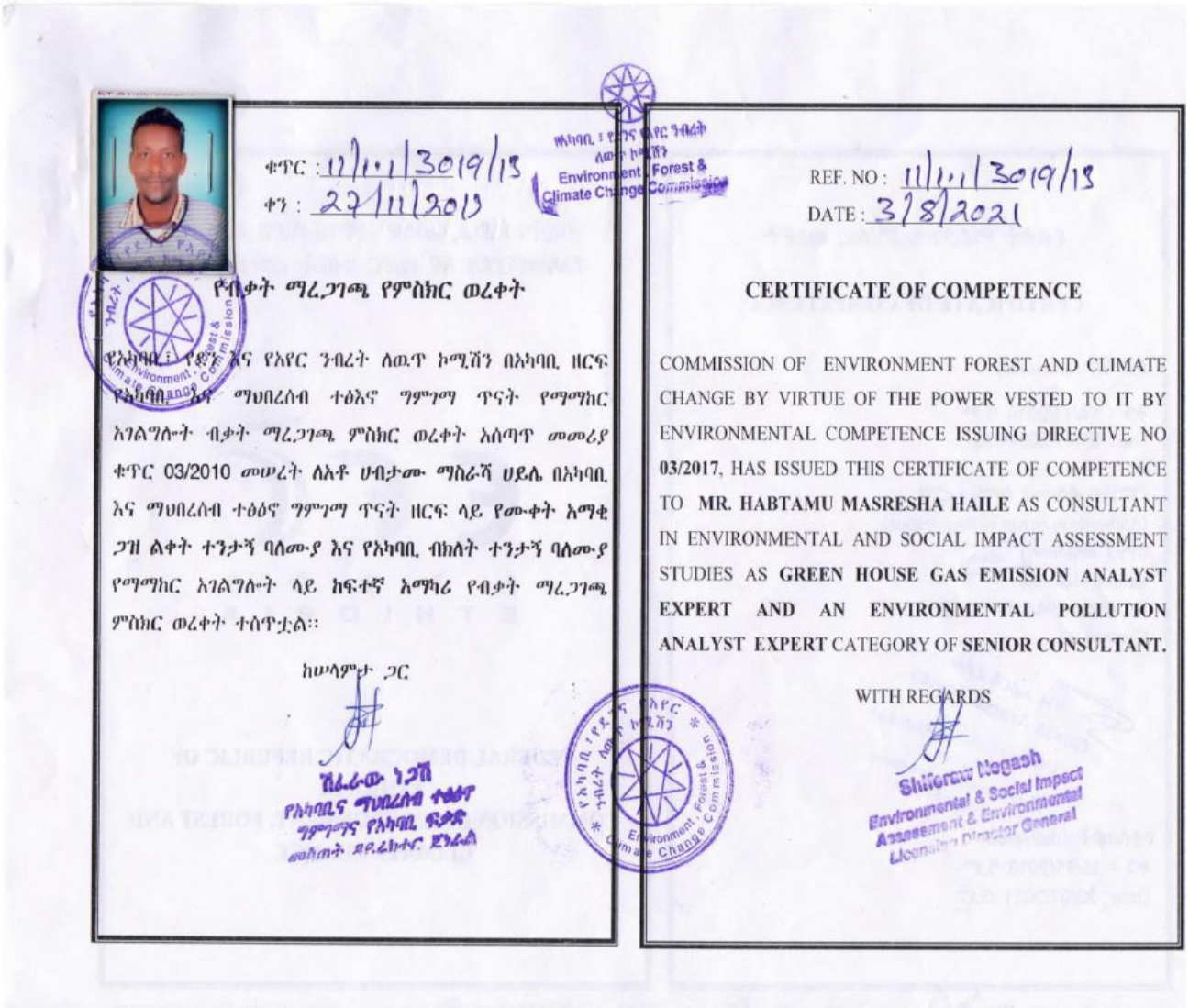
የሚሰጥ ሥልጣን መ/ቤት ማህተም
Seal of Issuing Authority

ANNEX X: CV SUMMARY AND COMPITENCY CERTIFICATE OF CONSULTANTS

1. Mr.Habtamu Masresha (Greenhouse gas emission control expert)

1.1 Personal Data

- Full name: Habtamu Masresha (Greenhouse gas emission control expert)
- Marital status: Married
- Age: 34
- Mailing address: habtamumar@gmail.com
- Permanent address: AA, Ethiopia
- Mobile: +251-921964514



ቁጥር : 11/1.1/3019/13
ቀን : 27/11/2013

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደንና የአየር ንብረት ለውጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ ሀብታሙ ማስራሻ ሀይሌ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የሙቀት አማቂ ጋዝ ልቀት ተንታኝ ባለሙያ እና የአካባቢ ብክለት ተንታኝ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል፡፡

ከሠላምታ ጋር

ሽፈራው ነጋሽ
የአካባቢና ማህበረሰብ ተፅዕኖ ግምገማና የአካባቢ ፍቃድ መስጠት ዳይሬክተር ጀነራል

REF. NO : 11/1.1/3019/13
DATE : 3/8/2021

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO **03/2017**, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **MR. HABTAMU MASRESHA HAILE** AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS **GREEN HOUSE GAS EMISSION ANALYST EXPERT AND AN ENVIRONMENTAL POLLUTION ANALYST EXPERT** CATEGORY OF **SENIOR CONSULTANT.**

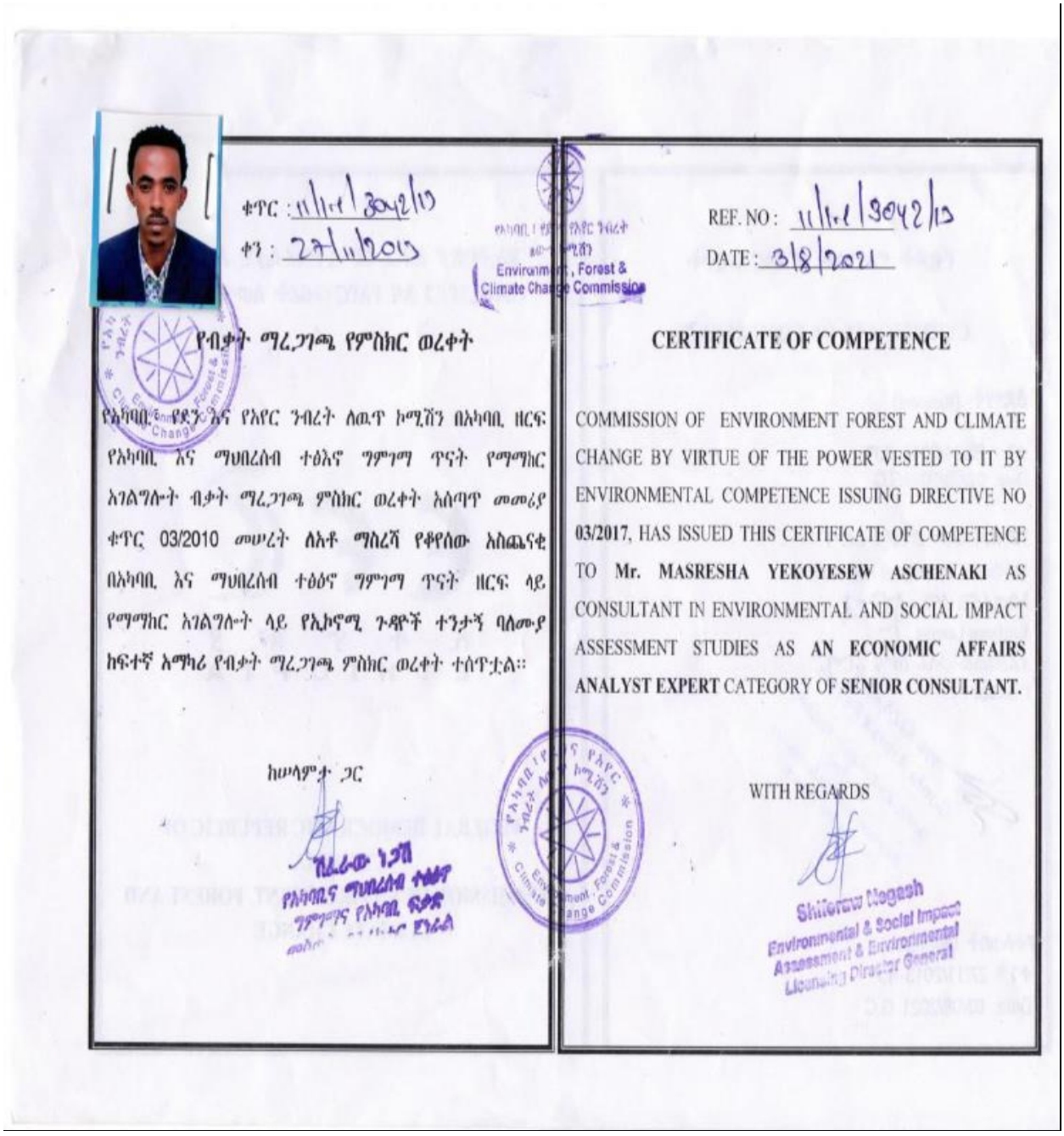
WITH REGARDS

Shiferaw Nogash
Environmental & Social Impact Assessment & Environmental Licensing Director General

2. Mr.Masresha Yekoyesew (MSc, Economic Expert)

2.1 Personal Data

- Full name: Masresha Yekoyesew (Ecoonomic expert)
- Marital status: Single
- Age: 35
- Mailing address: masreshayekoyesew93@gmail.com
- Permanent address: Debrebirhan, Ethiopia
- Mobile: +251-912847366



ቁጥር : 11/1.1/3042/13
ቀን : 27/11/2013

የአካባቢ፣ የደን እና የአየር ንብረት ለውጥ ኮሚሽን
Environment, Forest & Climate Change Commission

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደን እና የአየር ንብረት ለውጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ ማስረሻ የቀየሰው አስጨናቂ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የማማከር አገልግሎት ላይ የኢኮኖሚ ጉዳዮች ተንታኝ ባለሙያ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

ሽፈራው ነጋሽ
የአካባቢና ማህበረሰብ ተፅዕኖ ግምገማና የአካባቢ ፍቃድ መስጫ ... ዳይሬክተር ጄነራል

REF. NO : 11/1.1/3042/13
DATE : 3/8/2021

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO 03/2017, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **Mr. MASRESHA YEKOYESEW ASCHENAKI** AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS **AN ECONOMIC AFFAIRS ANALYST EXPERT** CATEGORY OF **SENIOR CONSULTANT.**

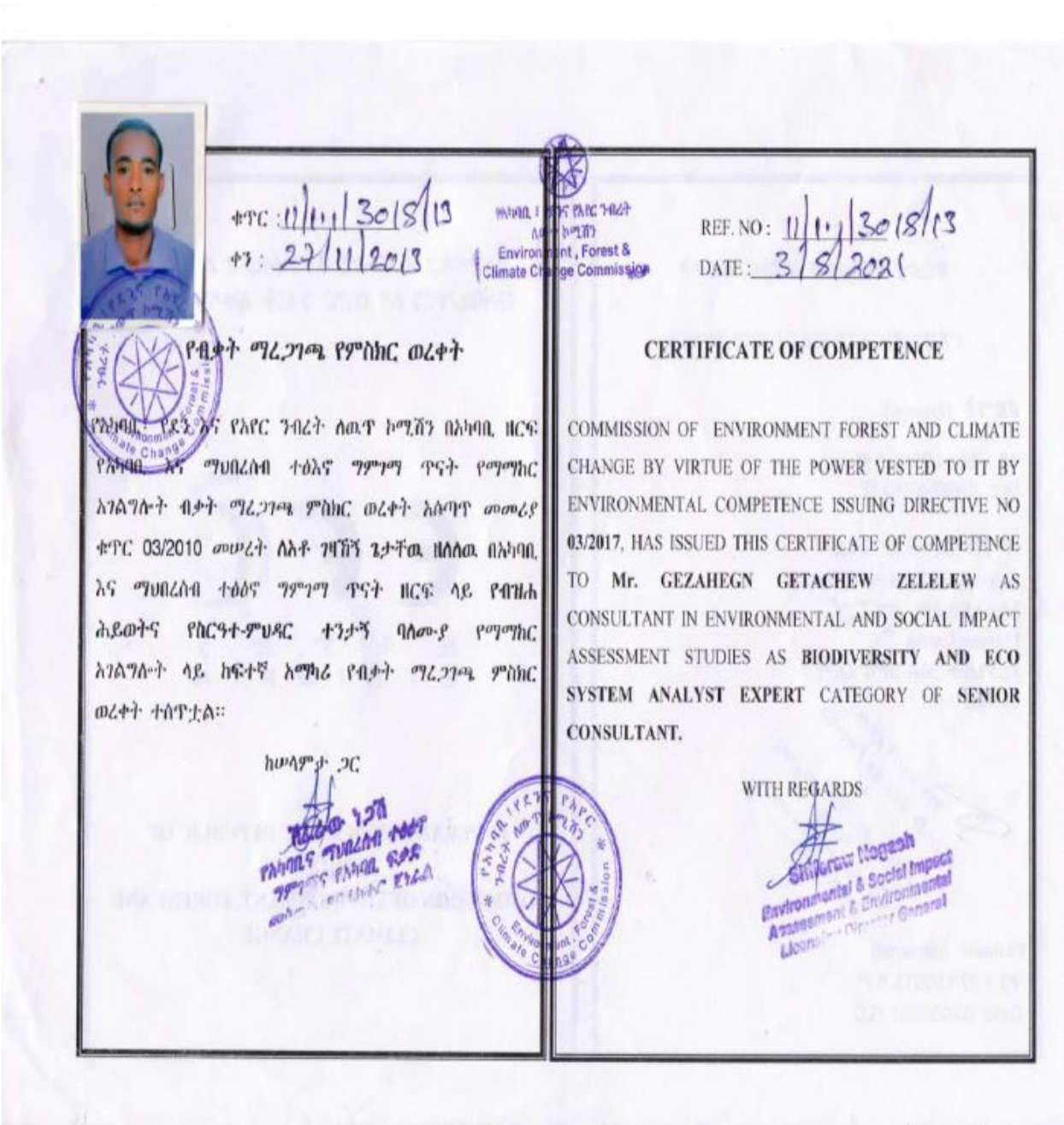
WITH REGARDS

Shiferaw Negash
Environmental & Social Impact Assessment & Environmental Licensing Director General

3. Dr. Gezahegn Getachew **Zelelew** (PhD, MSc, Ecology, Biodiversity Expert)

3.1 Personal Data

- Full name: Gezahegn Getachew Zelelew
- Marital status: Married
- Age:
- Mailing address: geze89@yahoo.com
- Permanent address: Wollo University, Dessie, Ethiopia
- Mobile: +251-912865113



ቁጥር : 11/11/3018/13
ቀን : 27/11/2013

የአካባቢ፣ የደን እና የአየር ንብረት ለውጥ ኮሚሽን
Environment, Forest & Climate Change Commission

REF. NO : 11/11/3018/13
DATE : 3/8/2021

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደን እና የአየር ንብረት ለውጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ ገዛኸኝ ጌታቸዉ ዘለለዉ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የብዝሐ ሕይወትና የስርዓተ-ምህዳር ተንታኝ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

ሽፈራው ነጋሽ
የአካባቢና ማህበረሰብ ተፅዕኖ ግምገማና የአካባቢ ዳታ መሰብሰብ ዳይሬክተር ጄነራል

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO **03/2017**, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **Mr. GEZAHEGN GETACHEW ZELELEW** AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS **BIODIVERSITY AND ECO SYSTEM ANALYST EXPERT** CATEGORY OF **SENIOR CONSULTANT.**

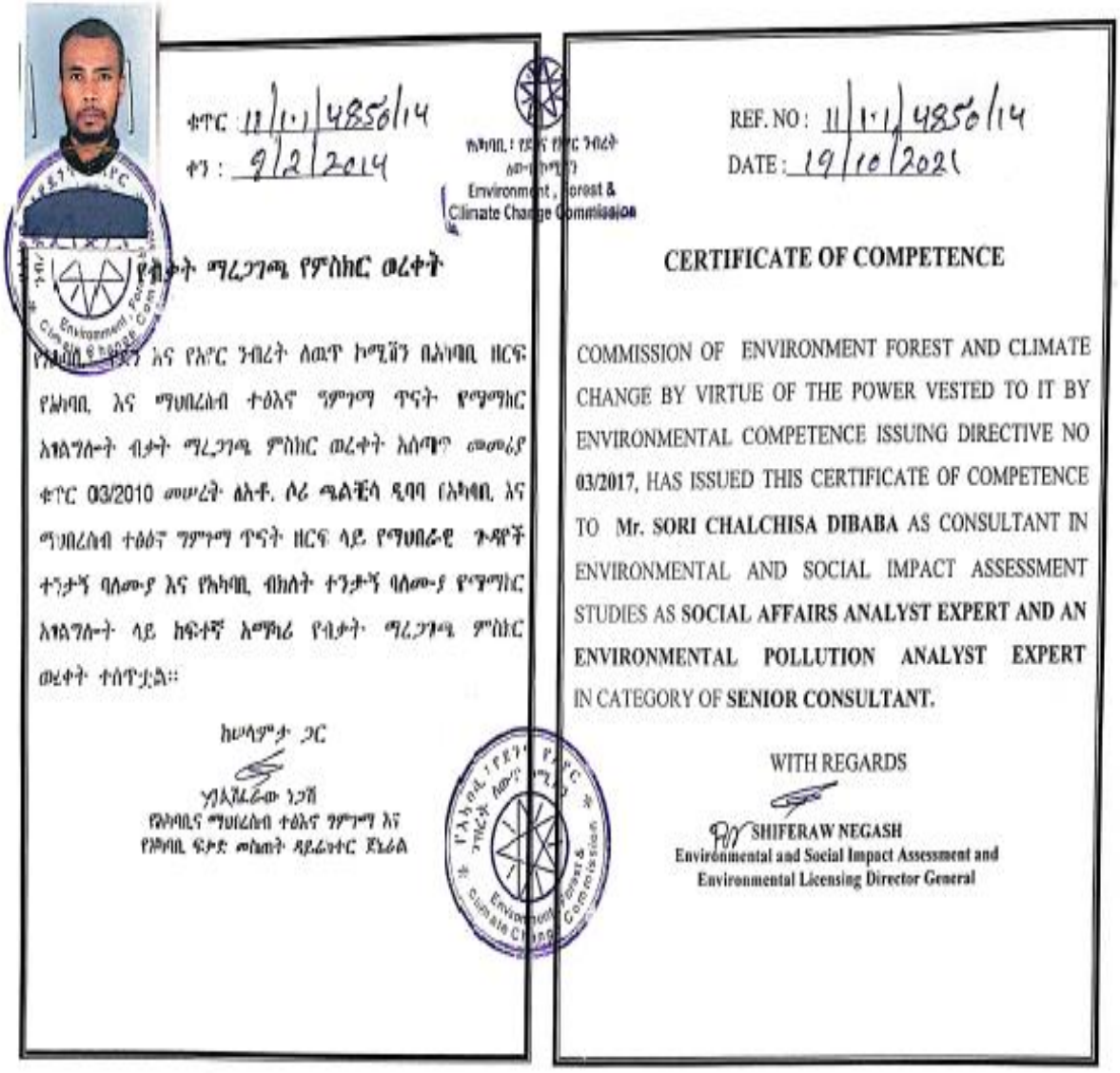
WITH REGARDS

Shiferaw Negash
Environmental & Social Impact Assessment & Environmental Licensing Director General

4. Mr.Sori Chalchisa Dibaba (M.A in Development Studies (Environment and Development))

4.1 Personal Data

- **Full Name:** **Mr. Sori Chalchisa (Environmental pollution Analyst)**
- Marital status: Married
- Age: 34
- Mailing address: soribs2000@gmail.com/ soribs2000@yahoo.com
- Permanent address: Addis Ababa, Ethiopia
- Mobile: +251912-830933



ቁጥር 11/101/4850/14
ቀን: 9/2/2014

የአካባቢ፣ የደንና የአየር ንብረት ለውጥ ኮሚሽን
Environment, Forest & Climate Change Commission

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ ደንና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ. ሶሪ ቻልቺሳ ዲባባ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የማህበራዊ ጉዳዮች ተንታኝ ባለሙያ እና የአካባቢ ብክለት ተንታኝ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

ሃያሲፈራው ነጋሽ
የአካባቢና ማህበረሰብ ተፅእና ግምገማ እና
የአካባቢ ፍቃድ መስጠት ዳይሬክተር ጀኔራል

REF. NO: 11/101/4850/14
DATE: 19/10/2021

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO 03/2017, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **Mr. SORI CHALCHISA DIBABA** AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS **SOCIAL AFFAIRS ANALYST EXPERT AND AN ENVIRONMENTAL POLLUTION ANALYST EXPERT** IN CATEGORY OF **SENIOR CONSULTANT.**

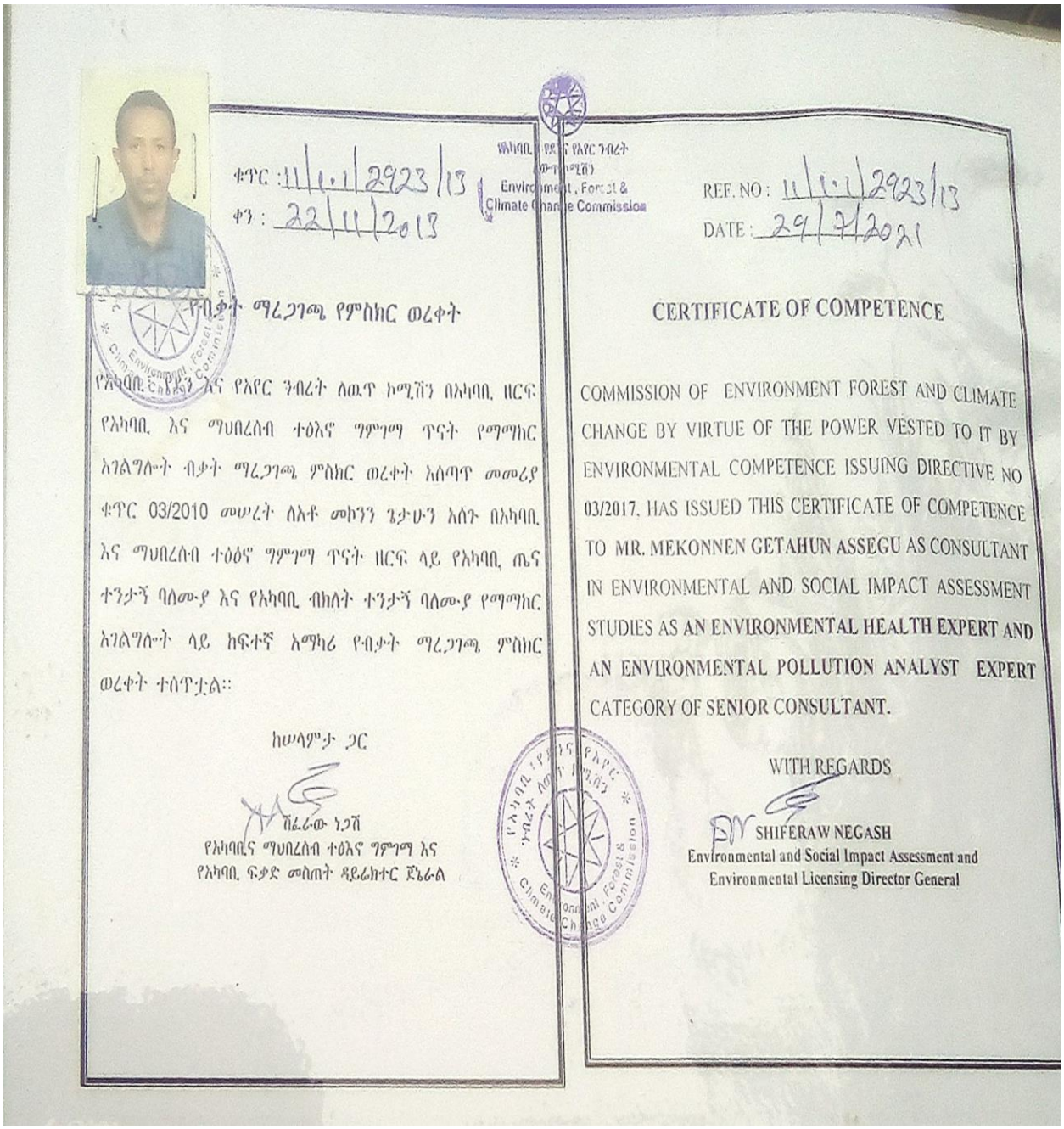
WITH REGARDS

SHIFERAW NEGASH
Environmental and Social Impact Assessment and Environmental Licensing Director General

5. Mr.Mekonnen Getahun (Environmental health expert)

5.1 Personal Data

- Full name: mekonnen Getahun Assegu
- Marital status: Married
- Age: 34
- Mailing address: yalkenu@gmail.com
- Permanent address: Dessie, Ethiopia
- Mobile: +251 912 021016



ቁጥር : 11/1.1/2923/13
ቀን : 22/11/2013

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደንና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ፣ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ መኮንን ጌታሁን አሰጉ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የአካባቢ ጤና ተንታኝ ባለሙያ እና የአካባቢ ብክለት ተንታኝ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

ሽፈራው ነጋሽ
የአካባቢና ማህበረሰብ ተፅእኖ ግምገማ እና
የአካባቢ ፍቃድ መስጠት ዳይሬክተር ጀኔራል

REF. NO : 11/1.1/2923/13
DATE : 29/7/2021

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO 03/2017, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO MR. MEKONNEN GETAHUN ASSEGU AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS AN ENVIRONMENTAL HEALTH EXPERT AND AN ENVIRONMENTAL POLLUTION ANALYST EXPERT CATEGORY OF SENIOR CONSULTANT.

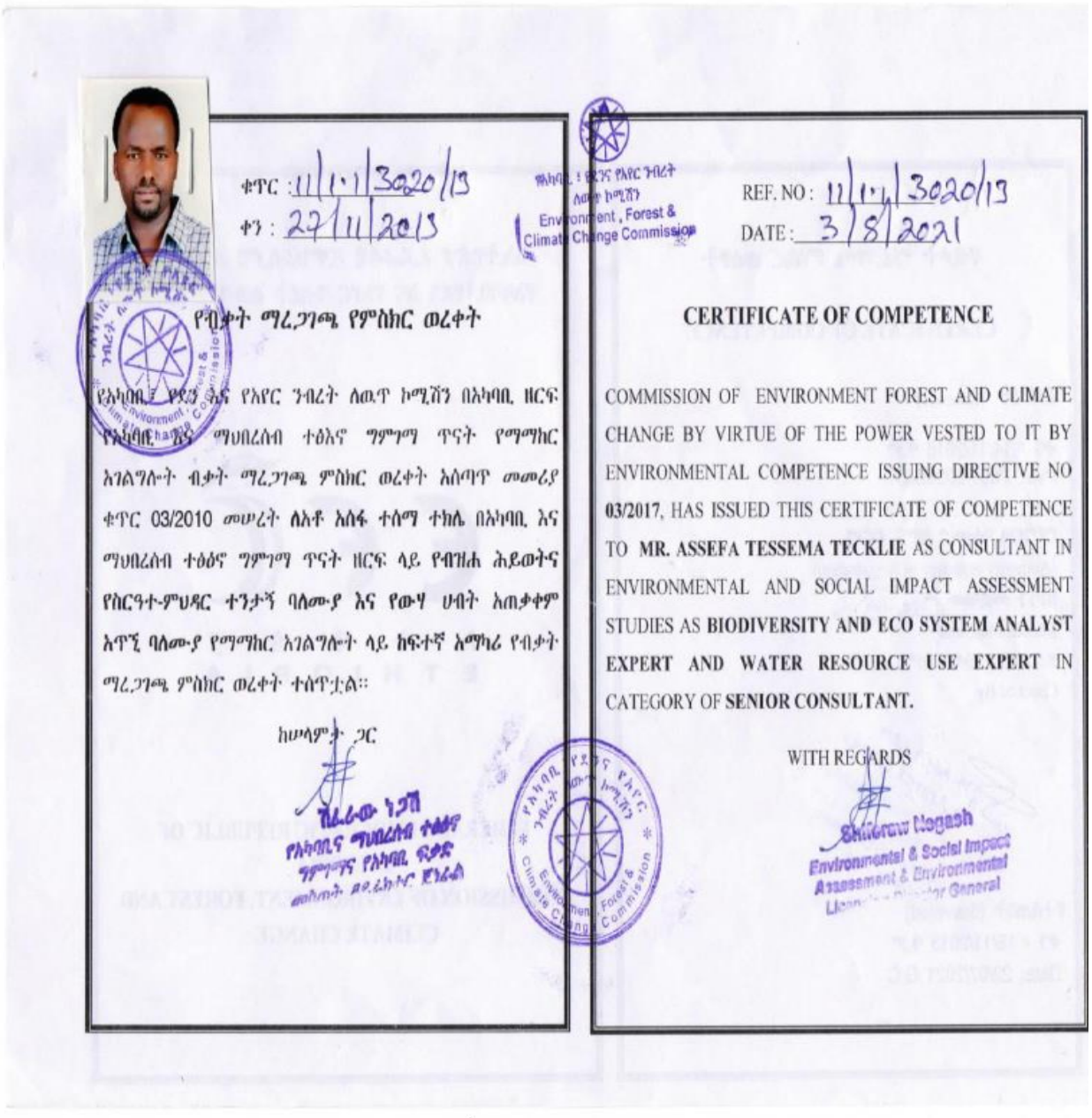
WITH REGARDS

SHIFERAW NEGASH
Environmental and Social Impact Assessment and
Environmental Licensing Director General

6. Dr. Assefa Tessema (Water resource use expert)

6.1. Personal data

- Full name: Assefa Tessema tecklie (Water resource use expert)
- Marital status:
- Age: 38
- Mailing address: atecklie@yahoo.com
- Permanent address: Dessie, Ethiopia
- Mobile: +251-921529218



ቁጥር : 11/10/3020/13
ቀን : 27/11/2013

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደንና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ አሰፋ ተሰማ ተክሌ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የብዝሐ ሕይወትና የስርዓተ-ምህዳር ተንታኝ ባለሙያ እና የውሃ ሀብት አጠቃቀም አጥኚ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

ሽፈራው ነጋሽ
የአካባቢና ማህበረሰብ ተፅዕኖ ግምገማና የአካባቢ ጥቃት መከላከያ ዳይሬክተር ጀነራል

የአካባቢ፣ የደንና የአየር ንብረት ለዉጥ ኮሚሽን
Environment, Forest & Climate Change Commission

REF. NO : 11/10/3020/13
DATE : 3/8/2021

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO 03/2017, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **MR. ASSEFA TESSEMA TECKLIE** AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS **BIODIVERSITY AND ECO SYSTEM ANALYST EXPERT AND WATER RESOURCE USE EXPERT** IN CATEGORY OF **SENIOR CONSULTANT.**

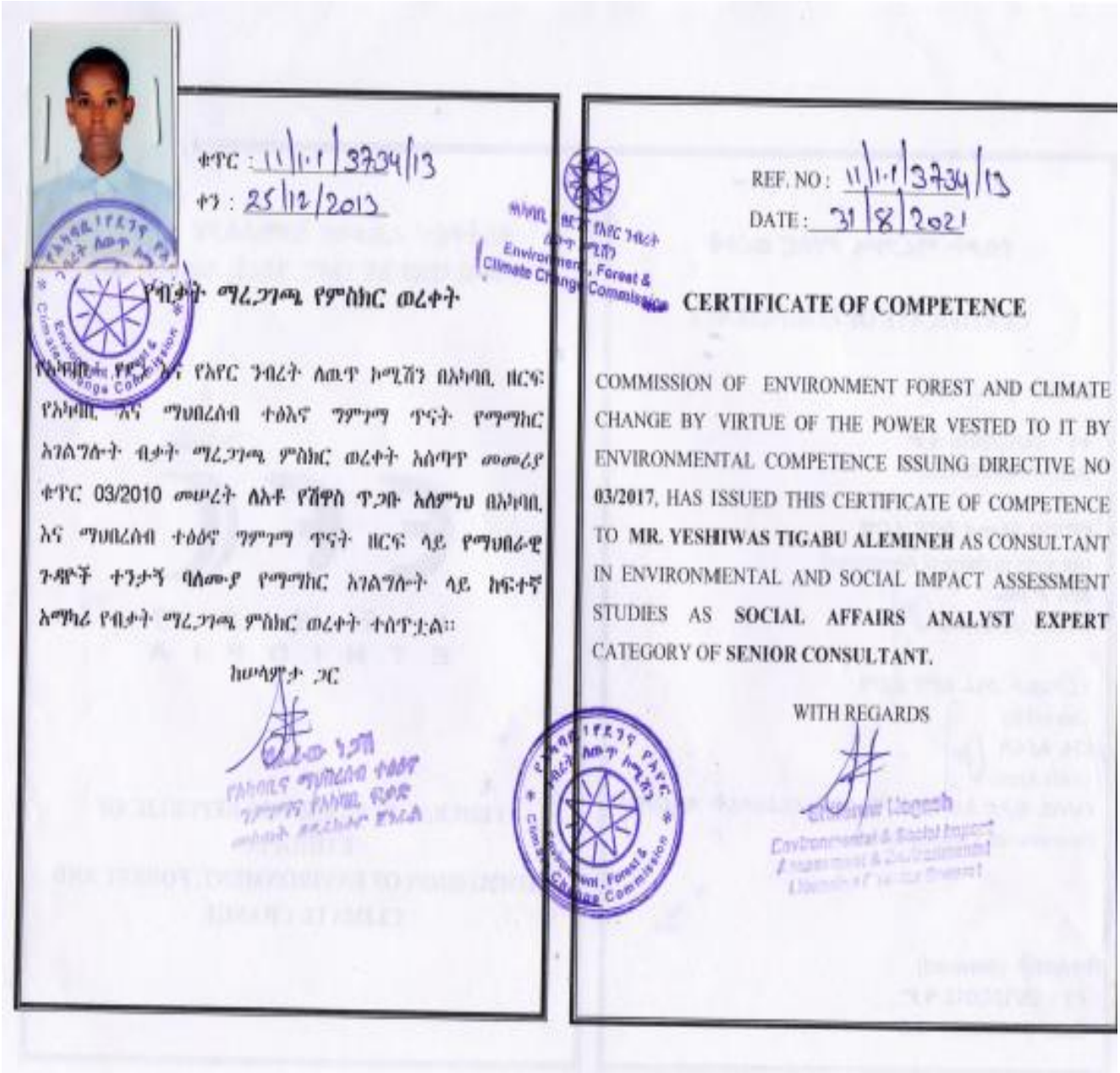
WITH REGARDS

Shiferaw Negash
Environmental & Social Impact Assessment & Environmental Licensing Director General

7. Mr. Yeshiwas Tigabu (MSc, Sociologist)

7.1. Personal data

- Full name: Yeshiwas Tigabu **Alemineh** (MSc, Sociology)
- Marital status: Married
- Age: 30
- Mailing address: yeshikocha@gmail.com
- Permanent address: Wollo University, Dessie, Ethiopia
- Mobile: +251-920215788



ቁጥር : 11/1.1/3734/13
ቀን : 25/12/2013

የብቃት ማረጋገጫ የምስክር ወረቀት

የአካባቢ፣ የደን እና የአየር ንብረት ለዉጥ ኮሚሽን በአካባቢ ዘርፍ የአካባቢ እና ማህበረሰብ ተፅእኖ ግምገማ ጥናት የማማከር አገልግሎት ብቃት ማረጋገጫ ምስክር ወረቀት አሰጣጥ መመሪያ ቁጥር 03/2010 መሠረት ለአቶ የሽዋስ ጥጋቡ አለምነህ በአካባቢ እና ማህበረሰብ ተፅዕኖ ግምገማ ጥናት ዘርፍ ላይ የማህበራዊ ጉዳዮች ተንታኝ ባለሙያ የማማከር አገልግሎት ላይ ከፍተኛ አማካሪ የብቃት ማረጋገጫ ምስክር ወረቀት ተሰጥቷል።

ከሠላምታ ጋር

REF. NO : 11/1.1/3734/13
DATE : 31/8/2021

CERTIFICATE OF COMPETENCE

COMMISSION OF ENVIRONMENT FOREST AND CLIMATE CHANGE BY VIRTUE OF THE POWER VESTED TO IT BY ENVIRONMENTAL COMPETENCE ISSUING DIRECTIVE NO 03/2017, HAS ISSUED THIS CERTIFICATE OF COMPETENCE TO **MR. YESHIWAS TIGABU ALEMINEH** AS CONSULTANT IN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES AS **SOCIAL AFFAIRS ANALYST EXPERT** CATEGORY OF **SENIOR CONSULTANT.**

WITH REGARDS

8. Additional Consultants Participated

8.1. Dr. Beekam Kabede Olkeba (PhD, Assist. Prof in Environmental Health, PhD in Bioscience Engineering), Environmental health and Biodiversity Analyst, Email: beekamkebede@gmail.com, Mobile: +251933405221.

8.2. Mrs Haregewyen Hailu (Water Resource Management Expert), Email: haregewyenhailu24@gmail.com, Mobile: +251936669331.

8.3 . Ms Banchayehu Etana Duguma (Environmental Pollution Analyst), Email: banchayehue03@gmail.com, Mobile: +251913457003.

8.4 . Mr. Yohannis Fetene (BSc, MSc) National Environmental and Social Safeguard Specialist, Individual Consultant, Africa CDC Regional Investment Finance Project, Ministry of Health, Addis Ababa, Ethiopia. (Email: feteneyohannis@yahoo.com, Mobile: +251-924468665)

8.5 . Mr. Biruk Gobena (BSc, MSc) Environmental and Social Safeguard Specialist, Individual Consultant, Africa CDC Regional Investment Finance Project, Ethiopian Public Health Institute, Addis Ababa, Ethiopia (Email: birukgobena@gmail.com; Mobile: +251912855633)

8.6 . Mr. Semaw Asamre (Bpharm, MSC) Environmental Pollution Expert; Basal Consulting, Addis Ababa, Ethiopia (Email: basalconsulting@gmail.com, Mobile: +251930285738; Website: www.basalconsult.com.et)