ZAMBIA NATIONAL PUBLIC HEALTH INSTITUTE

MINISTRY OF HEALTH

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

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Africa CDC Regional Investment Financing Program (P167916)

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ABBREVIATIONS AND ACRONYMS

7NDP	Seventh National Development Plan
BSL1	Biosafety Level 1
BSL 2	Biosafety Level 2
BSL3	Biosafety Level 3
CDC	Center for Disease Control
CSO	Central Statistical Office
EMA	Environmental Management Act
ESIA	Environmental and Social Impact Assessment
EQA	External Quality Assurance
ESF	Environmental Social Framework
ESMP	Environmental and Social Management Plan
GRZ	Government of the Republic of Zambia
HIV	Human Immunodeficiency Virus
IDA	International Development Association
MOH	Ministry of Health
PCN	Project Concept Note
PDO	Project Development Objective
PHEOC	Public Health Emergency Operations Center
PPE	Personal Protective Equipment
RCC	Regional Collaboration Centers
SADC	Southern Africa Development Community
SA-RCC	Southern Africa Regional Collaboration Centers
VCT	Voluntary Counselling and Testing
ZEMA	Zambia Environmental Management Agency
ZNPHI	Zambia National Public Health Institute

EXECUTIVE SUMMARY

Background

The Government of Zambia has established the Zambia National Public Health Institute (ZNPHI) as a specialised technical arm of the Ministry of Health responsible for protecting the Public Health security of the country. Zambia also serves as host country for the Africa Centres for Disease Control and Prevention (Africa CDC) Southern Africa Regional Collaborating Center (SA-RCC), which coordinates public health and disease prevention strategies among ten regional Member States (Angola, Botswana, eSwatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe). The ZNPHI through the Ministry of Health has received support from The World Bank through the Africa Centres for Disease Control (CDC) Regional Investment Financing Program (ACDCP). The ACDCP is providing support to three entities: the Africa CDC headquarters; Ethiopia as host country for Africa CDC; and Zambia National Public Health Institute (ZNPHI) and Southern Africa Regional Collaborating Centre (SA-RCC) in Lusaka, Zambia.

In the Zambian component of the Africa CDC financing program, ZNPHI proposes to construct, equip, staff and operate a four-storey purpose-built laboratory and office complex that will comprise Biosafety Levels 1, 2 and 3 Laboratory suites, Public Health Emergency Operations Centre (PHEOC), Information Communication and Technology (ICT) suite, Proficiency Panel Production Center, Biomedical Equipment Maintenance Center, training facilities, Conference facilities and office accommodation to enable it meet both national and regional public health responsibilities. This will provide additional capacity to fulfil obligations in line with the International Health Regulations (IHR) 2005 core capacities, the 2017-2021 Zambia National Health Strategic Plan, and vision of the Africa CDC for strong institutions that support national, regional and international partnerships for disease control and public health security. The laboratory and office complex will be a fixed asset owned by the Government of the Republic of Zambia (GRZ) under the Ministry of Health (MOH).

Unlike cross contamination in other laboratories, which typically only leads to false-positives in scientific tests, contamination in BSL-3 facility has the potential to lead to a life-threatening epidemic[1]. In this respect, the aseessment on BSL 3 laboratory has most significant environmental, health and safety impacts when compared with BSL 2 and 1, and therefore most discussed in the Environmental and Social Management Plan of this document.

The main infrastructure is envisioned to be a four-storey building of an inverted “T” shape, with accessory two-storey arc-shaped blocks at its rear. The front of the building will be connected through a central circular façade that will serve as the primary public entrance into the complex. The two rectangular blocks

[1] Biosafety Manual, 2016

will accommodate the offices, training/seminar rooms, ICT suite, conference facilities and library/resource center. The top two floors of the circular area will house the PHEOC (one floor each for national and regional). The stem of the inverted "T" will be the main laboratory block, with the BSL-3 suite occupying the uppermost floor, while BSL 1 and 2 laboratories will be on the lower three floors. These will support functions including Virology, Bacteriology, Immunology/Vaccinology, Vector biology & Parasitology, a Molecular biology suite, Chemistry, Haematology, Toxicology and and proficiency testing panel production center to support quality assurance programs. The arch-shaped blocks will house the Biorepository and animal health laboratory facilities.

Other accessory features will include a biomedical equipment maintenance center, power substation, onsite industrial autoclave and shredder unit, and waste management system (for liquid and solid biomedical, domestic waste and e-waste).

Need for the Project

Zambia currently does not have a dedicated public health laboratory BSL-3 and relies on clinical laboratories which are primarily mandated to support clinical management of patients and one BSL-2 laboratory at Levi Mwanawasa Hospital. The proposed project will address this gap by providing financial and technical assistance for construction, equipping and staffing of a dedicated National Public Health Laboratory at Biosafety Level 3 (BSL3), with associated ICT support for data management and security. In addition, the project will also construct BSL-1 and BSL-2 to address the current challenges being faced at the Ministry of Health, which include limited medical research activities (BSL-1) and limited access to appropriate and applicable clinical, diagnostic, and other laboratories in which work is done with moderate-risk agents that are present in the community and associated with human (BSL-2).

Objectives of the Project

The project objective is to establish resilient public health security capacity, infrastructure and human resource capacity and systems for Zambia and the SA-RCC region, encompassing:

- Surveillance and disease intelligence,
- Effective preparedness and efficient management of public health emergencies and events,
- Efficient Public Health Laboratory Networks,
- Public Health and scientific workforce development
- Generation, management and dissemination of scientific data to support evidence-based formulation of national and regional policies, strategies and programs for public health actions.

ESIA Study Objectives

The main objective of this ESIA study is to identify and assess impacts resulting from the proposed project to the biophysical, social and economic environment as well as to highlight possible mitigation measures for these impacts. Anticipated positive and negative impacts from the proposed project have been assessed in accordance with the Environmental Impact Assessment Regulations established under

the Environmental Management Act (EMA), World Bank Safeguards Policies, WHO Laboratory Biosafety Manual as well as Good International Industry Practise (GIIP).

ESIA Methodology and Approach

A detailed study for the ESIA was undertaken in light of the legislative requirements of the Environmental Impact Assessment Regulations of Zambia. During the ESIA study, the key focus was to identify potential environmental, social and cultural impacts of the proposed project and highlight possible mitigation measures for these impacts. The study procedure involved desk review, field visits and observation to collect field baseline data, interviews with stakeholders, photography, geo-referencing and design of an environmental and social management plan. Field site surveys formed part of the preparation of the ESIA report. The main objective of the field surveys were to carry out on-site field assessments of the expected effects of the planned developments on the physical, biological and socio-economic environment, and use the data collected to develop the environmental and social management plan incorporated into this ESIA document.. Additional data collected to incporporate in the management plan together with thhe corresponding mitigation measures, included the concerns about the proposed project, from the affected groups.

Legal, Policy and Administrative Framework and World Bank Safeguards Policies

The proposed project activities touch on many regulatory instruments which need compliance with. Presented below is some the key Zambian legislation relevant to the project and requiring legal compliance will be applicable.

- Environmental Management Act, 2011
- Environmental Impact Assessment Regulations, 1997
- National Health Research Act, 2013
- Public Health Act, 1995
- The Medicines and Allied Substances, 2013

The World Bank Safeguards Policies, namely OP/BP 4.01 (Environmental Assessment) and OP 4.11 (Physical Cultural Resources) are applicable to this project and hence have been triggered. Air emissions from incineration of decontaminated wastes and effluents from the Zambia BSL3 laboratory should comply with the requirements of the World Bank Group Environment Health and Safety Guidelines including the General Guidelines and Guidelines for Healthcare Facilities and Waste Management. The project will also comply with Good International Industry Practices (GIIP) such as WHO guidelines for healthcare facilities and laboratory biosafety.

The Baseline Environment

The three BSL laboratory suites (BSL 1, BSL 2 and BLS 3) will be located approximately 26km from Lusaka central business district along Palabana road in Silver Rest, Chongwe district. The project site is approximately 4.8km at the terminal end of the newly tarred Silverest road from Silverest primary school

on Great East Road. The tarred road leading to the project site branches off from the Great East road (T2) at Silverest primary school, 9km from the airport roundabout. The central GPS coordinates for the 10-hectare project site are; Latitude 15°23' 38 South and Longitude 28°28 41' East. Air quality in the project area is generally good although pollutants generated by vehicle exhaust emissions and dust raised by traffic passing through the area contributes to deterioration of the ambient air quality, especially when local inversions are experienced. Apart from vehicular traffic, other sources of air pollution include the burning of fuel (wood and charcoal) in townships and informal settlements and the burning of bush and scrub as well as charcoal burning in surrounding areas around Silver Rest, especially during the dry season. Increases in fugitive dust levels, particularly under hot and dry conditions, also periodically results in the deterioration of air quality.

The project site is found in an upcoming mixed-use area with infrastructural developments such as Silver Rest Gardens, subsistence and commercial farms and government institutions. In the eastern part of the proposed site, the main sources of livelihood include subsistence agriculture (crops, livestock), charcoal burning and selling, trading, beer brewing, and "wild" natural resources, including trees, grasses, nuts, fruits, and medicinal plants. The most ubiquitous activity is agriculture - virtually all households in the village grow crops. The Project site is located in close proximity with different social receptors police post (located approximately 1km from the proposed site location), north east of the site, also located 5.17km in the north direction of the site is Silver Rest primary school and Silver Rest gardens residential estate is located 3.4 km, north of the site.

Project alternatives

Various project alternatives were taken into account including no action alternative. The no action alternative was not preferred as Zambia currently lacks a dedicated public health laboratory system, specifically the BSL-3,and relies on the already overloaded clinical laboratories whose core mandate is to provide diagnostic services to support the clinical management of patients in hospitals. The alternative analysis has therefore focused on analysis of options for medical waste management, domestic waste managemet, electronic waste management, water supply, energy supply, at the project site. The ZNPHI shall have a central autoclaving system for sterilisation of health care solid waste. Health care solid waste from the BSL -3 laboratory will be initially autoclaved within the laboratories as per BSL -3 biosafety requirements, while medical waste from BSL-1 and 2 will be decontaminated by an approved decontamination method and/or disposed of as medical waste, and not necessarily autoclaved prior to disposal. The sterilised solid waste from the BSL-3 laboratory will then be conveyed to the central solid waste autoclaving system for secondary autoclaving. From the central autoclaving system, sterilised solid waste will be shredded to reduce on the volume. The shredded waste, now rendered as safe as domestic waste, will be held temporarily until scheduled for transport to the designated (Chunga) landfill. Where required, ZNPHI will incinerate medical and pharmaceutical waste at its incinerator to be located at Levy Mwansawasa Hospital, behind the ZNPHI Laboratory. As per current practice, the ash from the incinerators will be transported by trucks and disposed of at the Chunga landfill site. The BSL3 lab

complex will have two separate wastewater networks for management of healthcare waste effluent and domestic waste effluent.

The medical wastewater will be collected into a leak proof storage tank whose filling capacity will be auto monitored so as not to exceed ¾ full. The wastewater will then be steam sterilised using the liquid cycle of the autoclave connected to the storage tank. The autoclaved wastewater will then be discharged into the solid particle filtration system to allow solid particles to be filtered out of the waste water as it flows through the system. The filtered waste water will be collected in the retention tanks which will be vacuum tanked by licenced waste collectors for further treatment at the offsite municipal sewage treatment site (Kaunda Square Wastewater Treatment Plant) at regular intervals. The domestic waste water network will have several inspection chambers as it leads to the sedimentation tanks. A layer of accumulated solids or sludge will form at the bottom of the sedimentation tank as the waste water slowly flows through it thereby providing a level of purification prior to discharge. The sludge at the bottom of the sedimentation tanks will be periodically removed during routine maintenance and will be disposed of at Kaunda Square Wastewater Treatment Plant site.

The preferred source of energy to cater for the three BSL laboratory facilities is from the national grid. However, the project will install a stand by generator for the facility for emergency purposes only. The preferred source of water for this project is borehole water with plans by the project to drill a borehole to provide water for the three laboratory facilities. Pipe water from the water utility was rejected due to the lack of a water supply system in the project area. International best practices will be considered in designing the lab. The laboratory facilities which will be constructed at ZNHIP would be designed and operated in accordance with guidance established by reputable international organizations (CDC 1999, NIH 2001, WHO 2004).

Public Consultation and Information Disclosure

The study team consulted with stakeholders including government authorities, the community and relevant organizations involved directly and indirectly with the proposed project in order to seek their views on the impacts (adverse and beneficial) of the proposed project on the environment and socio-economic characteristics of the project area. The ESIA team conducted a stakeholder mapping and analysis in order to identify potential stakeholders and their level of interest as regards the project. Consultations with identified stakeholders were carried out through key stakeholder/informant engagements and public meetings. This was done in june 2018, November/December 2018 (Annex 5) and July 2019 (Annex 6). Feedback from the consultations was incorporated in developing project mitigation measures.

On 16th July 2019, a public consultative and disclosure meeting on the project was held at the Ministry of Health Headquarters and attended by a wide representation of stakeholders including community

members, local leaders, cooperating partners, MOH senior leadership, NGO, and government agencies (Annex 6). The meeting was chaired by the Honourable Minister of Health Dr Chitalu Chilufya and the area Chiefdom, the Busoli royal establishment (BRE), was represented by Princess Cholwe Nkomeshya. Following description of the various aspects of the project by the ZNPHI Director Dr Victor Mukonka, an open question and answer session was held, durimg which the stakeholders sought clarity on a number of issues. These centered mainly around security and safety matters, institutional relationships/roles, and benefits of the projet to the local community and the nation at large. Overall there was acceptance and support for the project. This position was also echoed by the BRE through Princes Cholwe, who pledged full support and expressed gratitude to the Government for considering to set up the infrastructure and investment in the Busoli Chiefdom.

Environmental and Social Impacts and Mitigation Measures

The major environmental and social impacts that are likely to arise from the construction and operational phases as well as mitigation measures for the riks are summarized in the table following:

Table 1: Adverse Impacts and Mitigation Measures (Construction Phase)

Environmental / Social Impact	**Mitigation Measures**
Traffic Congestion	Provide and implement a traffic management plan Provision temporary road signs or notices to indicate ongoing works. Effecting traffic controls to avoid congestion and accidents on construction site and associated roads. Choosing suitable traffic routes to reduce the impact in the neighbourhood. Ensuring no interference with traffic through traffic control, designated parking, speed limits and hiring a banksman.
Site Related Oil Spills	Employee awareness on company procedures for dealing with spills and leaks from oil storage tanks. Containment of leaks. Provision of absorbent material Maintenance of contractor's equipmentProvision of relevant emergency numbers
Soil Related Impacts	Stock piling of soil for reuse Provision temporary drainage channels or holding ponds as a precautionary measure Restoration of the ground by planting adequate grass cover and trees. Planning emergency response measures in case of accidental oil spills.
Impact on Water Resources	Provide implement a waste management plan Proper solid and liquid wastes disposal mainly from the construction camps, sites and offices. Ensuring proper measures are in place for collection and disposal of spilled oils and lubricants.
Influx/Inmigration	Hiring unskilled construction and skilled (if available) labour from the local population as far as possible. Use of manual labour during excavation and construction works where possible. Prepare a labour influx plan to manage labour influx Sensitizing workers and the surrounding community on awareness, prevention and management of HIV/AIDS. Enforcing and maintaining a code of conduct for employees

Environmental / Social Impact	Mitigation Measures
Air Quality	□ Use of personal protective clothing (PPE) like dust masks on construction crew. □ Regular water spraying of murram and earth roads and construction site □ Operated and maintenance of contractor's plant in compliance with relevant vehicle emission standards and manufacturer's specification to minimize air pollution.
Noise Pollution	□ Use of personal protective equipment (PPE) such as ear plugs on construction crew. □ Avoiding night time construction when noise is loudest near residential areas. □ No discretionary use of noisy machinery within 50 m of residential areas and near institutions or use of manual labour in these sections. □ Good maintenance and proper operation of construction equipment. □ Where possible, ensure non mechanized construction to reduce the use of machinery
Impact on flora and fauna	□ Re-planting the indigenous vegetation as much as possible once work is completed. □ Sparing the vegetation that must not necessarily be removed. □ Provide and implement a waste management plan □ Promoting non-mechanized methods of construction. Ensure that the employees on site are aware of the company procedures for dealing with spills and leaks from oil storage tanks □ Provision of dustbin and sanitation facilities.
Public Health & Safety	□ Ensuring proper maintenance and operation of Contractors' machinery to mitigate noise and dust impacts. □ Providing crossing areas for access to pedestrians to minimise accidents. □ Provide workers with adequate drinking water and breaks. □ Drain all pools of standing water to minimize or altogether eliminate mosquito breeding sites. □ Provide a waste management plan. □ Cordon off trenches and working areas with a reflective tape to ensure safety of pedestrians and provide crossing areas
HIV & AIDS Impacts	□ Sensitizing workers and the surrounding communities on awareness, prevention and management of HIV/AIDS. □ Provide an on-site clinic to provide Voluntary Counselling and Testing (VCT) services to construction crew.
Gender empowerment	□ Ensuring equitable distribution of employment opportunities between men and women □ Providing toilets and bathrooms for both male and female workers on site
Child Labour and Protection	□ Provide and implement a child protection strategy □ Ensuring no children are employed on site in accordance with national labour laws □ Ensuring that any child sexual relations offenses among contractors' workers are promptly reported to the police
Gender Equity, Sexual Harassment	□ Provide and implement a gender based violence strategy, which will include: • Gender mainstreaming in employment at the worksite with opportunities provided for females to work, in consonance with local laws and customs • Grievance redress mechanisms including non-retaliation. □ Provide and implement an employee code of conduct □ The works contractor should be required, under its contract, to prepare and enforce a No Sexual Harassment and Non-Discrimination Policy, in accordance with national law where applicable.

Environmental / Social Impact	Mitigation Measures
Liability for loss of life, injury or damage to private property	Provision of PPE. Training workers on the operation of the machinery and equipment Ensuring there are adequate warning and directional signs. Ensuring that the prepared code of conduct for staff is followed to prevent accidents. Developing a site safety action plan. Cordoning off unsafe areas Provision of first Aid kit within the construction site. Recording of all injuries that occur on site in the incident register, corrective actions for their prevention are instigated as appropriate. Compliance with the Workmen's Compensation Act, ordinance regulations and union agreements.
Ecological impact (It is anticipated that small scale vegetation clearing activities during the construction phase of the project may result in loss of flora and fauna).	To minmise this, ZNPHI will ensure all vegetation clearance are restricted to the project footprint
Excavation activities during construction phase of the project may lead to soil instability and erosion at the project site while movement of construction equipment and machinery would lead to compaction of top soil.	As much as possible excavated soil will be re-used on the site as backfill and will be compacted to make it stable. All cut slopes, embankments, and other erosion- prone working areas will be stabilized to any feasible extent

Adverse Impacts (Operation Phase)

Environmental / Social Impact	Mitigation Measure
Wastewater generated by the facility during the operational phase has potential to pollute soils, surface and groundwater through surface drainage regimes and infiltrating the underlying aquifer.	ZNPHI shall ensure effective solid waste management and wastewater from the laboratories will be collected and channeled to a collection tank linked to decontamination and disinfection equipment for primary treatment. The decontaminated and disinfected waste water will then be channeled into the interceptor tanks for secondary treatment before being transported to a waste water treatment facility. In addition, ZNPHI has developed an Infection Prevention, Control and Waste Management Plan (IPCWMP) for this purpose.
Impacts associated with **inadequate** BSL-3 Facility Design leading to among others: (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	Ensure the BSL-3 Facility is designed in accordance with the design requirements provided by WHO Laboratory Biosafety Manual)
Impacts associated with **inadequate** BSL-2 Facility Design leading to among others: (Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	Ensure the BSL-2 Facility is designed in accordance with the design requirements provided by WHO Laboratory Biosafety Manual)
Impacts associated with **inadequate** BSL-1 Facility Design leading to among others:	Ensure the BSL-1 Facility is designed in accordance with the design requirements provided by WHO Laboratory Biosafety Manual)

Environmental / Social Impact	Mitigation Measure
(Occupational Health and Safety Risks, and Environmental Risks)	
Impacts associated with operating BSL-3 laboratory which has not been commissioned because it has not met the design requirements, include the following a. Human Health Risks, b. Occupational Health and Safety Risks, c. Community Health and Safety Risks, d. Environmental Risks a.	□ Ensure that the BSL-3 Facility is commissioned as per the requirements and in accordance with the design requirements provided by WHO Laboratory Biosafety Manual). □
Impacts associated with operating BSL-2 laboratory which has not been commissioned because it has not met the design requirements, include the following; a. Occupational Health and Safety Risks, b. Community Health and Safety Risks, c. Environmental Risks)	□ Ensure that the BSL-2 Facility is commissioned as per the requirements and in accordance with the design requirements provided by WHO Laboratory Biosafety Manual). □ Ensure that on an annual basis, **RE-CERTIFICATION** of the BSL-2 Facility is undertaken by an independent expert.
Impacts associated with operating BSL-1 laboratory which has not been commissioned because it has not met the design requirements, include the following a. Occupational Health and Safety Risks, b. Environmental Risks	□ Ensure that the BSL-1 Facility is commissioned as per the requirements and in accordance with the design requirements provided by WHO Laboratory Biosafety Manual).
Impact associated with Workers' Chemical Exposure leading to Occupational Health and Safety Risks,	□ Provide training to workers in BSL-2 and BSL-3 and ensure they have proper knowledge of the toxic effects of these chemicals, the routes of exposure and the hazards that may be associated with handling and storage. □ Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. □ Ensure that there are Biological Safety Cabinets (BSCs) (Class III) in the BSL-3 and BSCs (Class II) in the BSL-2 designed to protect the operator, the laboratory environment and work materials from exposure to infectious aerosols and splashes that may be generated when manipulating materials containing infectious agents, such as diagnostic specimens.
Impacts associated with inadequate management of infectious solid waste from the the BSL-3 Facility to among others:-	□ Develop and implement a solid waste management plan for infectious and harzadious solid wastes with WHO Laboratory Biosafety Manual □ Autoclave all infectious and harzadious solid wastes □ Incinerate infectious and harzadious solid wastes in an incinerator that meets the specifications for incinerating wastes from BSL-3 facility

Environmental / Social Impact	Mitigation Measure
(Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Provide training for workers handling for infectious and harzadious solid wastes □ Provide PPE for workers handling for infectious and harzadious solid wastes
Impacts associated with inadequate management of infectious effluent/liquid waste from the the BSL-3 Facility leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Develop and implement a liquid waste management plan for infectious and harzadious solid wastes in accordance with WHO Laboratory Biosafety Manual □ Autoclave all infectious and harzadious liquid wastes □ Provide training for workers handling for infectious and harzadious liquid wastes □ Provide PPE for workers handling for infectious and harzadious liquid wastes
Impacts associated with inadequate disinfection of BSL-2 and BSL-3 Facility leading to among others:- Occupational Health and Safety Risks)	□ All items within BSCs, including equipment, should be surface-decontaminated and removed from the cabinet when work is completed, since residual culture media may provide an opportunity for microbial growth. The interior surfaces of BSCs should be decontaminated before and after each use. □ The work surfaces and interior walls should be wiped with a disinfectant that will kill any microorganisms that might be found inside the cabinet. □ At the end of the work day, the final surface decontamination should include a wipe-down of the work surface, the sides, back and interior of the glass. A solution of bleach or 70% alcohol should be used where effective for target organisms. A second wiping with sterile water is needed when a corrosive disinfectant, such as bleach, is used. □ BSCs must be decontaminated before filter changes and before being moved. The most common decontamination method is by fumigation with formaldehyde gas. BSC decontamination should be performed by a qualified professional.
Impacts associated with specimen exposure of BSL-2 and BSL-3 Facility leading to among others:- Occupational Health and Safety Risks)	□ To avoid accidental leakage or spillage, secondary containers, such as boxes, should be used, fitted with racks so that the specimen containers remain upright. The secondary containers may be of metal or plastic, should be autoclavable or resistant to the action of chemical disinfectants, and the seal should preferably have a gasket. They should be regularly decontaminated. □ The facility should designate a **Receipt of specimens** room or area designated for this purpose. □ Personnel who receive and unpack specimens should be aware of the potential health hazards involved, and should be trained to adopt standard precautions (2), particularly when dealing with broken or leaking containers. □ Primary specimen containers should be opened in a biological safety cabinet. Disinfectants should be available. □ Every laboratory that works with infective microorganisms should institute safety precautions appropriate to the hazard of the organisms and the animals being handled.
Impacts associated with **Emergency Hazards** from the BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Develop a **Contigency Plan Procedure** for the BSL-Facility □ Provide First-aid kit, including universal and special antidotes □ Provide Appropriate fire extinguishers, fire blankets □ Full protective clothing (one-piece coveralls, gloves and head covering – for incidents involving microorganisms in Risk Groups 3); lab coats, gloves, eye protection and face shields for incidents involving risks in Group 2. □ Full-face respirators with appropriate chemical and particulate filter canisters in both Group 2 and 3.

Environmental / Social Impact	Mitigation Measure
Impacts associated with **Emergency Hazards** from the BSL-2 Facility design leading to among others: - Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Room disinfection apparatus, e.g. sprays and formaldehyde vaporizers in both Group 2 and 3. □ Hazard area demarcation equipment and notices in both Groups.
Impacts associated with Fire Hazards from BSL-1, BSL-2 and BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Fire-fighting equipment should be placed near room doors and at strategic points in corridors and hallways. This equipment may include hoses, buckets (of water or sand) and a fire extinguisher. Fire extinguishers should be regularly inspected and maintained, and their shelf-life kept up to date. □ Close cooperation between safety officers and local fire prevention officers is essential. □ The assistance of local fire prevention officers in the training of laboratory staff in fire prevention, immediate action in case of fire and the use of fire-fighting equipment is desirable. □ Fire warnings, instructions and escape routes should be displayed prominently in each room and in corridors and hallways.
Impacts associated with Electrical Hazards from BSL-1, BSL-2 and BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ It is essential that all electrical installations and equipment are 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 should be earthed/grounded, preferably through three-prong plugs. □ All laboratory electrical equipment and wiring should conform to national electrical safety standards and codes.
Impacts associated with Noise Hazards from BSL-1, BSL-2 and BSL-3 Facility design leading to among others: - Occupational Health and Safety Risks.	□ Where noise levels cannot be abated and where laboratory personnel routinely experience excessive exposures, a hearing conservation programme that includes the use of hearing protection while working in hazardous noise and a medical monitoring programme to determine the effect of noise on the workers should be instituted. □ Noise measurement surveys be conducted to determine the noise hazard. □ Where warranted by data, engineering controls such as enclosures or barriers around noisy equipment or between noisy areas and other work areas, can be considered

Environmental / Social Impact	Mitigation Measure
Impacts associated with Ionizing Radiation Hazards from the BSL-3 Facility leading to among others: - Occupational Health and Safety Risks.	To limit the harmful effects of ionizing radiation, the use of radioisotopes should be controlled and should comply with relevant national standards. Protection from radiation is managed on the basis of four principles: □ Minimizing the time of radiation exposure □ Maximizing the distance from the radiation source □ Shielding the radiation source □ Substituting the use of radionuclides with non-radiometric techniques. □ Mark radiation containers with the radiation symbol, including radionuclide identity, activity and assay date □ Use radiation meters to monitor working areas, protective clothing and hands after completion of work. □ Use appropriately shielded transport containers □ Remove radioactive waste frequently from the working area. □ Maintain accurate records of use and disposal of radioactive materials. □ Screen dosimetry records for materials exceeding the dose limits. □ Establish and regularly exercise emergency response plans. □ In emergencies, assist injured persons first. □ Clean contaminated areas thoroughly. □ Request assistance from the safety office, if available. □ Write and keep incident reports.
Impacts associated with transport of infectious samples and specimens (including wastes) to and from the the BSL-3 Facility leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks) Impacts associated with transport of infectious samples and specimens (including wastes) to and from the the BSL-2 Facility leading to among others:- (Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Use the protocol for transporation and shipment of specimen and wastes in accordance with the United Nations Model Regulations on the Transport of Dangerous Goods (40) and local country laws (Annex 7). □ Provide training to workers and ensure they have proper knowledge of the toxic effects of these chemicals in both BSL-2 and BSL-3, the routes of exposure and the hazards that may be associated with handling and storage, especially as it relates to activities under BSL-3. □ Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. □ Laboratory personnel must ship infectious substances according to applicable transport regulations. □ Develop a Spill Clean Up Procedure

Environmental / Social Impact	Mitigation Measure
Impacts associated with inadequate or lack of bio-security system program for BSL-1. BSL-2 and BSL-3 Facility leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Develop laboratory biosecurity measures based on a comprehensive programme of accountability for pathogens and toxins that includes an updated inventory with storage location, identification of personnel with access, description of use, documentation of internal and external transfers within and between facilities, and any inactivation and/or disposal of the materials. □ Develop institutional laboratory biosecurity protocol for identifying, reporting, investigating and remediating breaches in laboratory biosecurity, including discrepancies in inventory results □ Define the involvement and roles and responsibilities of public health and security authorities in the event of a security infraction. □ Undertake laboratory biosecurity training, distinct from laboratory biosafety training to all personnel. Such training should help personnel understand the need for protection of such materials and the rationale for the specific biosecurity measures, and should include a review of relevant national standards and institution specific procedures. □ Develop procedures describing the security roles and responsibilities of personnel in the event of a security infraction should also be presented during training. □ Develop code of conduct and professional ethical suitability among workers for working with dangerous pathogens of all personnel who have regular authorized access to sensitive materials is also central to effective laboratory biosecurity activities and should be done through an assessment of the suitability of personnel, security-specific training and rigorous adherence to pathogen protection procedures are reasonable means of enhancing laboratory biosecurity. □ Develop compliance checks with these procedures, with clear instructions on roles, responsibilities and remedial actions. □ Undertake regular risk and threat assessments, and regular review and updating of procedures..
Impacts associated with inadequate or lack of training of the BSL-3 Facility workers/personell leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks) Impacts associated with inadequate or lack of training of the BSL-2 Facility workers/personell leading to among others:- (Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks) Impacts associated with inadequate or lack of training of the BSL-1 Facility workers/personell leading to among others:-	□ Recruit qualified personell to work in the BSL-3 facility □ Conduct safety organisation and training for the BSL-3 workers □ Appoint a **Biosafety Officer** to ensure that biosafety policies and programmes are followed consistently throughout the laboratory. The biosafety officer executes these duties on behalf of the head of the institute or laboratory. □ Undertake **Support Staff Safety Training** for skilled engineers and craftsmen who maintain and repair the structure, facilities and equipment, should have some knowledge of the nature of the work of the laboratory, and of safety regulations and procedures. □ Testing of equipment after servicing, e.g. testing the efficiency of biological safety cabinets after new filters have been fitted, may be carried out by or under supervision of the biosafety officer. □ Engineering and maintenance staff should only enter the Biosafety Level 3 facility with clearance and supervision by the biosafety officer and/or the laboratory supervisor. □ The Biosafety Level 3 facility should only be cleaned by the laboratory staff. □ Cleaning personnel should only enter Biosafety Level 3 or Biosafety Level 4 laboratories with clearance and supervision by the biosafety officer and/or the laboratory supervisor. □ Constitute a **Biosafety Committee** to develop institutional biosafety policies and codes of practice. The biosafety committee should also review research protocols for work involving infectious agents, animal use. Other functions of the committee may include risk assessments, formulation of new safety policies and arbitration in disputes over safety matters.

Environmental / Social Impact	Mitigation Measure
(Occupational Health and Safety Risks and Safety Risks, Environmental Risks)	

Environmental and Social Management Plan (ESMP)

An Environmental and Social Management Plan outlining potential environmental and social riks associated with the proposed BSL1,2 and 3 laboratories, institutional arrangement for management of risks, parties responsible for implementing and monitoring actions, associated costs, indicators and capacity building needs and reporting requirements have been prepared. Responsibilities of ZNPHI, the Project implementation unit, Biosafety Committtee, Biosafety and Biosecurity Officer, Zambia Environmental Management Agency and other relevant staff and stakeholders have been described. Monitoring will be undertaken by Zambia Environment Management Agency and ZNPHI. Capacity building measures have been proposed to improve the ZNPHI's ability to manage the risks associated with the project. To maintain regulatory compliance and to protect personnel, the community and the environment from construction activities during the construction phase and biohazards during the operation phase, ZNPHI will be responsible for deploying pertinent staff for proper implementation of the ESMP and ICWMP, in the respective phases. Capacity building training for ESMP implementation monitoring will be provided to relevant staff of MoH, ZNPHI, and Zambia Environment Management Agency. The proposed budget for the capacity building activities will be USD 68,000. The estimated cost for the implementation of the ESMP and environmental monitoring is **USD 1,460,000.00**.

1. INTRODUCTION

1.1 Background and Rationale for the Project

The Africa Centres for Disease Control and Prevention (Africa CDC) was formally launched in January 2017 to galvanise leadership and ownership in safeguarding Africa's public health security by support Afrian Union (AU) Member States in improving the health of their people through building the capacity of public health institutes to focus on prevention of infection, surveillance and response to emergencies (including outbreaks, human-made and natural disasters, and public health events of regional and international concern), and building capacity to reduce disease burden on the continent. This is in line with the AU's Agend 2063 which concretises the continental vision of "*An integrated, prosperous and peaceful Africa, driven by its own citizens, representing a dynamic force in the international arena"*. The Resolution AU/Dec.554 (XXIV) of January 2015 which established Africa CDC also called for each AU Member State to have a National Public Health lnstitute (NPHI) or an equivalent entity. Operationally, Africa CDC is organized at three levels (figure 1): 1) the Secretariat based within the AU Commission in Addis Ababa, Ethiopia; 2) Regional Collaborating Centres (RCCs) to coordinate activities in five sub-regions; 3) NPHIs at individual country level.

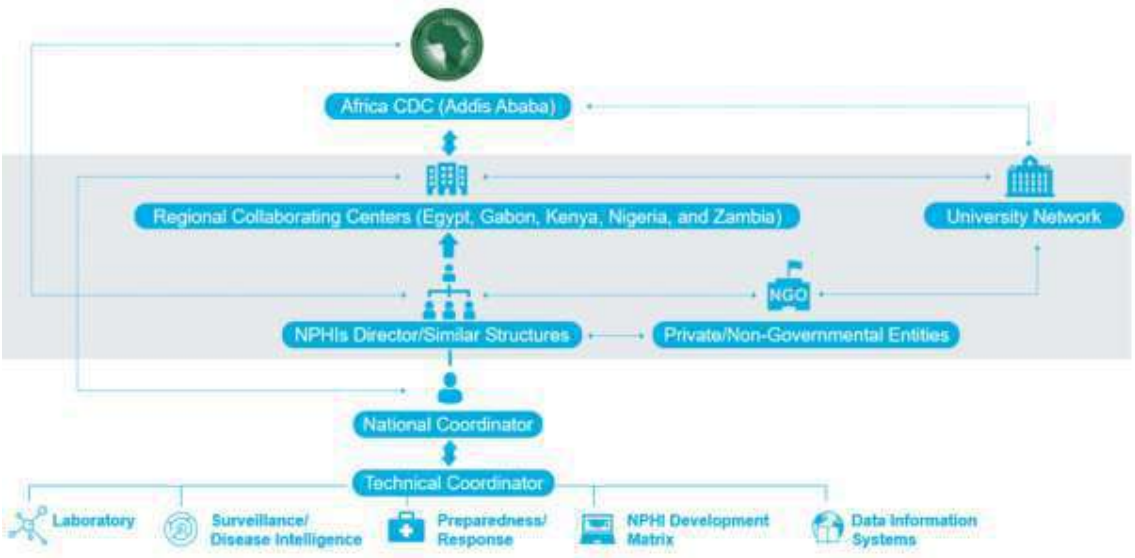

Figure 1: Africa CDC Operating Framework

The Zambian Government has fully embraced Africa CDC, committing high-level leadership to serve on both the Africa CDC Governing Board and the Africa CDC Technical Advisory Council. In line with the Africa CDC operational model, Zambia was elected to host the Southern Africa RCC (SA-RCC), which encompasses ten (10) regional AU Member States, namely

Angola, Botswana, eSwatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe. The ten Member States have a combined population of 174 million citizens. In accordance with the hosting agreement, the Zambian Government has to date supported the SA-RCC by providing office accommodation, support staff, and interim management and technical staff to operationalize the SA-RCC. Furthermore, an allocation has been included in Zambia's annual National Budget to meet RCC operational costs.

At country level, a bold policy decision was taken in February 2015 to establish the Zambia National Public Health Institute (ZNPHI) as a specialized technical arm of the Ministry of Health mandated to promote and protect the health of Zambia and support health facilities at all levels in improving public health through prevention of infection, disease surveillance, preparedness and response to emergencies including outbreaks, man-made and natural disasters, as well as other events of public health importance. The ZNPHI is tasked to detect and respond quickly and effectively to disease threats and outbreaks based on science, policy and data-driven interventions and programs.

Through the ZNPHI, the Ministry of Health endeavours to build resilient capacity through infrastructure, skilled human resources and systems for 1) surveillance and disease intelligence, 2) effective preparedness and efficient management of public health emergencies, 3) efficient Public Health Laboratory networks, and 4) generation, management and dissemination of scientific data to support evidence-based formulation of national policies, strategies and programs for public health actions.

Zambia's public health security faces both in-country and external threats:

- Located at the heart of Southern Africa, Zambia is surrounded by eight countries with which she shares land borders. This poses the challenge of increased risk of importation of diseases from neighbouring countries and beyond.
- Population movement for trade and socioeconomic activities, refugees and displaced populations, and the unregulated movement of people across the long and porous borders exacerbate the risk of disease spread.
- Emerging and re-emerging infections and other public health threats from neighbouring countries including recent disease threats and outbreaks of Ebola virus disease, Listeriosis, yellow fever, influenza, vaccine-derived polio, cholera, typhoid, Rift Valley fever, dengue, plague, anthrax, and Marburg. Most of these pathogens require high bio-containment capabilities which are currently inadequate.

- The control of disease outbreaks remains a challenge, particularly in some neighbouring fragile states with weak healthcare systems, thereby increasing the risk of spill over across borders.
- Within the country, epidemic-prone areas exist due to environmental, climatic, geographic, cultural and social-economic factors.
- Zambia lacks a dedicated public health laboratory and relies on clinical laboratories whose primary mandate is to support patient management. Although, Zambia has more than 2,900 healthcare facilities, only 359 have some form of laboratory support. The bulk of existing clinical laboratories have limited infrastructure and capacity to adequately perform public health functions.
- The reliance on clinical laboratories for public health functions has often led to delays in establishing diagnoses, detecting outbreaks and reporting of results, highlighting a weakness in both the early-warning system and management of outbreaks. A case in point is the cholera outbreak experienced in 2017/18, which amplified these gaps.
- Other critical public health laboratory functions related to water and air quality monitoring, animal health, nutrition and food safety, and environmental health protection are limited and largely uncoordinated. Some of these functions are overseen by multiple agencies.

These challenges bring to the fore the need for a strong, effective, and efficient national surveillance system, coupled with a state of preparedness and ability to mount timely, appropriate and effective responses when required. These capabilities require to be anchored in a strong National Public Health Laboratory System, which provides timely scientific evidence to back surveillance data and guide decisions pre-, during and after the response stage.

Highly dangerous pathogens continue to emerge and re-emerge in new geographic areas in Africa at increasing rates and impact on health, socio-economic and healthcare delivery systems. The following challenges threaten public health security in the region and limit capacity for intervention:

- Inadequate public health laboratory capacities, and weak healthcare systems among member states.
- Insufficient and uncoordinated surveillance and research programmes on Antimicrobial Resistance (AMR) and pathogens of public health importance including emerging, re-emerging and vector-borne diseases.
- Limited regional capacity to develop, validate and implement novel diagnostic assays for rapid and accurate detection and identification of pathogens, including the use of novel

molecular and immunological techniques for development, production and deployment of high quality diagnostics, research reagents and therapeutics.

- Inadequate bio-containment infrastructure for handling dangerous pathogens and materials thereby limiting research on the continent.
- Lack of strategic regional biobanks for long-term secure storage and preservation of reference clinical materials and strains for research and future development of diagnostic assays, vaccines and therapeutics;
- Limited regional External Quality Assurance (EQA) programmes for dangerous endemic pathogens (e.g. those causing Ebola virus disease, Anthrax, Cholera, Typhoid, Influenza, Rabies, Rift Valley fever, Marburg, Crimean Congo-haemorrhagic fever, dengue, West Nile virus, yellow fever, Lassa fever, Chikungunya, Monkey pox, bacterial meningitis) limiting the ability to ascertain African capacity to accurately diagnose and characterise these and similar pathogens.
- Insufficient number of African scientists trained in working and managing research programmes in high bio-containment facilities;
- Limited expertise in bioinformatics hampering rapid characterisation and discovery of new pathogens isolated from humans and animals in Africa;
- Inadequate resources for capital investment in public health infrastructure development, compounded by competing social-economic demands and a high regional debt ratio.
- Visa-free population movement within the region and high traffic of trade, with insufficient port health management programs pose the challenge of control and prevention of diseases and facilitate easy spread of infections.

To address the foregoing national and regional challenges and responsibilities, the Zambian Government through the Ministry of Health and ZNPHI aspires to establish resilient public health security systems. Of the priority functional capacities is infrastructure development of Biosafety Level 3 (BSL-3) laboratory to support disease surveillance, enhanced diagnostic capability, containment of pathogens and agents, research, training, and bio-banking of strains and other relevant materials. The project will also construct and commission BSL-1 and BSL-2 to support research programmes and clinical diagnostics respectively. This will also provide footing for compliance with the International Health Regulations (IHR) 2005 core capacities, the Zambia National Health Strategic Plan 2017-2021, and the Africa CDC vision of strong institutions that support regional and international partnerships.

Thus the MoH through ZNPHI intends to set up four-storey purpose-built infrastructure (see conceptual model, figure 6) in Lusaka, comprising a BSL-3 laboratory suite, BSL-1 and BSL-2 laboratoies which will be next to each other but right below BSL-3 laboratorty suite, Public Health Emergency Operations Centre (PHEOC), ICT suite, Proficiency Panel Production Center, Biomedical Equipment Maintenance Center, training facilities, conference facilities and office accommodation. The BSL-3 facility will provide the capability to handle organisms and other materials up to hazard group 3, while BSL-2 facility will handle organisms and other materials up to hazard group 2. BSL-1 laboratories will mostly be used for reseach programmes and will handle organisms and other materials in hazard group 1. This will be in a graduated manner as appropriate staff, facilities, and procedural control experience are attained over time. The scale up will also be informed by evolving needs, certification, regulatory compliance and legal requirements.

As SA-RCC host, Zambia will provide infrastructure, equipment, facilities and technical competencies required for national needs and for the SA-RCC to provide support to the ten RCC member states.

1.2 Africa Centres for Disease Control and Prevention Regional Investment Financing Program (ACDCP)

The ACDCP, encoded by the Bank as P167916, will support vital institutional capacity-building efforts by the Africa CDC headquarters in Addis Ababa, and the health authorities in Ethiopia and Zambia. The ACDCP will thus target three entities: (i) the Africa CDC headquarters; (ii) the Ethiopian Public Health Institute (EPHI); the Southern Africa Regional Collaboration Centre (SA-RCC) and the ZNPHI. The actions supported by ACDCP are organized under the following components: (i) Governance and Legal Framework; (ii) Public Health Assets; (iii) Human-Resources Development; (iv) operational. In each area, complementary actions by the three implementing bodies – the Africa CDC Secretariat and the governments of Ethiopia and Zambia- will establish the physical and organizational infrastructure necessary for the Africa CDC to execute its core functions and lay the groundwork for its continued expansion into a continental health institution. The project components described below are designed to leverage network effects and exploit economies of scale to enhance the efficiency of scarce public health resources, overcome national-level capacity constraints, and maximize the positive spillovers produced by integrated transnational disease surveillance and emergency-response systems. Detailed information on each component and sub-component is provided in the Project Description.

1.2.1 Project Development Objective

The Project Development Objective is to

establish resilient public health security capacity, infrastructure and human resource capacity and systems for Zambia and the SA-RCC region, encompassing:

- Surveillance and disease intelligence,
- Effective preparedness and efficient management of public health emergencies and events,
- Efficient Public Health Laboratory Networks,
- Public Health and scientific workforce development
- Generation, management and dissemination of scientific data to support evidence-based formulation of national and regional policies, strategies and programs for public health actions.

1.2.2 Project Components

The proposed project will support vital institutional capacity-building efforts by the Africa CDC headquarters in Addis Ababa, the SA-RCC in Lusaka, and the Ethiopian and Zambian health authorities. The actions supported by ACDCP are organized under three strategic components: (i) Governance and the Legal Framework; (ii) Public Health Assets; and (iii) Human Resource Development. In each area, complementary actions by the three implementing bodies—the Africa CDC Secretariat and the Ethiopia and Zambia governments—will establish the physical, organizational infrastructure and technical capabilities necessary for the Africa CDC to execute its core functions and lay the groundwork for its continued expansion into a continental health institution. The Ethiopia and Zambia National Public Health Institutes (NPHIs) and Centers of Excellence. The project components described below are designed to leverage network effects and exploit economies of scale to enhance the efficiency of scarce public health resources, overcome national-level capacity constraints, and maximize the positive spillovers produced by integrated transnational disease surveillance and emergency-response systems. The Zambian component of the programme will involve institutional strengthening of the Zambia National Public Health Institute (ZNPHI) and suppport to operationalise the Africa CDC Southern Africa RCC in Lusaka.

1.2.3 Component 1: Governance, Advocacy, and Operational Frameworks

This component covers four key areas. To ensure that adequate governance, advocacy, and operational frameworks are in place to support the core functions of the Africa CDC, the ACDCP will support the development of standardized guidelines and standards for coordination between the Africa CDC Secretariat and the NHPIs across the continent, including provisions for sharing

public health assets, transferring specimens, and sharing data on disease surveillance and outbreaks. The ACDCP will also ensure that the relevant institutional arrangements facilitate efficient coordination among EPHI, the Africa CDC, the SA-RCC, and the ZNPHI, and it will create a framework for implementing the RCC and RISLNET.

1.2.3.1 The Government of the Republic of Zambia: Subcomponent 1.3

In keeping with the Host Country Agreement between Zambia and the AU, since 2016 the Zambian government has been providing office space, interim management, and technical and support staff to operationalize the SA-RCC. This component will finance technical assistance to support: (i) the adaptation and operationalization of the Africa CDC protocols and guidelines developed under Component 1.1 in Zambia; and (ii) the development of institutional arrangements, operational guidelines, and protocols for operationalizing the SA-RCC Host Country Agreement.

1.2.4 Component 2: Public Health Assets

The ACDCP will support the establishment of a small number of sophisticated laboratories, transnational surveillance networks, emergency-response mechanisms, and other health assets designed to manage disease risks on a regional or continental scale. This approach reflects a longstanding international consensus regarding the vital role of shared health assets in Africa, and it is closely aligned with both the World Bank's Africa Action Plan and Pillar III of the Regional Integration Assistance Strategy, which underscores the need for coordinated interventions to provide regional public goods, including disease monitoring, information sharing, as well as the importance of pooling national-level administrative and institutional capacity to address shared health risks.

1.2.4.1 The Government of the Republic of Zambia: Subcomponent 2.3

Strengthening Zambia's national public health laboratory system and associated information networks will improve the ability of the ZNPHI and SA-RCC to effectively detect and rapidly respond to disease outbreaks. Zambia's current lack of a dedicated national public health laboratory system significantly weakens the country's disease surveillance, detection, and response capabilities, negatively affecting its ability to host the SA-RCC. Within Zambia, environmental, climatic, geographic, cultural, and socioeconomic factors contribute to the persistence of epidemic-prone areas. Zambia also shares overland borders with eight countries, heightening the risk of imported diseases.

The ACDCP will enable the ZNPHI and SA-RCC to serve as a center of excellence for Southern Africa in multiple areas. These include disease-surveillance systems, epidemic preparedness and

response, laboratory systems and networks, information-management systems, health and medical research, and health-sector workforce development. The project will finance the procurement of technical services, goods, and civil works for the design, construction, equipping, and maintenance of a laboratory, office complex, and network that will include the PHEOC, ICT Center, training facilities, and other critical infrastructure. This subcomponent will finance: (i) the design, construction, equipping, and maintenance of a BSL-3 national reference laboratory, including a proficiency testing system and panel production for quality assurance, a biomedical equipment maintenance center, a biobank center for various reference materials, a central warehouse to serve as logistics supply hub for ZNPHI and the SA-RCC countries, and an animal laboratory construction/rehabilitation to be determined in year 2 of project and safeguards instruments will be prepared prior to any physical works . The subcomponent will also finance the design and construction, equipping and maintenance of BSL-2 and BSL-1 laboratories including the installation of relevant equipment in the respective laboratories.

The BSL-1, BSL-2 and BSL-3 laboratories will serve as a center of excellence for Southern Africa. It will provide: (i) advanced testing facilities for human and animal health; (ii) offices for both the ZNPHI and the SA-RCC; (iii) a PHEOC that will serve both Zambia and the SA-RCC member states; (iv) an ICT suite that will anchor data management, communication and security systems; and (v) training facilities. This subcomponent will also finance technical assistance to support: (i) the strengthening of disease-prevention and control capabilities in Zambia and the SA-RCC member states; (ii) the expansion of sentinel surveillance sites for AMR and major human and animal diseases; (iii) the creation of public health research and information systems; and (iv) the operationalization of the SA-RCC RISLNET.

1.2.5 Component 3: Human-Resources Development

To fulfill its complex mandate and to ensure that the public health assets described above are fully utilized, the Africa CDC will support the development of diverse and skilled cadre of public health workers in line with the One Health Approach. The Africa CDC will build human-resource surge capacity at the national, regional, and continental levels by working with RCCs and NPHI partners to create a pool of trained African professionals able to respond rapidly and effectively to infectious disease outbreaks and other public health emergencies. Training programs will build on existing courses in member states to increase the number of highly skilled technical experts operating in key areas.

1.2.5.1 The Government of the Republic of Zambia: Subcomponent 3.3

To fulfill Zambia's domestic and regional mandates, and to ensure that the public health assets created under subcomponent 2.3 are functional and fully utilized, the Africa CDC will assist the ZNPHI in developing a diverse and skilled cadre of public health and livestock sector workers in line with the "One Health" approach. This subcomponent will provide financing and technical assistance to assess and build human-resource surge capacity at the national and regional levels. The subcomponent will assist the ZNPHI and SA-RCC in creating a pool of trained African professionals able to respond rapidly to infectious disease outbreaks and other public health emergencies. This component will finance the hiring and training of key personnel in critical skills related to laboratory systems, disease surveillance, outbreak investigations, emergency responses, data management, project management and execution, monitoring and evaluation, and risk communication. Training programs will build on existing courses in member states to increase the number of highly skilled technical experts operating in key areas. Seven staff members will be recruited and deployed to ZNPHI during the transition period to facilitate the implementation of the project. The subcomponent will also finance technical assistance to prepare a comprehensive human-resource needs assessment for the Zambian disease surveillance and response activities that are part of the Africa CDC's continental mission. This assessment will address: (i) current staffing shortages; (ii) retention issues; (iii) incentive structures; (iv) staffing requirements; and (v) initial and ongoing training for both new and existing staff. The assessment will form the basis for a comprehensive training program, which will be implemented with funds from the project's allocated budget following the completion of the assessment.

1.2.6 Cross cutting Component: The Contingent Emergency Response Component

The occurrence of a large-scale disease outbreak or other health emergency during the life of the project could entail deeply negative social and economic consequences. This component will improve emergency-response capacity in Ethiopia and Zambia by financing the preparation of two Emergency Response Operational Manuals for Ethiopia and Zambia that reflect the procedures set forth in OP/BP 10.00 paragraph 13 (Rapid Response to Crisis and Emergencies). The component will provide the technical assistance necessary to develop these manuals and cover their production cost. The manuals will define the triggers for an emergency response, the process for reallocating funds from other project components to finance the emergency response, and the approved list of goods, works, and services eligible for emergency-response funding.

1.2.7 Access to the Laboratory / Office Complex and Sample Transportation

The ACDCP will address this significant shortcoming by providing financial and technical assistance to construct and equippe dedicated National Public Health Laboratories at Biosafety Levels 1, 2 and 3, with associated information and communication technology. The new facilities will enable the country to detect, confirm, track and characterize economically important pathogens for human and livestock as well as support a research platform and training facility. Where applicable, the BSL-2 and BSL-3 will provide support for the integration of surveillance programs and cross-border cooperation in responding to outbreaks in RCC member countries in addition to providing a platform for the development of a regional External Quality Assurance (EQA) program for livestock and human pathogens, and a regional biobank. BSL-1 will provide support in research programmes and training.

The laboratory facility and services will be accessible to all ten SA-RCC Member States, based on the hosting agreement, MoUs and other guiding legal frameworks to be developed and signed under the ACDCP. The ACDCP will facilitate support towards the intra-country transportation of samples and specimens. Furthermore, it is expected that the ACDCP grant to the Africa CDC will contribute to the cost of trans-boundary transportation of samples and materials as well as reagent costs. Additionally Member States will provide contributions (financial and in kind) to support and sustain the smooth operations of the facility as spelt out in the MoUs and Agreements. ZNPHI shall adopt standard package, label, and transport procedures in conformance with all applicable local and international transportation / shipping regulations and standards, elaborated in Annex 7.

1.3 Project Environmental and Social Impact Assessment (ESIA) Methodology

In line with Zambia's Environmental Management Act No.12 of 2011, and in conformity with the Bank, (OP4.01), the project is subject to an environmental and social impact assessment, outlined hereunder. The ZNPHI has therefore engaged the responsible national competent authority, Zambia Environmental Management Agency (ZEMA), which have provided guidance on the required instruments to be used for appraising the project. This is the Environmental Project Brief (EPB), as per Annex 1. Consideration has also been given to satisfy the Bank's internal requirements as per OP4.01.

The study followed the Environmental Impact Assessment regulation (1997) of Zambia Environment Management Authority (ZEMA). It followed a typical process of establishing baseline conditions, identifying specific environmental and social risks that need to be addressed,

characterization of the effects the project will have and the impacts (positive or negative) they will result in, determination of significance of the issues identified, establishment of mitigation measures and monitoring measures, and finally proposals for management plans to ensure effective implementation of mitigation and management of the anticipated issues.

The approach and methodology chosen ensures that World Bank safeguards policies, the ZEMA Environment and Social Impact Assessment (ESIA) processes have been followed. This involved collecting data on the environmental and social situation, conducting consultations with stakeholders and data analysis. An essential element of the ESIA is the environmental scoping study which was undertaken in accordance with World Bank OP4.01 and the EIA ZEMA regulations. It should be emphasized that much of the work initiated in the environmental scoping process continues as a logical set of steps merging into the ESIA process. The background data collected, reviews conducted, draft reports, plans, assessment of risks looked at during scoping are simply moved to a higher level of environmental assessment with emphasis on risk aversion and adaptation strategies during project implementation.

Relevant literature was reviewed while conducting the assessment. This included studying relevant legislation and policies; national and local secondary (collated) data sources; available maps of the Project area; and other related reports and documents related to the proposed construction of the Zambia National Public Health Laboratory and World Bank safeguards policies on ESIA and associated guidelines. Key documents reviewed included: The Constitution of Zambia, Environmental Management Act 2011, Environmental (Impact Assessment and Audit) Regulations, 1997, The Physical Planning Act, 1996, The Public Health Act (Cap 242), Occupational Safety and Health Act, Water Act, Layout Design Report for Project, and World Bank OP. 4.01. The data in the environmental baseline comprised secondary data collected through review of literature and primary data which was collected through field site visit and transect walks on the project area.

Site surveys were carried as part of the ESIA study process to understand the baseline biophysical and socio-economic environment which would be affected by the proposed project. Besides, stakeholder consultation was conducted. The specific objectives of public consultations were to: disseminate information on the proposed project; collect views and issues to be considered in the scoping process and ESIA study; evaluate perceptions about positive and negative impacts of the project; and receive concerns about environmental impacts and other implementation problems such as communication strategy and avenues for participation in the project.

1.4 Construction Cost and Proposed Implementation Timeframe

The overall construction cost for core infrastructure and accessory components of the complex is estimated at US$36.5million. This includes the main office and laboratory blocks, biobank, animal health laboratory, biomedical equipment maintenance center, waste management facilities, sewage/waste water managemnt system, power substation and backup systems, paving/landscaping & external lighting, security infrastructure and perimeter fence. Project implementation is envisaged to start in **January 2020**, with the construction phase expected to take around 24-36 months.

2. DESCRIPTION OF THE PROJECT

2.1 Location

The proposed laboratories, BSL-1, BSL-2 and BSL3 will be located approximately 26km from Lusaka central business district along Palabana road in Silver Rest , Chongwe district (Latitude 15º23’38’’ S; Longitude 28º28’41’’ E). It will be built on a 10-hectare piece of land.

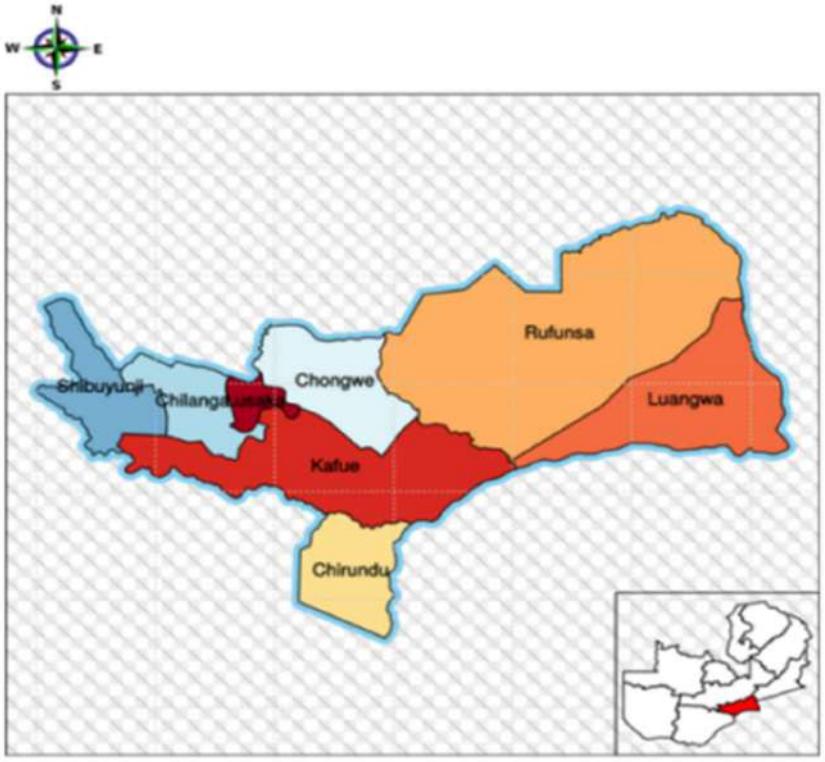

Figure 2: Map showing the location of Chongwe District in Lusaka province

The tarred road leading to the project site branches off from the Great East road (T2) at Silver Rest primary school, 9km from the airport roundabout.

The Project site is located in close proximity with the following social receptors as shown in Table 2 below. It is imperative to mention that the general surrounding to the site location is farm area.

Table 2: Social receptors in proximity to the site

No	Social receptor in Proximity	Distance from Site	Vector
1	Police Post	1 Km	North East
2	Silver Rest Primary School	5.17 Km	North
3	Silver Rest Gardens Residential Estate	3.4 Km	North

The police post is located approximately 1km from the proposed site location, north east of the site, also located 5.17km in the north direction of the site is Silver Rest primary school and Silver Rest gardens residential estate is located 3.4 km, north of the site.

Figure 3: Sign post showing the location of Silver Rest at the junction with Great East Road

Figure 4: Silver Rest junction with the Great East Road

Figure 5: Satellite map showing location of the project site

2.2 Nature of the Infrastructure

The main infrastructure is envisioned to be a four-storey building of an inverted "T" shape, with accessory two-storey arc-shaped blocks at its rear. The front of the building will connected through a central circular façade that will serve as the primary public entrance into the complex. The two rectangular blocks will accommodate the offices, training/seminar rooms, ICT suite, conference facilities and library/resource center. The top two floors of the circular area will house the PHEOC (one floor each for national and regional). The stem of the inverted "T" will be the main laboratory block, with the BSL-3 suite occupying the uppermost floor, while other support laboratories (BSL-1 and BSL-2) will be on the lower three floors. These will support functions including Virology, Bacteriology, Immunology/Vaccinology, Vector biology & Parasitology, a Molecular biology suite, Chemistry, Haematology, Toxicology and and proficiency testing panel production center to support quality assurance programs. The arch-shaped blocks will house the Biorepository and animal health laboratory facilities.

Other accessory features will include a biomedical equipment maintenance center, power substation, onsite industrial autoclave and shredder unit, and waste management system (for liquid and solid biomedical, domestic waste as well as e-waste). The entire building will be surrounded by a road network connecting to a number of parking spaces.

As per figure 6:

- Blocks A and C will accommodate the offices, training/seminar rooms, ICT suite, conference facilities and library.
- Block B which is the main access point into the facility will have a lobby and reception area. The top two floors will accommodate the PHEOC (one floor each for national and regional).
- Block D, the stem of the inverted T, will be the main laboratory block. The BSL-3+suite will occupy the uppermost floor, while other laboratories (at BSL-1 and BSL-2 levels) will be on the lower three floors. These will include Virology, Bacteriology, Immunology/Vaccinology, Vector biology & Parasitology, Molecular biology suite, Chemistry, Haematology, and Toxicology.
- Block E will house the Biorepository.
- Block F will house animal health laboratory facilities

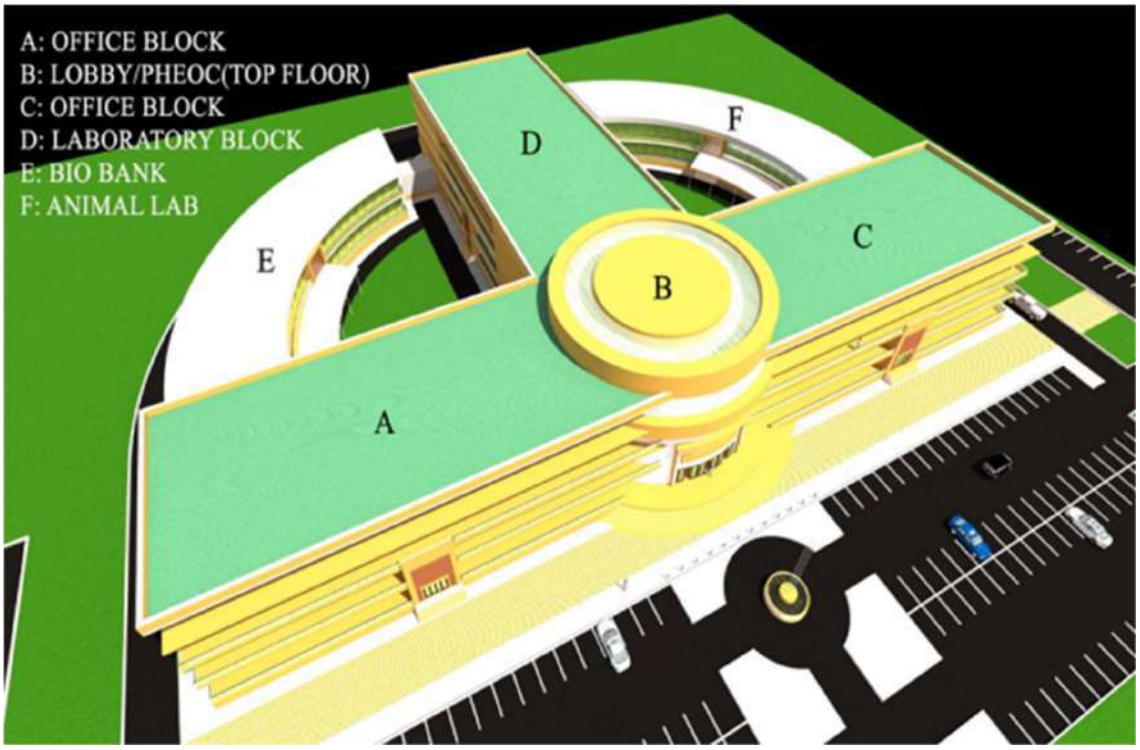

Figure 6: Conceptual Design of the Proposed Complex

The structure spans approximately 109m from Wing A to C and approximately 78m from the main entrance of Wing B to the Rear Entrance of Wing D. The surface area breakdown of the building is shown in the table below.

Table 3: proposed Floor Area Distribution

Section	**Dimensions**	**Area per Floor (m^2)**	**No. of Floors**	**Cummulative Floor Area**
A: ZNPHI Office Block	43.1m X 18m	775.8	4	3,103.2
B: Central Lobby	(circular)	528.3	3	1,584.9
C: RCC Office Block	43.1m X 18m	775.8	4	3,103.2
D: Laboratory Block (BSL-3)	55.2m X 24.9m	1,374.3	1	1,374.3
Laboratory Block (BSL-1 & 2)	55.2m X 24.9m	1,374.3	3	4,122.9
E: Bio-Bank	(curved)	1,352.7	2	2,705.4
F: Animal Laboratory	(curved)	1,352.7	2	2,705.4
Walkway 1		31.5	1	31.5
Walkway 2		31.5	1	31.5
Totals		**6,222.6**		**20,847.0**

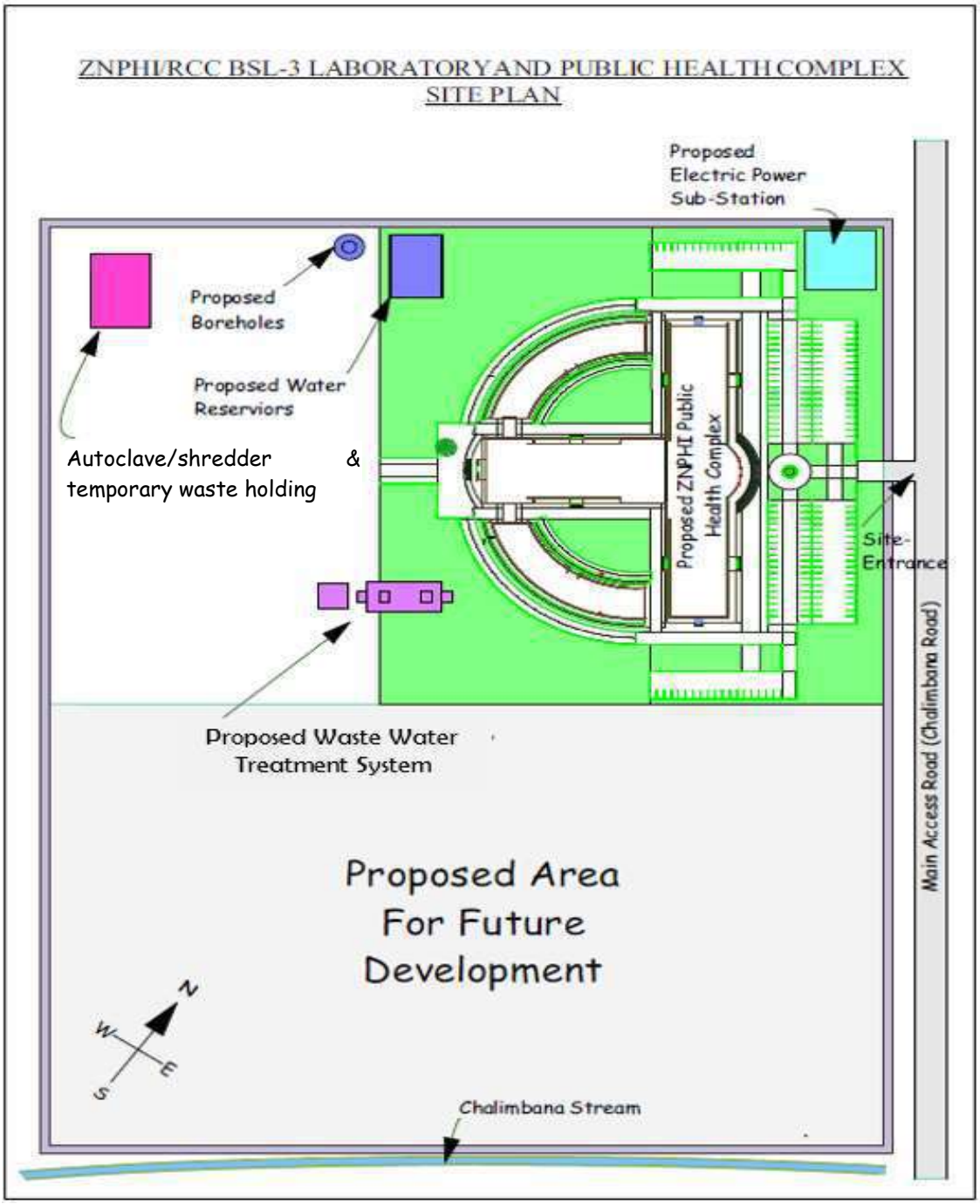

Figure 7: BSL-3 Laboratory and office complex site layout plan

2.3 The proposed Biosafety Laboratories

Laboratory facilities are designated as basic – Biosafety Level 1, basic – Biosafety Level 2, containment – Biosafety Level 3, and maximum containment – Biosafety Level 4. Biosafety level designations are based on a composite of the design features, construction, containment facilities, equipment, practices and operational procedures required for working with agents from the various risk groups. For this project, laboratory facilities to be constructed are BSL-1, BSL-2 and BSL-3. The BSL-3 Laboratory is proposed to be on the upper floor of block D, while BSL1 and 2 laboratories which will be next to each other are proposed to be on the lower floor with a total floor area equal to that of BSL-3 laboratory.

2.3.1 BSL-1

The BSL-1 laboratory which will be constructed at ZNHIP, next to BSL-2 Laboratory but below BSL-3 laboratory will be designed and operated in accordance with guidance for BSL-1 laboratories established by reputable international organizations (CDC 1999, NIH 2001, WHO 2004).

The BSL1 laboratory does not require special features and therefore the design of the laboratory has normal construction and may not have to be separated from other laboratory sections. BSL-1 laboratory will essentially be furnished with an open work bench, basins for washing hands, a laboratory trush and an emergency shower.

Laboratory workers will do their work on open bench tops and there will be no need to use special equipment simply because BSL-1 laboratories are the lowest security level for handling biological material. Workers in the BSL-1 laboratories will be sensitised to adhere to the following;

- Ensure mechanical pipetting only (no mouth pipetting allowed)
- Ensure safe sharps handling
- Avoidance of splashes or aerosols
- Daily decontamination of all work surfaces when work is complete
- Consistently wash their hands after particular assignments are concluded.
- Ensure no worker eats from the laboratory (no food, no drinks and no smoking)

- Ensure Personal protective equipment, such as; eye protection, gloves, a lab coat or gown and face masks.
- Place biohazard signs at appropriate locations

For any spills in the laboratory, this will be cleaned up immediately and all work surfaces will be decontaminated each time work is completed. Under BSL-1, infection materials will be decontaminated prior to disposal. Generally autoclaving will only be required when there will be work involving genetically modified organism.

2.3.2 BSL-2

The BSL-2 laboratory will be constructed next to BSL-1 Laboratory at ZNHIP. The laborary will be designed and operated in accordance with guidance for BSL-2 laboratories established by reputable international organizations (CDC 1999, NIH 2001, WHO 2004). The proposed laboratory will be tested for verification that the design and operational parameters have been met prior to operation

As regards design of BSL-2 laboratory, this shall includes all the features of BSL-1. However, BSL-2 has additional design parameters because the laboratory require higher security standards than a BSL-1. The higher security standard needed for BSL-2 is triggered by the fact that this type of a laboratory uses biological material that consists of bacteria, viruses and organisma associated with human diseases. This therefore implies extreme precautions are taken with contaminated items.

The additional design parameters for BSL-2 laboratory shall include the following;

- Biohazard sign posted on the door
- Bench tops on which work will be performed, should be easily be sterilized and the aerosols formed, to be handled in a biosafety cabinet.
- A sink and eyewash will be installed and available for use
- Self-closing or lockable doors will be used/installed.

Contaminated broken glass or pipettes shall be disposed of in puncture-resistant container that will be labelled to warn everyone that the contents are hazardous.

In addition to BSL-1 expectations, the following practices will be followed, in a BSL 2 lab setting:

- Appropriate personal protective equipment (PPE) will be worn, including lab coats and gloves. Eye protection and face shields and face masks can also be worn, as needed.
- All procedures that can cause infection from aerosols or splashes shall be performed within a biological safety cabinet (BSC).
- An autoclave or an alternative method of decontamination will be available for proper disposals as per standard practice for BSL-2 laboratories.
- Biohazard warning signs shall be installed.

2.3.3 BSL=3

The BSL-3 laboratory which is going to be constructed at ZNHIP would be designed and operated in accordance with guidance for BSL-3 laboratories established by reputable international organizations (CDC 1999, NIH 2001, WHO 2004). The proposed laboratory will be tested for verification that the design and operational parameters have been met prior to operation.

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. Also reference should be made Annex 3 for further guidance.

2.3.1 Raw Materials for construction of the lab and construction phase activities

The main raw materials to be used in the project are both consumptive and non-consumptive materials the majority will be non-consumptive ones. The consumptive raw materials are in the form of construction materials. The table below shows the list of raw materials to be used in the project during the construction phase.

Table 4: Raw material to be using during the construction phase

No.	Raw Material	Source	Mode of Delivery
1	River and building sand for concrete and building mortar	Local suppliers	Road truck
2	Laterite / gravel for foundations and construction of road sub base	ZEMA approved quarry	Road truck
3	Cement for concrete, mortar and road works	Local approved supplier	Road truck
4	Bricks	Registered local clay brick Supplies	Road truck
5	Concrete blocks	Local approved supplier	Road truck
6	Diesel for operation of plant and machinery	Approved ERB bulk fuel storage facility	Approved ERB fuel bowser
7	Water for construction, dust suppression and workers domestic use	Local streams and on site borehole(s)	Pump and reticulation
8	Electricity	Initial supply by on-site generator, subsequentl power supply from ZESCO	33kV transmission line
9	General building materials (e.g. timber for shuttering, door and window frames, polythene sheeting, brick force and mesh reinforcement, timber purlins, sewer pipes, paint etc.)	Local approved suppliers. Trusses will be produced locally	Road truck
10	Finished products and equipment (e.g. IBR roofing sheets (chromadeck), PVC and HDPE piping, switches, aluminium window frames, geysers, sanitary ware, glassware and finishes, ceramic floor tiles, booster pumps, etc.)	Imported ensuring compliance with Zambian standards and regulations	Road truck

Project activites will be intiatied in the following sequence; preparatory, construction and operational phases.

2.3.1.1 Site Preparation Phase Activities

Site preparation will involve the following activities;

- Stripping of topsoil and vegetative material for access roads and building foundations.
- The foundation which will be constructed with a view to minimise the need for rock breaking. In the event that blasting is carried out this will be controlled to minimise noise and the scattering of debris.
- Basic earthworks to establish required finished road and foundation levels and falls. This will entail some filling of areas with laterite and aggregates.
- Excavation and foundations:
- Excavation of trenches for foundation strips (the concrete footing will not exceed a depth of 1500 mm), drainage, sewage trench, etc. This may require rock breaking and possibly the use of explosives.
    - Compaction of underside of foundation trenches
    - Mixing, pouring and compaction of concrete

2.3.1.2 Construction Phase Activities

Construction activites will involve the following activities:

- Sub-structural works for laying of incineration
    - Block work
    - Mixing, pouring and compaction of concrete
    - Backfilling and compaction of material according to specifications
- Internal access roads and drainage construction:
    - Stabilization of the base with the piling, spreading and compaction of gravel and aggregate.
    - Spreading and compaction of aggregates and tar materials on the road for bitumen surface and preparation, pouring and compaction of concrete for concrete surfaced areas.Excavation and shaping of drains.
- Installation of electrical/mechanical equipment/engineering services:
    - This will involve installation of electric power supply, cables, lighting, medical and specialised equipment etc.

- Materials Storage:
    - Materials such as blocks/bricks, sand, gravel and aggregate, which are not required for immediate use will be stockpiled in a designated area on the site.

2.3.2 Resources needed at Operational Phase

For operationalization of the the BSL3 lab, the resources needed include among others:

a) <u>Equipment</u>

1. Biosafey Cabinets
2. Fume Hood
3. Centrifuge
4. Microscope
5. Spectrophotometer
6. Autoclave
7. Freezers

b) <u>Chemicals</u>

The number and amounts of chemicals that need to be stored should be reduced to an absolute minimum. Physically segregate your chemicals into their respective hazard categories—corrosive, flammable, reactive, and toxic. Chemicals should be stored based on their compatibility; compatible chemicals can be stored alphabetically. Acids, flammable liquids, oxidizers and highly reactive chemicals should all be separated and stored properly to avoid an unwanted chemical reaction.

Chemicals for Use in Laboratory

- Nitric Acid
- Sulphuric Acid
- Hydrolflouric Acid
- Ethidium Bromide
- Dimethyl Mercury
- Cryogenic liquids, such as liquid nitrogen,
- Chemicals causing acute health effects or long-term chronic health effects e.g. hydrogen cyanide, phosgene or arsine.
- Hydrogen peroxide
- Potassium

- Bromine
- Ammonium nitrate
- Acetylene
- Sulfuric acid
- Sodium peroxide
- Sodium
- Oxygen
- Chlorine dioxide

c) Compressed Gases

Compressed gases may present both physical and health hazards. Gases may be flammable, reactive, corrosive, or toxic and these properties must be considered when developing experimental procedures and designing apparatus. In addition, compressed gases, when not handled properly or not contained in properly designed vessels, can be extremely hazardous with a high potential for explosion.

d) Facility Cleaning Chemicals

Many types of chemicals will be used as disinfectants and/or antiseptics to clean/disinfect the facility. They include among others:-

Facility Cleaning Chemicals

- Chlorine (sodium hypochlorite)
- Sodium dichloroisocyanurate
- Chloramines
- Chlorine dioxide
- Formaldehyde
- Glutaraldehyde
- Phenolic compounds
- Quaternary ammonium compounds
- Alcohols
- Iodine and iodophors
- Hydrogen peroxide and peracids

2.3.3 Expected Types and Quantities of Wastes

The operation of the BSL-3 facility will generate different types of wastes (gaseous, liquid and solid) in nature and general and harzadious in categorization. The wastes will emanate from the different activities from the three laboratories (BSL-1, BSL-2 and BSL-3 facilities). The waste will be infectious waste and non infectious in nature and will include, but is not limited to, cultures and stocks of infectious agents, pathological wastes, waste human blood and blood products, sharps used in patient and animal care, biological laboratory wastes among others. . In general, the hazardous waste will be generated primarily from the BSL2 and 3 laboratory facilities. There will also be the generation of E-waste from the ICT operations, from time to time. The office functions and occupation will generate mainly domestic waste, while the ICT operations will generate E-waste. The different types of wastegenerated will be handled in specific ways elaborated in the project's infection Control and Waste Management Plan (ICWMP) and the E-Waste Management Plan respectively. A description of the types of waste follows, with methods of treatment summarised in table 5.

Laboratory Cultures and Microorganism Stocks (BSL-3 facility)

This type of waste is expected to be generated predominantly from the BSL3 facility, cell culture labs, Microbiology laboratories, animal health laboratory, biobank, and proficiency testing panel production center. The waste will be include cultures and stocks of infectious agents or microorganisms; cultures of medical and clinical specimens from pathology units; and receptacles and other potentially contaminated materials used in processing of microbial cultures and stocks.

Blood, Blood Products and Tissues of Human Origin (BSL-2 and BSL-3 facilities)

This includes human tissue, body parts, organs, blood and blood products (plasma, platelets, red cells, leukocytes, and other derivatives) and other body fluids such as cerebrospinal, peritoneal, pleural, pericardial, synovial, genitourinary fluids. Additionally there may be items that incorporate human bodily fluids or receptacles and apparatus used in processing, storing or delivery of tissues human of human origin.

Tissues of Non-human Origin (BSL-2 and BSL-3 facilities)

Operations of the animal health laboratory will include use of various approved animal tissues and organs. Remnants from animal autopsies, animal droppings, receptacles and apparatus used

in processing, storing or delivery of tissues and other residues will constitute the main waste in this category.

Sharps (BSL-1, BSL-2 and BSL-3 facilities)

This category includes any sharp objects such as used blades, broken glass, syringes, needles (hollow or solid), pipettes, scalpel blades, vials, test tubes, lancets, microscope slides, covers slips, microtome blades and other such objects that would have been in contact with infectious or potentially infectious material.

Chemical Waste (BSL-1, BSL-2 and BSL-3 facilities)

This includes, but not limited to: most laboratory reagents, drugs, pharmaceutical products, organic and inorganic solvents, disinfectants such as hypochlorite, phenol, chloroform, formaldehyde, alcohols (ethyl alcohol, isopropyl alcohol, amyl alcohol, etc) and others. Included are chemicals that are no longer required or that have expired or become unsuitable for use.

Liquid Waste from the Laboratories (BLS-1, BSL-2 and BSL-3 facilities)

Several laboratory procedures and functions require the use of water which is eventually discharged as potentially infectious / hazardous waste. This includes discharges from the sluice rooms and re-usable equipment wash units.

Domestic Liquid Waste

This will include waste water and sewerage from the kitchens, rest rooms / lavatories, showers and other areas outside the laboratories. The volume of waste is based on maximum occupancy of the facility, expected to be at 200 when fully operational.

Non-Hazardous Waste

Common waste in this category includes paper, newsprint, cardboard, plastic wrapping, and other non-infectious / non-contaminated materials. These materials will predominantly be generated from office functions and packaging materials for supplies.

E-Waste from ICT operations

The operations of the ICT will, from time to time, have obsolete equipment to dispose, such as mulfunctional computers, laptops, desk tops and various other electronic equipment. This type

of waste is called the E-waste, classified by the Zambia Environmental Management Agency, as hazardous waste, and therefore will require special disposal methods. This implies that the ICT stuff shall be required to separate the E-waste from domestic waste to avoid E-waste disposed at designated disposal site together with the ordinary waste. Additionally, the ICT stuff must ensure the E-waste does not get mixed with the medical waste and end up being mishandled.

The Environmental Management (Licensing) Regulations (SI. No 112 of 2013) implements the Environmental Management Act 2011 and concerns a wide variety of matters regarding environmental protection including air quality control, waste management, hazardous waste, and other substances harmful to the environment such as pesticides and ozone-depleting substances. E-Waste belongs to the fifth schedule, regulation 18 (1), list of hazardous wastes, 'Waste electronic or electronic assemblie.' ZNPHI ICT may require that the obsolete ICP equipment is disposed of at an appropriate site. This is normally done via a ZEMA licensed contractor. Therefore any contractor that is contracted to treat, handle, transport, store, dispose of, transit, trade in E-waste shall be in possession of a ZEMA hazardous waste license, to ensure this type of waste is disposed of in an appropriate manner.

In respect of the requirements by the World Bank, the project will have to be consistent with the local requirements, the Environmental Social, Health and Guidelines (ESHG) and the Good International Industry best Practices (GIIP), for the management of E-waste. The WBG ESHG promotes waste prevention, reuse and recycling, good housekeeping, inventory control, avoidance of damage and instituting procurement measures that allow the return of reusable material. Similarly, GIIP promotes the use of an obligation on distributors to offer to consumers a take-back system where E-waste items can be disposed of free of charge.

Table 5: Expected Quantities of Waste and Methods of Treatment

Type of Waste	**Main Sources**	**Expected Quantity**	**Method of Treatment**
Laboratory Cultures and Microorganism Stocks	BSL-3 facility, cell culture labs, Microbiology laboratories, vector biology labs, animal health labs	40 kg/day	Sterilization within the laboratory/point of generation, followed by high temperature incineration (at ZNPHI Laboratory located at Levi Mwanawasa Hospital)
Blood, Blood Products and	BSL-2 and BSL-3 facilities, Microbiology laboratories,	6 kg/day	Chemical disinfection, autoclaving (within the lab) and incineration.

Tissues of Human Origin	biobank, proficiency testing panel production center		
Tissues of Non-human Origin	BSL-2 and BSL-3 facility, vector biology labs, insectaries, animal health lab	2kg/day	Chemical disinfection, autoclaving (within the lab) and incineration.
Sharps	BSL2 and BSL-3 facility, cell culture labs, Microbiology laboratories, vector biology labs, animal health labs	3.5 kg/day	Sharps to be collected in puncture-proof sharps containers. When three-quarters full, the sharps containers and contents will be shredded by the sharps shredding module within the onsite industrial shredder.
Chemical waste	BSL-1, BSL-2 and BSL-3 facilities, cell culture labs, Microbiology laboratories, vector biology labs, insectaries, animal health labs, biobank, proficiency testing panel production center	5 litres/day	Dilution with distilled water; neutralization (using an acid or alkali as appropriate). Expired pharmaceutical products to be returned to supplier or disposed of at the incinerator located south of ZNPHI Laboratory, which is behind Levi Mwanawasa Hospital.
Laboratory Liquid Waste	BSL-1, BSL-2 and BSL-3 facility, cell culture labs, Microbiology laboratories, vector biology labs, insectaries, animal health labs, biobank, proficiency testing panel production center	400 litres/day	Disinfection with hypochlorite, where appropriate, followed by treatment through the liquid waste channel).
Domestic Liquid Waste	Rest rooms, lavatories, showers, kitchens	4,320 litres/day*	Domestic liquid waste will be treated through the onsite sewerage network.
Non-hazardous waste	Office areas, BSL3 facility, support labs	23 kg/day	Non-hazardous wastes would be incinerated after sorting.
Fly ash	Incinerator		The fly ash will be disposed of at Chunga landfill. This ESIA will be updated during implementation to assess the capability of Chunga landfill[2] to serve the purpose.
Sludge	Onsite wastewater treatment system		The sludge will be disposed of Manchinchi WWTP[3]. This ESIA will be updated during implementation to assess the capability of the WWTP to serve the purpose.
E-waste	ICT activities		ICT will get into an arrangement where the obsolete equipment is returned to the supplier.

*Based on Zambian standard of 80% of 27 litres water use per capita per day for office occupancy.

The table 6 below highlights the wastes that will be generated from the laboratory facilities during its operation phase.

Table 6: Waste Types and Disposal Method

Waste Type	**Treatment Method**
Aerosols (gasesous) Emissions	Biosafety Cabinet: HVAC system
General Wastes (Broken glasses, paper, used gloves, laboratory equipment) etc	Shredding and/or Incineration
Bilogoical wastes (urine, blood, silava, sharps)	Autoclaving and/or Incineration

[2] Has an approved ESIA

[3] Environmental and social brief is being prepared for the WWTP

Effluent Waste	Sterlisation, filtration and disposal at LWSC Kaunda Square Ponds
E- waste from the ICT activities	Arrangements will be in place for all new procurements of ICT machinery to have the resulting obsolete items returned to the supplier.

The proposed BSL-1, BSL-2 and BSL-3 laboratories will have procedures for compliance with all applicable regulations for collecting, storing, processing, and disposing of sanitary liquid wastes, solid wastes and hazardous wastes.

2.3.3.1 Waste Minimization

Appropriate plans, strategies and actions would be established to ensure minimization of healthcare wastes. The proposed laboratories will implement the following waste minimization strategies :

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

2.3.3.2 Waste Segregation

Proper segregation of waste at source generation is essential, efficient and effective in managing healthcare wastes. It helps in reducing the quantity of waste requiring treatment prior to 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. The waste generated from the proposed laboratories, will be segregated and color-coded as outlined below in Table 6 as recommended by WHO.

Table 6: Laboratory waste collection and segregation methods

Waste categories	Colour of 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 biohazard symbol.	Leak-proof strong plastic bag placed in a container.	When three-quarters filled or at least once a day.
Chemical waste	Brown, labelled 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.

2.3.3.3 Colour Coding

Color coding is done by using colors to differentiate waste classes from one other. It is efficient and helps in the process of waste segregation at source. It is also simple, easy to use and thus can be understood even by illiterate patients particularly at health posts where 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.

2.3.3.4 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. The following guidelines would be included for packaging sharps and other health care wastes:

- Sharps (sharp items or items with sharp corners) would be placed in rigid, puncture-resistant containers made of glass, metal, rigid plastic, or cardboard.
- Liquid infectious wastes would be placed in capped or tightly stopped bottles or flasks; large quantities may be placed in containment tanks.
- 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.

2.3.3.5 Labelling

An important aspect of colour coding is labelling. All waste bags or containers would be labelled with basic information 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, ensure that each staff member feels more responsible for what they put into the bag/receptacle

2.3.3.6 Waste Collection approach at the proposed BSL 3 laboratory

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 machinery such as laboratory trolley and carts. The laboratory staff will be actively involved in 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. The following would also be adhered to when collecting waste

- All HCW would be sorted on site before collection and transportation. This will bring about easy identification of content of containers thus preventing careless handling and the risk of secondary infection.
- There would be a fixed schedule for the collection of waste bags and containers from each medical department. This is to ensure the regular removal of waste from each location and to ensure coordination between medical staff and cleaning or housekeeping staff. The minimum frequency of waste removal would be once per working shift.
- No bags would be removed without labelling indicating the point of generation (department, office and laboratory section) and content;
- Laboratory workers would immediately replace the bags or containers with new ones of the same type.
- There would be separate schedules and separate collection times for different colour coded containers. Separate trolleys would be used for different types of waste.

- Vehicles will be disinfected and cleaned daily or at the end of haulage with an appropriate disinfectant at an appropriate site where wastewater will be properly disposed of.
- Waste ducts that convey sacks of waste by gravity will not be used, as they tend to scatter wastes at the exits of the chutes, and are subject to fouling by the wastes, leading to nuisances such as smell and insects.
- Carts and vehicles used to transport the waste will be carefully designed so that they are stable, quiet in operation, and so that transportation can be achieved with the minimum of effort and inconvenience.
- Trolleys or carts would be large enough so that waste is not piled up on them in an unsafe way and the trolleys and carts would be designed to prevent and accommodate any form of spillages.
- Sealed sharps containers would be placed in a labelled, yellow infectious health-care waste bag before removal from the healthcare or laboratories.
- Water and hand-wash materials would be readily available for healthcare waste handlers to wash their hands after handling HCW.

2.3.3.7 Handling Waste at the BSL 3 lab

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

Proposed Waste Handling Safety Measures at the BSL-1, BSL-2 and BSL-3 Labs

1. 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 prior to leaving the work area and to place it in a designated area or container. When performing procedures where splashing is not expected, gloves are the minimum PPE that would be worn;
2. Protective medical clothing and PPE would not be submitted for laundering unless sterilized;
3. 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 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).

- **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.

- Safety boxes will also be sealed and collected when they are ¾ full and will never be emptied or opened.
- Sharps containers (i.e., safety boxes) will be placed as close to the point of use as possible and practical, ideally within arm's reach.
- Safety boxes will be labeled so that people will not unknowingly use them as a garbage container for discarding other items.
- Safety box will not be shaken to settle their contents.
- Safety boxes will not be placed in high traffic areas (corridors outside laboratory rooms or sample preparation rooms) where people could bump into them or be stuck by someone carrying sharps to be disposed of.
- Containers will not be placed on the floor or anywhere they could be knocked over.

- **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.

2.3.3.8 Waste Storage at the BSL-3 Laboratory Facility

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. The following rules would be observed for proper storage of healthcare wastes from the BSL3 lab:

- Initial packaging and storage would take place where healthcare waste is generated.
- Storage of waste will then be moved to a temporary on-site storage location (onsite storage refers temporary storing of disinfected solid wastes on the premises of the lab)
- Non-risk healthcare wastes would always be stored in a separate location from the infectious/ hazardous healthcare wastes to avoid cross-contamination.

Internal storage is the temporary placement of waste at the point of generation before transfer to external storage points. A storage location for the healthcare wastes 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 healthcare wastes before it is transferred to external storage facilities would 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. The external waste storage will be located in a secure area within the vicinity of the autoclave/shredder (figure 7).

To ensure that waste is kept separated, the central storage receptacles (include bags, bins, sharps boxes should be available to staff in each medical and other waste-producing area) for each colour coded bags will be placed in similarly colour coded receptacles.

- There will be one or more external storage points for hazardous and non-hazardous waste depending on the layout of BSL 3 laboratory.
- The external storage point(s) for the hazardous and non-hazardous waste will be geographically separate at BSL 3 laboratory section.
- The walls and floors would be smooth, without cracks, impervious, easy to clean and disinfect
- The site will be spacious, well ventilated and lit;

- All loading and unloading of waste would take place within the designated collection area around the storage point;
- Larger volume waste bins would be available at the external storage facility to receive waste containers from the internal storage points.

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

The time gap between generation and treatment should not exceed the following periods: Infectious waste should be kept cool or refrigerated at a temperature preferably no higher than 3 °C to 8 °C if stored for more than a week. Unless a refrigerated storage room is available, storage times for infectious waste (e.g

Temperate climate	**Warm climate**
72 hours in winter	48 hours during the cool season
48 hours in summer	24 hours during the hot season

2.3.3.9 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 (e.g., off-site transport will be done for, autoclave disinfected solid waste, sludge from the onsite wastewater treatment and wastewater)**.**

2.3.3.9.1 On site transportation

The on-site transport involves conveying of wastes from the various points of generation within a laboratory to a temporary storage location also within the same area. The following would be

adhered to when carrying out *On Site transportation* and every effort would be made to avoid unnecessary handling of healthcare wastes;

- All waste bags would in-place and intact at the end of transportation;
- Carts, trolley, or containers used for the transportation of health-care waste would not be used for the transportation of any other material; and would be used for transporting safety boxes and bins
- Waste that has the potential to leak will be double bagged;
- Waste bags would be placed in containers (e.g. cardboard boxes or wheeled, rigid, lidded plastic or galvanized bins), before being placed directly into the transportation vehicle
- A trolley, bin, or wheelbarrow will be used for transporting safety boxes and bins.
- The collected waste will not be left even temporarily anywhere other than at the designated storage room (external waste storage facility; see Figure 8).
- Containers would be covered with lids during storage and transport.

2.3.3.9.2 Off-site Transportation

During the transportation of waste outside the three laboratories compound, the following safety precautions would be needed:

- Single-bagged waste and containers of sharps and liquids would be placed within a rigid or semi-rigid container such as a bucket, box, or carton lined with a plastic bag.
- Containers would be covered with lids during transportation.
- When transporting plastic bags of infectious waste, care would be taken to prevent tearing of the bags.
- Infectious waste would not be compacted before treatment.
- Outside the BSL3 lab, infectious waste would be transported in closed, leak-proof, rigid containers using trucks
- 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.

- The vehicles would carry adequate supplies of plastic bags, protective clothing, cleaning tools, and disinfectants to clean and disinfect in case of any spillage.
- Staff would be properly trained in the handling, loading and unloading, transportation, and disposal of waste
- Staff would be fully aware of emergency procedures for dealing with accidents and spillage.

2.3.4 BSL-3 Laboratory Hazardous Waste Treatment

Health care solid waste from the BSL -3 laboratory will be initially autoclaved within the laboratories as per BSL -3 biosafety requirements. From the central autoclaving system, sterilised solid waste will be shredded to reduce on the volume. The autoclaved and shredded waste will be taken to the waste collection chambers/ temporary solid waste storage facility and ultimately be transported to the ZNPHI Incinerator located south of Levi Mwanawasa Hospital, for incineration, as shown in the flowchart labelled figure 8 below.

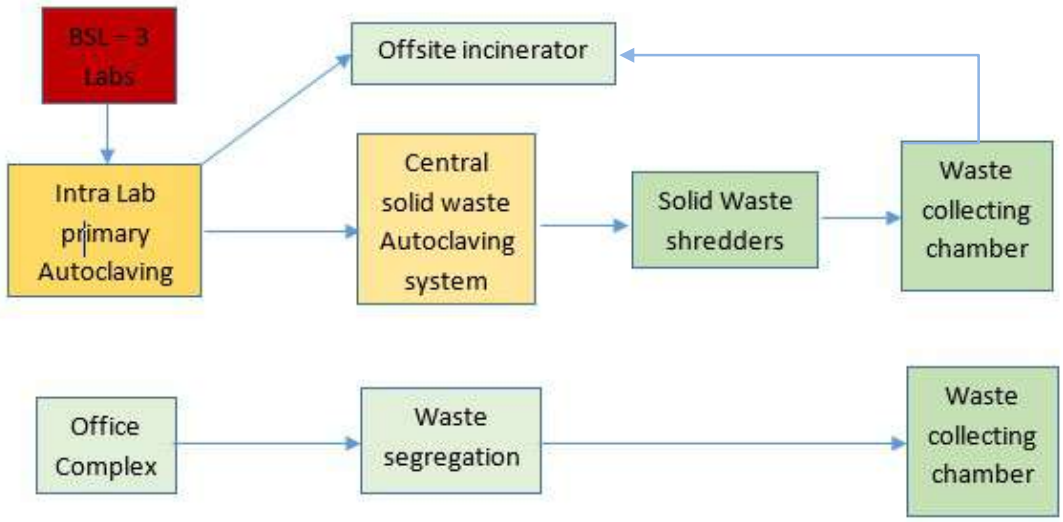

Figure 8: Managment of General and Healthcare Waste

2.3.4.1Autoclaving

In line with the Stockholm convention on persistent organic pollutants (POPs) to which Zambia is a signatory, ZNPHI shall promote current best practices of using non- incineration methods including the use of autoclaves for health care waste management to minimize emission of POPs in order to meet the Stockholm convention requirements. Therefore, the ZNPHI shall have a

central autoclaving system for sterilisation of health care solid waste. Waste from the BSL-3 laboratory will be initially autoclaved within the facility as per BSL -3 biosafety requirements provided for by WHO Laboratory Biosafety Manual. The sterilised solid waste will then be conveyed to the central solid waste autoclaving system for secondary autoclaving. The disinfected solid waste will then be transported to ZNPHI Laborary for incineration. As discussed earlier, ZNPHI Laboratory will have an incinerator installed about 100m south of the laboratory, behind Levi Mwanawasa Hospital.

2.3.4.2 Incineration at Levi Mwanawasa Hospital

During the operational phase, disposal of the medical and pharmaceutical waste will be done at ZNPHI incinerator. The incinerator will be located at Levy Mwanawasa Hospital, behind the ZNPHI Laboratory. The installation of the incinerator commenced in the month of July 2022 and will be completed within a period of 2 months.

Figure 9: ZEMA Approved site for ZNPHI Incinerator, behind Levy Mwanawasa Hospital.

Most of the incinerator materials at the site include pharmaceuticals, medicines and other materials brought for incineration, from BSL-1, BSL-2 and BSL-3 laboratories. These are stored in secure storage facilities, with the highest level of hygiene.

The type of an incinerator to be installed at Levy Mwanawasa Hospital, about 100m south of the ZNPHI Laboratory, will a diesel dual chamber, fully automatic process control with top or front loading. The primary fuel source is diesel. The minimum burning capacity is 100kg/hour, witrh operating temperatures in the Primary Chamber of between 850 – 1200°C, and in the Secondary Chamber of between 1200 – 1300°C.

Figure 10: Proposed Containerised Incinerator to be installed at Levi Mwanawasa Hospital

For the ncineratpor propoed incinerator, the components include but not limited to the following;

a) Incinerator type and capacity
b) Graduated Fuel tank and pipe support
c) Primary and secondary chambers
d) Primary and Secondary burners (with digital temperature gauges)
e) Control unit
f) Loading chamber/mechanism
g) De-ashing chamber
h) Chimney stack
i) Thermocouples

Table 7. Average Emissions from the proposed incinerator

Parameter	**Limits ½ hr (av)**
Total Dust	30mg/m3
Sulphur Dioxide	200mg/m3
Nitrogen Oxide	400mg/m3
Carbon Momoxide	100mg/m3

2.3.4.3 Management of of incinerator fly ash

The plan is to trap particulate emissions within the stack. The ash generated will be transported by a ZEMA licensed waste transporter to an approved disposal site. The physical properties of fly ash are listed in table 8 below.

Table 8 Physical properties of fly ash

Property	**Parameters**
Density	2.17 g/cm^3
Bulk density	1.26 g/cm^3
Moisture content	2 %
Particle shape	Spherical/irregular
Color	Gray
pH	6.0 - 10.0
Specific gravity	1.66 – 2.55
Grain size distribution	Sandy silt to silty loam
Porosity	45% – 55%
Water holding capacity	45% – 60%
Electrical conductivity (dS/m)	0.15 – 0.45

Disposal of fly ash from incineration, if not well managed, poses a risk to the environmental (air, soil, surface water and ground water) pollution as well as health problems. This raises concerns for efficient ash disposal mechanisms. Figure 16 below highlights the pathways of ash pollutant dispersal into the environment.

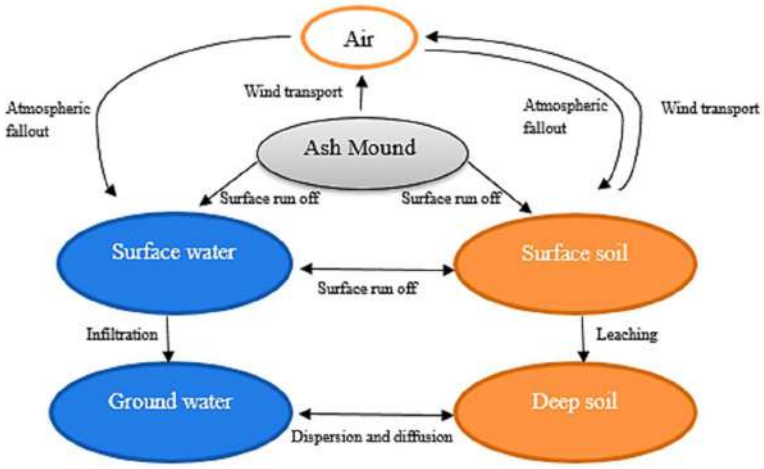

Figure 11: Schematic pathways of ash pollutant movement in the environment

The fly ash from the incinerator is presently collected using a dry disposal system. The incinerator is equipped with an electrostatic precipitator which removes the ash from the flue gas and maintains the flue gas emissions below 30mg/m^3. The ash is collected into ash collection hoppers and removed periodically by a pneumatic ash handling system into storage silos. During retrieval of dry fly ash from the silos, adequate water injection will be made to prevent spreading of dust.

As per the provisions of the the Environmental Protection and Pollution Control Act, Ninth Schedule (Regulation 11) of the Laws of Zambia, incinerator ash can be disposed of at approved landfill sites. After collection from the storage silos, the ash will be transported by trucks and disposed of at the Chunga landfill site, which is located next to the Lusaka North Forest Reserve. Chunga landfill has an approved ESIA.

Chunga is the proposed landfill which is an engineered landfill that meets the prescribed standard. It is a licensed and accredited by Zambia Environmental Management Agency (ZEMA) which monitors operations at the site. It occupies a land area of 26 hectares and the engineered cell sits on an land area of about 5 hectares. The site was opened in 2001 followed by the engineered part which was opened in 2007.Waste received come from Municipal Solid Waste (MSW) generated in the city of Lusaka and operated by the Lusaka City Council. This means that industrial waste,waste from the trade and commerce, from institutions, markets,

hospitals and clinics is collected, transported and disposed at the landfill. The landfill has a workforce of 30 workers who include the Superintendent, Foreman, Supervisors, Cashiers, Pointers and machine operators. There are different machines which include; landfill compactor, excavator, loaders, and tipper trucks(Strategic Municipal Solid Waste Management Plan for Lusaka City, 2003).

Transportation and delivery of waste is carried out by licensed transporters including Franchise contractors, Community based Enterprises and individual companies. Chunga landfill receives an average per day of 550 tonnes of waste per day. Zambia Environmental Management Agency (ZEMA) regulates and monitors the operations of the landfill. Paramount to the selection of a credible and operational landfill that meets the required standards is the assurance that what is planned to be dumped at these sites is safe and does not filter into and contaminate the environment. The landfill operates under the legal provisions provided in the Environmental Management Act.

2.3.5 Medical Wastewater Management Approach for the proposed BSL3 lab

The complex will have two separate wastewater networks for management of healthcare waste effluent and domestic waste effluent as descriebd below. The medical wastewater will be collected into a leak proof storage tank whose filling capacity will be auto monitored so as not to exceed ¾ full. The wastewater will then be steam sterilised using the liquid cycle of the autoclave connected to the storage tank. The autoclaved wastewater will then be discharged into

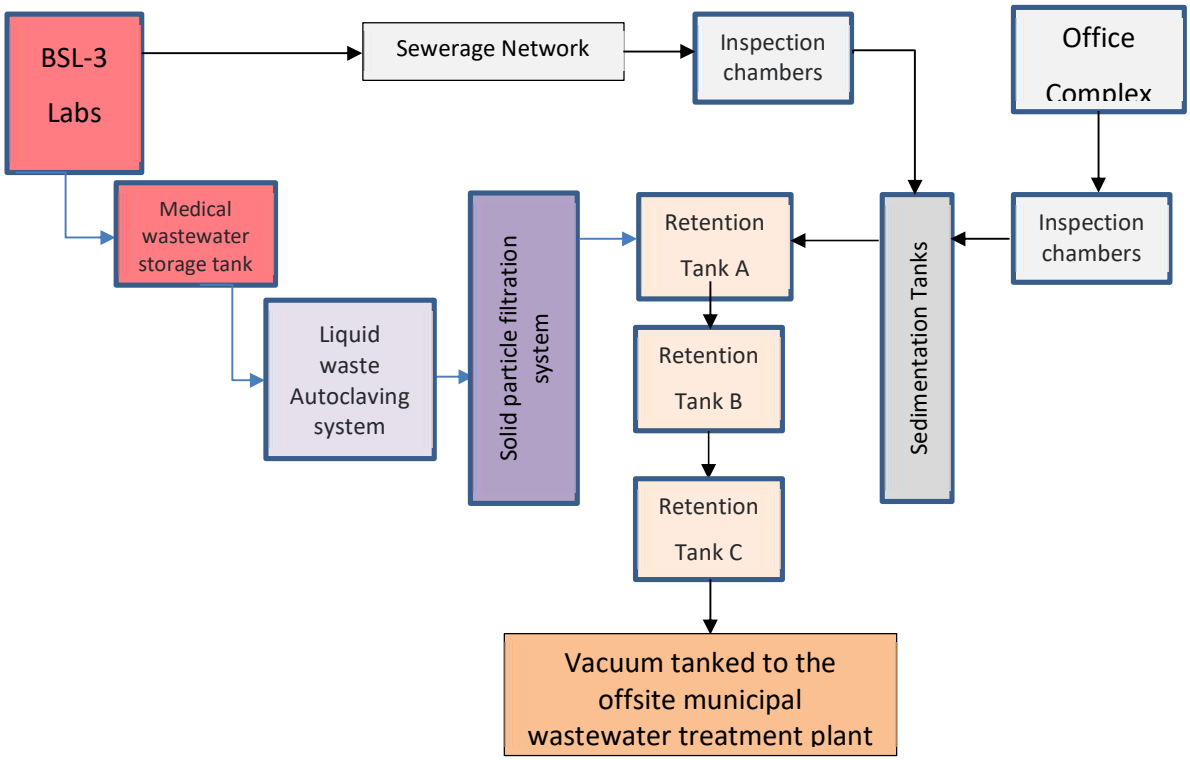

Figure 12: Management of Domestic and Laboratory Waste Water

the solid particle filtration system to allow solid particles to be filtered out of the waste water as it flows through the system. The filtered waste water will be collected in the retention tankswhich will be vacuum tanked by licenced waste collectors for further treatment at the offsite sewage treatment site (Kaunda Square Sewerage Treatment Stabilisation Ponds) at regular intervals.

The domestic waste water network will have several inspection chambers as it leads to the sedimentation tanks. A layer of accumulated solids or sludge, will form at the bottom of the sedimentation tank as the waste water slowly flows through it thereby providing a level of purification prior to discharge. The sludge at the bottom of the sedimentation tanks will be periodically removed during routine maintenance as illustrated in figure 15, above.

2.3.6 Wastewater Treatment in Lusaka

Kaunda Square Wastewater Treatment Ponds

Management of wastewater in Lusaka province falls under the responsibility of the Lusaka Water and Sewerage Company (LWSC). Their sewerage system is divided into five sewer-sheds namely: Western, Ngwerere, Manchinchi, Kaunda Square, and Chelston. Out of these, a larger percentage of the wastewater in Lusaka is treated at Manchinchi Wastewater Treatment Plant and Kaunda Square Stabilisation Ponds. The disposal of outoclaved waste material from BSL-3 will finally be discharged at the Kaunda Square Stabilisation Ponds.

The Kaunda Square Ponds were originally intended to provide waste stabilization (oxidation) sewage treatment for a population of less than 18,000, treating no more than 3,600 m^3/day of sewage. Since 1970, Lusaka's local government had neither expanded nor conducted major maintenance to the ponds, resulting in an overload of the ponds, collapse of the embankments separating the three treatment units, malfunctioning of the inlet works, and accumulated silt. By 2010, sewage flow to the ponds had increased to as much as 5,800 m^3/day, well in excess of their capacity. These conditions rendered the ponds ineffective in treating sewage. After the upgrade funded by the Millennium Challenge Compact, the Kaunda Square Ponds could treat up to 41,000 m^3/day—more than 8 times the original design—enough to serve the estimated 156,000 residents. The Sanitation Investment Master Plan calls for the construction of a new sewage treatment plant that will replace Kaunda Square and several other pond systems by 2035. MCC's investment in Kaunda Square was therefore an important bridging measure to cover acute sanitation needs.

The expansion and rehabilitation of the Kaunda Square Ponds, being an interim measure, has provided an opportunity boost efficient removal of sediments, and active management of the sewer treatment to ensure that short circuiting of the treatment process does not occur. Following the rehabilitation and expansion of the Kaunda Sewer Treatment Ponds, there is a general improvement in the quality of effluent discharge, according to ZEMA Effluent Standards, and therefore appropriate for disposal of BSL-3 autoclaved waste water at the said ponds.

Disposal of liquid waste at the ponds is currently charged at the rate of K36 ($2.7) per 1,000 litres ($1m^3$) as at 6 June 2019. In the same year, the average cost of vacuum tanker services per trip is K800 ($60) and tankers available on the market have capacity ranging from 7,000 to 15,000 litres. There are around 61 private companies licensed to handle transport wastewater to Manchinchi wastewater treatment plant.

The LWSC also regulates the discharge of trade effluent into its sewer networks for both onsite and offsite sanitation using the local administration (Trade Effluent Regulations) Act of 1994. The effluent and pollution control section at LWSC monitors and regulates discharge of trade effluent and enforces the "Polluter Pays Principle" in accordance with the trade effluent regulations. The section conducts fortnight inspections on clients or operators who discharge in its sewer networks. They also collect trade effluent samples which are analyzed for key parameters.

Other Wastewater Treatment Plants

Other sewage treatment plants and ponds in the city of Lusaka include Chunga sewage treatment plant, Chelstone stabilization ponds, Garden stabilization ponds, Kaunda Square stabilization ponds, and Ngwerere stabilization ponds. Chunga treatment plant receives industrial wastewater for treatment through a sewer network serving the western side of Lusaka.

2.3.7 Surveillance and Maintenance of the Wastewater Treatment System

ZNPHI shall have trained Environmental Health personnel to conduct routine monitoring and surveillance of the waste management system at the complex. ZNPHI shall have trained Environmental Health personnel to conduct routine monitoring and surveillance of the waste management system at the complex. For wastewater, the officers will be responsible for collecting waste water samples, for isolation of indicator orgasms which ideally are not naturally found in the environment, at several sampling points including medical wastewater storage tank, after the wastewater autoclaving and solid particle filtration systems. In addition, ZNPHI shall have a dedicated maintenance unit that will be responsible for routine maintenance of the wastewater management system.

3. LEGAL AND POLICY FRAMEWORK

3.1 Institutional Framework

The legislative responsibility for environmental impact assessment is vested in the Zambia Environmental Management Agency (ZEMA) which administers the Environmental Management Act (EMA) of 2011. It is responsible for enforcing environmental regulations and coordinating sectoral government agencies involved in environmental management in their sectors. This ESIA has been developed in accordance with the EIA Regulations of 1997.

3.2 Review of Relevant National Regulatory Framework

The proposed project activities touch on many regulatory instruments which need compliance with. Presented below is a listing of key legislation relevant to the project and requiring legal compliance were applicable.

Table 7: Relevant Legislation

LEGISLATION	INTERPRETATION	RELEVANCE
Environmental Management Act, 2011	The Act provides for continued existence of the Zambia Environmental Management Agency (ZEMA) and mandates it to do all such things as necessary to protect the environment and control pollution to provide for the health and welfare of persons, animals, plants and the environment in general. Noting that program activities involving crop production closely interacts with the environment the provisions of this Act and its subsidiary pieces of legislation will require compliance with. This will be done through implementation of the appropriate ESIA and obtaining the relevant licenses.	The proposed construction of an office complex housing a BSL3 laboratory falls within the first schedule of the EIA Regulations of 1997. The ZHPHI have submitted an ESIA to comply with the regulation and will only initiate construction activities once an approval and accompanying decision letter has been issued by ZEMA.
Environmental Impact Assessment Regulations, 1997	*The Regulations state that "a developer shall not implement a project for which a project brief or an environmental impact statement is required under the Regulations, unless a Project Brief or an Environmental Impact Assessment has been concluded in accordance with the Regulations and the Council has issued a decision letter".*	
Gender Equity and Equality Act, 2015	An Act to establish the Gender Equity and Equality Commission and provide for its functions and powers; provide for the taking of measures and making of strategic decisions in all spheres of life in order to ensure gender equity, equality and integration of both sexes in society; promote gender equity and equality as a cross cutting issue in all spheres of life and stimulate productive resources and development opportunities for both sexes; prohibit harassment, victimization and harmful social,	The project will undertake surveillance and disease intelligence and this will help identify potential threats to public health security. Women and children still remain the most vulnerable to public health risks as they are often maginalised in society. Availability of data from surveillance and disease intelligence will insure measures are put in place to protect the public health of the most vulnerable and maginalised in society.

LEGISLATION	INTERPRETATION	RELEVANCE
	cultural and religious practices; provide for public awareness and training on issues of gender equity and equality; provide for the elimination of all forms of discrimination against women, empower women and achieve gender equity and equality by giving effect to the Convention on the Elimination of all Forms of Discrimination against Women, the Protocol to the African Charter on Human and People's Rights on the Rights of Women in Africa and the SADC Protocol on Gender and Development; and provide for matters connected with, or incidental to, the foregoing.	
Human Rights Commission Act, 1996	An Act to provide for the functions and powers of the Human Rights Commission; to provide for its composition and to provide for matters connected with or incidental to the foregoing.	Access to information and guaranteed public health security remain one of the fundamental human rights. The operation of the facility will ensure they is an established early warning system for diseases in the region and protect the health of members of the beneficiary countries.
National Health Research Act, 2013	An Act to establish the National Health Research Authority and provide for its functions and powers; establish the National Health Research Ethics Board and provide for its functions and powers; provide a regulatory framework for the development, regulation, financing and coordination of health research and ensure the development of consistent health research standards and guidelines for ethically sound health research; provide for the establishment of health research ethics committees and the regulation and management of research institutions, health researchers and health establishments involved in or undertaking research; provide for the regulation of biological material for health research; provide for ethical approval for the conduct of clinical trials;	The proposed facility will undertake field survey and research This will require that all research is undertaken in like with the requirements of the National Health Research Ethics Board.

LEGISLATION	INTERPRETATION	RELEVANCE
	provide for the use of traditional, complementary and alternative medicines in health research; provide for data management and intellectual property rights in health research; provide for the designation of bio banks; and provide for matters connected with, or incidental to, the foregoing.	
Non-Governmental Organizations Act, 2009	An Act to provide for the co-ordination and registration of non-governmental organizations; establish the Non-Governmental Organizations' Registration Board and the Zambia Congress of Non-Governmental Organizations; constitute the Council of Non-Governmental Organizations; enhance the transparency, accountability and performance of non- governmental organizations; and provide for matters connected with or incidental to the foregoing.	Non-Governmental Organizations (NGO's) are some of the major stakeholders on the project, their involvement on the project will range from; information dissemination, educational activities and livelihood initiatives. This will require that NGO's are registered, regulated and adhere to ethical practices set by the Non-Government Organizations Registration Board and The Zambia Congress of Non-Governmental Organizations.
Public Health Act, 1995	The Act provides for the prevention and suppression of diseases and general regulation of all matters connected with public health in the country. The Act also stipulates conditions for production, distribution and vending of food products.	The establishment of the CDC Regional Center in Zambia that will house a BSL3 Laboratory that will conduct research and tests for various communicable diseases. This will be done within a bio- safety environment that is regulated and will not pose a risk to members of the public. The center will further enhance public health by establishing early warning systems.
Public Procurement Act, 2008	An Act to continue the existence of the Zambia National Tender Board and re-name it as the Zambia Public Procurement Authority; revise the law relating to procurement So as to ensure transparency and accountability in public procurement; regulate and control practices relating to public procurement in order to promote the integrity of, fairness and public confidence in, the procurement process; repeal and	The project will involve the procurement of studies, works, goods and services and this will require that the process to follow the Zambia Public Procurement Authority (ZPPA) guidelines to ensure fairness, transparency, integrity, accountability and promote public and stakeholder confidence. The process will be further complimented by World Bank procurement polices

LEGISLATION	INTERPRETATION	RELEVANCE
	replace the Zambia National Tender Board Act, 1982; and provide for matters connected with or incidental to the foregoing	
The Local Government Act (1991	The Act provides for the establishment of Councils or Districts, the functions of local authorities and the local government system. Some of these functions relate to pollution control and the protection of the environment in general.	The proposed project will fall within the jurisdiction of Chongwe District Council. The developer, ZNPHI will be required to obtain all the required permits from the local authority.
The Medicines and Allied Substances, 2013	An Act to continue the existence of the Pharmaceutical Regulatory Authority and re-name it as the Zambia Medicines Regulatory Authority; provide for the functions and powers of the Authority; provide for the registration and regulation of pharmacies, health shops and agro-veterinary shops; provide for the registration and regulation of medicines and allied substances; provide for the regulation of the manufacture, importation, exportation, possession, storage, distribution, supply, promotion, advertising, sale and use of medicines and allied substances; provide for the regulation and control of clinical trials; repeal and replace the Pharmaceutical Act, 2004; and provide for matters connected with, or incidental to, the foregoing.	During the operation of the center, the use of any medication or allied substance and control of clinical trials will be done in line with the requirement of the Zambia Medicines Regulatory Authority. The center will obtain all the requiremed licences and permits before resuming operations.
Urban and Regional Planning Act, 2015	The Act provides for the development, planning and administration principles, standards and requirements for urban and regional planning processes and systems; provide for a framework for administering and managing urban and regional planning for the Republic; provide for a planning framework, guidelines, systems and processes for urban and regional planning for the Republic; establish a democratic, accountable,	The Act is relevant to this project because all project activities such as infrastructure development will require planning permission from the planning authorities in each respective area. The project will ensure that all relevant permissions are obtained before embarking on any project that requires development planning authorization.

LEGISLATION	INTERPRETATION	RELEVANCE
	transparent, participatory and inclusive process for urban and regional planning that allows for involvement of communities, private sector, interest groups and other stakeholders in the planning process.	
National Council for Construction Act, 2003	This Act provides for the establishment of the National Council for Construction (NCC) and to define its function; to provide for the promotion and development of the construction industrial in Zambia; to provide for the registration of the contractors to provide for the affiliation to the council of professional bodies or organisation whose members are engaged in activities related to the construction industry; to provide for the regulation of the construction industry; to provide for the establishement for the construction school; to provide for the training of persons engaged in construction or in activities related to the construction; and provide for matters connected with or incidental to the fore-going.	The construction of the proposed Regional Laboratory will involve engaging a contractor and/or subcontractors. During the implementation of the Regional Laboratory, ZNPHI will only engage registered contractors/subcontractors who adhere to the regulation Act.
Road and Traffic Control, 2002	The Road Traffic Act No. 11 of 2002 establishes and defines the functions of the Road Transport and Safety Agency(RTSA) which replaced the National Roads Safety Council. The new act repealed the National Roads Safety Council Act and parts V to XIV, First Schedule, Second Schedule and Third Schedule of the Roads and Road Traffic Act.	Relevance: The proposed ZABs Regional Laboratory is located off Great East Road and will involve traffic movement to and from the site during operations. ZNPHI will engnage RTSA to ensure the smooth flow of traffic.
Water Resources Management Act (Act no. 21 of 2011)	The Act provides for the control, ownership and use of water excluding that of the Zambezi, Luapula and parts of the Luangwa Rivers which form borders with other countries. The Act establishes the Water Resources Management Authority and regulates the use of public water including protection against pollution.	The project will be implemented in the Silverest area on land whose boundary is transverse by the Chalimbana stream. Any plans by the developer to abstract or alter the flow of the stream will be in line with the provision of the Water Resources Act of 2011.

3.3 Review of Relevant Policy Framework

Two main sector policies are identified as relevant to the proposed program and need to be complied with, namely the National Health Policy and the National Policy on Environment.

3.3.1 National Health Policy

The National Health Policy for Zambia seeks to respond to these challenges. It has been developed within the context of the Vision 2030 and has taken into consideration other relevant national, regional and global health related policies, protocols and strategic frameworks, including the Millennium Development Goals (MDGs).

3.3.2 National Policy on Environment

The overall vision of the National Policy on Environment is to provide a framework management guide for the management of Zambia's environment and natural resources so as to ensure that they are managed on a sustainable basis and retain their integrity to support the needs of the current and future generation without compromising either of the two. The guiding principle on heatlh are;-

- Urban, district and rural planning and development activities should incorporate human settlement and health concerns;
- Human settlements should incorporate environmental concerns as well as disaster preparedness;
- Temporary settlements for refugees and other displaced people are managed using the same guidelines for environmental, pollution and health concerns as for all other human settlements including environmental impact assessment and monitoring;
- Development and improvement of human settlements should incorporate the concept of community development with focus upon social services, particularly water supply, schools, health facilities, recreation facilities, communications, transport and security, in order to discourage random roadside ribbon development which is difficult to maintain and tend to be environmentally unfriendly.

3.4 World Bank Operational Policies

In addition to the national environmental legal framework, this ESIA takes into consideration the ten of the World Bank Safeguards Policies. Two out of the ten safeguards polices have been triggered by the project. Table 9 lists the safeguards policies that have been triggered and reasons for the same.

Table 9: Explanation of Policies Triggered

World Bank Safeguards Policies	Explanation for Triggering
Environmental Assessment (OP/BP 4.01)	The project funded activities have the potential of high risk due to the highly infectious nature of the agents and samples which are to be collected, transported and tested and the environmental and social risks on human health and general environment. Construction of BSL-1, BSL-2 and BSL-3 facilities will not only lead to generation of hazardous solid and liquid waste and the disposal of the same, but also other impacts related to occupational health and safety, including labor influx etc. This Policy is triggered to ensure that all potential adverse environmental and social impacts are managed and mitigated.
Physical Cultural Resources OP/BP 4.11	The policy is triggered for precautionary purposes as chance finds may happen during the construction of laboratory. Chance Find Procedures will be included in the ESIA/ESIA and in the civil works contract.

3.5 International and Regional Conventions

Zambia is a party to many international and regional conventions aimed at addressing environmental concerns. Those relevant to the proposed construction of a CDC Regional Center and its environmental setting will require compliance with and include but not limited to:

- United Nations Framework Convention on Climate Change
- United Nations Convention on Biological Diversity
- International Plant Protection Convention for the prevention and control of the introduction and spread of pests of plants and plant products
- Stockholm Convention on Persistent Organic Pollutants
- Convention on Wetlands of International Important especially as Waterfowl Habitat (RAMSAR Conventions)

This entails that national developments should be done with due consideration to these conventions and protocols and as such ZNPHI under the Ministry of health is obliged to abide by these national commitments.

Epidemics Control and Public Health

Surveillance: Zambia is still prone to outbreaks of epidemics including cholera, measles and polio, leading to significant public health concerns. In order to improve the detection and

management of epidemics, in 2000, the country adopted the Integrated Disease Surveillance and Response Strategy (IDSR). The policy direction will focus on improving capacity to conduct surveillance, preparedness and control of epidemics at all levels.

3.6 The World Bank Group EHS and WHO Biosafety manuals

The World Bank Group EHS guidelines and WHO guidelines related to healthcare facilities are usually considered as bench mark International Good Practice Standards. For the proposed BSL-1, BSL-2 and BSL3 Laboratory, the WHO Laboratory Biosafety Manual and the World Bank Group guideline for healthcare facilities appears to be directly relevant. Besides, the World Bank Group General EHS Guideline has important provisions which are applicable to various components of the proposed project namely Hazardous waste management,Occupational health and safety (against biological and chemical hazards), Community health and safety including traffic safety such as during project construction or disease prevention (where incinerators emission waft into and affect the local communities) and Construction and decommissioning.The incinerator (s) to be used by the proposed laboratories need to fulfil the air emission standard proposed in the WBG EHS guidelines (2007).

Table 10: Air Emission Levels for Hospital Waste Incineration Facilities

Pollutants	**Units**	**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/m3 for new plants or for existing incinerators with a normal capacity exceeding 6 tones per hour, 400 mg/m3 for existing incinerators with a nominal capacity of 6 tones per hour or less b. Oxygen level for incinerators is 7 percent		

Source: the WBG EHS guideline , Health Care Facilities, 2007

These emission levels should be achieved without dilution, at least 95 percent of the time that the plant or unit is operating, to make calculation as a proportion of annual operating hours.

The World Bank Group EHS guideline for effluent levels for Health Care Facilities are shownin the Table below. The wastewater to be generated from the BSL-3 laboratory complex will be autoclaved and pass through the solid particle filtration system to allow solid particles to be filtered out of the waste water as it flows through the system. The wastewater will be collected into the vacuum tank and disposed into the ponds at Kaunda Square Ponds for further treatment prior to discharge into the environment. Intermitently, the solids will also be collected and end up at the same Kaunda Square Treatment Plant for further treatment. Because of this arrangement, the effluent requirements of the WBG EHS guideline does not seem to apply for this laboratory complex. This is because the guidelines are applicable for direct discharges of treated effluents to surface waters for general use.

Table 8: 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]	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		

These levels should be achieved, without dilution, at least 95 percent of the time that the treatment unit is operating, to make calculations as a proportion of annual operating hours.

4. DESCRIPTION OF THE BASELINE ENVIRONMENT

4.1 Location

The project site is approximately 4.8km at the terminal end of the newly tarred Silverest road from Silverest primary school on Great East Road. The tarred road leading to the project site branches off from the Great East road (T2) at Silverest primary school, 9km from the airport roundabout. The central GPS coordinates for the 10-hectare project site are; Latitude 15°23' 38 South and Longitude 28°28 41' East.

Figure 14: Sign post showing the location of Silverest at the junction with Great East Road

Figure 15: Google map showing location of the project site

4.2 Physical Environment

4.2.1 Climate

Zambia is divided into three major agro-ecological regions (Regions I, II and III), based primarily on rainfall amount and other climatic and soil characteristics. Region I is semi-arid, while Region II has the most fertile soils and annual rainfall averages 800-1000mm, and Region III is the high rainfall area, receiving over 1000mm of precipitation each year. The area around Silver Rest lies in Region II of the agro-ecological regions.

The climate essentially comprises a long dry season (May to September) and a wet season (November to March), April and October are mainly transitional months. The annual rainfall is 800 mm of which nearly 75% falls from December to February. The reliability of rainfall over the last decade has generally been very low. June and July are the coldest months, with an average minimum temperature range of 9^0 C to 14^0 C. October has the highest maximum temperatures, averaging 18^0 C to 32^0 C. Daily maximum temperature of 37^0 C may be reached during the period from September to January. From December to April, the monthly average temperatures are 16.7^0 C minimum and 26.1^0 C maximum. The annual mean temperature is 20.6^0 C. The mean relative humidity ranges from 42% in October to 89% in February. Figures 18-21 below show a 16-year summary of average climatic data for Lusaka, including humidity, rainfall, and sunshine hours.

The area around Silverest lies in region two of the agro ecological regions; the climate essentially comprises a long dry season (May to September) and a wet season (November to March), April and October are mainly transitional months. The annual rainfall is 800 mm of which nearly 75% falls from December to February; the reliability of rainfall over the last decade has generally been very low. June and July are the coldest months, with an average minimum temperature of about 9^0 C and an annual average of about 14^0 C. October has the highest maximum and minimum temperatures, averaging 32^0 C and 18^0 C respectively.

The period from December to April has monthly averages close to 26.1^0 C for the maximum and 16.7^0 C for the minimum temperature. The annual mean temperature is 20.6^0 C the mean relative humidity ranges from 42% in October to 89% in February. Figures 19, 20,21 and 22 below show summary of some average climatic data for Silverest.

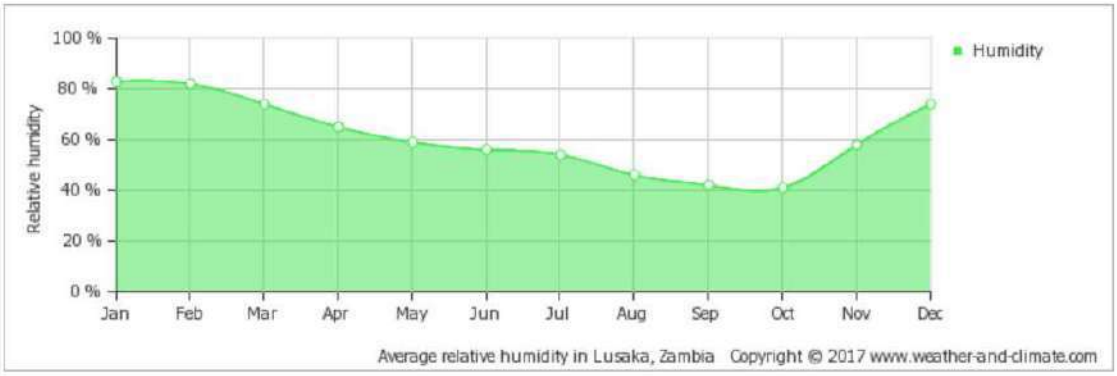

Figure 16:Figure Average Relative Humidity for Lusaka (sourced from www.weather-and-cimate.com)

Figure 17: Average Sunshine Hours for Lusaka

Rainfall mainly occurs in heavy thunderstorms producing typical precipitation events of between 10 and 40mm. Rainfall is unpredictable, and the mean annual rainfall is 804mm per annum.

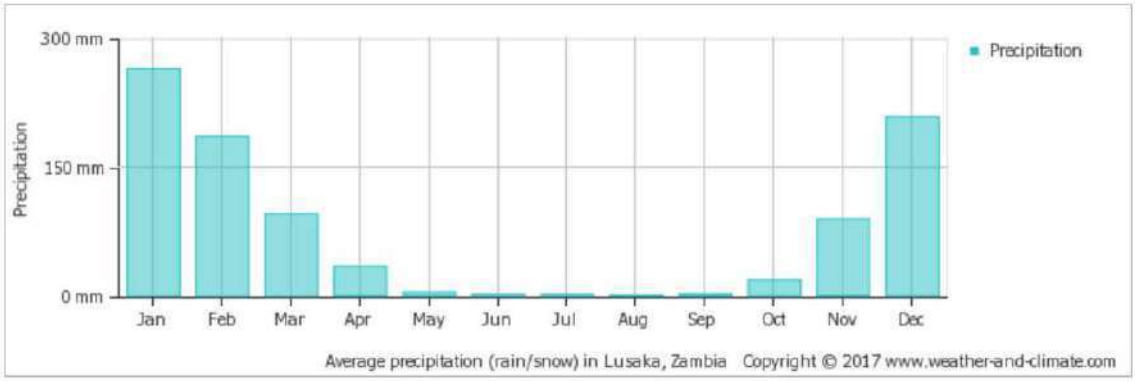

Figure 18: Average Precipitation for Lusaka

The area experiences annual temperature averaging 20°C. Lower temperatures occur during the dry season months with the lowest temperatures occurring in June and July. The highest temperatures occur in October.

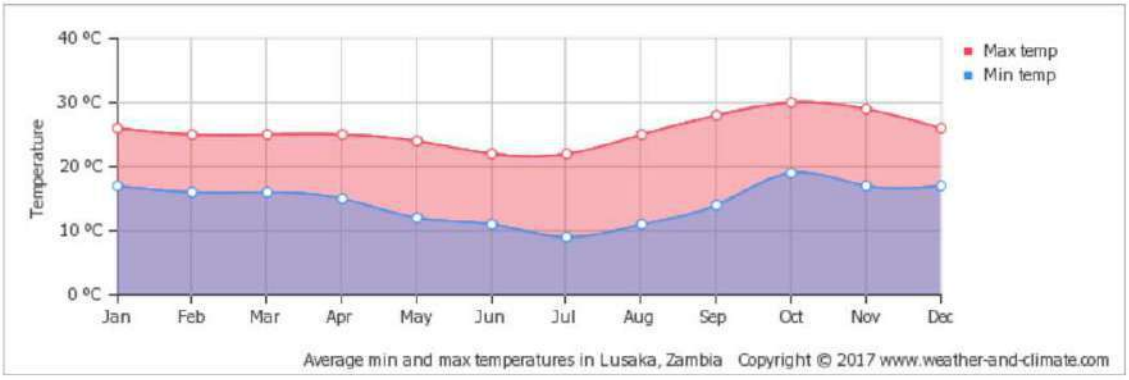

Figure 19: Average Temperature for Lusaka

4.2.2 Air Quality

Air quality in the project area is generally good although pollutants generated by vehicle exhaust emissions and dust raised by traffic passing through the area contributes to deterioration of the ambient air quality, especially when local inversions are experienced. Apart from vehicular traffic, other sources of air pollution include the burning of fuel (wood and charcoal) in townships and informal settlements and the burning of bush and scrub as well as charcoal burning in surrounding areas around Silver Rest, especially during the dry season. Increases in fugitive dust levels, particularly under hot and dry conditions, also periodically results in the deterioration of air quality.

4.2.3 Soils and Land use

The in-situ materials range from silty sands, clayey/silty sands, silts to coarse gravels while several areas have rocky outcrops. There are alluvial soils along the rivers, streams, and valley floors. The soil types have positive implications for agriculture. The soils in the project area are particularly susceptible to erosion, more so where the ground cover has been cleared, where gradients are steeper, or where soil and vegetation cover has been disturbed by both human and animal activity, for example cultivation, tree felling, overgrazing and trampling. The soils are permeable, well drained and reflect possibly the gemstone geology beneath. The soils fall under the Ibex Soil series, which represent agriculturally productive soils with high inherent fertility. This arises from a relatively high organic matter content which forms a pool of nutrients. The

mineralogy of the soils, which have developed over the basic rocks such as gemstone and dolomite, also supports the high inherent fertility.

Figure 20: Typical soils at the project site

4.2.4 Landscape and Topography

The Chongwe catchment can be divided into the mountainous lower part dominated by the Zambezi escarpment and the relatively flat upper part comprising all sub catchments but the Lower Chongwe. The upper part ranges between an elevation of 1000m and 1300m above sea level while the Lower Chongwe reaches from approximately 1300m (with peaks up to 1500 m) to the Zambezi River at 330m above sea level.

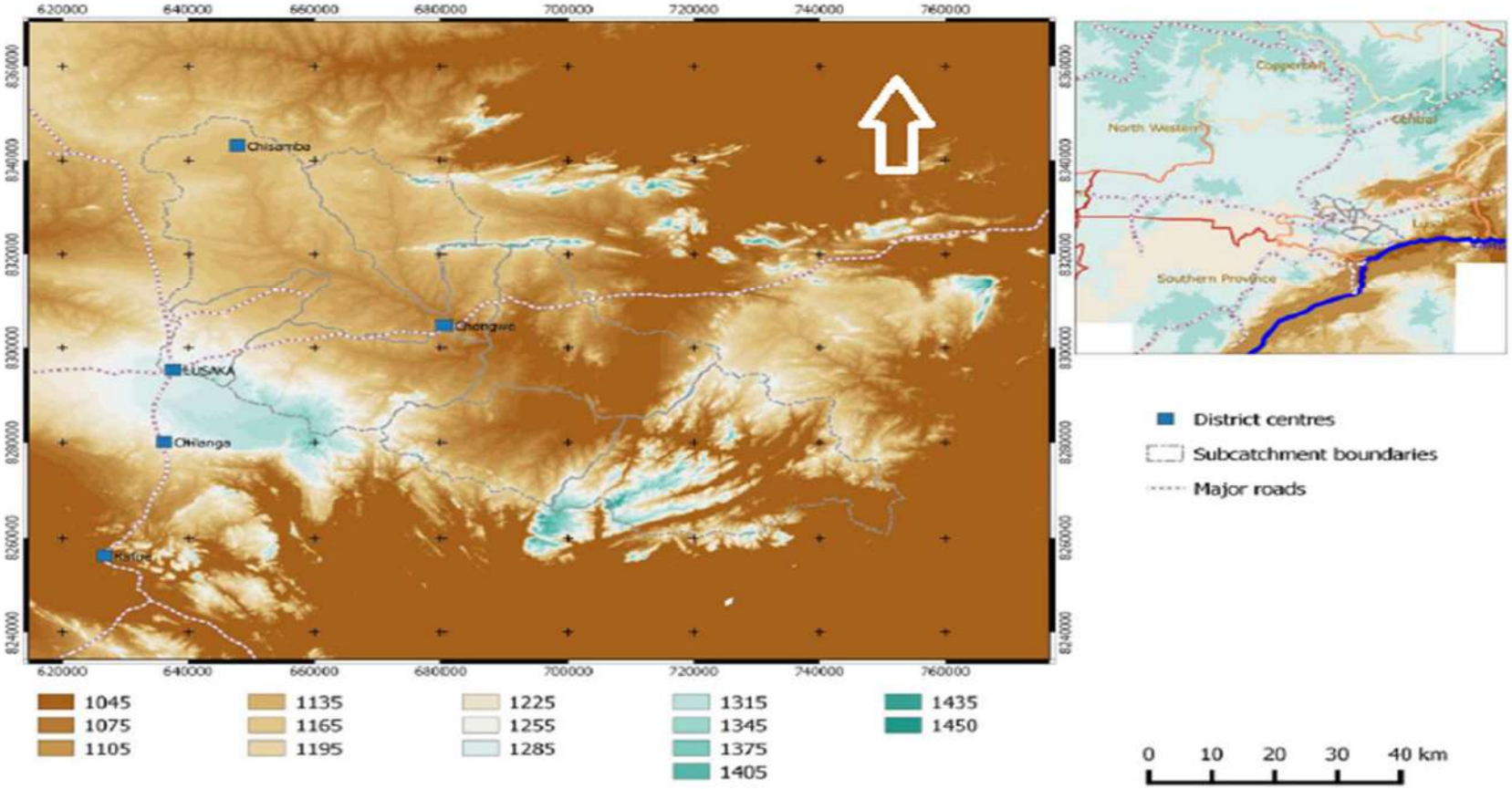

Figure 21: Topography of Lusaka and Chongwe

4.2.5 Ground and Surface Water

In terms of ground water resources, while rainfall is the primary contributor, it is the lithology (or rock type) and the structural character (porosity, clay content, folding, faulting, jointing and foliation) that are relevant to water availability. The rainfall regime has remained reasonably uniform over a long period in the project area and provides sufficient recharge facility for the aquifer although seasonal ground water level fluctuations occur depending on rainfall and pumping. Generally, ground water levels go down between May and November and rise between December and April during the rainy season. While the Lusaka Dolomite Formation normally provides the best aquifer in the region, the schists associated with the beds below, especially within the Cheta formation give relatively poor yields. This is indicative of the structural character of the geological environment which, as reflected by the geophysical investigations of the area, should be relatively conducive to water production.

Figure 22: Chalimbana Stream on the Eastern Boundary of the Project Site

The quality of the ground water associated with the three significant lithologies present in the area may be characterized as good based on similar geological formation elsewhere, even though

no specific chemical analysis or bacterial tests were carried out in this specif location. The following general hydro chemical parameters for water may be ascribed to the rock formations encountered in the area:

Dolomite and dolomitic gemstone: Ground water in these rock types are characterized by pH values from 7.0 to 7.5 and total dissolved solids (TDS) in the range of 250 to 600 ppm (parts per million). The TDS are generally of the calcium salt type with low chlorine and sulphate content.

Schists, Sandstones and Phyllites (psammites and pelites): In these rock formations the groundwater is characterized by pH values in the range of 6.5 to 7.0 with TDS values around 300 to 1000 ppm. The relatively high TDS values are usually associated with the schists.

Alluvial cover (weathered profile): The superficial cover in this area is relatively thin but thickens to the west and southwest. The pH in these is generally neutral (7.0) and TDS often less than 500 ppm.

4.2.6 Geology

The project area is dominated by the geology of the Basement Complex which is extensively exposed. The Basement Complex is extensively interrupted by granite inselbergs, a product of granite intrusions. As a result, paragneiss and granite are the dominant rock forms within the vicinity of the project. Close to the valley floor are red sandstone, basalt and sandstone all belonging to the Karroo System. A variety of rocks, such as biotite schists, quartzite, meta-quartzite, granite gneisses calci-silicate and carbon rocks, distributed widely in the region, were produced by ancient volcanic activities and metamorphism in the region.

4.2.7 Noise Levels

There is very limited noise pollution as the area is away from densely populated areas and has been reserved for the development of Government institutions and research centers. Field observations showed very low noise levels emanating from within the existing road traffic and infrastructural developments. Although no documented noise studies have been done in the Silver Rest area, since the population density is low, it can be assumed that the area experiences low noise levels.

4.3 Ecological Resources

4.3.1 Fauna

The presence of anthills formed a unique vegetation thicket, with the presence of Euphorbia ingens, due to the rich nutrients attributed by insect/termite activity, hence forming a moderate habitat for smaller terrestrial fauna and common bird species. Jatropha inflorescence attracted bees on the project site and other insects. The rocky nature of the proposed project site is believed to be characterised by snakes which are regarded as venomous and non-venomous. Among the snakes reported by the local people to occur on the project site yet not encountered at the time of the survey, included the cobra, blind snake, puff adder, and the house snake. Associated with the project area were smaller terrestrial animals such as hares and mice as evidenced from excrete matter and their activity in the study area. These are considered as food as well as pests in the agriculture fields (non- significant impact) by the indigenous people. The land subdivision project area and the immediate surrounding areas presented a variety of common bird species among which include:

- *Mammals*: Wildlife in the project site is limited to smaller species such as hare and grant rat, since the natural habitat for wildlife has greatly lost its value due to agricultural purposes. Only small mammals were observed during the field survey. The following mammals were sighted within the proposed area: *Rattus rattus* (Black Rat), *Thryonomys swinderianus*, (Cane Rat) and, *Paraxereus cepapi* (Bush Squirrel).
- *Reptiles:* It is believed that Snakes such as cobra (*Naja mosambica*), puff adder (*Bitis arietans*), blind snake, and house snake are present in the project area. Representative of the tortoises, Terrapins and Turtles are also believed to be found in the project area. Other reptiles include representatives of lizards such as monitor lizard (*Varantus niloticus*), geckos, chameleons and skinks.
- *Insects:* Insect survey at the project site was done and several insects were observed in the area. Insect life included a variety of species of dragonfly, wasps, bees, crickets, grasshoppers, termites, mosquitoes, ants, red ants, lady bugs, butterflies and moths

4.3.2 Flora

The diverse vegetation types of the area are closely associated with the physiographic, geology, soils, and moisture regimes. These are zoned along topographic gradients. The vegetation around the project area is dominated by Miombo species, which contains a wide variety of species of the genera *Brachystegia, Julbernardia* and *Isoberlina*. The majority of the species are deciduous, dropping their leaves in the early dry season and flushing in August as temperatures rise. In

addition to the above genera, local patches of *Combretum-Terminalia* may be present. Gorges cutting down from the mountain ranges to the valley floor support richer vegetation due to seepage, and include species of *Ficus, Commiphora marlothii, Afzelia quanzensis, Kirkia acimunata, Terminalia sambesiaca* and *Albizia zimmermannii*.

Figure 23: Vegetation around the Chalimbana Stream

Figure 24: Distribution of grass vegetation around the project site

xFigure 25: Vegetation type close to the surface water body

4.4 Social, Economic and Cultural Issues

4.4.1 Administration

The project site is located within Chongwe District in Lusaka Province. In terms of traditional administration, the project site falls under Chieftainess Nkhomeshya of the Soli speaking people.

4.4.2 Land Tenure

Land tenure at the site is similar to the rest of the country and is vested in the Republican President who holds it on behalf of the Zambian people. The parent land title at the proposed site is held by NISIR. NISIR has allocated approximately 10 hectares of the land in Silver Rest to ZNPHI for the construction of the proposed project.

Figure 26: UNZA farm located westward of the project site

4.4.3 Culture and Traditional Establishments in the Project Area

In Chongwe district, there are three major ethnic groupings- the Soli people, who dominate much of the district, the Chikunda and Nsenga Luzi people. The people close to the project site (i.e. Soli people) celebrate the Chibwela Kumushi traditional ceremony annually, which is an appeal

to the ancestral spirits for good rains and good yield. The ceremony takes place when the rainy season is commencing, normally around late October.

The Soli tribe a matrilineal tribe, meaning that an individual takes his or her mother's clan. A village, in the sense of the people in the project area of influence, is usually a grouping of matrilineally related men and women with their wives, husbands and unmarried siblings and children, under the authority of a headman– which literally means 'owner of the village'. A headman is the intermediary between the village community and the chief and has authority to allow distant relatives and strangers or newcomers to take residence in the village. The primary group in each village is the matrilineal extended family.

Figure 27: Rural household structures for the Caretaker within the Project Site

The household structure shown above was put up by NISIR to accommodate a local employee to guard the area from unathorised squatters in the area. Since ownership of the land has now been transferred to ZNPHI, NISIR will transfer their employee to the other NISIR sites and ZNPHI shall find alternative means of securing the land from encroachment and unathorised squartters.

4.4.4 Economic Activity

The project site is found in an upcoming mixed-use area with infrastructural developments such as Silver Rest Gardens, subsistence and commercial farms and government institutions. In the

eastern part of the proposed site, the main sources of livelihood include subsistence agriculture (crops, livestock), charcoal burning and selling, trading, beer brewing, and “wild” natural resources, including trees, grasses, nuts, fruits, and medicinal plants. The most ubiquitous activity is agriculture -- virtually all households in the village grow crops. However, it is noticeable both from literature review and field interviews that although almost all residents of the project areas identify agriculture as their main activity, it is only some who rely on it as their main source of income.

4.4.5 Built Environment

Apart from the newly constructed Silver Rest Gardens residential area, the area remains undeveloped with a lot of natural vegetation cover and seasonal gardens and it is generally virgin land with farming activities around the project site.

5. PROJECT ALTERNATIVES

5.1 No Project Alternative

Zambia currently lacks a dedicated public health laboratory system, and relies on the already overloaded clinical laboratories whose core mandate is to provide diagnostic services to support the clinical management of patients in hospitals. These laboratories are located mainly at health centers, hospitals, research centers, private health institutions, defense, mines, NGOs and the animal health sector. The reliance on clinical laboratories for public health functions has led to delays in establishing diagnoses and reporting of results, highlighting a weakness in the early-warning system. The ever-present risk of epidemics and public health threats from within the country, the region and elsewhere underscores the pressing need for a dedicated Public Health Laboratory Complex.

5.2 Site Alternatives

Site alternatives considered for location of the three Laboratories and an Office Complex project were based on the availability of government-owned land (Annex 2) in a less densely populated area so as to avoid impacts associated with community exposure by the facility and possible need for resettlement of residents. NISIR has allocated a 10-hectare piece of land to ZNPHI for the proposed project in the Silver Rest area which is sparsely populated.

5.3 Design Alternative

The World Health Organisation (WHO) Laboratory Biosafety Manual contains a design requirement for BSL-1, BSL-2 and BSL-3 facilities. In view of this requirement, which is aimed at ensuring that risks associated with especially BSL-2 and BSL-3 facilities are minimized at the design stage, the general design of the facility was fashioned along the WHO requirement and therefore other possible designs were not considered.Because of the nature of the laboratories, the design of the Laboratory and Office complex was dictated by the need to isolate the block for laboratory facilities as far away as possible from the offices and workers. Therefore, only one design option was considered and preferred in order to collocate the laboratory and the offices and grantee biosafety and biosecurity so as to minimise exposure of workers to diseases pathogens.

5.4 Construction Materials Alternative

The laboratory and office complex and other site structures can be made from concrete blocks, clay bricks, hydra form bricks or a combination of them. Conventional building methods (i.e.

using block-work, mortar and roofing sheet) are more time consuming but offer several advantages, which has led to the adoption of this approach for the proposed project. These advantages include:

- Under the present economic climate, this building method is the most econzomically viable
- A large proportion of construction materials are locally produced which would benefit the local and regional economy due to multiplier effects
- This method is more labour intensive and will offer more employment opportunities
- Generally, the skills and technology for this construction method are already available in the country

5.5 Water source alternatives

Water sources for use in the BSL-3 facility include among others:-

- Borehole water
- Roof catchment water
- Water from existing water utility

The preferred source of water for this project is borehole water with plans by the project to drill a borehole to provide water for the three BSL facilities. The use of roof catchment and supply from water utility was rejected even though they were considered. Pipe water from the water utility was rejected due to the lack of a water supply system while roof catchment was not considered as an adequate option to supply the quantity of water required by the three laboratory facilities.

5.6 Alternative Energy Source

The preferred source of energy use in the three laboratory facilities is from the national grid. Other sources that were considered and rejected include:

- **Solar Power:**-This was considered to be too costly for the project even though it is environmentally friendly. In future, the project may consider use of solar energy for the facility.
- **Generator:-**Even though the project will install a stand by generator for the facility, this will be for emergency purposes only and this was not considered as the main source of energy.

5.7 Solid waste treatment options

In line with the Stockholm convention on persistent organic pollutants (POPs) to which Zambia is a signatory, ZNPHI shall promote current best practices of using non- incineration methods which include the use of autoclaves for health care waste management, to minimize emission of POPs in order to meet the Stockholm convention requirements. Therefore, the ZNPHI shall have a central autoclaving system for sterilisation of health care solid waste. Health care solid waste from the BSL -3 laboratory will be initially autoclaved within the laboratories as per BSL -3 biosafety requirements. The sterilised solid waste will then be conveyed to the central solid waste autoclaving system for secondary autoclaving. From the central autoclaving system, sterilised solid waste will be shredded to reduce on the volume.

During the operational phase, ZNPHI will make use of its own incinerator that will be located at its Laboratory behind Levy Mwanawasa Hospital. The new incinerator shall handle most of the incinerator materials, including pharmaceuticals, medicines and other materials brought for incineration from the new BSL-1, BSL-2 and BSL-3 laboratories. The incinerator is an electic fired type that taps power from the ZESCO grid system. The ash from the incinerators will be disposed of in an approved disposal site, by a ZEMA licensed transporter .

5.8 Wastewater management alternatives

5.8.1 Wastewater Management 1st Alternative

Medical Waste Water : The Medical Waste Water will be collected into a leak proof storage tank whose filling capacity will be auto monitored so as not to exceed ¾ full. The medical waste water will then be steam sterilised using the liquid cycle of the autoclave connected to the storage tank. The autoclaved waste water will then be discharged into the solid particle filtration system to allow solid particles to be filtered out of the wastewater as it flows through the system. The filtered waste water will be collected in the retention tanks which will be vacuum tanked by licenced waste collectors for further treatment at the offsite municipal sewage treatment site at regular intervals.

Domestic Waste Water Network: The domestic waste water network will have several inspection chambers as it leads to the sedimentation tanks. A layer of accumulated solids or sludge, will form at the bottom of the sedimentation tank as the waste water slowly flows through it thereby providing a level of purification prior to discharge. The sludge at the bottom of the sedimentation tanks will be periodically removed during routine maintenance.

Proposed Water Treatment Plant: The proposed sewerage treatment plant to be utilised for processing sewer waste from the facility is the Kaunda Square Stabilisation Ponds, which is located approximately 19Km North-West of the Project site. The Kaunda Square Sewerage Treatment plant in Lusaka is a fully functional conventional sewer treatment facility. Within the stages of sewage treatment, there are different steps and methods that can be employed to treat the water. These include: Preliminary treatment, Primary sedimentation, Biological treatment and Secondary sedimentation and Sludge treatment. A Sludge from the onsite wastewater treatment system will be also be disposed of at Kaunda Square Sewerage Treatment plant. Additionally, also available are alternative sewerage treatment plants that can provide substitute options for sewerage treatment should the ideal treatment plant develop faults which include Chunga Sewerage Treatment Plant and Mutumbi Sewerage Treatment Plant to mention a few.

5.8.2 Waste Water Management 2nd Alternative

The second option considered was linking the domestic and medical waste systems. This was ruled out as the area is not connected to a sewerage network and this may result in ground water contamination and public health risks.

Figure 28: Location of Waste Treatment Systems Relative to the ZNPHI Project Site

6. STAKEHOLDER CONSULTATIONS AND INFORMATION DISCLOSURE

In order to get input, promote wide ownership and incorporate the views of stakeholders, the general public, interest groups and institutions, the ZNPHI held several interactive consultative meetings at various stages starting from the development of the project concept. These include meetings held at Waterfalls lodge in June 2019, Anina's lodge in November and December 2018 (Annex 5), and Ministry of Health in July 2019 (Annex 6). The meetings were attended by relevant stakeholders that included: government agencies, regulator bodies, the local community representatives, civic and traditional leaders. Among others, the consultations incorporated representatives from the Department of Veterinary Services, Ministry of Fisheries and Livestock; University of Zambia; Food and Drugs Control Laboratory; Environmental Health Department, Ministry of Health; Infrastructure and Medical Technologies Unit, Ministry of Health; National Institute for Scientific and Industrial Research; Department of Public Infrastructure, Ministry of Housing and Infrastructure Development; Ministry of Defence; Ministry of Justice; Lusaka City Council; Chongwe Municipal Council; Ministry of Higher Education; Ministry of Lands and Natural Resources; Ministry of Finance; Ministry of National Development Planning; Center for Infectious Disease Research in Zambia (CIDRZ); Lusaka apex Medical University (LAMU); ZAMRA; ZEMA; Zambia Bureau of Standards; School of Public Health, University of Zambia; University Teaching Hospital; Africa CDC; World Health Organisation (WHO); US Centers for Disease Control and Prevention (CDC); Japan International Cooperation Agency (JICA); and others. As need arises, bilateral and cross-sector consultations continue to be made with relevant Government departments and agencies, as well as Cooperating Partners, individuals and interest groups.

On 16th July 2019, a public disclosure and consultative meeting on the project was held at the Ministry of Health Headquarters and attended by a wide representation of stakeholders including community members, local leaders, cooperating partners, MOH senior leadership, NGO, and government agencies (Annex 6). The meeting was chaired by the Honourable Minister of Health Dr Chitalu Chilufya and the area Chiefdom, the Busoli royal establishment (BRE), was represented by Princess Cholwe Nkomeshya. Following detailed description of the the project by the ZNPHI Director Dr Victor Mukonka, an open question and answer session was held, durimg which the stakeholders were encouraged to seek clarity on anything related to the project and air any concerns. The following were the issues raised and responses given:

1. *How the multiple functions at the proposed laboratory complex will link with the functions already being played by specific entities, such as the Food and Drugs Control Laboratory (FDCL) which among other areas looks at food safety and toxicology.*

   Response: The National Public Health Laboratory (NPHL) is not meant to replace existing capacities, but rather enhance them. The NPHL would be at the apex of a network of laboratories that will also incorporate some existing capacities based on competence and competitive advantage. Furthermore the project would provide additional capacity beyond what is currently available in existing institutions.

2. *What considerations would be taken into account in dividing the country into the proposed three sub-regions for the planned National Public Health Laboratory system.*

   Response: Risk mapping willguide the division of the country into the respective regions. This will be to ensure that each part of the country is assigned due attention, as informed by both identified and potential public health threats in each region. The availability of laboratory capacity would be another factor, although the vision of ZNPHI was to ensure that where capacity didn't yet exist, this would eventually be established as the NPHL system is expanded.

3. *What capacity the biobank was planned to have and whether there were plans to generate sequence data, and if so what mechanisms were being considered to safeguard such information and materials.*

   Response: The project will provide adequate capacity for storage of a range of samples, isolates and other reference materials to support research and understanding of diseases in the local context. This will also provide a resource for developing appropriate diagnostic tests, therapeutic agents and vaccines. The biobank will be certified and operate in accordance with the regulations set by the National Health Research Authority (NHRA) and in conformity with international best practice. As for sequencing, provision has been made for molecular biology a core laboratory as well as a bioinformatics suite to support the modern diagnostic capabilities. This will be augmented by the ICT capabilities which the project is also funding. Biosecurity and biosafety issues will also be addressed through the engineering designs, policies, procedures, training, medical surveillance for staff, administrative controls and infection control and waste management protocols. Biosecurity has been recognised as a gap through the JEE and the Africa CDC has launched a

continental initiative to improve the capacities in this area. To this end the SA-RCC convened a regional meeting in June 2019 to devise strategies of improving biosafety and biosecurity in Member States, as per JEE requirements. A key aspect addressed was the need to develop lists of High Consequence Agents and Toxins (HCATs) as well as to develop relevant legislation on regulating use/stocking of these HCATs. Zambia is fully participating in these initiatives and when developed and consensus reached at national, regional and continental level, these shall also guide practices in the laboratory facility. Furthermore, relevant security and access control systems have been factored into the project to ensure that only those with the required level of clearance can access certain areas of the laboratory, or access certain information.

4. A resident from Silver rest area requested for a *detailed description of the proposed location of the project site within Silver rest area*.

   Response: A satellite image of the area was reviewed and key landmarks outlined. The proposed project site is adjacent to the UNZA farm on Palabana road (D153), and the surrounding area is generally farmland. He indicated that the site lies at the junction of the recently tarred road which branches off southwards from the Great east road at Silver Rest Primary School and Palabana road (D153). Key social receptors in the area are located north east of the site and are: (i) a Police Post (approximately 1 Km away); (ii) Silver Rest Gardens Residential Estate (about 3.4 Km away); and (iii) Silver Rest Primary School (approximately 5.17 Km away).

5. The representative of Her Royal Highness Chieftainess Mukamambo II, Princess Cholwe Nkomeshya, expressed her elation at that the Government had considered setting up the project in the Busoli Chiefdom. She pledged full support for the project by the Busoli Royal Establishment and indicated that the BRE was full of expectation that once complete the laboratory would greatly help to answer health challenges faced by the people in the Chiefdom and across the entire country and Southern Africa region. She indicated that the BRE was in support of the efforts by the Ministry of Health to safeguard the health and security of the country's residents. Princess Cholwe also indicated interest in showing the detailed powerpoint presentation directly to Her Royal Highness Senior Chieftainess Nkomesha Mukamambo II to enable her fully appreciate the scale and importance of the modern infrastructure being proposed to be established in the chiefdom. She requested the

ZNPHI team to contact the Busoli palace when they are ready for a special session with Her Royal Highness the Chieftainess.

Overall there was acceptance and support for the project.

7. ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

The proposed construction of the ZNPHI BSL-1, BSL-2 and BSL-3 Laboratories/SA-RCC office complex is likely to have both negative and positive impacts on the environment and community around the project site. Therefore it important that ZNPHI puts in place measures to mitigate the anticipated negative impacts and to enhance the anticipated positive impacts of the proposed project on the community and environment. An assessment of the overall significance of these impacts based on consequence and likelihood is made on the basis of information gathered during the environmental baseline study of the project area which has included field visits, as well as a desk study of relevant existing documents and information pertaining to the study and information describing the nature and design of the proposed project. Major impacts that are likely to arise during the construction and operational phases of the project are highlighted below.

7.1 Positive Impacts

The new infrastructure, especially the BSL-3 laboratory will aid the institute to be more efficient in implementing its mandate of monitoring new diseases that threaten global health security (like the Ebola virus, SARS etc.) and the changes in distribution and virulence of well-known diseases. Having different sectors housed in the same building will reduce response time, enhanced multi-sectoral collaboration, improve communication with public health workers, health care professionals, and the public about emerging health threats. The institute will also act as a command centre to identify, prepare, manage and promptly respond to public health events. Therefore, the institute will help the country to establish an early warning system for highly infectious diseases. The institute will also contribute to preventing or reducing the impacts of disasters on our communities which will help reduce the financial costs of these hazards on the economy. The new infrastructure will increase technical sustainability by fostering leaders capable of designing, monitoring, supervising, and evaluating programs to reduce health threats based on cutting-edge information and tools.

The new laboratories will improve biosecurity in the region, as the country will be able to handle highly infectious pathogens, using the BSL-3 laboratory,both in animal and human sectors with a one health approach. The laboratory infrastructure will build capacity in surveillance and monitoring of antimicrobial resistance (AMR) in the country and region. This will involve training and mentoring in public health. Provision of state of the art facilities for Public Health

and Bio-medical Research, using the BSL-1 laboratory,will add to the country and regional evidence based knowledge that may inform implementation of interventions and policy. Food security- through food and water monitoring will also be improved. Other socioeconomic positive impacts include:

I. **Provision of Employment**: - The project will be a source of employment as it will require skilled technicians and crafts people as well as un-skilled labour for the construction of the four-storey ZNPHI/RCC laboratory & office complex of the project. It is expected that a temporal workforce of up to 50 to 100 (at peak period) persons will be required on the construction site at a time. This will provide employment opportunities not only to the people of the immediate vicinity (Lusaka District) but other districts/regions in the country. Many employment opportunities, especially for semi and unskilled labour, will benefit local communities within the project area. It is anticipated that employment opportunities will also be available for women from the local communities; women are often regarded as reliable workers and contractors generally hire women as casual workers for various jobs, including domestic ones for construction workers living on site who come from elsewhere. The project will also avail opportunities for technical experts like engineers, architects etc. to collaborate with other experts in the sub region or continents.

II. **Boost to construction sector (regional/national multiplier effect):-** Implementation of the project will provide a positive boost to various sectors related to the construction industry as the developer is committed to ensuring that local raw materials, finished products and services will be utilized as much as possible for its successful completion. This in turn will promote employment opportunities in related sectors in the region. Manufacturers and suppliers of local (i.e. regional) materials will include manufacturers of protective ware, cement manufacturers, local manufacturers of blocks, sub-contractors for the supply of sand and gravel as well as manufacturers of other local building materials such as timber and door / window frames.

III. **Increased Revenue: -** Multiplier effects resulting from increased employment and operation will include increased public revenues such as taxes (PAYE to ZRA) and contributions to NAPSA from formally employed persons and other indirect taxes resulting from the construction project such as VAT on materials and services.

IV. **Boost to the local economy: -** The workforce will get most of their food and other necessities from the surrounding area and this will provide a market for the local

agricultural producers and other small businesses (local shops). This will in turn increase the incomes of the local people which can be invested in other (productive) activities and be used for paying school fees, medical expenses and other domestic needs.

V. **Improved Access Road: -** The access road to the area of the planned area for the construction of the four-storey ZNPHI/RCC laboratory & office complex of the project will allow an increase of other users to reach other communities, including traders, NGO and government support programmes and even some forms of public transport.

VI. **General security in the area:** The site and its immediate surrounds are isolated and it is likely for incidences of mugging and rape to occur in the area, especially at night. It is expected that the development of the project which will operate day and night will have a significant positive impact on general security in the area. There is also a police post located 1km from the project site and this will add to the improved security in the area. The project will be manned by a hired security firm that will manage the premises and surrounding areas. This will add to the general security and reassure the community of a safe environment.

7.2 Construction Phase Negative Impacts

7.2.1 Negative Physical Environment

I. **Deterioration of public access roads due to heavy traffic**: The project will at times experience a high volume of heavy construction traffic delivering materials and/or equipment to the site. This has the potential to cause damage to access roads approaching the site which is beyond normal wear and tear, especially at point of ingress and egress to the site.

II. **Dust Emissions:** Dust will be generated by the operation of the front end loader and other heavy duty machinery.Dust is a major environmental problem on gravel roads.When vehicles pass,road dust in settlements is an extreme inconvenience and health hazard,Dust also pollutes surface water for drinking for human beings and animals. Fume emissions will come from the fossil fuel consuming vehicles that will be used during the construction phase leading to an increase in the emission of carbon monoxide and other fumes that have negative impacts on the environment.

These emissions will have direct effects on the quality of air which may result in increased respiratory diseases among the nearby community.

III. **Soil Erosion: Soil movement is common during construction projects.** Machinery will be used during the site preparation and construction phases for earth movement and excavation. would lead to instability of the soil at the project site and may lead to top soil erosion while movement of equipment would lead to compaction of top soil. As a consequence of poorly designed erosion control and drainage measures may result,this will lead to further pollution of waste water. As much excavated soil as possible will be re-used on the site as backfill and will be compacted to make it stable. All cut slopes, embankments, and other erosion- prone working areas will be stabilized while work is going on to the extent that is feasible. All earth disturbed areas will be stabilized after earth movement has ceased at the site.

IV. **Occupational Health And Safety: Health problems likely to be encountered range from skin diseases, heat stroke, lung irritation and eye strains as**impacts from dust, hazardous waste and explosives: Various operating procedures have been proposed and these include provision of personal protective equipment, monitoring and medical check-ups for all the employees. A detailed Infection Prevention, Control and Waste Management Plan (IPCWMP) has been developed and it provide procedures for ensuring Occupational Health and Safety**.**

V. **Solid Waste Pollution: Huge quantities of solid wastes are normally generated from construction projects.** Solid waste will mainly be construction debris,rods of metal,wood,stones, packaging materials, kitchen waste etc. During the operation phase domestic and operational waste from offices and laboratories (both human and animal) that will require proper management. Therefore, all solid waste generated during operations should be taken for proper disposal to approved landfills by licenced handlers.

VI. **Noise and vibration due to blasting and movement of machinery:** Noise and vibration pollution is another health and safety harzard which may lead to annoyance and disruption of concentration.Physical effects include loss of hearing, pain, nausea and interference with communication when exposure is severe.**-** Noise monitoring shall be done every three months, noise protective clothes shall be provided to workers and warning signs to show places where protective clothes are required shall be installed.

VII. **Impacts on Aesthetics:** The proposed construction of the office complex and the BSL3 Laboratory will be undertaken in an area that is predominately virgin land. Apart from the newly constructed Silverest Gardens residential area, the area remains undeveloped with a lot of vegetation cover and seasonal gardens. The construction of the facility is likely to alter the aesthetics of the area due to visual intrusion. The design of the complex will factor in the receiving environment to ensure the structure blends into the surroundings.

7.2.2 Negative impacts on Biological Environment

I. **Loss of flora and fauna due to site clearing activities:** This shall be managed by restricting site clearing to specific areas, obtaining a site clearing permit from management before site clearing and conducting conservation awareness activities. This implies that the significance in terms of loss shall be minimal.

II. **Contamination of surface and ground water: -** There is a potential for surface and groundwater pollution occurring due to contaminants emanating from various waste products generated by construction activities entering the surface drainage regime and / or polluting the soil and infiltrating the underlying aquifer.

III. **Contamination surface and ground water by waste water from the Labs: -** There is a potential for surface and groundwater pollution occurring due to contaminants emanating from waste products generated by the laboratory activities entering the surface drainage regime and infiltrating the underlying aquifer. Waste water from the laboratories will be collected and channeled to a collection tank linked to decontamination and disinfection equipment for primary treatment. The decontaminated and disinfected waste water will then be channeled into the Interceptor Tanks for secondary treatment before being transported to a waste water treatment plant.

IV. **Laboratory Emissions: -** There is a potential for air pollution occurring due to contaminates emanating from airborne pathogens processed in the laboratory into the natural air. The Laboratories will be designed to be air tight and negatively pressured. All compartments of the Laboratories will be fitted with the Highly Effective Particulate Air Filtration (HEPA) systems. The fumes from the Laboratories will collected and channeled through the HEPA systems for treatment before emission into the air.

7.2.3 Negative impacts on socio-economic Environment

I. **Conflicts with the community and nearby facilities:** ZNPHI shall developed a grievance and redress management plan (GRMP) to manage any conflict that may arise during the project life cycle. This GRMP shall be publicized to the community once developed will provide a platform for presenting and addressing grievances.

II. **Community health and safety:** Construction projects are commonly associated site excavation which would create water collecting bodies which if left uncovered will lead to breeding gound for diseases such as Malaria and other tropical diseases such as bilhazia among children ..Furthermore the construct projects are associated with social interactions amongst the construction workers and local communities which can lead to casual or commercial sexual relationships producing an inherent increased risk of the incidence of the transmission of sexually transmitted diseases (STDs) and HIV. To mitigate this risk, the project will as much as is possible employ personnel (especially general and semi-skilled workers) from within nearby local communities. Other workers such as the contractor's core personnel who may come from other areas will be accommodated appropriately in Lusaka and all staff will commute daily to site. The potential for epidemiological impacts associated with the presence of construction workers is considered moderate.

III. Impacts Associated with Air Quality Emissions: Construction activities of materials delivery, excavation, concrete works and construction traffic will generate dust. Vehicular traffic to the proposed site is expected to increase especially during delivery of raw materials and construction. Vehicular traffic emissions will bring about air pollution by increasing the fossil fuel emissions into the atmosphere. However, the construction activities are mainly going to be through manual labour and use of hand held equipment with limited use of mechanized machines whenever necessary.

IV. **Impacts Associated with Noise and Vibration.** Noise and vibration generated during construction by construction machinery, such as excavators, and transportation vehicles. There will be limited use of construction machinery which will not be heavy in nature. In order to create employment, the project will use

manual forms of labour and equipment. Generally, construction noise exceeding a noise level of 70 decibels (dB) has significant impacts on surrounding sensitive receptors within 50m of the construction site. The noise impact will be short term in nature and not continuous to significantly affect sensitive receptors. There are no sensitive receptors e.g. health and educational facilities within 300m of the project site.

Summary of Potential Impacts associated with the Construction Phases

Table 12 List of Potential Impacts during the Constrction of the Phase

Potential Impacts during Construction	Nature of Impact Significance:	Extent	Magnitude of impact
Temporary job creation during construction phase	Positive	Local[4]/ Regional[5]	Moderate
Skills Transfer in the construction of an office complexes housing BSL-1, BSL-2 and BSL3 Laboratories	Positive	Local	Moderate
Increased local revenue for the local communities from wages and trading with the workers	Positive	Local	Moderate
Increased noise levels during the construction phase from heavy machinery	Negative	Local	Moderate
Soil erosion and impacts on soils due to spillage of hydrocarbon fuels and lubricants	Negative	Local	Low
Effect on ambient air quality from increased levels of dust	Negative	Local	Low
Visual intrusion (aesthetics) during the construction of the multi-storey building	Negative	Local	Low
Increased incidences of sexually transmitted diseases (STD's) and HIV between contractors and local communities	Negative	Local	Low
Risks related to Community safety and security impacts on the site and surrounding areas	Negative	Local	Moderate
Increase influx of workers seeking employment on the construction site	Negative	Local	Moderate
Ecological impacts on Flora, avifauna and Fauna, from the clearing of vegetation	Negative	Local	moderate
Gender bias in construction jobs	Negative	Local	Moderate
Trafic congestion	Negative	Local	low
Child labor	Negative	Local	high

Table 13: Mitigation measures for anticipated construction phase impacts

[4] Local refers to surrounding Communities
[5] Regional refers to Nationwide and the Southern African Region

Potential Negative Impacts Construction Phase	Frequency	Mitigation measures	Time Frame	Performance Indicator	Monitoring and Reporting	Cost
Ecological impacts on Flora, avifauna and Fauna, from the clearing of vegetation	Construction Phase	Restricting clearance of vegetation to only specific areas of the project footprint	12 Months	Reduced impacts on the ecology of the area	The Contractor, Supervising Engineer and ZNPHI	From the 580,0000 allocated to ESIA
Increased noise levels during the construction phase from heavy machinery	Construction Phase	Construction activities will be restricted to normal working hours, 06:00hours to 18:00hours	12 Months	Zero complaints or reports of increased noise levels	The Contractor, Supervising Engineer and ZNPHI	From the 580,0000 allocated to ESIA
Soil erosion and impacts on soils due to spillage of hydrocarbon fuels and lubricants	Construction Phase	The contractor Earth movement will provide a waste management planbe restricted to areas earmarked for management of solid and liquid waste The contractor to engage a ZEMA licensed waste operator to dispose wastes Contractor to provide litter bins for waste disposal to recycle or re-use certain types of wastes (scrap metal) etc, to provide mobile toilets for workers at the construction site works Reagents and hazardous chemicals should be stored in a bunded area All construction equipment will be serviced regularly.	12 Months	Rehabilitation of affected areas before the onset of the operational phase	Contractor	From the 580,0000 allocated to ESIA
Effect on ambient air quality from increased levels of dust	Construction Phase	During the dry season with no rainfall, the site will be watered down as required to reduce dust levels.	12 Months	Zero reports of increased dust levels from construction activities and associated health risks.	The Contractor and Supervising Engineer	From the 580,0000 allocated to ESIA

Visual intrusion (aesthetics) during the construction of the the lab complex	Construction Phase	Equipment during construction will be stored/parked in a designated area to avoid visual intrusion.	12 Months	Disturbance to the natural scenery in the area should be negligible	Contractor	From the 580,0000 allocated to ESIA
Increase influx of workers seeking employment on the construction site	Construction Phase	The orientation programme will include sensitizing workers on the social and cultural values of the local communities.	12 Months	Zero incidences of conflicts with the local community	ZNPHI and the Contractor	Costs to be included in contractual agreements of contractors
Increased incidences of sexually transmitted diseases (STD's) and HIV	Project Life Cycle	Sensitizing the workers on the danger of STDs and HIV including preventative measures.	Duration of the Project	Workers made aware on the dangers of STDs and HIV	ZNPHI and the Contractor	Costs to be included in contractual agreements of contractors
Risks related to Community safety and security impacts on the site and surrounding areas	Construction Phase	All the construction sites will be barricaded, and signage will be placed at strategic points.	Duration of the Project	No of theft or Accidents	Contractor	From the 580,0000 allocated to ESIA
Traffic Congestion	Construction Phase	Provide and implement a traffic management plan Provision temporary road signs or notices to indicate ongoing works. Effecting traffic controls to avoid congestion and accidents on construction site and associated roads. Choosing suitable traffic routes to reduce the impact in the neighbourhood. Ensuring no interference with traffic through traffic control, designated parking, speed limits and hiring a banksman.	Duration of the Project		Contractor	5,000.00
Gender empowerment	Construction Phase	Ensuring equitable distribution of employment opportunities between men and women	Construction phase	Equal opportunty provided	Contractor	
Child Labour and protection	Construction Phase	Prepare and implement a child protection strategy Ensuring no children are employed on site in accordance with national labour laws Ensuring that any child sexual relations offenses among contractors' workers are promptly reported to the police	Construction phase	Child labor and offenses are avoided	Contractor	

7.3 Operations and maintenance phase impacts and mitigation measures

There are risks associated with operations of BSL3 labs, due to the highly infectious nature of pathogens and samples which are tested and disposed. The mitigation measures associated with operational phase is detailed in a separate document, Infection Control and Waste Maagement Plan, associated with this project. The following are the anticipated risks at this phase:

7.3.1 Impacts Associated with Inadequate Proposed Facility Design

According to the World Health Organsiation (WHO) Laboratory Biosafety Manual, there is a requirement to adopt particular designs for BSL-2 and BSL-3 laboratories in order to ensure containment of infectious and harzadous materials and minimize the risks associated with activities in such a facility. The poor designs of BSL2 and BSL-3 facilities which fail to comply with the WHO Laboratory Biosafety Manual will lead to human health, environmental and social impacts due to exposure associated with poor containment and will have adverse impacts on occupational health and safety and the environment. Additional imacts associated with poor designs of BSL-3 extends to the health and safety of the community as well.

Impact Significance BSL-1:
Contrywide; Moderate and Short Term
Mitigation:
The laboratory design and facilities for the facility must comply with WHO BSL-1 design requirements including but not limited to: 1. 2. Surfaces of walls, floors and ceilings should be water-resistant and easy to clean. Openings through these surfaces (e.g. for service pipes) should be sealed to facilitate decontamination of the room(s). 3. The laboratory room must be sealable for decontamination. Air-ducting systems must be constructed to permit gaseous decontamination. 4. Windows must be closed, sealed and break-resistant. 5. A hand-washing station with hands-free controls should be provided near each exit door. 6. There must be a controlled ventilation system that maintains a directional airflow into the laboratory room. A visual monitoring device with or without alarm(s) should be installed so that staff can at all times ensure that proper directional airflow into the laboratory room is maintained. 7. The building ventilation system must be so constructed that air from the containment laboratory. Air may be high-efficiency particulate air (HEPA) filtered, reconditioned and recirculated within that laboratory. 8.

Impact Significance – BSL-2:

Contrywide; Moderate and Long Term

Mitigation:

The laboratory design and facilities for the facility must comply with WHO BSL-2 design requirements including but not limited to:

1. The laboratory must 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 should have facilities for separating clean and dirty clothing and a shower may also be necessary.
2. 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.
3. Surfaces of walls, floors and ceilings should be water-resistant and easy to clean. Openings through these surfaces (e.g. for service pipes) should be sealed to facilitate decontamination of the room(s).
4. The laboratory room must be sealable for decontamination. Air-ducting systems must be constructed to permit gaseous decontamination.
5. Windows must be closed, sealed and break-resistant.
6. A hand-washing station with hands-free controls should be provided near each exit door.
7. There must be a controlled ventilation system that maintains a directional airflow into the laboratory room. A visual monitoring device with or without alarm(s) should be installed so that staff can at all times ensure that proper directional airflow into the laboratory room is maintained.
8. The building ventilation system must be so constructed that air from the containment laboratory – Biosafety Level 2 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 must 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 should be given to the installation of audible or clearly visible alarms to notify personnel of HVAC system failure.
9. All HEPA filters must be installed in a manner that permits gaseous decontamination and testing.
10. Biological safety cabinets should be sited away from walking areas and out of crosscurrents from doors and ventilation systems.
11. The exhaust air from Class I or Class II biological safety cabinets (see Chapter 10), which will have been passed through HEPA filters, must be discharged in such a way as to avoid interference with the air balance of the cabinet or the building exhaust system.
12. Backflow-precaution devices must be fitted to the water supply. Vacuum lines should be protected with liquid disinfectant traps and HEPA filters, or their equivalent. Alternative vacuum pumps should also be properly protected with traps and filters.
13. The containment laboratory – Biosafety Level 2 facility design and operational procedures should be documented.

Impact Significance – BSL-3:

Contrywide; Moderate and Long Term

Mitigation:

The laboratory design and facilities for the facility must comply with WHO BSL-3 design requirements including but not limited to:

1. The laboratory must 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 should have facilities for separating clean and dirty clothing and a shower may also be necessary.
2. 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.
3. Surfaces of walls, floors and ceilings should be water-resistant and easy to clean. Openings through these surfaces (e.g. for service pipes) should be sealed to facilitate decontamination of the room(s).
4. The laboratory room must be sealable for decontamination. Air-ducting systems must be constructed to permit gaseous decontamination.
5. Windows must be closed, sealed and break-resistant.
6. A hand-washing station with hands-free controls should be provided near each exit door.
7. There must be a controlled ventilation system that maintains a directional airflow into the laboratory room. A visual monitoring device with or without alarm(s) should be installed so that staff can at all times ensure that proper directional airflow into the laboratory room is maintained.
8. The building ventilation system must 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 must 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 should be given to the installation of audible or clearly visible alarms to notify personnel of HVAC system failure.
9. All HEPA filters must be installed in a manner that permits gaseous decontamination and testing.
10. Biological safety cabinets should be sited away from walking areas and out of crosscurrents from doors and ventilation systems.
11. The exhaust air from Class I or Class II biological safety cabinets (see Chapter 10), which will have been passed through HEPA filters, must be discharged in such a way as to avoid interference with the air balance of the cabinet or the building exhaust system.
12. An autoclave for the decontamination of contaminated waste material should be available in the containment laboratory. If infectious waste has to be removed from the containment laboratory for decontamination and disposal, it must be transported in sealed, unbreakable and leakproof containers according to national or international regulations, as appropriate.

13. Backflow-precaution devices must be fitted to the water supply. Vacuum lines should be protected with liquid disinfectant traps and HEPA filters, or their equivalent. Alternative vacuum pumps should also be properly protected with traps and filters.
14. The containment laboratory – Biosafety Level 3 facility design and operational procedures should be documented.

7.3.2 Impacts Associated with Non-Commissioning of Proposed BSL-3 Facility

Laboratory/facility commissioning may be defined as the systematic review and documentation process signifying that specified laboratory structural components, systems and/or system components have been installed, inspected, functionally tested and verified to meet national or international standards, as appropriate.

The lack of non-commissioning of BSL-2 and BSL-3 facilities as required by the WHO Laboratory Biosafety Manual because they do not meet design requiremenst and become operational in the uncompliance state will lead to human health and environmental and social impacts due to exposure associated with poor containment and will have adverse impacts on occupational health and safety as well as community health and safety including the environment in general.

Impact Significance for BSL-1, BSL-2 and BSL-3:
Regional; Moderate and Long Term
Mitigation:
□ Ensure that BSL-1, BSL-2 and BSL-3 facilities are commissioned as per WHO Laboratory Biosafety Manual. □ Ensure that the commissioning is undertaken by an outside commissioning agent who has demonstrated experience and success in the commissioning of complex biosafety laboratory and animal facilities. □ Ensure that, in addition to the commissioning agent, the institution's Safety Officer, Project Officer, Programme Manager and a representative of the Operations and Maintenance staff are also part of the team. The following is a list of laboratory systems and components that may be included in a commissioning plan for functional testing, depending on the containment level of the facility being renovated or constructed. The list is not exhaustive and the actual commissioning plan will reflect the complexity of the laboratory being planned. 1. Building automation systems including links to remote monitoring and control sites 2. Electronic surveillance and detection systems 3. Electronic security locks and proximity device readers 4. Heating, ventilation (supply and exhaust) and air-conditioning (HVAC) systems 5. High-efficiency particulate air (HEPA) filtration systems 6. HEPA decontamination systems

7. HVAC and exhaust air system controls and control interlocks
8. Airtight isolation dampers
9. Laboratory refrigeration systems
10. Boilers and steam systems
11. Fire detection, suppression and alarm systems
12. Domestic water backflow prevention devices
13. Processed water systems (i.e. reverse osmosis, distilled water)
14. Liquid effluent treatment and neutralization systems
15. Plumbing drain primer systems
16. Chemical decontaminant systems
17.Medical laboratory gas systems
18. Breathing air systems
19. Service and instrument air systems
20. Cascading pressure differential verification of laboratories and support areas
21. Local area network (LAN) and computer data systems
22. Normal power systems
23. Emergency power systems
24. Uninterruptible power systems
25. Emergency lighting systems
26. Lighting fixture penetration seals
27. Electrical and mechanical penetration seals
28. Telephone systems
29. Airlock door control interlocks
30. Airtight door seals
31.Window and vision-panel penetration seals
32. Barrier pass-through penetration
33. Structural integrity verification: concrete floors, walls and ceilings
34. Barrier coating verification: floors, walls and ceilings
36. Biological safety cabinets
37. Autoclaves
38. Liquid nitrogen system and alarms
39.Water detection systems (e.g. in case of flooding inside containment zone)
40. Decontamination shower and chemical additive systems
41. Cage-wash and neutralization systems
42.Waste management.

7.3.3 Impacts Associated with Non-Certification of Proposed BSL-1, BSL-2 and BSL-3 Facilities

In order to avoid impacts associtaited with BSL-1, BSL-2 and BSL-3 facilities, there is need to undertake laboratory certification of such a facility. The proposed laboratory facilities are likely to lead to adverse occupational health and safety risks as well as community health and safety risks and environmental risks if not certififed prior to operationalization.

Laboratory certification is the systematic review of all safety features and processes associated with the laboratory (engineering controls, personal protective equipment, building and system integrity, standard operating procedures (SOPs) and administrative controls such as documentation and record retention systems).

This validation assures that all reasonable facility controls and prudent practices are in place to minimize, to the greatest extent possible, the risks associated with laboratory operations and the use of biohazardous materials. Standardization of an initial and annual certification process for the proposed laboratory facilities will provide accountability that ensures proper and regular maintenance and demonstrates the use of Stanadrd Operating Procedures (SOPs) that protect human and animal occupants, the environment and the research integrity. Biosafety Level 3 (BSL-3/ABSL-3) containment laboratories for animals and research are the most difficult containment level facilities to design and operate. They should be certified for use before initial operation and subsequently on an annual schedule or after a program change, renovation or replacement of critical HVAC/exhaust system components (specifically fans, air valves, or fan motors) that may affect the operating environment of the laboratory.

Impact Significance – BSL-1:
Regional/Countrywide; Moderate and Long Term
Mitigation:
• Undertake Re-certification of the facility will be performed on an annual basis, as a minimum. • A comparison should be made to the baseline established during initial certification. Detailed records of the certification process and test results must be maintained to provide an accurate operations history of the laboratory.

Impact Significance – BSL-2 and BSL-3:
Regional/Countrywide; Moderate and Long Term
Mitigation:
• Ensure that all the BSL laboratories are performed by a team of professionals with experience and credentials in engineering and biosafety/occupational safety and health. • As a part of the laboratory certification process, a sample attached checklist which must be completed as a retained record document • Undertake Re-certification of the facility will be performed on an annual basis, as a minimum. • A comparison should be made to the baseline established during initial certification. Detailed records of the certification process and test results must be maintained to provide an accurate operations history of the laboratory.

7.3.4 Impacts Associated with Workers's Chemical Exposure

Some chemicals used specifically in the BSL-3 facility are likely to adversely affect the health of workers who handle them or inhale their vapours during laboratorya activities. Apart from overt poisons, a number of chemicals are known to have various toxic effects. The respiratory system, blood, lungs, liver, kidneys and the 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. Workers in microbiological laboratory are not only likely to be exposed to pathogenic microorganisms, but also to chemical hazards. Aerosol particles of less than 5 μ m in diameter and small droplets of 5–100 μ m in diameter are not visible to the naked eye. The laboratory worker is generally not aware that such particles are being generated and may be inhaled or may cross contaminate work surface materials. Other laboratory activities, such as streaking agar plates, inoculating cell culture flasks with a pipette, using a multichannel pipette to dispense liquid suspensions of infectious agents into microculture plates, homogenizing and vortexing infectious materials, and centrifugation.

Exposure to hazardous chemicals may occur by:-

1. Inhalation
2. Contact
3. Ingestion
4. Needle-sticks
5. Through broken skin.

Impact Significance:
Localised; Moderate and Long Term
Mitigation:
• Provide training to workers in the BSL-3 and ensure they have proper knowledge of the toxic effects of these chemicals, the routes of exposure and the hazards that may be associated with handling and storage. • Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. • Ensure that there are Biological Safety Cabinets (BSCs) (Class III) in the BSL-3 designed to protect the operator, the laboratory environment and work materials from exposure to infectious aerosols and splashes that may be generated when manipulating

materials containing infectious agents, such as primary cultures, stocks and diagnostic specimens. • BSCs, when properly used, have been shown to be highly effective in reducing laboratory-acquired infections and cross-contaminations of cultures due to aerosol exposures. BSCs also protect the environment.

7.3.5 Impacts Associated with Inadequate Disinfection of BSL-2 and BSL-3 laboratories

Workers in BSL-1, BSL-2 and BSL-3 are likely to get exposed to occupational health and safety risks as a result of inadequate disinfection of thesefacilities. Working areas especially within the BSL3-facility contain infectious materials which need to be disinfected.

Impact Significance:
Localised; Moderate and Long Term
Mitigation:
• All items within BSCs, including equipment, should be surface-decontaminated and removed from the cabinet when work is completed, since residual culture media may provide an opportunity for microbial growth. The interior surfaces of BSCs should be decontaminated before and after each use. • The work surfaces and interior walls should be wiped with a disinfectant that will kill any microorganisms that might be found inside the cabinet. • At the end of the work day, the final surface decontamination should include a wipe-down of the work surface, the sides, back and interior of the glass. A solution of bleach or 70% alcohol should be used where effective for target organisms. A second wiping with sterile water is needed when a corrosive disinfectant, such as bleach, is used. • BSCs must be decontaminated before filter changes and before being moved. The most common decontamination method is by fumigation with formaldehyde gas. BSC decontamination should be performed by a qualified professional.

7.3.6 Impacts Associated with Exposure through Pipetting

The most common hazards associated with pipetting procedures are the result of mouth suction. Oral aspiration and ingestion of hazardous materials have been responsible for many laboratory-associated infections. Pathogens can also be transferred to the mouth if a contaminated finger is placed on the suction end of a pipette. A lesser known hazard of mouth pipetting is the inhalation of aerosols caused by suction.

Impact Significance:
Localised; Moderate and Long Term
Mitigation:
• Provide training to workers in the BSL-3 and ensure they have proper knowledge of the toxic effects of these chemicals, the routes of exposure and the hazards that may be associated with handling and storage. • Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. • Provide piping aids to prevent the ingestion of pathogens by workers. • Pipettes with cracked or chipped suction ends should not be used as they damage the seating seals of pipetting aids and so create a hazard.

7.3.7 Impacts Associated with Liquid Waste Exposure

Effluent wastes from the BSL-3 facility will be hazadious (infectious and domestic) in nature and will emanate from among other the suit area, decontamination chamber, decontamination shower, or Class III biological safety cabinet which must be decontaminated before final discharge. The effluent wastes if not properly disposed, will adversely affect the environment and could lead to impacts and harm human health and biolociagal environment.

This project has designed an effluent wates disposal/handling method which is in accordance with the WHO Laboratory Biosafety Manual for handling of effluent wastes.

The medical wastewater will be collected into a leak proof storage tank whose filling capacity will be auto monitored so as not to exceed ¾ full. The wastewater will then be steam sterilised using the liquid cycle of the autoclave connected to the storage tank. The autoclaved wastewater will then be discharged into the solid particle filtration system to allow solid particles to be filtered out of the waste water as it flows through the system. The filtered waste water will be collected in the retention tanks which will be vacuum tanked by licenced waste collectors for further treatment at the offsite municipal sewage treatment site (Manchinchi Wastewater Treatment Plant) at regular interval

Impact Significance:
Local; High and Long Term
Mitigation:
Onsite wastewater treatment offsite sewage treatment (Kaunda Square Sewerage Treatment Plant) Sludge disposal at Kaunda Square Treatment Plant

7.3.8 Impacts Associated with Transport of infectious Substances

Transport of infectious and potentially infectious materials to the BSL-3 facility for analysis as well as transport of the same for disposal may lead to contamination of the environment through accidental spills or impact on the human health due to the accidental exposures. Mitigation measures will include: training of personnel on specimen and waste handling, transport and storage; Use triple package during transportation of infectious materials; Use of rigid and leak-proof specimen containers. Furthermore, transportation of infectious and potentially infectious materials to the BSL-3 facility is subject to strict national and international regulations. The project will comply with these regulations specifically (United Nations Model Regulations on the Transport of Dangerous Goods (40) regulations describe the proper use of packaging materials, as well as other shipping requirements.

Impact Significance:
Contrywide; High and Long Term
Mitigation:
Provide training specific to workers in the BSL-3 and ensure they have proper knowledge of the toxic effects of these chemicals, the routes of exposure and the hazards that may be associated with handling and storage. Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. Laboratory personnel must ship infectious substances according to applicable transport regulations. Compliance with the rules will: 1. Reduce the likelihood that packages will be damaged and leak, and thereby 2. Reduce the exposures resulting in possible infections 3. Improve the efficiency of package delivery. The regulations for the transport of infectious materials (by any mode of transport) based upon the United Nations Model Regulations on the Transport of Dangerous Goods (40) should be followed including:- The basic triple packaging system Spill clean-up procedure

- Materials for incineration, even with prior decontamination, should be transported to the incinerator in bags, preferably plastic.
- Incinerator attendants should receive proper instructions about loading and temperature control. It should also be noted that the efficient operation of an incinerator depends heavily on the right mix of materials in the waste being treated.

In the event of a spill of infectious or potentially infectious material, the following spill clean-up procedure should be used.

- Wear gloves and protective clothing, including face and eye protection if indicated.
- Cover the spill with cloth or paper towels to contain it.
- Pour an appropriate disinfectant over the paper towels and the immediately surrounding area (generally, 5% bleach solutions are appropriate; but for spills on aircraft, quaternary ammonium disinfectants should be used).
- Apply disinfectant concentrically beginning at the outer margin of the spill area, working toward the centre.
- After the appropriate amount of time (e.g. 30 min), clear away the materials. If there is broken glass or other sharps involved, use a dustpan or a piece of stiff cardboard to collect the material and deposit it into a puncture-resistant container for disposal.
- Clean and disinfect the area of the spillage (if necessary, repeat steps 2–5).
- Dispose of contaminated materials into a leakproof, puncture-resistant waste disposal container.
- After successful disinfection, inform the competent authority that the site has now been decontaminated

7.3.9 Impacts Associated with Specimen Exposure

Receipt and opening of samples/specimen during the operation of the BSL-3 facility could result to human health impacts due to exposure to the infectious samples.

Impact Significance:
Local; High and Long Term
Mitigation:
- To avoid accidental leakage or spillage, secondary containers, such as boxes, should be used, fitted with racks so that the specimen containers remain upright. The secondary containers may be of metal or plastic, should be autoclavable or resistant to the action of chemical disinfectants, and the seal should preferably have a gasket. They should be regularly decontaminated. - The facility should designate a **Receipt of specimen** room or area designated for this purpose. - Personnel who receive and unpack specimens should be aware of the potential health hazards involved, and should be trained to adopt standard precautions (2), particularly when dealing with broken or leaking containers. - Primary specimen containers should be opened in a biological safety cabinet. Disinfectants should be available. - Every laboratory that works with infective microorganisms should institute safety precautions appropriate to the hazard of the organisms and the animals being handled.

7.3.10 Impacts Associated with Emergency Hazards

During the operation of the BSL-2 and BSL-3 facility, there are emergency situations and hazards that may be encountered and caused as a result of the BSL-2 and BSL-3 activities. Such hazards, if not contained rapidly and effectively could lead to adverse occupational health and safety impacts, environmental impacts as well as community health and safety in the case of BSL-3 laboratory activities.. The leakages/exposure of some of the toxic and infectious materials from the BSL could harm human health and the environment. Typical emergency incidences that may be encountered during the operation of the BSL-3 facility include:-

- Puncture wounds, cuts and abrasions
- Ingestion of potentially infectious material
- Potentially infectious aerosol release (outside a biological safety cabinet)
- Broken containers and spilled infectious substances
- Breakage of tubes containing potentially infectious material in centrifuges
- not having sealable buckets
- Breakage of tubes inside sealable buckets (safety cups)
- Fire and natural disasters
- Emergency services: whom to contact

The contingency plan should provide operational procedures for:

The BSL-3 management will be expected to develop a written **contingency plan procedure** for dealing with laboratory and animal facility accidents for a BSL-3 and the national and/or local health authorities should be involved in the development of the emergency preparedness plan. Key plans and procedures to be developed should include among others:-

1. Precautions against natural disasters, e.g. fire, flood, earthquake and explosion
2. Biohazard risk assessment
3. Incident-exposure management and decontamination
4. Emergency evacuation of people and animals from the premises
5. Emergency medical treatment of exposed and injured persons
6. Medical surveillance of exposed persons

7. Clinical management of exposed persons
8. Epidemiological investigation
9. Post-incident continuation of operations.

In the development of this plan the following items should be considered for inclusion:
1. Identification of high-risk organisms
2. Location of high-risk areas, e.g. laboratories, storage areas, animal facilities
3. Identification of at-risk personnel and populations
4. Identification of responsible personnel and their duties, e.g. biosafety officer, safety personnel, local health authority, clinicians, microbiologists, veterinarians, epidemiologists, and fire and police services
5. Lists of treatment and isolation facilities that can receive exposed or infected persons
6. Transport of exposed or infected persons
7. Lists of sources of immune serum, vaccines, drugs, special equipment and supplies
8. Provision of emergency equipment, e.g. protective clothing, disinfectants, chemical and biological spill kits, decontamination equipment and supplies.

The following emergency equipment must be available:
1. First-aid kit, including universal and special antidotes
2. Appropriate fire extinguishers, fire blankets

Emergency Equipment

The following are also required.
1. Full protective clothing (one-piece coveralls, gloves and head covering – for incidents involving microorganisms in Risk Groups 3)
2. Full-face respirators with appropriate chemical and particulate filter canisters
3. Room disinfection apparatus, e.g. sprays and formaldehyde vaporizers
4. Stretcher
5. Tools, e.g. hammers, axes, spanners, screwdrivers, ladders, ropes
6. Hazard area demarcation equipment and notices.

7.3.11 Impacts Associated with Fire Hazards

Laboratory personnel may confront hazards posed by forms of energy including fire, electricity, radiation and noise. The proposed BSL laboratory facilities are likely to experience fire related hazards that could lead to occupational health and safety harm (including death), community health and safety injury (including death), accidental releases of infectious and toxic substances as a result of the fire and destruction or property. Common causes of fires in laboratories are:

1. Electrical circuit overloading
2. Poor electrical maintenance, e.g. poor and perished insulation on cables
3. Excessively long gas tubing or long electrical leads
4. Equipment unnecessarily left switched on
5. Equipment that was not designed for a laboratory environment
6. Open flames
7. Deteriorated gas tubing
8. Improper handling and storage of flammable or explosive materials
9. Improper segregation of incompatible chemicals
10. Sparking equipment near flammable substances and vapours
11. Improper or inadequate ventilation.

Impact Significance:
Local; High and Long Term
Mitigation:
• Fire-fighting equipment should be placed near room doors and at strategic points in corridors and hallways. This equipment may include hoses, buckets (of water or sand) and a fire extinguisher. Fire extinguishers should be regularly inspected and maintained, and their shelf-life kept up to date. • Close cooperation between safety officers and local fire prevention officers is essential. • Apart from chemical hazards, the effects of fire on the possible dissemination of infectious material must be considered. This may determine whether it is best to extinguish or contain the fire. • The assistance of local fire prevention officers in the training of laboratory staff in fire prevention, immediate action in case of fire and the use of fire-fighting equipment is desirable. • Fire warnings, instructions and escape routes should be displayed prominently in each room and in corridors and hallways.

7.3.12 Impacts Associated with Electrical Hazards

The proposed BSL laboratory facilities are likely to experience electrical related hazards that could lead to occupational health and safety harm (including death), community health and safety injury (including death), accidental releases of infectious and toxic substances as a result of the fire and destruction or property. Common causes of fires in laboratories are:

Impact Significance:
Local; High and Long Term
Mitigation:
• It is essential that all electrical installations and equipment are 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 should be earthed/grounded, preferably through three-prong plugs. • All laboratory electrical equipment and wiring should conform to national electrical safety standards and codes.

7.3.13 Impacts Associated with Noise Hazards

The equipment in use in the BSL-3 facility is likely to lead to excessive noise even if insidious over time which would have an impact on the workers. Some types of laboratory equipment, such as certain laser systems, fans etc. will likely produce significant noise exposure to workers.

Impact Significance:
Local; Low and Long Term
Mitigation:
• Where noise levels cannot be abated and where laboratory personnel routinely experience excessive exposures, a hearing conservation programme that includes the use of hearing protection while working in hazardous noise and a medical monitoring programme to determine the effect of noise on the workers should be instituted. • Noise measurement surveys be conducted to determine the noise hazard. • Where warranted by data, engineering controls such as enclosures or barriers around noisy equipment or between noisy areas and other work areas, can be considered.

7.3.14 Impacts Associated with Ionizing Radiation Hazards

The use of radiological emitting equipment in the BSL-3 facility is likely to lead to harmful effects of radiation to the workers which may include somatic effects, e.g. clinical symptoms observable in exposed individuals. Somatic effects include radiation-induced cancers, e.g. leukaemia and bone, lung and skin cancers, the onset of which may occur many years after irradiation. Less severe somatic effects include minor skin damage, hair loss, blood deficiencies, gastrointestinal damage

and cataract formation. Exposure of the developing fetus, particularly in weeks 8–15 of pregnancy, may increase the risk of congenital malformations, mental impairment or radiation-induced cancers in later life.

Impact Significance:
Local; High and Long Term
Mitigation:
To limit the harmful effects of ionizing radiation, the use of radioisotopes should be controlled and should comply with relevant national standards. Protection from radiation is managed on the basis of four principles: - Minimizing the time of radiation exposure - Maximizing the distance from the radiation source - Shielding the radiation source - Substituting the use of radionuclides with non-radiometric techniques. - Mark radiation containers with the radiation symbol, including radionuclide identity, activity and assay date - Use radiation meters to monitor working areas, protective clothing and hands after completion of work. - Use appropriately shielded transport containers - Remove radioactive waste frequently from the working area. - Maintain accurate records of use and disposal of radioactive materials. - Screen dosimetry records for materials exceeding the dose limits. - Establish and regularly exercise emergency response plans. - In emergencies, assist injured persons first. - Clean contaminated areas thoroughly. - Request assistance from the safety office, if available. - Write and keep incident reports.

7.3.15 Impacts Associated with Inadequate Biosecurity System and Programme

Global events in the recent past have highlighted the need to protect laboratories and the materials they contain from being intentionally compromised in ways that may harm people, livestock, agriculture or the environment. "Laboratory biosecurity" refers to institutional and personal security measures designed to prevent the loss, theft, misuse, diversion or intentional release of pathogens and toxins.

The absence of a robust biosecurity programme for the proposed BSL-3 facility may lead to intentional exposure of the infectious materials and could harm people, livestock, agriculture or the environment as indicated above.

Impact Significance:
Countrywide; High and Long Term
Mitigation:
• Develop laboratory biosecurity measures based on a comprehensive programme of accountability for pathogens and toxins that includes an updated inventory with storage location, identification of personnel with access, description of use, documentation of internal and external transfers within and between facilities, and any inactivation and/or disposal of the materials. • Develop institutional laboratory biosecurity protocol should be established for identifying, reporting, investigating and remediating breaches in laboratory biosecurity, including discrepancies in inventory results • The involvement and roles and responsibilities of public health and security authorities in the event of a security infraction must be clearly defined. • Undertake laboratory biosecurity training, distinct from laboratory biosafety training to all personnel. Such training should help personnel understand the need for protection of such materials and the rationale for the specific biosecurity measures, and should include a review of relevant national standards and institution specific procedures. • Develop Procedures describing the security roles and responsibilities of personnel in the event of a security infraction should also be presented during training. • Develop code of conduct and professional ethical suitability among workers for working with dangerous pathogens of all personnel who have regular authorized access to sensitive materials is also central to effective laboratory biosecurity activities and should be done through an assessment of the suitability of personnel, security-specific training and rigorous adherence to pathogen protection procedures are reasonable means of enhancing laboratory biosecurity • Develop compliance checks with these procedures, with clear instructions on roles, responsibilities and remedial actions. • Undertake regular risk and threat assessments, and regular review and updating of procedures.

7.3.16 Impacts Associated with Inadequate/Lack of Training For Laboratory Personnel

Inadequate or lack of recruitment and training of qualified personnel to work in the BSL-2 and BSL-3 facility could lead to adverse impacts on the workers within the facility caused by exposure to infectious substances and even to the external environment (community health) in the event of external leakages. Laboratory safety is also the responsibility of all supervisors and laboratory employees, and individual workers are responsible for their own safety and that of their colleagues.

Impact Significance:
Local; High and Long Term
Mitigation:
- Conduct safety organisation and training - Employees are expected to perform their work safely and should report any unsafe acts, conditions or incidents to their supervisor. - Periodic safety audits by internal or external personnel are desirable. - Wherever possible a biosafety officer should be appointed to ensure that biosafety policies and programmes are followed consistently throughout the laboratory. The biosafety officer executes these duties on behalf of the head of the institute or laboratory. - Undertake **Support Staff Safety Training** for skilled engineers and craftsmen who maintain and repair the structure, facilities and equipment, should have some knowledge of the nature of the work of the laboratory, and of safety regulations and procedures. - Testing of equipment after servicing, e.g. testing the efficiency of biological safety cabinets after new filters have been fitted, may be carried out by or under supervision of the biosafety officer. - Engineering and maintenance staff should only enter the Biosafety Level 2 and 3 facilities with clearance and supervision by the biosafety officer and/or the laboratory supervisor. - The Biosafety Level 2 and 3 facilities should only be cleaned by the laboratory staff. - Cleaning personnel should only enter Biosafety Level 3 laboratories with clearance and supervision by the biosafety officer and/or the laboratory supervisor. - Constitute a **Biosafety Committee** to develop institutional biosafety policies and codes of practice. The biosafety committee should also review research protocols for work involving infectious agents, animal use. Other functions of the committee may include risk assessments, formulation of new safety policies and arbitration in disputes over safety matters. The membership of the biosafety committee should reflect the diverse occupational areas of the organization as well as its scientific expertise. The composition of a basic biosafety committee may include: 1. Biosafety officer(s) 2. Scientists 3. Medical personnel 4. Veterinarian (s) (if work with animals is conducted) 5. Representatives of technical staff 6. Representatives of laboratory management.

The estinmated costs for implementation of mitigation measures are summarized in table 14.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

In this chapter, institutional responsibilities for management of environmental and social risks, environmental monitoring, capacity development and training, and Chance Finds and GRM Procedure are presented. In addition of this ESMP, an Infection Control and Waste Management Plan (ICWMP) has been prepared to address environmental and social risks specifically associated with the proposed BSL3 lab, which deals with highly infectious diseases.

8.1 Institutional Arrangements for Management of Environmental and Social Risks Associated with BSL-1, BSL-2 and BSL3 Laboratories

For successful implementation of environmental and social risks mitigation measures, the following institutions, organizational units, committee(s) and specilalists will play key roles.

8.1.1 ZNPHI

ZNPHI will be responsible for overall management of the proposed three (03) types of laboratories. It will be responsible for appointing for technical and support staff required for BSL-1, BSL-2 and BSL-3 laboratories; capacity building; ensuring that research at the proposed BSL-1 lab conforms to the best international practices (such as the NIH Guidelines, BMBL and WHO Biosafety Manual) ; 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 relevant Zambian regulatory agencies ; and facilitating the preparation of guidelines, policies and plan relevant for smooth functioning of the laboratories.

8.1.2 Project Implementation Unit (PIU)

A Project Implementation Unit (PIU) for this project will be established by Zambia National Public Health Institute (ZNPHI) which is the implementing agency. The ZNPHI Project Implemetation Unit (PIU) will be responsible for ensuring compliance with the necessary, health, safety and environmental standards as specified in the ESMP and specifically during the operation phase. The ZNPHI will bear overall responsibility for environmental and social management at all the project phases. However, during the construction phase, the contractor

will bear responsibility for compliance with the relevant health, safety and environmental aspects of the project.

The PIU will be required to among others undertake and assure the following during the operation phase:-

1. Review and approve the design of BSL-1, BSL-2 and BSL-3 facilities and ensure that it is in line with the WHO Laboratory Biosafety Manual as appertains to design and layout.
2. Identify an independent entity to commission the facility before operations begin
3. Identify an independent entity to certify the facility before operations begin
4. Oversee the recruitment of a qualified biosafety and biosecurity officer for the BSL-3 facility
5. Oversee the establishment of a Biosafety Committee for the three types of laboratory facilities
6. Ensure that all the other staff recruited, especially in the BSL-2 and BSL-3 are competent
7. Develop or engage experts to develop Standard Operating Procedures for the three laboratories in accordance with WHO Laboratory Biosafety Manual.

8.1.3 The Biosafety Committee

The Biosafety Committee will oversee the review, approval and oversight of biohazards in research activities at the EPHI campus. The committee will be responsible for 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 standard, CDC Guidelines, the BMBL, and other standards and regulations. 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, supervise the Infection control and waste management system of ZNPHI and the committee will be responsible to action for any deviation from the waste management procedure practices or malpractice during waste handling transportation, storage, treatment and disposal.

8.1.4 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
- Advise on disinfection policy
- Prepare contingency plans for action following accidents and incidents involving biological agents
- Advise and assist management in investigations following accidents and incidents involving biological agents
- Carry out periodic inspections of containment facilities
- Develop, implement, and maintain the lab's biosafety program to address issues of biosafety and biosecurity.
- Perform and review the required risk assessment to determine appropriate biosafety level and personal protective equipment (PPE) for 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 lab'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 Biosafety Committee on research safety procedures.
- Provide technical advice to ensure that individuals working in the wastewater treatment Plant
- Supervise the infection control and waste management system of the BSL3 lab and

- Ensure the implementation 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.

8.1.5 Project Supervision Engineer

The Project Supervision Engineer with a qualified Environmental Health and Safety Officer will be charged with the responsibilities of supervision, review of site reports, preparation of monthly progress reports, prepare and issue appropriate instructions to the Contractor and monitor ESMP implementation.

8.1.6 Contractor

For an effective integration of environmental and social safeguards into the project implementation the Contractor will need to adopt this ESMP and prepare a comprehensive Construction Environment and Social Management Plan (C-ESMP) that will provide the key reference point for compliance. The Contractor will ensure that the established safeguards are integrated and implemented throughout the project works as per the C-ESMP. The Contractor will internalize the ESMP/C-ESMP, prepare monthly progress reports and implement instructions issued by the Supervision Consultant. The Contractor will also undertake ESIA Studies for sites outside the project zone and seek appropriate ZEMA licenses. The Contractor, therefore, will engage qualified Environmental Health and Safety Officer to interpret the C-ESMP and advice on the implementation of the same, as well to the Counterpart Personnel for the Supervision Expert. The full Contractor's Team will comprise of the following key staff cadres as specified in the Bidding Document.

8.1.7 Zambia Environment Management Authority

The Zambia Environment Management Authority (ZEMA) is responsible for ensuring environmental compliance in Zambia and its staff will further ensure that the ESMP is implemented as part of their mandate, functions and responsibilities. ZEMA will undertake surveillance on the project implementation and review compliance performance based on the supervision monitoring reports. 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.

8.2 Mitigation Measures Plan

The mitigation measures for antipated environmental risks associated with the proposed BSL-1, BSL-2 and BSL-3 laboratories and estimated costs for mitigation activities are presented in Table 14 below.

Table 14 : Environmental and Social risks mitigation measures plan

Construction phase			
Environmental / Social Impact	**Mitigation Measures**	**Responsibility**	**Cost USD** **Contractor to revise ESMP and reflect actual costs based on update.*
Traffic Congestion	Provide and implement a traffic management plan Provision temporary road signs or notices to indicate ongoing works. Effecting traffic controls to avoid congestion and accidents on construction site and associated roads. Choosing suitable traffic routes to reduce the impact in the neighbourhood. Ensuring no interference with traffic through traffic control, designated parking, speed limits and hiring a banksman.	Contractor	5,000.00
Site Related Oil Spills	Employee awareness on company procedures for dealing with spills and leaks from oil storage tanks. Containment of leaks. Provision of absorbent material Maintenance of contractor's plant Provision of relevant emergency numbers	Contractor	10,000.00
Soil Related Impacts	Stock piling of soil for reuse Provision temporary drainage channels or holding ponds as a precautionary measure Restoration of the ground by planting adequate grass cover and trees. Planning emergency response measures in case of accidental oil spills.	Contractor	7,000.00
Impact on Water Resources	Provide and implement a waste management plan Proper solid and liquid wastes disposal mainly from the construction camps, sites and offices. Ensuring proper measures are in place for collection and disposal of spilled oils and lubricants.	Contractor	5,000.00
Influx/Inmigration	Hiring unskilled construction and skilled (if available) labour from the local population as far as possible. Use of manual labour during excavation and construction works where possible. Prepare a labour management plan to include management of labour influx Sensitizing workers and the surrounding community on awareness, prevention and management of HIV/AIDS. Enforcing and maintaining a code of conduct for employees	Contractor	8,000.00
Air Quality	Use of persomal protective clothing (PPE) like dust masks on construction crew.	Contractor	20,000.00

Construction phase			
Environmental / Social Impact	**Mitigation Measures**	**Responsibility**	**Cost USD** **Contractor to revise ESMP and reflect actual costs based on update.*
	Regular water spraying of murram and earth roads and construction site Operated and maintenance of contractor's plant in compliance with relevant vehicle emission standards and manufacturer's specification to minimize air pollution.		
Noise Pollution	Use of persomal protective clothing (PPE) like ear muffs on construction crew. Avoiding night time construction when noise is loudest near residential areas. No discretionary use of noisy machinery within 50 m of residential areas and near institutions or use of manual labour in these sections. Good maintenance and proper operation of construction machinery. Where possible, ensure non mechanized construction to reduce the use of machinery	Contractor	15,000.00
Impact on flora and fauna	Re-planting the indigenous vegetation as much as possible once work is completed. Sparing the vegetation that must not necessarily be removed. Provide a waste management plan Promoting non-mechanized methods of construction. Ensure that the employees on site are aware of the company procedures for dealing with spills and leaks from oil storage tanks Provision of dustbin and sanitation facilities.	Contractor	4,000.00
Public Health & Safety	Ensuring proper maintenance and operation of Contractors' machinery to mitigate noise and dust impacts. Providing crossing areas for access to pedestrians to minimise accidents. Provide workers with adequate drinking water and breaks. Drain all pools of standing water to minimize or altogether eliminate mosquito breeding sites. Provide a waste management plan. Cordon off trenches and working areas with a reflective tape to ensure safety of pedestrians and provide crossing areas	Contractor	10,000.00
HIV & AIDS Impacts	Sensitizing workers and the surrounding communities on awareness, prevention and management of HIV/AIDS. Provide an on-site clinic to provide VCT services to construction crew. Ensure availability of condoms for workers at construction site	Contractor	35,000.00
Gender empowerment	Ensuring equitable distribution of employment opportunities between men and women Providing toilets and bathrooms for both male and female workers on site	Contractor	3,000.00

Construction phase			
Environmental / Social Impact	**Mitigation Measures**	**Responsibility**	**Cost USD** **Contractor to revise ESMP and reflect actual costs based on update.*
Child Labour and Protection	Provide and implement a child protection strategy Ensuring no children are employed on site in accordance with national labour laws Ensuring that any child sexual relations offenses among contractors' workers are promptly reported to the police	Contractor	3,000.00
Gender Equity, Sexual Harassment	Provide and implement a gender based violence strategy, which will include: Gender mainstreaming in employment at the worksite with opportunities provided for females to work, in consonance with local laws and customs Grievance redress mechanisms including non-retaliation. Provide and implement an employee code of conduct The works contractor should be required, under its contract, to prepare and enforce a No Sexual Harassment and Non-Discrimination Policy, in accordance with national law where applicable.	Contractor	3,000.00
Liability for loss of life, injury or damage to private property	Provision of PPE. Training workers on the operation of the machinery and equipment Ensuring there are adequate warning and directional signs. Ensuring that the prepared code of conduct for staff is followed to prevent accidents. Developing a site safety action plan. Cordoning off unsafe areas Provision of first Aid kit within the construction site. Recording of all injuries that occur on site in the incident register, corrective actions for their prevention are instigated as appropriate. Compliance with the Workmen's Compensation Act, ordinance regulations and union agreements.	Contractor	3,000.00
Soil erosion and impacts on soils due to spillage of hydrocarbon fuels and lubricants	The contractor will provide and implement a waste management plan be restricted to areas earmarked for management of solid and liquid waste The contractor to engage a ZEMA licensed waste operator to dispose wastes Contractor to provide litter bins for waste disposal to recycle or re-use certain types of wastes (scrap metal) etc, to provide mobile toilets for workers at the construction site works Reagents and hazardous chemicals should be stored in a bunded area All construction equipment will be serviced regularly.	Contractor	

Construction phase			
Environmental / Social Impact	**Mitigation Measures**	**Responsibility**	**Cost USD** **Contractor to revise ESMP and reflect actual costs based on update.*
Visual intrusion (aesthetics) during the construction of the multi-storey building	Equipment during construction will be stored/parked in a designated area to avoid visual intrusion.	Contractor	

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
Impacts associated with **inadequate** BSL-3 Facility Design leading to among others: (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	Ensure the BSL-3 Facility is designed in accordance with the design requirements provided by WHO Laboratory Biosafety Manual)	ZNHIP	TBD through detailed design and Bill of Quantities.
Impacts associated with **inadequate** BSL-2 Facility Design leading to among others: (Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	Ensure the BSL-2 Facility is designed in accordance with the design requirements provided by WHO Laboratory Biosafety Manual)	ZNHIP	TBD through detailed design and Bill of Quantities.
Impacts associated with operating a **NON-Commissioned and certified** BSL-3 Facility design leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community	Ensure that the BSL-3 Facility is commissioned as per the requirements and in accordance with the design requirements provided by WHO Laboratory Biosafety Manual). Ensure that on an annual basis, **RE-CERTIFICATION** of the BSL-3 Facility is undertaken by an independent expert	ZNHIP	15,000.00

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
Health and Safety Risks, Environmental Risks)			
Impacts associated with **NON-CERTIFICATION** of the BSL-3 Facility design leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Ensure that the BSL-3 facility is commissioned as per the requirements and in accordance with the design requirements provided by WHO Laboratory Biosafety Manual). □ Ensure that on an annual basis, **RE-CERTIFICATION** of the BSL-3 Facility is undertaken by an independent expert.	ZNHIP	15,000.00
Impact associated with Workers' Chemical Exposure leading to Occupational Health and Safety Risks	□ Provide training to workers in the laboratories and ensure they have proper knowledge of the toxic effects of these chemicals, the routes of exposure and the hazards that may be associated with handling and storage. □ Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. □ Ensure that there are Biological Safety Cabinets (BSCs) (Class III) in the BSL-2 and BSL-3 designed to protect the operator, the laboratory environment and work materials from exposure to infectious aerosols and splashes that may be generated when manipulating materials containing infectious agents, such as primary cultures, stocks and diagnostic specimens.	ZNHIP	TBD through detailed design and Bill of Quantities.
Impacts associated with inadequate management of infectious solid waste from the the BSL-3 Facility to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Develop and implement a solid waste management plan for infectious and harzadious solid wastes with WHO Laboratory Biosafety Manual □ Autoclave all infectious and harzadious solid wastes □ Incinerate infectious and harzadious solid wastes in an incinerator that meets the specifications for incinerating wastes from BSL-3 facility □ Provide training for workers handling for infectious and harzadious solid wastes	ZNHIP	3,000.00 (excludes cost of autoclave which is part of project overall cost to be determined via the detailed design and Bill of Quantities.

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
	□ Provide PPE for workers handling for infectious and harzadious solid wastes		
Impacts associated with inadequate management of infectious effluent/liquid waste from the the BSL-3 Facility leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Develop and implement a liquid waste management plan for infectious and harzadious solid wastes in accordance with WHO Laboratory Biosafety Manual □ Autoclave all infectious and harzadious liquid wastes □ Provide training for workers handling for infectious and harzadious liquid wastes □ Provide PPE for workers handling for infectious and harzadious liquid wastes	ZNHIP	10,000.00 (excludes cost of autoclave which is part of project overall cost to be determined via the detailed design and Bill of Quantities.
Impacts associated with inadequate disinfection of BSL-3 Facility leading to among others:- Occupational Health and Safety Risks	□ All items within BSCs, including equipment, should be surface-decontaminated and removed from the cabinet when work is completed, since residual culture media may provide an opportunity for microbial growth. The interior surfaces of BSCs should be decontaminated before and after each use. □ The work surfaces and interior walls should be wiped with a disinfectant that will kill any microorganisms that might be found inside the cabinet. □ At the end of the work day, the final surface decontamination should include a wipe-down of the work surface, the sides, back and interior of the glass. A solution of bleach or 70% alcohol should be used where effective for target organisms. A second wiping with sterile water is needed when a corrosive disinfectant, such as bleach, is used. □ BSCs must be decontaminated before filter changes and before being moved. The most common decontamination method is by fumigation with formaldehyde gas. BSC decontamination should be performed by a qualified professional.	ZNHIP	No costs associated with daily operations of workers in the lab as appertains to disinfecting the work areas
Impacts associated with specimen exposure of the laboratory facilities' workers leading to among others:- Occupational Health and Safety Risks	□ To avoid accidental leakage or spillage, secondary containers, such as boxes, should be used, fitted with racks so that the specimen containers remain upright. The secondary containers may be of metal or plastic, should be autoclavable or resistant to the action of chemical disinfectants, and the seal should	ZNHIP	Cost of items/infrastructure related to minimising OHS risks to be outlined in detailed design and Bills of Quantities.

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
	preferably have a gasket. They should be regularly decontaminated. - The facility should designate a **Receipt of specimens** room or area designated for this purpose. - Personnel who receive and unpack specimens should be aware of the potential health hazards involved, and should be trained to adopt standard precautions (2), particularly when dealing with broken or leaking containers. - Primary specimen containers should be opened in a biological safety cabinet. Disinfectants should be available. - Every laboratory that works with infective microorganisms should institute safety precautions appropriate to the hazard of the organisms and the animals being handled.		
Impacts associated with **Emergency Hazards** from the BSL-3 Facility design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	- Develop a **Contigency Plan Procedure** for the BSL-Facility (refer to Annex 4) - Provide First-aid kit, including universal and special antidotes - Provide Appropriate fire extinguishers, fire blankets - Full protective clothing (one-piece coveralls, gloves and head covering – for incidents involving microorganisms in Risk Groups 3) - Full-face respirators with appropriate chemical and particulate filter canisters - Room disinfection apparatus, e.g. sprays and formaldehyde vaporizers - Hazard area demarcation equipment and notices	ZNHIP	10,000.00
Impacts associated with **Emergency Hazards** from the BSL-2 Facility design leading to among others: - (Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	- Develop a **Contigency Plan Procedure** for the BSL-Facility (refer to Annex 4) - Provide First-aid kit, including universal and special antidotes - Provide Appropriate fire extinguishers, fire blankets - Full protective clothing (one-piece coveralls, gloves and head covering – for incidents involving microorganisms in Risk Groups 3) - Full-face respirators with appropriate chemical and particulate filter canisters	ZNHIP	Consolidated Contingency Plan to be developed within the budgeted USD 10,000, above.

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
	□ Room disinfection apparatus, e.g. sprays and formaldehyde vaporizers □ Hazard area demarcation equipment and notices		
Impacts associated with **Emergency Hazards** from the BSL-1 Facility design leading to among others: - Occupational Health and Safety Risks, and Environmental Risks)	□ Develop a **Contigency Plan Procedure** for the BSL-Facility (refer to Annex 4) □ Provide First-aid kit, including universal and special antidotes □ Provide Appropriate fire extinguishers, fire blankets □ Full protective clothing (one-piece coveralls, gloves □ Room disinfection apparatus, e.g. sprays and formaldehyde vaporizers □ Hazard area demarcation equipment and notices	ZNHIP	10,000.00
Impacts associated with Fire Hazards from the laboratory facilities design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Fire-fighting equipment should be placed near room doors and at strategic points in corridors and hallways. This equipment may include hoses, buckets (of water or sand) and a fire extinguisher. Fire extinguishers should be regularly inspected and maintained, and their shelf-life kept up to date. □ Close cooperation between safety officers and local fire prevention officers is essential. □ The assistance of local fire prevention officers in the training of laboratory staff in fire prevention, immediate action in case of fire and the use of fire-fighting equipment is desirable. □ Fire warnings, instructions and escape routes should be displayed prominently in each room and in corridors and hallways.	ZNHIP	15,000.00
Impacts associated with Electrical Hazards from the three types of laboratory facilities respective design leading to among others: - (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ It is essential that all electrical installations and equipment are 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 should be earthed/grounded, preferably through three-prong plugs. □ All laboratory electrical equipment and wiring should conform to national electrical safety standards and codes.	ZNHIP	Costs are related to construction infrastructures and to be included in overall detailed design and construction costs.

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
Impacts associated with Noise Hazards from the three laboratory facilities respective designs leading to among others: - Occupational Health and Safety Risks.	□ Where noise levels cannot be abated and where laboratory personnel routinely experience excessive exposures, a hearing conservation programme that includes the use of hearing protection while working in hazardous noise and a medical monitoring programme to determine the effect of noise on the workers should be instituted. □ Noise measurement surveys be conducted to determine the noise hazard. □ Where warranted by data, engineering controls such as enclosures or barriers around noisy equipment or between noisy areas and other work areas, can be considered	ZNHIP	5,000.00
Impacts associated with Ionizing Radiation Hazards from the BSL-3 Facility leading to among others: - Occupational Health and Safety Risks.	To limit the harmful effects of ionizing radiation, the use of radioisotopes should be controlled and should comply with relevant national standards. Protection from radiation is managed on the basis of four principles: □ Minimizing the time of radiation exposure □ Maximizing the distance from the radiation source □ Shielding the radiation source □ Substituting the use of radionuclides with non-radiometric techniques. □ Mark radiation containers with the radiation symbol, including radionuclide identity, activity and assay date □ Use radiation meters to monitor working areas, protective clothing and hands after completion of work. □ Use appropriately shielded transport containers □ Remove radioactive waste frequently from the working area. □ Maintain accurate records of use and disposal of radioactive materials. □ Screen dosimetry records for materials exceeding the dose limits. □ Establish and regularly exercise emergency response plans. □ In emergencies, assist injured persons first. □ Clean contaminated areas thoroughly. □ Request assistance from the safety office, if available.	ZNHIP	20,000.00

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
	□ Write and keep incident reports.		
Impacts associated with transport of infectious samples and specimens (including wastes) to and from the the BSL-3 Facility leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Use the protocol (Annex 7) for transporation and shipment of specimen and wastes. □ Provide training to workers in the BSL-3 and ensure they have proper knowledge of the toxic effects of these chemicals, the routes of exposure and the hazards that may be associated with handling and storage. □ Material safety data sheets or other chemical hazard information should be available from chemical manufacturers and/or suppliers. These should be accessible in laboratories where these chemicals are used, e.g. as part of a safety or operations manual. □ Laboratory personnel must ship infectious substances according to applicable transport regulations. □ Develop a Spill Clean Up Procedure	ZNHIP	3,000.00
Impacts associated with inadequate or lack of bio-security system program for the BSL-3 Facility leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Develop laboratory biosecurity measures based on a comprehensive programme of accountability for pathogens and toxins that includes an updated inventory with storage location, identification of personnel with access, description of use, documentation of internal and external transfers within and between facilities, and any inactivation and/or disposal of the materials. □ Develop institutional laboratory biosecurity protocol for identifying, reporting, investigating and remediating breaches in laboratory biosecurity, including discrepancies in inventory results □ Define the involvement and roles and responsibilities of public health and security authorities in the event of a security infraction. □ Undertake laboratory biosecurity training, distinct from laboratory biosafety training to all personnel. Such training should help personnel understand the need for protection of such materials and the rationale for the specific biosecurity measures, and should include a review of relevant nationa standards and institution specific procedures.	ZNHIP	20,000.00

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
	Develop procedures describing the security roles and responsibilities of personnel in the event of a security infraction should also be presented during training. Develop code of conduct and professional ethical suitability among workers for working with dangerous pathogens of all personnel who have regular authorized access to sensitive materials is also central to effective laboratory biosecurity activities and should be done through an assessment of the suitability of personnel, security-specific training and rigorous adherence to pathogen protection procedures are reasonable means of enhancing laboratory biosecurity Develop compliance checks with these procedures, with clear instructions on roles, responsibilities and remedial actions. Undertake regular risk and threat assessments, and regular review and updating of procedures.		
Impacts associated with inadequate or lack of training of the BSL-3 Facility workers/personell leading to among others:- (Human Health Risks, Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	Recruit qualified personell to work in the BSL-3 facility Conduct safety organisation and training for the BSL-3 workers Appoint a **Biosafety Officer** to ensure that biosafety policies and programmes are followed consistently throughout the laboratory. The biosafety officer executes these duties on behalf of the head of the institute or laboratory and shall cover all the three laboratories (BSL-1, BSL-2 and BSL-3). Undertake **Support Staff Safety Training** for skilled engineers and craftsmen who maintain and repair the structure, facilities and equipment, should have some knowledge of the nature of the work of the laboratory, and of safety regulations and procedures. Testing of equipment after servicing, e.g. testing the efficiency of biological safety cabinets after new filters have been fitted, may be carried out by or under supervision of the biosafety officer. Engineering and maintenance staff should only enter the Biosafety Level 3 facility with clearance and supervision by the biosafety officer and/or the laboratory supervisor.	ZNHIP	15,000.00

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
	□ The Biosafety Level 3 facility should only be cleaned by the laboratory staff. □ Cleaning personnel should only enter Biosafety Level 3 or Biosafety Level 4 laboratories with clearance and supervision by the biosafety officer and/or the laboratory supervisor. □ Constitute a **Biosafety Committee** to develop institutional biosafety policies and codes of practice. The committee must cover BSL-2 and BSL-1 as well, in their scope. The biosafety committee should also review research protocols for work involving infectious agents, animal use. Other functions of the committee may include risk assessments, formulation of new safety policies and arbitration in disputes over safety matters.		
Impacts associated with inadequate or lack of training of the BSL-2 Facility workers/personell leading to among others:- (Occupational Health and Safety Risks, Community Health and Safety Risks, Environmental Risks)	□ Recruit qualified personell to work in the BSL-2 facility □ Conduct safety organisation and training for the BSL-2 workers □ Undertake **Support Staff Safety Training** for skilled engineers and craftsmen who maintain and repair the structure, facilities and equipment, should have some knowledge of the nature of the work of the laboratory, and of safety regulations and procedures. □ Testing of equipment after servicing, e.g. testing the efficiency of biological safety cabinets after new filters have been fitted, may be carried out by or under supervision of the biosafety officer. □ Engineering and maintenance staff should only enter the Biosafety Level 2 facility with clearance and supervision by the biosafety officer and/or the laboratory supervisor. □ The Biosafety Level 2 facility should only be cleaned by the laboratory staff.	ZNHIP	10,000.00
Impacts associated with inadequate or lack of training of the BSL-1 Facility workers/personell leading to among others:-	□ Recruit qualified personell to work in the BSL-2 facility □ Conduct safety organisation and training for the BSL-2 workers □ Undertake **Support Staff Safety Training** for skilled engineers and craftsmen who maintain and repair the structure, facilities and equipment, should have some knowledge of the nature of	ZNHIP	5,000.00

Operation phase			
Environmental / Social Impact	**Mitigation Measure**	**Responsibility**	**Cost USD**
(Occupational Health and Safety Risks, and Environmental Risks)	the work of the laboratory, and of safety regulations and procedures. - Engineering and maintenance staff should only enter the Biosafety Level 1 facility with clearance and supervision by the biosafety officer and/or the laboratory supervisor. - The Biosafety Level 1 facility should only be cleaned by the laboratory staff. -		

Impact Significance:Project Phase	**Allocate Budget (US$)**	**Percentage (%)**
Localised; Low and Long TermConstruction	580,000	40
Mitigation: Operations	880,000	60
Total The design of the complex will factor in the receiving environment to ensure the structure blends into the surroundings.	**1,460,000**	**100**

8.3 Environmental and Social Monitoring

The ZNPHI Project Implemetation Unit (PIU) will be responsible for ensuring compliance with the necessary, health, safety and environmental Standards. It will develop a monitoring plan in and around the project site to monitor environmental performance and compliance with the existing statutory environmental regulations. The ZNPHI will bear overall responsibility for environmental management at all the project phases. However, during the construction phase, the contractor will bear responsibility for compliance with the relevant health, safety and environmental aspects of the project. In this project, key stakeholders in the environmental management activities include the ZNPHI, the contractor, the ZEMA, Ministry of Health, NHCC, Zambia Bureau of Standards, and members of the public. The provisions of the monitoring plan outlined here below will apply from the onset of the construction works right through to the operation phase.

Monitoring will provide information for periodic review and alteration of the ESMP as may be necessary to ensure optimization of environmental protection throughout the lifespan of the project. This will ensure early detection and remediation of undesirable impacts. With respect to the envisaged activities, the environs of interest are air, land, flora, surface and ground water resources, traffic, health and safety. Each of these environs will be impacted upon as already explained in the impacts section. The monitoring plan highlights measures put in place to ensure adherence to the proposed management plan.

The main objectives of the enviormental monitoring are:

1. To provide a database from which the enviormental impacts of the project can be assessed

2. To provide an early indication should any of the enviormental control measures or practices fail to achieve the accepatable standards
3. To monitor the performance of the project and effectiveness of the mitigation measures
4. To determibne project compliance with regualatory reuquirements, standards and government polices.
5. To take remedial actions if unexpected problems or unacceptable impacts arise.

The implemention of mitigation measures will be monitored based on the **Environmental and Social Monitoring Plan** presented in Table 15.

Table 15: Environmental and Social Monitoring Plan

Environmental and Social Component	Performance Indicators	Monitoring Requirements	Frequency	Responsibility
Solid and liquid Waste	□ Scattered litter □ Signs of obstruction of water ways. □ Flow of wastewater on the ground surface. □ Provision of sanitary facilities to the construction crews.	□ Physical inspection □ Number of complaints	□ Monthly	□ Contractor
Noise Pollution	□ Level of noise generated. □ Provision of PPE. □ Compliance with existing noise standard issued by ZEMA.	□ Liaise with other stakeholders. □ Documentation on complaints about noise	□ Monthly	□ Contractor
Air Pollution	□ Level of dust generated. □ Levels of ambient air pollutants from construction vehicles □ Provision of PPE.	□ Physical inspection □ Interview residents including workers □ Liaise with other stakeholders	□ Monthly	□ Contractor
Flora and Fauna	□ Amount of vegetation removed □ Change in animal behavioural patterns □ Change in plant growth	□ Documentation of uprooted trees □ Observation	□ Quarterly	□ Contractor
Gender Empowerment	□ Number of female employees □ Number of male and female toilets	□ Review of company staff records. □ Physical Inspection	□ Quarterly	□ Contractor
Child Labour	□ Record of employees including IDs	□ Review of records □ Interviews with staff and local community	□ Monthly	□ Contractor
Gender Equity and Sexual Harassment	□ Number of complaints	□ Review of grievance redress forms. □ Interviews with local community	□ Monthly	□ Contractor
Loss of Life, Injury and Damage to Private property	□ Record of near misses, accidents and damages done	□ Review of records □ Interviews with staff and local community.	□ Monthly	□ Contractor
HIV&AIDS	□ Number campaign meetings on transmission of diseases like HIV/AIDS and other STDs. □ Number of condom dispensers within the site.	□ Inspection of HIV/AIDS prevention services within the site. □ Number of condoms, A provided.	□ Quarterly	□ Contractor

Environmental and Social Component	Performance Indicators	Monitoring Requirements	Frequency of monitoring	Responsibility
Design of BSL-1, BSL-2 and BSL-3 Facility	Availability of detailed design for BSL-1, BSL-2 and BSL-3 Facilities in accordance with WHO Laboratory Biosafety Manual.	Availability of approved Detailed Design for BSL-1, BSL-2 and BSL-3 Facilities	Once during design stage	ZNHIP
Commissioning of BSL-1, BSL-2 and **BSL-3 Facilities**	Recruitment of consultant to undertake commissioning of BSL-1, BSL-2 and BSL-3 Facilities in accordance with WHO Laboratory Biosafety Manual.	Availability of Contract Documents showing recruitment of commissioning consultant.	Once during commissioning	ZNHIP
Certification of BSL-1, BSL-2 and **BSL-3 Facilities**	Recruitment of consultant to undertake certification of BSL-1, BSL-2 and BSL-3 Facilities in accordance with WHO Laboratory Biosafety Manual.	Availability of Contract Documents showing recruitment of certification consultant.	Annual or whenever changes are made in the facility e.g. fitting of new HVACs, BSC etc.	ZNHIP
Workers Exposure to Chemicals	Availability and proposer use of PPE for all workers Availability of specimen reception area Availability of Biosafety Cabinet Record of trainings given to workers on exposure minimisation Number of worker exposures recorded	Physical and routine inspections to determine use of PPEs and other equipment. Documentation of training given to workers Documentation of exposure incidences	Daily inspection Training frequency conducted annually or as needed	ZNHIP
Solid Waste (Infectious and non-infectious)	Availability of a functional autoclave Availability of a functional incinerator Record of trainings given to waste equipment operators	Physical routne inspections to ascertain use of waste disposal equipment Documentation of training given to workers Documentation of exposure incidences	Daily inspection Training frequency conducted annually or as needed	ZNHIP
Effluent Waste (Infectious and non-infectious)	Availability of a functional autoclave Record of trainings given to waste equipment operators	Physical routne inspections to ascertain use of waste disposal equipment Documentation of training given to workers Documentation of exposure incidences	Daily inspection Training frequency conducted annually or as needed	ZNHIP

Emergency Hazards (Fire, Electric, Noise, Radiation) etc	□ Evidence of written Contigency Plan □ Number of emergency hazards recorded □ Record of trainings given to workers on emergency response □ Presence of First-aid kit, including universal and special antidotes □ Presence of fire extinguishers, fire blankets □ Availability of Full protective clothing (one-piece coveralls, gloves and head covering, Full-face respirators with appropriate chemical and particulate filter canisters □ Availability of room disinfection apparatus, e.g. sprays and formaldehyde vaporizers □ Hazard area demarcation equipment and notices □ Evidence of fire warnings, instructions and escape routes should be displayed prominently in each room and in corridors and hallways □ Number of emergency response drills undertaken	□ Documentation of training given to workers on emergency response procedures □ Documentation of exposure incidences due to emergency hazards □ Physical and routine inspections to ascertain use of PPEs □ Physical and routine inspections to ascertain presence of emergency response equipmemt □ Documentation of emergency drills conducted □ Medical reports of noise exposure impacts on workers □ Medical reports of radiation exposure impacts on workers □ Accurate records of use and disposal of radioactive materials.	□ Daily inspection on PPE use □ Training frequency conducted annually or as needed □ Emergency drills to be conducted annually □ Regualr (semi-annual) imspection of equipment (electrical and fire) including testing tested □ Noise measurement surveys conducted annually □ Medical monitoring of worker exposure to noise undertaken annually □ Medical monitoring of worker exposure to radiation undertaken annually	ZNHIP
Bio-Security Hazards	□ Availability of Bio-Security Protocol □ Number of Bio-security related breaches □ Record of trainings given to workers on biosecurity	□ Documentation of training given to workers on biosecurity □ Documentation of exposure incidences due to biosecurity breaches	□ Biosecurity protocol review to be undertaken annually □ Quarterly inspections on all the aspects in the facility aimed at ensuring security enhancement	ZNHIP

Personnel Training and Capacity Enhancement	□ Availability of organisational training program on safety □ Record of trainings given to workers on BSL-3 safety measures □ Availability of Biosafety Officer □ Availability of Biosafety Committee	□ Documentation of training given to workers on safety □ Documentation of number of meetings held by Biosafety Committee (minutes of meeting) □ Availability of contract for Biosafety Officer	□ Training frequency conducted annually or as needed □ Biosafety Committee meetings to be held on a monthly basis	ZNHIP

8.4 Capacity Development and Training

Given that the operation and maintenance of BSL3 labs will be a new practice in the implementing entity, there is a need for capacity development so that the potential environmental and social risks associated with the lab will be addressed effectively. To this end, the recommended training topics and estimated costs for training activities are summarized in the table below.

Table 16: Capacity building plan technical and support staff

Traiining topic	**Target Participant**	**Estimated Cost (USD)**
Infection control and waste management	All technical and support staff who will be working in the proposed BSL3 lab	10,000
Occuapation health and safety, safe work practices, and appropriate PPE	All technical and support staff who will be working in the proposed BSL3 lab	10,000
Training on biosafety and biosecurity	All technical and support staff who will be working in the proposed BSL3 lab	6,000.00
Quality management system	All technical staff	5000.00
Specimens management	All technical staff	6,000.00
Training on emergency preparedness and response	All technical and support staff who will be working in the proposed BSL3 lab other staff of the BSL 3 laboratory	6,000.00
Specific Laboratory technique (microbiology, molecular methods and other related training)	Technical staff	15, 000.00
Training on BSL 3 lab maintenance	The staff who will be in charge of maintenance activities	10, 000.00

8.6 Grievance redress and Chance Find Procedures

8.6.1 Grevance redress mechanism

Grievance redress mechanisms provide a way to provide an effective avenue for expressing concerns and achieving remedies for communities, promote a mutually constructive relationship and enhance the achievement of project development objectives. GRMs are increasingly important for development projects where ongoing risks or adverse impacts are anticipated. They serve as a way to prevent and address community concerns, reduce risk, and assist larger processes that create positive social change. GRMs provide a formal avenue for affected people or stakeholders to engage with the project implementers or owners on issues of concern or unaddressed environmental and social impacts.

People adversely affected (or about to be affected) by a development project will raise their grievances and dissatisfactions about actual or perceived environmental and social impacts in order to find a satisfactory solution. Not only should affected persons (APs) be able to raise their

grievances and be given an adequate hearing, but also satisfactory solutions should be found that mutually benefit both the APs and the project. It is equally important that APs have access to legitimate, reliable, transparent, and efficient institutional mechanisms that are responsive to their complaints.

Objectives of Grievance Redress Mechanism

The objective of the GRM is to ensure that the views and concerns of those affected by the project activities are heard and acted upon in a timely, effective and transparent manner.

Principles of GRM:

- Protect beneficiaries'/partners rights to comment and complain;
- Neutrality and equity while handling complaints;
- Timing: short cycle, quick response to the critical complaints;
- Transparency: Partners will be aware of the procedures; understand its purpose, have sufficient information on how to access it and understand how it works;
- Confidentiality: Create an environment in which people are more likely to raise concerns, complain or stand in witness. Confidentiality assures that any information given is restricted

In this project, the following grievance redress process will be followed.

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, date lodged, action taken to address complaint or reasons the grievance was not acted on; information provided to complainant and date the grievance was closed. Grievances should be lodged at work hours, directly to the complaint hearing office.

The process for lodging a complaint is outlined below:

- Complaint hearing officer receives complaint(s) from complainant and records it in 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.

Step 2: Determination of corrective action

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 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.

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. 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.

Step 5: Verification of corrective action

To verify satisfaction, the aggrieved person will be asked to return if not satisfied with the corrective action.

Step 6: Action by ZNPHI and project contractors

If the Work supervisor cannot solve the grievance, he will refer it to ZNPHI and contractor through the Supervising Engineer. It is expected all possible grievances can be solved at this level.

8.6.2 Chance finds procedure

Requirements for chance find during construction

Requirements for chance finds are outlined in National Heritage Conservation Commission (NHCC) state that: Any person, who discovers what appears to be an ancient heritage or relic shall-

a. report his discovery to the Commission within fourteen days;
b. suspend his operations in the immediate vicinity of his discovery until thirty days after the delivery of his report, unless the Commission authorises their continuance; and

c. deliver to the Commission as soon as practicable, or request the Commission to examine and remove, any object which is, or appears to be, a relic.

Upon receipt of a report under section forty-two the Commission may-

a. examine and remove any relic;
b. allow the person to continue his activities;
c. order suspension of the operations not in excess of thirty days to carry out an environmental impact assessment or archaeological survey or recovery analysis of the discovery areas; or
d. order the engineering, mining or agricultural project to pay for the costs of the assessment, survey, or analysis.

If the Commission does not exercise any of its powers under section forty-three the person may resume his operations thirty days after delivery of his report. Any relic whose ownership cannot be reasonably determined shall be deemed to belong to the Commission. The procedures to avoid damage to cultural property would include carrying consultations with the appropriate authorities and local inhabitants to identify known or possible sites during project planning. Construction procedure for dealing with "chance finds includes cessation of work until the significance of a "find" has been determined by the appropriate authorities and local inhabitants, and until fitting treatment of the site has been determined and carried out.

The Contractor will be responsible for familiarizing themselves with the following "Chance Finds Procedures", in case culturally valuable materials are uncovered during excavation, including:

- Stop work immediately following the discovery of any materials with possible archaeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
- Protect artefacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artefact
- Prevent and penalize any unauthorized access to the artefact
- Restart construction works only upon the authorization of the relevant authorities.

8.7 Reporting Requirements

As ZNPHI will be responsible for overall management of the proposed BSL-1, BSL-2 and BSL3 laboratories, it will also be responsible for environmental and social safeguards compliance monitoring and reporting to pertinent regulatory agency and MOH on monthly basis. The report

should comprehensively address among others the actions taken to fulfil the requirements of the ESIA and outstanding issues, if any. It is responsible to conduct construction and operation phase environmental and social audits and share the audit reports to the regulatory agency and MOH. It is also expected to report, annual certification reports, any incidents, unintentional injuries and security breaches.

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ANNEX 1: PROJECT SCREENING AND GUIDANCE ON ENVIRONMENTAL IMPACT ASSESSMENT

ZAMBIA ENVIRONMENTAL MANAGEMENT AGENCY

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Corner of Church & Suez Roads
P.O. Box 35131
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Tel: +260- 211-254130/254023/254059
Fax:+260-211-254164/256658

Northern Regional Office
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Livingstone Office
Plot No. 555
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P.O. Box 60195
Livingstone, Zambia
Tel / Fax:+260-213-321297

Chirundu Border Office
Lusaka Road
P.O. Box CRU31
Chirundu, Zambia
Tel/Fax: +260-211-515261

In reply please quote

No:

ZEMA/DEPT/101/1

December 3, 2018

The Permanent Secretary
Ministry of Health
P.O Box 30205
Ndeke House
LUSAKA.

Dear Sir,

RE: REQUEST FOR SCREENING OF PROPOSED PROJECT FOR OPERATIONALIZATION OF THE AFRICA CDC SOUTHERN AFRICA RCC AND STRENGTHENING OF THE ZAMBIA NATIONAL PUBLIC HEALTH INSTITUTE (ZNPHI) UNDER THE WORLD BANK'S AFRICA CDC REGIONAL INVESTMENT FINANCING PROGRAM (P167916)

Reference is made to your correspondence submitted on November 27, 2018 in which you notified the Agency on a proposed project for operationalization of the Africa CDC Southern Africa RCC and strengthening of the Zambia National Public Health Institute in Lusaka District.

The Agency has since reviewed the letter and based on the information provided by yourselves, kindly be informed that your proposed activities (as contained in the correspondence) requires you to conduct an Environmental Impact Assessment (EIA) and submit an **Environmental Project Brief** (EPB) report to ZEMA for consideration. This is in accordance with the requirements of the Environmental Management Act No. 12 of 2011 as read with the Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997. Please find attached the format of an EPB for your attention.

Do not hesitate to contact the undersigned should there be any issues herein that you would wish to clarify.

Yours faithfully,

John Msimuko
Director General
ZAMBIA ENVIRONMENTAL MANAGEMENT AGENCY

All correspondence to be addressed to the Director General - Head Office
Email: info@zema.org.zm, Website: www.zema.org.zm
Emergency Toll Free No. on Zamtel Lines: 953

ANNEX 2: LAND ACQUISITION DOCUMENTS

Telephone: +260 211 250610
Fax: +260 211 250 610
Telegrams: LANDS

In reply please quote:
No:.....
L/638/M

REPUBLIC OF ZAMBIA

MINISTRY OF LANDS AND NATURAL RESOURCES

OFFICE OF THE COMMISSIONER OF LANDS
P.O. BOX 30069
LUSAKA

29th March, 2019

TO WHOM IT MAY CONCERN

RE: COMFORT LETTER - SUBDIVISION OF L/638/M/B

Reference is made to the subject matter and a letter from NISIR attached hereto authorising the subdivision.

The subject property in extent of 10.0047Hecteres as described on Survey Diagram No. SD_4325/2019 has been hived off from L/638/M to cater for National Public Health Laboratory and ZNPHI/Africa CDC Southern RCC office complex.

Please take note that the Commissioner of Lands' Office is in the process of preparing lease and Certificate of Title in favour of Zambia National Public Health Institute (ZNPHI). You may therefore accord the necessary support to the institution as we are processing the Certificate of Title.

Attached hereto are Survey Diagram and other documents for your reference.

Your valued support to this Institution will be highly appreciated.

George S. Sindila
ACTING COMMISSIONER OF LANDS

Communications should be addressed to the Director

In reply please quote No. .....

NATIONAL INSTITUTE FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

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Fax: +260 211 282060 / 281084
E-mail: nisir@zamnet.zm

Kenneth Kaunda International Airport Road
P.O. Box 310158
15302 LUSAKA
Zambia

29th March, 2019

The Commissioner of Lands
Ministry of Lands, Natural Resources
P.O. Box 30069
LUSAKA

Dear Sir,

RE : ACQUISITION OF LAND FOR CONSTRCTUION OF THE NATIONAL PUBLIC HEALTH LABORATORY AND ZNPHI/AFRICA CDC SOUTHERN RCC OFFICE COMPLEX

Reference is made to your letter dated 28th December, 2018, on the above subject, wherein you requested NISIR to give consent on the allocation of 10 Hectares of land for the construction of the National Public Health Laboratory and ZNPHI/Africa CDC Southern RCC office Complex.

The National Institute for Scientific and Industrial Research (NISIR) hereby consents to the allocation of approximately 10 ha of land, designated as SUB B of Lot 638/M for the construction of the National Public Health Laboratory and ZNPHI/Africa CDC Southern RCC office Complex.

The subject subdivision has the following coordinates in UTM 27 and is located southwest of Palabana road (D153).

Point D	E	N
A	658370.6	8298060
B	658814.9	8297751
C	658541.7	8297554

Yours faithfully,
NATIONAL INSTITUTE FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

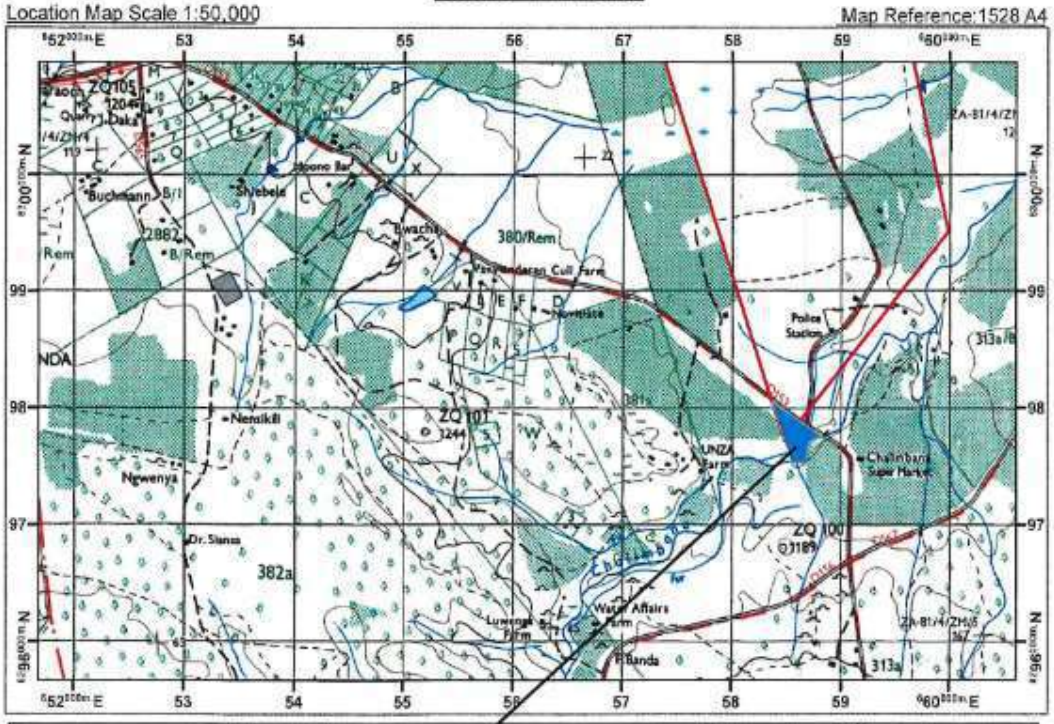
Dr. Henry Njapau
ACTING DIRECTOR

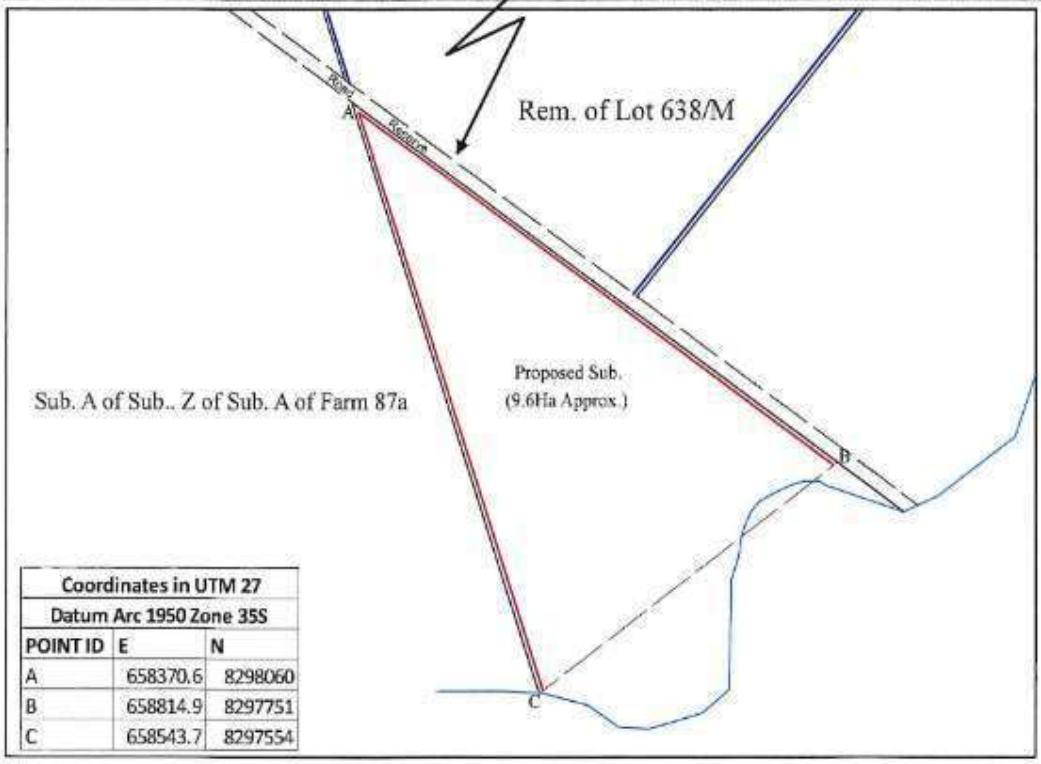
encls.....

Proposed Subdivision of Rem. of Lot 638/M
for National Institute for Science and Industrial Research(NISIR)
Lusaka Province
Scale 1:12,500

Location Map Scale 1:50,000

Map Reference:1528 A4





Coordinates in UTM 27		
Datum Arc 1950 Zone 35S		
POINT ID	E	N
A	658370.6	8298060
B	658814.9	8297751
C	658543.7	8297554

ANNEX 3: GOOD LABORATORY PRACTICES, SAFETY AND DESIGN FOR BSL-1, 2 and 3 LABORATORIES

BSL-1 Laboratory

This is the lowest security level for handling biological material. This kind of material poses no or only a low risk to healthy adult humans and presents minimal potential hazard to laboratory personnel and the environment. BSL-1 laboratory does not have to be separated from the rest of a building

The parameters to observed include

a) Code of practice for management of occupational health and hygiene
b) Laboratory design and facilities
c) Protection of the environment

1) Code of practice for the proposed BSL1 lab

a. The BSL-1 laboratories are not necessarily separated from the general traffic in the building
b. The international biohazard warning symbol and sign biohazard must be displayed on the doors of the rooms where microorganisms of Risk Group 1 are handled.
c. Laboratory personnel must be provided with specific training in the procedures to be conducted in the laboratory, which is then supervised by a scientist with training in microbiology or related sciences.
d. Only authorized persons should be allowed to enter the laboratory working areas.
e. Laboratory doors should be kept closed.
f. Children should not be authorized or allowed to enter laboratory working areas.
g. The international biohazard warning symbol and sign displayed on laboratory access doors will identify the biosafety level
h. Ordinary laboratory protective clothing. Laboratory protective clothing will not be worn outside the laboratory, and it would be decontaminated before it is laundered.

2) Laboratory design and facilities for the proposed BSL2 lab

The laboratory design and facilities for basic laboratories include the following;

a. 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.

b. Surfaces of walls, floors and ceilings would be water-resistant and easy to clean.
c. The laboratory room will be sealable for decontamination. Air-ducting systems will be constructed to permit gaseous decontamination.
d. A hand-washing station with hands-free controls would be provided near each exit door.
e. There would be a controlled ventilation system that maintains a directional airflow into the laboratory room.
f. The containment laboratory – Biosafety Level 1 facility design and operational procedures would be documented.

3. Laboratory Equipment

a) Unique laboratory design or containment equipment are not required but may be used depending on the risk assessment.
b) Most of the work is typically conducted on open bench tops using general microbiological practices.
c)

4. **Health And Medical Surveillance**

Participation in the Medical Surveillance Program and vigilant adherence to appropriate Exposure Control Plans in the laboratory are required to protect the health and safety of these individuals.

BSL-2 Laboratory

The containment laboratory – Biosafety Level 2 is designed and provided for work with Risk Group 2 microorganisms and with average volumes or lower concentrations of Risk Group 2 microorganisms that pose an increased risk of aerosol spread. Biosafety Level 2 containment requires the strengthening of the operational and safety programmes equivalent to the classification of the laboratory. The guidelines given in this section are presented in the form of additions to those for Biosafety Levels 1.

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.

1) Code of practice for the proposed BSL2 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.

2) Laboratory design and facilities for the proposed BSL2 lab

The laboratory design and facilities for basic laboratories include the following;

g. 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.
h. 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.

i. 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).
j. The laboratory room will be sealable for decontamination. Air-ducting systems will be constructed to permit gaseous decontamination.
k. Windows will be closed, sealed and break-resistant.
l. A hand-washing station with hands-free controls would be provided near each exit door.
m. 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.
n. Biological safety cabinets would be sited away from walking areas and out of crosscurrents from doors and ventilation systems.
o. 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.
p. 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.
q. The containment laboratory – Biosafety Level 2 facility design and operational procedures would be documented.

3) Laboratory Equipment

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.

4) Health And Medical Surveillance

Participation in the Medical Surveillance Program and vigilant adherence to appropriate Exposure Control Plans in the laboratory are required to protect the health and safety of these individuals.

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.

1) 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.

2) 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:

a. 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.
b. 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.
c. 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).
d. The laboratory room will be sealable for decontamination. Air-ducting systems will be constructed to permit gaseous decontamination.
e. Windows will be closed, sealed and break-resistant.
f. A hand-washing station with hands-free controls would be provided near each exit door.
g. 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.
h. 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.

i. All HEPA filters would be installed in a manner that permits gaseous decontamination and testing.
j. Biological safety cabinets would be sited away from walking areas and out of crosscurrents from doors and ventilation systems.
k. 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.
l. 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.
m. 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.
n. The containment laboratory – Biosafety Level 3 facility design and operational procedures would be documented.

3) 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.

4) 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:

a) 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.

b) 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 4: LABORATORY SECURITY AND EMERGENCY RESPONSE GUIDANCE AT ZNPHI BSL-1, 2 and 3 FACILITIES

BSL-3

Traditional biosafety guidelines for laboratories have emphasized use of optimal work practices, appropriate containment equipment, well-designed facilities, and administrative controls to minimize risk of worker injury and to ensure safeguards against laboratory contamination. In recent years, concern has increased regarding use of biologic materials as agents of terrorism. Risk assessments would include reviews of the following: 1) physical security 2) security of data and electronic technology systems 3) employee security 4) access controls to laboratory 5) procedures for agent inventory and accountability 6) shipping/transfer and receiving of select agents 7) unintentional incident and injury policies 8) emergency response plans and 9) policies that address breaches in security. Therefore, for the BSL-1, BSL-2 and BSL3 that will be constructed, ZNPHI will prepare respective security and emergency response plans and these would be an integral part of daily operations. All employees would be well-trained and equipped, and at least, the respective plans would be reviewed annually.

- risk and threat assessment;
- facility security plans;
- physical security;
- data and electronic technology systems;
- security policies for personnel;
- policies regarding accessing the laboratory;
- specimen accountability;
- receipt of agents into the laboratory;
- transfer or shipping of select agents from the laboratory;
- emergency response plans; and
- reporting of incidents, unintentional injuries and security breaches.

Definitions

Threat assessment: A judgment, based on available information, of the actual or potential threat of malevolent action.

Vulnerability: An exploitable capability, security weakness, or deficiency at a facility. Exploitable capabilities or weaknesses are those inherent in the design or layout of the biologic

laboratory and its protection, or those existing because of the failure to meet or maintain prescribed security standards when evaluated against defined threats. Vulnerability assessment: A systematic evaluation process in which qualitative and quantitative techniques are applied to arrive at an effectiveness level for a security system to protect biologic laboratories and operations from specifically defined acts that can oppose or harm a person's interest.

1. Risk Assessment

Recommendation: ZNPHI will conduct a risk assessment and threat analysis of the three types of laboratories respectively as a precursor to the security plan.

Background: A threat analysis, the first step in determining risk, identifies and evaluates each threat on the basis of different factors (e.g., the capability and intent to attack an asset, the likelihood of a successful attack, and the attack's probable lethality). Risk management is the deliberate process of understanding risk (i.e., the likelihood that a threat will harm an asset with certain severity of consequences) and deciding on and implementing actions to reduce that risk. Risk management principles are based on acknowledgment that: 1) although risk usually cannot be eliminated, it can be reduced by enhancing protection from validated and credible threats, 2) although threats are possible, certain threats are more probable than others and 3) all assets are not equally critical. Therefore, each facility would implement certain measures to enhance security regarding select agents. ZNPHI management would conduct risk assessments and threat analysis of its assets (the respective laboratory types) and select agents. The threat would be defined against the vulnerabilities of the laboratory to determine the necessary components of a facility security plan and system.

The risk assessment would include a systematic approach in which threats are defined and vulnerabilities are examined; risks associated with those vulnerabilities are mitigated with a security systems approach. ZNPHI would ensure the security plan includes collaboration between senior management, scientific staff, human resource officials, information technology (IT) staff, engineering officials and security officials. This coordinated approach is critical to ensuring that security recommendations provide a reasonable and adequate assurance of laboratory security without unduly impacting the scientific work.

2. Facility Security Plans for ZNPHI BSL3 Lab

Recommendation: ZNPHI will establish the respective security plans for each of the three types of laboratories (BSL-1, BSL-2 and BSL-3)

ZNPHI will develop comprehensive security plans addressing: physical security, data and IT system security, security policies for personnel, policies for accessing select agent areas, specimen accountability, receipt of select agents into the laboratory, transfer or shipping of select agents from the laboratory, emergency response plans, and reporting of incidents, injuries and breaches. Based on the risk assessments, ZNPHI would develop security policies. Security plans would include measures that address physical security of building and laboratory areas. Policies would also address concerns associated with access, use, storage, and transfer of sensitive data. If sensitive electronic data are present, IT specialists will assess the security of hardware and software products in addition to the security of local area networks.

At least annually, ZNPHI will review safety, security and IT policies and procedures for consistency and applicability. These procedures would also be reviewed after any incident or change in regulations. Necessary changes would be incorporated into the revised plans and communicated to all. The respective laboratory supervisors would ensure that all laboratory workers and visitors understand security requirements and that all employees are trained and equipped to follow established procedures. The respective security plans would be an integral part of daily operations. New employees would receive training when they first begin work, and all employees would receive training at least annually thereafter. Training would be updated as policies and procedures change. All training would be documented by maintaining records of training schedules and employee attendance. Security plans would receive periodic performance testing to determine their effectiveness. Test procedures can vary from a simple check of keys, locks and alarms to a full-scale laboratory or facility exercise.

3. Security Policies for ZNPHI BSL-1, BSL-2 and BSL3 laboratories Personnel

Recommendation: ZNPHI will establish security-related policies for all personnel working in the respective laboratories. The lab administrators would be familiar with all laboratory workers. ZNPHI would also establish a policy for screening employees who require access to select agent areas to include full- and part-time employees, contractors, emergency personnel and visitors. Additional screening might be necessary for employees who require access to other types of sensitive or secure data and work areas. These screening procedures will commensurate with the sensitivity of the data and work areas (e.g., federal security clearances for government employees and contractors). ZNPHI will also ensure that all workers approved to get access to select agents (e.g., students, research scientists and other short-term employees) wear visible identification badges that include a photograph, wearer's name and an expiration date. The lab administrators

would consider using easily recognizable marks on the identification badges to indicate access to sensitive or secure areas.

4. ZNPHI BSL-1, BSL-2 and BSL3 Lab Access Control

Recommendation:

ZNPHI would strictly control access to areas where selected agents are used or stored. For Biosafety level 1, this is the lowest safety level, and the precautions required for the level are thus limited and not as extensive. The laboratory supervisor is expected to implement the policies regarding the access control to the laboratory

As regards the remaining two laboratory types (BSL-2 and BSL-3), the following measures must be executed;

- Consolidating laboratory work areas to implement security measures more effectively.
- Separating selected agent areas from the public areas of the buildings.
- Locking all select agent areas when unoccupied.
- Using keys or other security devices to permit entry into these restricted areas.

Methods of secure access and monitoring controls can include key or electronic locking pass keys, combination keypad, use of lock-boxes to store materials in freezers or refrigerators, video surveillance cameras, or other control actions. In addition, protocols for periodically changing combination keypad access numbers would be developed for maximum protection. Again, regular inspections will be conducted for graded levels of security protection on the basis of site-specific risk and threat analysis. This security can be accomplished through card access systems, biometrics, or other systems that provide restricted access. This would also involve:

- Locking all freezers, refrigerators, cabinets, and other containers where select agents are stored when they are not in direct view of a laboratory worker.
- Limiting access to select agent areas to authorized personnel. All others entering select agent areas must be escorted and monitored by authorized personnel.
- Recording all entries into these areas, including entries by visitors, maintenance workers, service workers, and others needing one-time or occasional entry.
- Limiting routine cleaning, maintenance, and repairs to hours when authorized employees are present and able to serve as escorts and monitors.
- Establishing procedures and training for admitting repair personnel or other contractors who require repetitive or emergency access to select agent areas.

- Ensuring visitors are issued identification badges, including name and expiration date, and escorted and monitored into and out of select agent areas. Such visits would be kept to a minimum.
- Ensuring procedures are in place for reporting and removing unauthorized persons. These procedures would be implemented through collaboration among senior scientific, administrative, and security management personnel. These procedures would be included in security training and reviewed for compliance at least annually.

5. Select Agent Accountability

Recommendation: ZNPHI would establish a system of accountability for select agents. A procedure to ensure adequate control of select agents and maintain up-to-date inventory of seed stocks, toxins, and agents in long-term storage would be established. Records would include data regarding the agent's location, use, storage method, inventory, external transfers (sender/receiver, transfer date, and amount), internal transfer (sender/receiver, transfer date, amount), further distribution, and destruction (method, amount, date, and a point of contact). It will also establish procedures that maintain accurate and up-to-date records of authorizations for entry into limited access areas (i.e., a current list of persons who possess door keys and those who have knowledge of keypad access numbers or the security system).

6. Receiving Select Agents at ZNPHI BSL-1, BSL-2 and BSL-3

Recommendation: ZNPHI will develop procedures for bringing select agent specimens into the laboratory. A centralized receiving area for select agents is recommended to maximize safety and minimize security hazards associated with damaged or unknown packages. The respective biosafety laboratories would establish procedures for inspecting all packages (i.e., by visual or noninvasive techniques) before they are brought into the laboratory area. Suspicious packages would be handled as prescribed by federal and Addis Ababa law enforcement agencies. Biologic safety cabinet or other appropriate containment device would be used when opening packages containing specimens, bacterial or virus isolates, or toxins. Packages would be opened by only trained and authorized personnel.

7. Transfer or Shipping of Select Agents

Recommendation: ZNPHI would develop procedures for transferring or shipping select agents from the laboratory. ZNPHI would adopt package, label, and transport select agents in conformance with all applicable local, federal, and international transportation and shipping regulations. Materials that are transported by airline carrier would also comply with packaging

and shipping regulations set by the International Air Transport Association (IATA). Personnel who pack, handle, and ship these agents (including import and export) would be subject to all applicable training. The responsible facility official would be notified of all select agent transfers, internal or external. ZNPHI would ensure that required permits (e.g., granted by the pertinent Ethiopian environmental and health regulatory organs and IATA) are obtained before select agents are prepared for transport. Standard operating procedures would be in place for import and export activities. Contaminated or possibly contaminated materials would be decontaminated before they leave the laboratory area. Avoid hand-carrying select agents when transferring them to other external facilities. If select agents are to be hand carried on common carriers, all applicable packaging, transport, and training regulations would be followed. ZNPHI would develop and follow a protocol for intra-facility transfer of all select agents.

8. Emergency Response Plans

Recommendation: ZNPHI would develop and integrate laboratory emergency plans with facility wide plans. These plans would also include such adverse event assessments as bomb threats, severe weather (e.g floods, earthquakes, power outages, and other natural or man-made disasters). While developing the plans, ZNPHI would include the BSL-1, BSL-2 and BSL-3 administrators, scientific directors, principal investigators, laboratory workers, maintenance and engineering support staff, facility safety officers, and facility security officials in emergency planning. Include provisions for immediate notification of and response by laboratory directors, laboratory workers, safety office personnel, or other knowledgeable persons when an emergency occurs. ZNPHI BSL-1, BSL-2 and BSL3 will establish advance coordination with local police, fire, and other emergency responders to assist community emergency responders in planning for emergencies in select agent laboratory and animal areas. Discussion would address security concerns associated with sharing of sensitive information regarding secure work areas. Consider circumstances that might require the emergency relocation of select agents to another secure location. Reevaluate and train employees and conduct exercises of the emergency response plan at least annually.

9.0 Incident Reporting

Recommendation: ZNPHI would establish a protocol for reporting adverse incidents. It would also ensure that the laboratory administrators for the three types of laboratories, in cooperation with facility safety, security, and public relations officials, have policies and procedures in place for reporting and investigating unintentional injuries, incidents (e.g., unauthorized personnel in restricted areas, missing biologic agents or toxins, and unusual or threatening phone calls), or

breaches in security measures. Pertinent environmental and health regulatory organs in Ethiopia would be notified immediately if select agents are discovered to be missing, released outside the laboratory, involved in worker exposures or infections, or misused. Additionally, all incidents involving select agents (e.g., occupational exposure or breaches of primary containment) would be reported to local public health authorities.

ANNEX 5: STAKEHOLDER CONSULTATIONS

Minutes of the consultative meeting held during the ZNPHI World Bank Project Preparatory Retreat Held at Anina's Lodge, Lilayi, Lusaka.

27th November – 3rd December 2018.

Consultative meeting held on Tuesday 27th November 2018

Agenda

1.0 Welcome remarks
2.0 Project Overview
    2.1 Background / Rationale for Project
    2.2 Key Project Components
3.0 Steps in WB Engagement to date
4.0 Feedback from invited stakeholders
5.0 Constitution of working teams
6.0 AoB

Present:

1. Dr. Victor Mukonka, Director – Zambia National Public Health Institute (ZNPHI)
2. Dr. Kunda Musonda, Head LSN – Zambia National Public Health Institute (ZNPHI)
3. Dr. Nyambe Sinyange, Head WFD – Zambia National Public Health Institute (ZNPHI)
4. Dr. Raymond Hamoonga, Managing Editor – Zambia National Public Health Institute (ZNPHI)
5. Dr. Nathan Kapata, Head EPR – Zambia National Public Health Institute (ZNPHI)
6. Dr. Muzala Kapin'a, Head SDI – Zambia National Public Health Institute (ZNPHI)
7. Dr. Paul Fandamu –Ministry of Fisheries and Livestock
8. Dr. Caesar Lubaba – Ministry of Fisheries and Livestock
9. Dr. Sumbukeni Kowa, Head – Food and Drugs Control Laboratory
10. Prof. Aaron Mweene – School of Veterinary Medicine, University of Zambia
11. Mrs. Mazuba Maryanga Liwewe, Head IS-Zambia National Public Health Institute (ZNPHI)
12. Mr. Mpanga Kasonde, Lab Scientist- Zambia National Public Health Institute (ZNPHI)
13. Ms. Otridah Kapoma, Lab Scientist - Zambia National Public Health Institute (ZNPHI)
14. Mrs. Tommida Zulu, Internal Auditor-Ministry of Health (MoH)
15. Mrs. Saukani Mulela, Accounts Specialist-Ministry of Health (MoH)
16. Ms. Sylvia Mwale, Procurement Specialist-Ministry of Health (MoH)
17. Mr. Joseph Kabwe-Safeguards Specialist / Consultant – METS Ltd
18. Mr. Nkole Kasonde, Architect-Department of Public Infrastructure, Ministry of Housing and Infrastructure

19. Mr. Maybin Musonda, Architect-Department of Public Infrastructure, Ministry of Housing and Infrastructure
20. Ms. Karen Musonda, Lab scientist/Int-Zambia National Public Health Institute (ZNPHI)
21. Mr. Nephan Frank Malunga, Lab scientist/Int Zambia National Public Health Institute (ZNPHI)
22. Mr. Moses Banda Surveillance-Zambia National Public Health Institute (ZNPHI)
23. Mr. William Ngosa-Information Systems-Zambia National Public Health Institute (ZNPHI)
24. Mr. Miyoba Dindi-M&E -Zambia National Public Health Institute (ZNPHI)
25. Mr. Mvula –Chief Environmental Health Officer -Ministry of Health
26. Mr Moses Banda-Surveillance & Disease Intelligence/Int - Zambia National Public Health Institute (ZNPHI)

Apologies

Mr. Raphael Mwanza, Infrastructure and Medical Technologies, Ministry of Health

1.0 Welcome Remarks

The meeting was called to order at 08:50hrs. After an opening prayer, Dr. Musonda welcomed everyone and then invited everyone to introduce themselves. Before calling upon Dr. Mukonka to address the meeting, he took the opportunity to recognize the new staff that were joining as specialists to reinforce the human resource of ZNPHI in Internal Audit, Procurement, Accounts and M&E.

Dr. Mukonka welcomed all present. He stated that the meeting was important as the project to be discussed is a great milestone and would be a game-changer for the country, the region and the continent. He stated that the Government of Zambia prioritises health security and has therefore committed to obtain a concessional loan from The World Bank to invest in critical Laboratory infrastructure and to strengthen systems for disease surveillance, preparedness and response to public health threats. Dr. Mukonka and Dr. Musonda went on to give an overview of the proposed Africa CDC Regional Investment Financing Program (ACDCP).

2.0 Project Background/Rationle

A power point presentation was made to give the background to the project and what was hoped to be achieved. As host of Africa Center for Disease Control and Prevention (ACDC) Southern Africa Regional Collaborating Center (RCC), Zambia is mandated to support member states in promoting and strengthening public health security capacities. Of the priority functional capacities for the region is infrastructure development of a Biosafety Level 3 (BSL-3) laboratory to support regional member states in disease surveillance, containment of disease pathogens, research, human resource development and training, and bio-banking of selected pathogens.

The Ministry of Health through the Zambia National Public Health Institute (ZNPHI) has engaged the World Bank and there is an opportunity to benefit from the ACDCP (P167916) aimed at strengthening the institutional capacity of the ZNPHI and operationalizing the Africa CDC Southern Africa RCC.

Dr Mukonka noted that through the ACDCP, the Zambian Government through the Ministry of Health proposes to set up four-story purpose-built infrastructure in Lusaka comprising a high-containment Biosafety level 3 (BSL-3) laboratory suite, Public Health Emergency Operations Centre (PHEOC), ICT suite, training facilities, office accommodation and other auxiliary features to support both national and regional public health responsibilities. The infrastructure will be in conformity with national and global standards and best practice. The project will also strengthen human capital through a robust training program.

It was noted that establishment of a national public health laboratory (NPHL) embracing the principles of One Health will greatly enhance national capacity to detect, confirm, track and characterize pathogens of public health importance including emerging and re-emerging diseases and those responsible for disease outbreaks. Effective functioning of the public health laboratory with co-located accessory functions is fundamental for strong national and regional public health emergency preparedness and response.

3.0 Steps in WB Engagement to date

Dr Mukonka outlined that there are several stages that the World Bank requires to be fulfilled before final effectiveness of the project. These are demanding and he encouraged everyone to persevere through the long road ahead. So far the 2 missions had interacted with the ZNPHi, in April and June. The project concept note was developed and submitted to the Bank in early

July. He informed the meeting that this had since been accepted by the Bank. Following this, a Pre-appraisal ission was scheduled from 3rd to 14th December 2018. Depending on the outcome, it was hoped that presentation of the project could occur around April 2019, with a target for the project to take effectiveness in July 2019. Dr Mukonka stressed the need to respond quickly whenever there was a query.

4.0 Feedback from invited stakeholders

After the director's presentation, time was allocated to address any questions or comments from the meeting attendees.

When asked about where the laboratory complex was going to be situated, Dr Mukonka clarified that land for construction was being requested from NISIR and most likely the project would be constructed in Silver rest area where NISIR still has a large stretch of unused land.

Participants from the Department of veterinary services welcomed the project and looked forward to see how the broader public health could be strengthened, especially concerning zoonotic diseases. Dr Lubaba indicated that some capacity existed in terms of qualified staff, but the main challenge was operational resources and laboratory supplies at the Central Veterinary Research Institute (CVRI). He indicated that the Ministry of Fisheries and Livestock was already working well with the ministry of Health on some areas such as AMR, Ebola preparedness, and Pandemic influenza preparedness. He hoped that the project would bring the two sectors closer. Dr Mukonka indicated that the plan was to include an animal health laboratory at the complex and so the expertise from DVS would be required at the stage of detailed designs so that the section is fit for purpose.

Prof Mweene also indicated that the School of Veterinary Medicine was pleased that more capacity through a high tech lab would become available to the country. This would help to support both the training of staff and students in special techniques, and also support research work. He noted that the School of Veterinary Medicine was part of the beneficiaries under a World Bank project for Capacity development and would complement the staff training needs. Other contacts that the school has established over the years with the Japanese could also be expanded on.

Dr Musonda clarified that the idea of having the NPHL was to complement the already existing capacity in various fields, and not necessarily to replace what was already working well. He noted that there was an advantage in allowing the clinical labs to focus on their primary mandate of supporting patient diagnosis and management. He noted that they are still a critical first point of contact that should be strengthened as part of the early warning system

However, the NPHL would provide additional specialised testing capacity over and above the limited routine tests which are available in clinical labs. Dr Mukonka further explained that as the host for the RCC it was important for Zambia to have additional capacity to effectively support the entire region.

The team from the department of public infrastructure shared some ideas of how the concept could be developed to the stage of detailed engineering drawings required for the actual construction. They indicated that for advice and assistance, formal engagement could be made through the Infrastructure unit within the Ministry of Health.

5.0 Constitution of working teams

The meeting was informed that several documents needed to be prepared by ZNPHI in readiness for the pre-appraisal mission. These include an Environmental and Social Impact Assessment; Infection Control and Waste Management Plan; Financial and Procurement plans, among others.

To address the various project documents required to be developed, teams were proposed to develop the project concept further. It was proposed that a further retreat would be required to address issues that might arise during the pre-appraisal mission. The assigned teams are presented in the action matrix. The individual participants were also asked to make power point presentations for discussions after individual works as so to get inputs from the team for further improvement to the documents.

Action matrix

S/N	Assignment	Responsible Persons
1	Regulatory Framework for the Project	Dr. Kapata, Dr Lubaba
2	Public Health Assets	Dr. Kapin'a, Dr Musonda, Ms Musonda, Dr Lubaba, Dr Kowa
3	Human Resource Development and Training Plan	Dr. Sinyange, Mrs. Liwewe, Prof. Mweene
4	Groundwork for Project Implementation Plan (PIP)	Dr. Raymond, Dr. Kapata, Mrs. Liwewe
5	Project Procurement Plan	Ms. Mwale
6	Project Financial Management Plan	Mrs. Mulele, Ms. Zulu
7	ESIA/EPB	Mr. Kabwe, Mr. Kasonde
8	IPC and Waste Management	Ms. Kapona, Mr. Mvula
9	Building Design concept	Mr. Kasonde, Mr. Musonda
10	Costing (Laboratory & Office equipment)	Mr. F.N. Mahunga

A work plan to guide the retreat was put up by Dr. Mukonka in which he gave assignments. In the work plan, director assigned the heads of clusters to lead in the different areas. In addition, in order to facilitate with the work load, Ms. Kapona was tasked to put together reference documents and categorize them according to assignment need and hand them over to the assigned individuals.

The Architects also submitted that there was need for them to be given as much information as possible to help them make a concept of the National Public Health Laboratory and office complex.

There being no further matters arising, the formal meeting was closed at 13:12hrs.

Prepared by:

Otridah Kapona
Lab Scientist, LSN
10 December 2018

Approved By:

Dr Victor Mukonka
Director, ZNPHI
10 December 2018

ZAMBIA NATIONAL PUBLIC HEALTH INSTITUTE

WORLD BANK AFRICA CDC REGIONAL INVESTMENT FINANCING PROGRAM PLANNING RETREAT

27TH NOVEMBER TO 2ND DECEMBER, 2018

ANINAS EXECUTIVE LODGE

ATTENDANCE LIST-Day 1

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20	Vision Mukonka	ZNPHI	Statistician	0977844714	vmukonka@gmail.com	
21	Hang Jan Se	ZNPHI	NUR	0977 888157	—	
22	MALAMA KAPINA	ZNPHI	Head Surveillance	0966 [illegible]062	mkapuni00@gmail.com	

ZAMBIA NATIONAL PUBLIC HEALTH INSTITUTE

WORLD BANK AFRICA CDC REGIONAL INVESTMENT FINANCING PROGRAM PLANNING RETREAT

8TH DECEMBER TO 9TH DECEMBER, 2018

ANINAS EXECUTIVE LODGE-LILAYI

ATTENDANCE LIST

NO	Name [S]	ORGANIZATION	DESIGNATION	SIGNATURE	
				8th Dec	9th Dec
1	Dr Victor Mukonka	ZNPHI	Director		
2	Dr Kunda Musonda	ZNPHI	Head LSN	[signature]	[signature]
3	Nyambe Sinyange	ZNPHI	Head Capacity Bldg	[signature]	[signature]
4	Raymond Hamoonga	ZNPHI	M/E	[signature]	[signature]
5	Mazyanga Liwewe	ZNPHI	Head - IS	[signature]	[signature]
6	Fennicllis Zulu	ZNPHI	IA	[signature]	[signature]
7	Sylvia Mwale	ZNPHI	Senior Procurement officer	[signature]	[signature]
8	Saulcani Banda	ZNPHI	Accountant	[signature]	[signature]
9	Kapina Otridah	ZNPHI	Lab Scientist-CD	[signature]	[signature]
10	Mwila Zakeyo	MOH - [illegible]	CEHO	[signature]	[signature]
11	MUZALA KAPINA	ZNPHI	Head - SDI	[signature]	[signature]
12	MOSES BANDA	ZNPHI	Intern - SDS	[signature]	[signature]
13	MUSONDA KAREN	ZNPHI	LS	[signature]	[signature]
14	Kusenda Mpanga	ZNPHI	Laboratory Scientist	[signature]	[signature]

ANNEX 6: MINUTES OF THE PUBLIC STAKEHOLDER CONSULTATION

THE ZAMBIA NATIONAL PUBLIC HEALTH INSTITUTE
MINISTRY OF HEALTH
13 Reedbuck road, Kabulonga, Lusaka

Minutes of the Stakeholder Consultation on the Project to Construct, Equip, and Staff the Zambia National Public Health Institute Laboratory & Office Complex.

Held on 16th July 2019

in the Global Fund Boardroom, Ministry of Health Headquarters, Ndeke house, Lusaka, Zambia.

AGENDA

The agenda was read and adopted as follows:

1. Welcome remarks and Introductions
2. Project Overview
    a. Background and Rationale
    b. Project Components
3. Feedback from invited stakeholders
4. Any other business

MEETING PROCEEDINGS

OPENING REMARKS

The moderator Mr Augustine Seyuba called the meeting to order at 10:15AM and welcomed all in attendance. He noted the presence of some dignitaries including Princess Cholwe Nkomeshya, the representative from the Busoli Royal Establishment (BRE); Dr Chitalu Chilufya, the Honourable Minister of Health; and Ms Kakulubelwa Mulalelo, the Permanent Secretary in charge of Administration at the Ministry of Health. After a round of introductions, the meeting convenor, Dr Mukonka, Director of the Zambia National Public Health Institute (ZNPHI) was called upon to guide on how the meeting would proceed.

Dr Mukonka expressed happiness at the wide representation of stakeholders ranging from community members, local leaders and government agencies (Appendix 1). He informed all that the meeting would be chaired by the Honourable Minister of Health. He then went on to invite PS Mulalelo, who guided that in the consultative spirit of the meeting, all stakeholders were free to ask questions on any matter related to the project, express any concerns and make submissions. She called upon the Honourable Minister of Health to officially open and chair the rest of the meeting.

The Honourable Minister welcomed all stakeholders to the meeting and thanked them for taking time off their schedules to consider and address issues related to the proposed project. The Minister stressed the need to secure the health of investments in the country against public health risks and events. He emphasised that the current administration under the leadership of His Excellency Dr Edgar Chagwa Lungu has identified the health of the citizenry as a

fundamental pillar in human and national development, as it guarantees a healthy and productive workforce to drive and sustain socioeconomic development. The Minister took time to outline the broad vision of the government and how the health sector fits and contributes to its attainment. He explained that the Zambian Government is on a path of health-sector transformation in line with the Vision 2030, Seventh National Development Plan (7NDP), and the Patriotic Front Party Manifesto. Based on this, the MoH is comprehensively building the health system to attain universal health coverage, anchored on 8 pillars: (i) Service Delivery; (ii) human resources for health; (iii) infrastructure and equipment; (iv) medicines and drugs; (v) research; (vi) health information systems; (vii) governance and strong leadership; and (viii) healthcare financing. The Minister expounded that under the Service Delivery pillar, the MoH was utilising a primary healthcare approach, spanning the entire continuum of care (preventive, promotive, curative, rehabilitative, and palliative care). A key component of this is public health security, which the government has taken seriously by establishing the Zambia National Public Health Institute (ZNPHI) as a specialised technical arm to lead in all matters of disease intelligence, epidemic preparedness and response to epidemics and events of public health significance. Addressing health security is vital in safeguarding socioeconomic investments in the country.

The Minister pointed out that in this regard, the World Bank, a key ally of the Zambian government has come in to help strengthen public health security through establishing infrastructure including the first national public health laboratory at biosecurity level 3 (BSL3) laboratory, and other support to strengthen surveillance and disease control systems. Upon completion, the infrastructure will not only benefit Zambia, but the Southern Africa region as a whole. Drawing on examples from the experience of West Africa during the Ebola outbreak, the Minister reiterated the importance of strong public health security in the country. He guided that a robust public health security shields the health of the citizenry, and it also shields the infrastructure of the nation. An epidemic has the potential to reverse, within a short period, industrial and economic gains that could have taken years to attain. Therefore, Zambia needs a public health laboratory support system that is alert in order to protect the health of the nation and that of the SADC region as is expected of Zambia by the African Union. The Minister concluded by making a clarion call to all stakeholders to deliberate freely and objectively assess

all aspects of the project, while recognizing that this was an opportunity to enhance national health security, which should be judged favourably by posterity.

PROJECT OVERVIEW

The ZNPHI Director Dr Mukonka gave a powerpoint presentation (Appendix 2) to the stakeholders and distinguished guests detailing the project.

Background and Rationale

Dr Mukonka began the presentation by clarifying that the steps being taken by Zambia to address health security through the ZNPHI were in fact linked to the wider vision of the African Union to take ownership and harness capacity on the continent for health security. He explained to the meeting that following the events of the 2014-2016 Ebola outbreak in west Africa, the AU heads of state and government were so moved by some of the dehumanising situations and practices that they decided to establish the Africa Centers for Disease Control and Prevention (Africa CDC) to provide leadership and coordination. Operationally the Africa CDC is operationalised through the Secretariat based in Addis Ababa, five Regional Collaborating Centers, of which Zambia hosts for Southern Africa, and National Public Health Institutes at individual country level. This is how the ZNPHI links to the Africa CDC vision and operational model. Director further explained the rationale behind establishment of the ZNPHI as a specialised disease intelligence wing in the health sector, including its mandate and current structure / clusters. He noted that all the work areas of the ZNPHI require a strong laboratory base in order to be effective. Dr Mukonka outlined the mandate of the Institute in four points: (i) To preserve the country's health security; (ii) To efficiently prevent disease transmission, conduct surveillance and be prepared to respond to health threats and outbreaks; (iii) To build national capacity to detect and respond effectively to disease threats and outbreaks, based on scientific evidence; and (iv) To host the Africa CDC RCC for Southern Africa.

Dr Mukonka went further to highlight the national and regional burden and profile of disease, indicating how disease outbreaks are not restricted by, nor do they adhere to country boundaries. He noted that currently Zambia currently lacks a dedicated Public Health Laboratory system and depends on clinical laboratories for the public health functions. However these hospital-based labs have a different primary mandate of supporting diagnosis

& clinical management of patients. Furthermore, their test profiles are limited, with functions being segmented. Often they are understaffed and get overstretched, particularly during outbreak situations, leading to delays in sample processing and reporting. Additionally, there is a human health sector bias. The current setup results in huge gaps in the backing required for epidemiological surveillance. Dr Mukonks thus stressed the Zambia's need for a dedicated National Public Health laboratory System that incorporates some of the already existing competencies and laboratories. The requirement for a dedicated national public health laboratory system was also necessitated by the fact that ZNPHI is an evidence-based institution that depends heavily on objective scientific data. Furthermore, the regional obligations as RCC host require strong national infrastructure / capacity to anchor and support other member states. To address this, the ZNPHI through the Ministry of Health has been engaging the World Bank for over 16 months to obtain funding under the Bank's Africa CDC Regional Investment Financing Program (ACDCP). The ACDCP is a regional project that aims to strengthen Africa CDC to improve networks for timely infectious disease detection and response. This will be through supporting vital institutional capacity-building within three institutions: the Africa CDC headquarters, the Ethiopian National Public Health Institute (EPHI) and the ZNPHI.

Project Components

Dr Mukonka indicated that Zambia was one of 3 institutions that had been given an opportunity to apply for support from the World Bank under the ACDCP. The Zambia component of the ACDCP will allow Zambia to obtain concessional credit under the international development assistance (IDA) scheme. The funds, worth $90M, will be utilised as an investment in critical infrastructure, equipment, human resource development, and strengthening of systems for disease intelligence, preparedness and response to public health threats.

The components of the project were explained as:

Infrastructure will be a Biosafety Level 3 (BSL-3) laboratory suite, biobank, Proficiency Testing Panel Production Center offices, Public Health Emergency Operations Center (PHEOC), ICT suite, training rooms, conference facilities, library / resource center to support ZNPHI and RCC operations. The project will also cater for other features such as a power substation, parking facilities, landscaping, perimeter fence and other security features. More than 70% of the project will go towards putting up and equipping this state-of-the art infrastructure.

The meeting was informed that the infrastructure would be set up in Chongwe District where 10 hectares of land had been secured from the National Institute for Scientific and Industrial Research (NISIR) in Silver rest area. A map was displayed showing the proposed project site.

Apart from infrastructure development other components of the project are earmarked to address:

- **Laboratory Systems strengthening:** In addition to the core infrastructure (BSL-3 laboratory suite, support laboratories, animal health laboratory, Biobank, biomedical equipment maintenance center; and a Proficiency Testing Panel Production Center), the project will strengthen laboratory Quality Management Systems, Microbiology skills, Biosafety/biosecurity, and specimen referral system. The infrastructure will also be utilised for training and skills development.
- **Enhancement of Disease Intelligence** through cross border surveillance initiatives, Event Based Surveillance, expansion of Sentinel Surveillance sites for selected human and animal health diseases/conditions and roll out of the Integrated Disease Surveillance and Response (IDSR) system.
- **Emergency Preparedness and Response capacity** by providing and operationalising a Public Health Emergency Operations Center (PHEOC) to address both national and regional response coordination capability. In line with the International Health regulations (IHR 2005) requirements, aspects relating to strengthening of points of entry and port health will also be addressed.
- **Information systems,** through the establishment, equipping and maintenance of an ICT suite and harmonised data system, Data repository, research skills, and expanding coverage of *The Health Press Zambia* journal.
- **Human Resources Development** through expansion of the Field Epidemiology Training Program (FETP), specialised skills training, and targeted professional & semi-professional training.
- **Governance and operational frameworks** to facilitate development of guidelines, MoUs and standards for coordination.

Dr Mukonka summed up the benefits of the national investment through the project as:

- State-of-the-art advanced laboratory facilities which will be accessible for public health use, and also support researchers, academics & regional member states

- Availability of office space for ZNPHi and the SA-RCC
- High biocontainment infrastructure for handling special pathogens
- Facilities for training high quality professionals & specialists – scientists, disease surveillance and response experts, epidemiologists and others
- Fully-fledged PHEOC for emergency response coordination
- Platform for sharing information including disease profiles/trends, risk assessment, and Antimicrobial Resistance patterns
- Opportunities for research
- Support for External Quality Assurance programs
- Repository for biobanking and preservation of African reference materials and strains for Research & Development of vaccines, therapeutics and diagnostics
- ICT suite as a centre for training, managing and sharing data (data warehousing, informatics, computational biology, etc)
- Infrastructure and other support RCC operationalisation & coordination of the Regional Integrated Surveillance and Laboratory Network (RISLNET)
- For the local community, employment would be created during the construction phase of the project, and also when the facility commences operations.

It was noted that the model for operationalising the national public health laboratory system would comprise a biosafety level 3 (BSL-3) National Reference laboratory situated in Lusaka province supported by 3 regional laboratories, and also incorporating some already existing clinical, academic, research, NGO and any other laboratories based on competencies and comparative advantage. It will address public health issues in a multisectoral One Health manner including animal health environment, nutrition and other relevant areas.

In concluding his presentation, Dr Mukonka showed pictures and a video depicting the layout and preliminary design concept for the Laboratory and office complex. He pointed out that the project had a heavy infrastructure arm and emphasised that all relevant national and applicable international laws, standards, guidelines and regulations were being followed to ensure that both the environment and people in the area are protected during and after the construction, and also when the facility comes into operation. As such an important aspect considered carefully was the management of the different types of waste materials that the facility would

be generating. It was disclosed that various agencies responsible for ensuring that the waste was managed properly were being engaged and the project would also adhere to the very strict international safeguards standards requirements of the funders, the World Bank. Other best practices and standards set by bodies such as the World Health Organisation (WHO) and US CDC were being referenced and would guide the technical designs and operations of the facility.

FEEDBACK FROM STAKEHOLDERS

The moderator Mr Augustine Seyuba, opened the floor for reactions and/or questions. The following were raised:

1. The representative from the Food and Drugs Control Laboratory (FDCL) asked for clarity on ***how the multiple functions at the proposed laboratory complex will link with the functions already being played by specific entities, such as the FDCL which among other areas looks at food safety and toxicology***.

   Response: Dr Mukonka remarked that the National Public Health Laboratory was not meant to necessarily replace existing capacities, but rather enhance them. The NPHL would be part of a network of laboratories that will also incorporate some existing capacities based on competitive advantage. Furthermore the project would provide additional capacity beyond what is currently available in existing institutions.

2. The representative from the Tropical diseases Research Center (TDRC) asked ***what considerations would be taken into account in dividing the country into the proposed three sub-regions in the context of the planned National Public Health Laboratory system***.

   Response: Dr Mukonka guided that risk mapping would guide the division of the country into the respective regions. This would be to ensure that each part of the country was assigned due attention, as informed by both identified and potential public health threats in each respective region. The availability of laboratory capacity would be another factor, although the vision was to ensure that where capacity didn't yet exist, this would eventually be established as the NPHL system is expanded.

3. The representative from the National Biosafety Authority (NBA) asked what capacity the biobank was planned have and whether there were plans to generate sequence data, and if so what mechanisms were being considered to safeguard such information.

Response: Dr Kunda Musonda, Head of Laboratory Systems and Networks at ZNPHI reiterated that the project would provide adequate capacity for storage of a range of samples, isolates and other reference materials to support research and understanding of diseases in the local context. This would also provide a resource for developing appropriate diagnostic tests, therapeutic agents and vaccines. The biobank would be certified and operate in accordance with the regulations set by the National Health Research Authority (NHRA) and in conformity with international best practice. As for sequencing, provision has been made for molecular biology a core laboratory as well as a bioinformatics suite to support the modern diagnostic capabilities. This will be supported by the ICT capabilities which the project is also funding. Biosecurity and biosafety issues will also be addressed from the engineering designs, policies, procedures, administrative controls and infection control and waste management protocols. Biosecurity has been recognised as a gap through the JEE and the Africa CDC has launched a continental initiative to improve the capacities in this area. To this end the SA-RCC convened a regional meeting in June 2019 to devise strategies of improving biosafety and biosecurity in Member States, as per JEE requirements. A key aspect addressed was the need to develop lists of High Consequence Agents and Toxins (HCATs) as well as to develop relevant legislation on regulating use/stocking of these HCATs. Zambia is fully participating in these initiatives and when developed and consensus reached at national, regional and continental level, these shall also guide practices in the laboratory facility. Furthermore, relevant security systems have been factored into the project to ensure that only those with the required level of clearance can access certain areas of the laboratory, or access certain information.

4. A resident from Silver rest area Ms Sharon Chuni, and Chief Lands Officer at the Ministry of Lands and Natural Resources (MLNR) requested for a ***detailed description of the proposed location of the project site within Silver rest area***.

   Response: Dr Mukonka reviewed a satellite image of the area, and outlined key landmarks. He indicated that the proposed project site is adjacent to the UNZA farm on Palabana road (D153), and the surrounding area is generally farmland. He indicated that the site lies at the junction of the recently tarred road which branches off southwards from the Great east road at Silver Rest Primary School and Palabana road (D153). Key

social receptors in the area are located north east of the site and are: (i) a Police Post (approximately 1 Km away); (ii) Silver Rest Gardens Residential Estate (about 3.4 Km away); and (iii) Silver Rest Primary School (approximately 5.17 Km away).

5. The representative of Her Royal Highness Chieftainess Mukamambo II, Princess Cholwe Nkomeshya, expressed her ***elation at that the Government had considered setting up the project in the Busoli Chiefdom. She pledged full support for the project by the Busoli Royal Establishment*** and indicated that the BRE was full of expectation that once complete the laboratory would greatly help to answer health challenges faced by the people in the Chiefdom and across the entire country and Southern Africa region. She indicated that the BRE was in support of the efforts by the Ministry of Health to safeguard the health and security of the country's residents. Princess Cholwe also indicated interest in showing the detailed powerpoint presentation directly to Her Royal Highness Senior Chieftainess Nkomesha Mukamambo II to enable her fully appreciate the scale of the modern infrastructure being proposed to be established in the chiefdom. She requested the ZNPHI team to contact the Busoli palace when they are ready for a special session with Her Royal Highness the Chieftainess.

ANY OTHER BUSINESS (A.O.B)

There being no further interventions, the Honoyrable Minister and Princess Cholwe led the meeting participants to have a group picture taken (Appendix 3).

CLOSING REMARKS

In concluding the meeting, the Honourable Minister thanked the various stakeholders supporting the project. He went further to recognise all the Cooperating Partners and their continued support to the Ministry of Health in its endeavour to deliver healthcare to the country and attain Universal Health Coverage. The Minister thanked the BRE through Princess Cholwe for the notable support and blessing to proceed with the project. He hailed the longstanding progressive partnership the Busoli Chiefdom had with the Ministry of Health and Government at large.

The meeting was formally closed at 12:20 hours.

Dr Victor Mukonka
Meeting Convenor
18 July 2019

Dr Raymond Hamoonga
Meeting Rapporteur
18 July 2019

APPENDIX 1: ATTENDANCE LIST

MINISTRY OF HEALTH
STAKEHOLDERS' CONSULTATIVE MEETING: AFRICA CDC REGIONAL INVESTMENT FINANCING PROGRAM FOR INSTITUTIONAL STRENGTHENING OF ZNPHI AND OPERATIONALISATION OF THE AFRICA CDC SOUTHERN AFRICA REGIONAL COLLABORATING CENTRE (RCC)
MINISTRY OF HEALTH GLOBAL FUND BOARDROOM-16TH JULY, 2019

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MINISTRY OF HEALTH GLOBAL FUND BOARDROOM-16TH JULY, 2019

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MINISTRY OF HEALTH GLOBAL FUND BOARDROOM-16TH JULY, 2019

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MINISTRY OF HEALTH GLOBAL FUND BOARDROOM-16TH JULY, 2019

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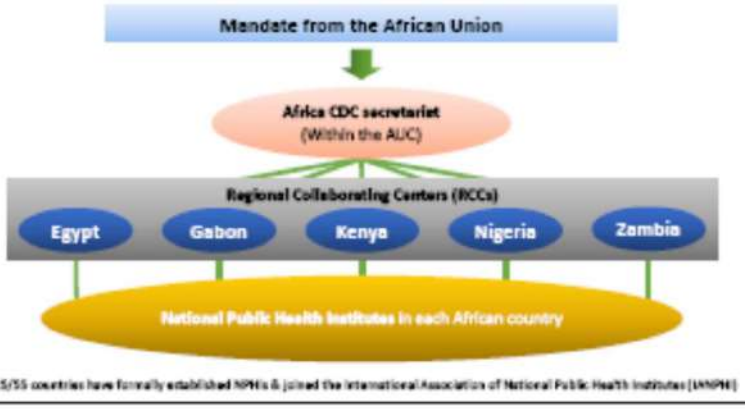
APPENDIX 2: POWERPOINT PRESENTATION MADE TO STAKEHOLDERS BY DIRECTOR – ZNPHI

Addressing Public Health Security in Africa:

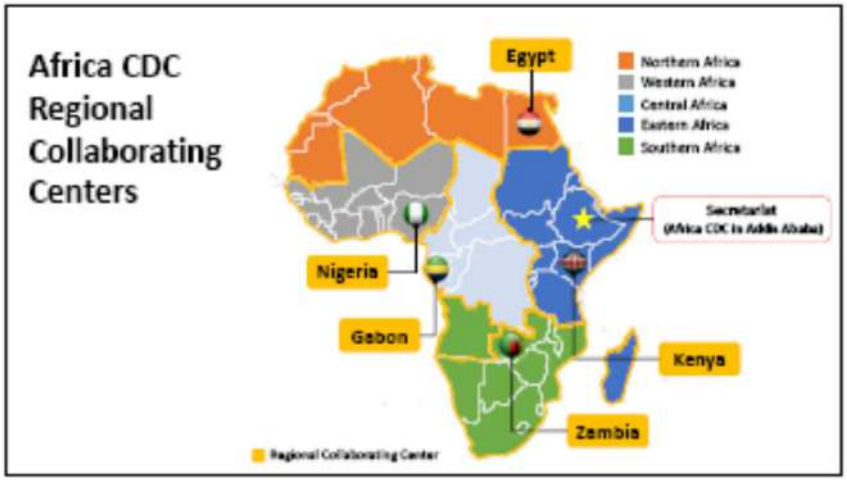
The Africa Centers for Disease Control and Prevention (Africa CDC)

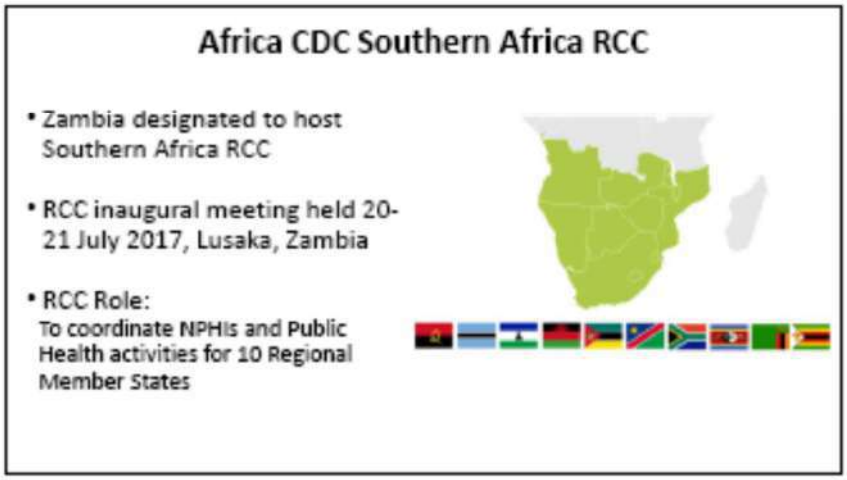
- Established by AU Heads of State and Government under Resolution (AU/Dec.554 (XXIV); endorsed in January 2015
- **Mission:**
  To strengthen Africa's public health institutions' capacities, capabilities and partnerships to detect and respond quickly and effectively to disease threats and outbreaks based on science, policy, and data-driven interventions and programs.

Africa CDC Operation Model



* 15/55 countries have formally established NPHIs & joined the International Association of National Public Health Institutes (IANPHI)


Africa CDC Regional Collaborating Centers
Egypt
Northern Africa
Western Africa
Central Africa
Eastern Africa
Southern Africa
Secretariat
(Africa CDC is Addis Ababa)
Nigeria
Gabon
Kenya
Zambia
Regional Collaborating Center


Africa CDC Southern Africa RCC
• Zambia designated to host Southern Africa RCC
• RCC inaugural meeting held 20-21 July 2017, Lusaka, Zambia
• RCC Role:
To coordinate NPHIs and Public Health activities for 10 Regional Member States

Zambia's Health Sector Transformation Agenda

2017-2021 National Health Strategic Plan (NHSP):

- provides framework for building a robust and resilient health system
- primary health care approach
- continuum of care covering:
  - promotive, preventive, curative, rehabilitative, palliative health services
- as close to the family as possible, leaving no one behind

- Key: **Public health security**, anchored on efficient Surveillance & Disease Intelligence, and epidemic preparedness & response
- **Robust laboratory support essential to provide objective scientific basis to guide decision-making**

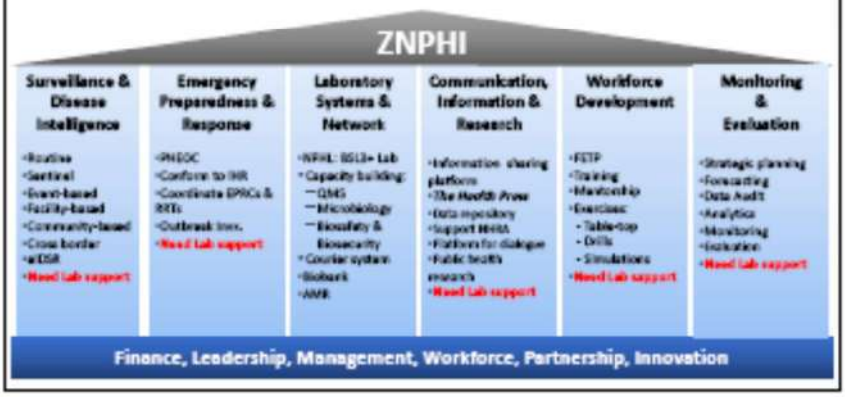
Rationale for ZNPHI

- Technical institution dedicated to addressing public health threats through:
  - Surveillance and disease intelligence
  - Epidemic preparedness and response capability
  - Specialised laboratory functions
  - Research and information management
  - Workforce development
- In line with current international best practice for strengthening national public heath security
- African Union aspiration
- Provides platform for actualizing the One Health concept
- Serves as national focal point for the International Health Regulations (IHR)

The Zambia National Public Health Institute (ZNPHI)

- Specialized technical arm of MoH
- Public Health Centre of Excellence
- Mandate:
  - To preserve the country's health security
  - To efficiently prevent disease transmission, conduct surveillance and be prepared to respond to health threats and outbreaks
  - To build national capacity to detect and respond effectively to disease threats and outbreaks, based on scientific evidence
  - To host Africa CDC RCC for Southern Africa

ZNPHI Strategic Pillars



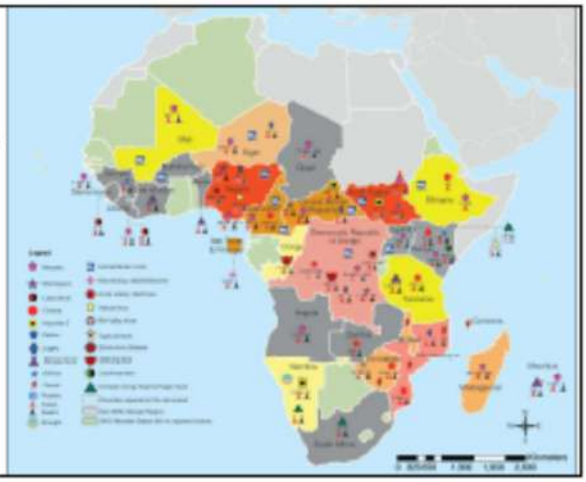
Situation In Zambia ...

Zambia currently lacks a dedicated Public Health Laboratory system

- Depends on clinical laboratories
  - Different mandate: support diagnosis & clinical management of patients
  - Limited test profile
  - Segmented
  - Understaffed
  - Overstretched
  - Delays in sample processing/reporting
  - Incomplete / lack of laboratory results
- Huge gap in supporting epidemiological surveillance
- Human health sector bias

Epidemic-prone Districts in Zambia

Outbreaks & Public Health Events in the WHO-AFRO Region
(January – May 2019)



Zambia's Need for a Dedicated National Public Health Laboratory (NPHL)

Experience in dealing with outbreaks has shown:
- Delays in diagnosis
- Limited capacity of existing clinical laboratories

Ever-present risk of epidemics and public health threats
- Cholera, Typhoid, Anthrax, Plague, Ebola, Yellow Fever, Polio, Marburg,

Support functions scattered for addressing:
- High-consequence pathogens
- Food and Water Quality

ZNPHI is an evidence-based institution
- Scientific base essential

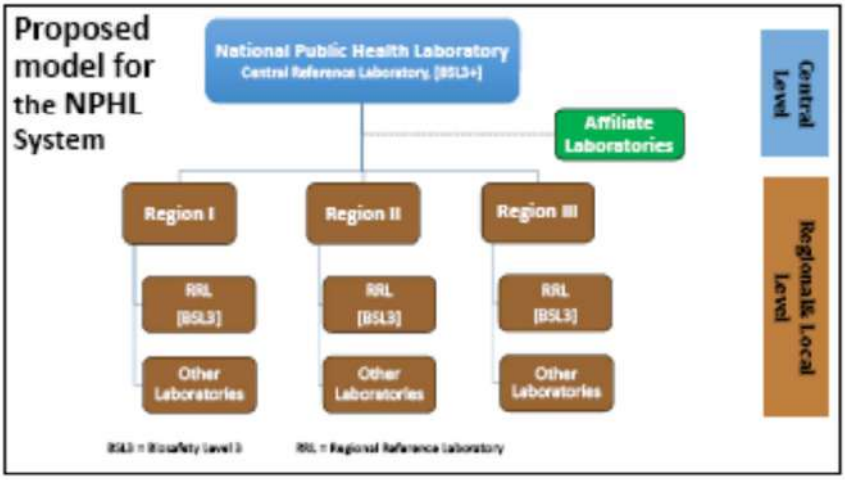
Regional obligations as RCC
- Anchor and support other member states
- Need strong national infrastructure / capacity

To effectively address Public Health Laboratory functions....

Establish the NPHL System

- National BSL3+ laboratory in Lusaka
- 3X Regional BSL3 laboratories
- Multisectoral public health laboratory network
- Integrate some existing laboratories, based on competency & comparative advantage

Proposed model for the NPHL System



NPHL Component Units

- Bacteriology
- Virology
- Mycology
- Parasitology & Vector Biology
- Molecular Biology
- Bioinformatics
- Food safety
- Drugs, Pesticides & Toxicology
- Environmental surveillance
- Haematology
- Chemistry
- Vaccinology
- Immunology
- EPI / VPDs surveillance
- Influenza surveillance
- Animal diseases

WORLD BANK AFRICA CDC REGIONAL INVESTMENT FINANCING PROGRAM (ACDCP)

Zambia Component:
Institutional Strengthening of the ZNPHI and Operationalization of the Africa CDC Southern Africa RCC

Project Components

Infrastructure
- Offices, training rooms, conference facilities, Library / resource center to support ZNPH and RCC operations

Laboratory
- BSL-3+ suite, Other support labs (BSL-1&2), animal health laboratory, Biorepository, Biomedical equipment maintenance center; Proficiency Testing Panel Production Center
- QMS, Microbiology, Biosafety/biosecurity strengthening, specimen courier system

Disease intelligence
- Cross border surveillance; Event Based Surveillance; IDSR; Sentinel surveillance sites

Emergency Preparedness and Response
- Public Health emergency Operations center (PHEOC) – 1 national & 1 regional); points of entry / port health strengthening

Information systems
- ICT suite; Data repository; *The Health Press Zambia* journal

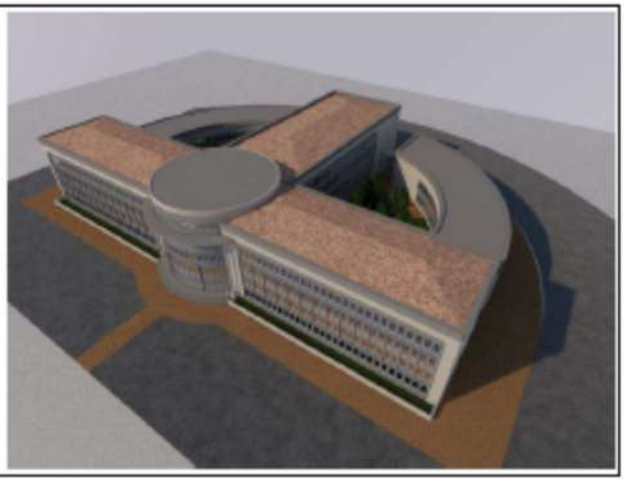
Human Resources Development
- FETP; Specialised skills training;
- Professional & semi-professional training

Governance, Advocacy and Operational Frameworks
- development of guidelines and standards for coordination

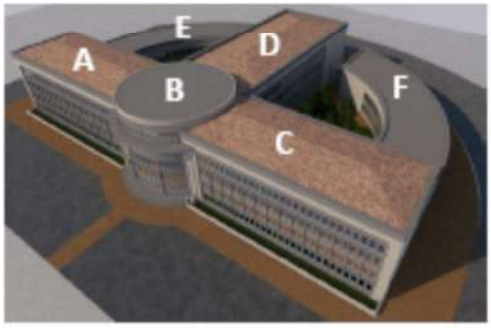
Model for the Building

4-storey building, inverted T-shape, with 2 curved accessory blocks

Total Floor Area approx. 20,850m²



Proposed Layout



- **Blocks A and C:** Offices, training rooms, ICT suite, conference facilities, library / resource center
- **Block B:** Main access into the facility, lobby & reception area
  Top two floors: PHEOC (1 floor national & 1 regional)
- **Block D:** Main laboratory block. BSL-3+ suite on uppermost floor; other labs (BSL-1&2) on lower 3 floors
- **Block E:** Biorepository
- **Block F:** Animal health laboratory
- **Accessory Units:** biomedical equipment maintenance center, electricity substation

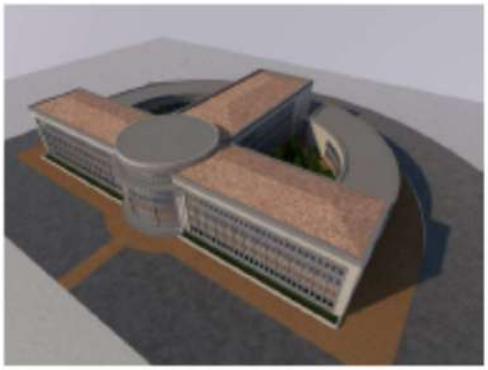
Institutional Arrangements & Benefits of the Investment

MOUs for access to the facility:

- Office space
- Access to state-of-the-art technologically advanced laboratory facilities for researchers, academics & regional member states
- High biocontainment infrastructure for handling special pathogens
- Facilities for training high quality professionals & specialists – scientists, disease surveillance and response experts, epidemiologists
- PHEOC for emergency response coordination

- Platform for sharing information on disease profiles, drug susceptibility, and Antimicrobial Resistance patterns
- Research opportunities
- Support for External Quality Assurance programs
- Repository for biobanking and preservation of African reference materials and strains for Research & Development
- ICT suite as a centre for training, managing and sharing data (data warehousing, informatics, computational biology, etc)
- Support RCC operationalisation & coordination of the Regional Integrated Surveillance and Laboratory Network (RISLNET)

Video



Thank You

APPENDIX 3: PICTURE GALLERY

The Honourable Minister of Health Dr Chitalu Chilufya addressing the stakeholders

Stakeholders following the meeting proceedings

Meeting stakeholders listening to proceedings

The Honourable Minister of Health Dr Chitalu Chilufya sharing a light moment with Princess Cholwe of the Busoli Royal Establishment

ANNEX 7: PROTOCOL FOR TRANSPORTATION OF INFECTIOUS SUBSTANCES

Introduction

Human and animal specimens are collected and shipped within countries and across international borders for a variety of reasons, including disease investigations, clinical trials, surveillance studies, antidoping testing, routine analyses, etc. The protocol provides information for;

- classifying infectious substances for transportation and ensuring their safe packaging.
- facilitating compliance with applicable international regulations for the transport of infectious substances and patient specimens by all modes of transport, both nationally and internationally.

It is obligatory upon shippers to ensure packaging and shipping conditions meet regulatory requirements to preserve the integrity of materials and facilitate their timely arrival at destination. The protocol also emphasizes on the importance of developing a working relationship between those involved – the sender, the carrier and the receiver – in order to provide for safe and expeditious transport of these materials. It is adopted from WHO Guidance on regulations for the transport of infectious substances 2015–2016.

Classification

Dangerous goods are assigned UN numbers and proper shipping names according to their hazard classification and their composition. Proper shipping names are used to clearly identify the dangerous article or substance.

Infectious substances are classified in Division 6.2 and assigned to UN 2814, UN 2900, UN 3291 or UN 3373, as appropriate.

Infectious substances are divided into the following categories:

Category A

An infectious substance which is transported in a form that, when exposure to it occurs, is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals.

Note: An exposure occurs when an infectious substance is released outside of the protective packaging, resulting in physical contact with humans or animals.

a) Infectious substances meeting these criteria which cause disease in humans or both in humans and animals shall be assigned to United Nations number UN 2814. Infectious substances which cause disease only in animals shall be assigned to UN 2900.
b) Assignment to UN 2814 or UN 2900 shall be based on the known medical history and symptoms of the source human or animal, endemic local conditions, or professional judgement concerning individual circumstances of the source human or animal.

Note 1: The proper shipping name for UN 2814 is INFECTIOUS SUBSTANCE, AFFECTING HUMANS. The proper shipping name for UN 2900 is INFECTIOUS SUBSTANCE, AFFECTING ANIMALS only

Category B

An infectious substance which does not meet the criteria for inclusion in Category A. Infectious substances in Category B shall be assigned to UN 3373.

Note: The proper shipping name of UN 3373 is "BIOLOGICAL SUBSTANCE, CATEGORY B"

Exemptions

Substances that do not contain infectious substances or that are unlikely to cause disease in humans or animals are not subject to dangerous goods regulations, unless they meet the criteria for inclusion in another class.

Substances containing microorganisms which are non-pathogenic to humans or animals are not subject to dangerous goods regulations, unless they meet the criteria for inclusion in another class. Substances in a form that any present pathogens have been neutralized or inactivated such that they no longer pose a health risk are not subject to dangerous goods regulations, unless they meet the criteria for inclusion in another class.

Note: Medical equipment which has been drained of free liquid is deemed to meet the requirements of this paragraph and is not subject to dangerous goods regulations.

Environmental samples (including food and water samples) which are not considered to pose a significant risk of infection are not subject to dangerous goods regulations, unless they meet the criteria for inclusion in another class.

- Dried blood spots, collected by applying a drop of blood onto absorbent material are not subject to dangerous goods regulations. Faecal occult blood screening samples are not subject to dangerous goods regulations.
- Blood or blood components which have been collected for the purposes of transfusion or for the preparation of blood products to be used for transfusion or transplantation and any tissues or organs intended for use in transplantation as well as samples drawn in connection with such purposes are not subject to dangerous goods regulations.
- Human or animal specimens (patient specimens) for which there is minimal likelihood that pathogens are present are not subject to dangerous goods regulations if the specimen is transported in a packaging which will prevent any leakage and which is marked with the words "Exempt human specimen" or "Exempt animal specimen", as appropriate. The packaging should meet the following conditions:
  a) The packaging should consist of three components:
     i) a leak-proof primary receptacle(s);
     ii) a leak-proof secondary packaging; and
     iii) an outer packaging of adequate strength for its capacity, mass and intended use, and with at least one surface having minimum dimensions of 100 mm × 100 mm;
  b) For liquids, absorbent material in sufficient quantity to absorb the entire contents should be placed between the primary receptacle(s) and the secondary packaging so that, during transport, any release or leak of a liquid substance will not reach the outer packaging and will not compromise the integrity of the cushioning material;
  c) When multiple fragile primary receptacles are placed in a single secondary packaging they should be either individually wrapped or separated to prevent contact between them.

Note 1: An element of professional judgment is required to determine if a substance is exempt under this paragraph. That judgment should be based on the known medical history, symptoms and individual circumstances of the source, human or animal, and endemic local conditions. Examples of specimens which may be transported under this paragraph include the blood or urine tests to monitor cholesterol levels, blood glucose levels, hormone levels, or prostate specific antigen (PSA); those required to monitor organ function such as heart, liver or kidney function for humans or animals with non-infectious diseases, or therapeutic drug monitoring; those conducted for insurance or employment purposes and are intended to determine the presence of drugs or alcohol; pregnancy test; biopsies to detect cancer; and antibody detection

in humans or animals in the absence of any concern for infection (e.g. evaluation of vaccine induced immunity, diagnosis of autoimmune disease, etc.).

Note 2: For air transport, packagings for specimens exempted under this paragraph shall meet the conditions in (a) to (c).

Except for:

a) Medical waste (UN 3291);
b) Medical devices or equipment contaminated with or containing infectious substances in Category A (UN 2814 or UN 2900); and
c) Medical devices or equipment contaminated with or containing other dangerous goods that meet the definition of another hazard class, medical devices or equipment potentially contaminated with or containing infectious substances which are being transported for disinfection, cleaning, sterilization, repair, or equipment evaluation are not subject to the provisions of dangerous goods regulations if packed in packagings designed and constructed in such a way that, under normal conditions of transport, they cannot break, be punctured or leak their contents. Packagings shall be designed to meet specific construction requirements – this is not considered further in these guidelines.

These packagings shall meet general packaging requirements not considered further in these guidelines, and be capable of retaining the medical devices and equipment when dropped from a height of 1.2 m. For air transport, additional requirements may apply.

The packaging shall be marked "USED MEDICAL DEVICE" or "USED MEDICAL EQUIPMENT". When using overpacks, these shall be marked in the same way, except when the inscription remains visible.

Biological products

For the purposes of transport, biological products are divided into two groups:

a) those which are manufactured and packaged in accordance with the requirements of appropriate national authorities and transported for the purposes of final packaging or distribution, and use for personal health care by medical professionals or individuals. Substances in this group are not subject to dangerous goods regulations;
b) those which do not fall under paragraph (a) and are known or reasonably believed to contain infectious substances and which meet the criteria for inclusion in Category A or

Category B. Substances in this group shall be assigned to UN 2814, UN 2900 or UN 3373, as appropriate.

Note: Some licensed biological products may present a biohazard only in certain parts of the world. In that case, competent authorities may require these biological products to be in compliance with local requirements for infectious substances or may impose other restrictions.

Genetically modified microorganisms and organisms

GMMOs or GMOs that do not meet the definition of toxic substances or infectious substances shall be assigned to UN 3245. GMMOs and GMOs assigned to UN 3245 shall be shipped following Packing Instruction P904 (ICAO/IATA PI959) – this is not considered further in these guidelines.

Note: The proper shipping name for UN 3245 is “GENETICALLY MODIFIED MICROORGANISMS” or "GENETICALLY MODIFIED ORGANISMS".

Medical or clinical wastes

Medical or clinical wastes containing Category A infectious substances shall be assigned to UN 2814 or UN 2900 as appropriate. Medical or clinical wastes containing infectious substances in Category B, or which are reasonably believed to have a low probability of containing infectious substances, shall be assigned to UN 3291 and shipped following Packing Instruction P621 (ICAO/IATA PI622) – this is not considered further in these guidelines. For the assignment, international, regional or national waste catalogues may be taken into account.

NOTE: The proper shipping name for UN 3291 is “CLINICAL WASTE, UNSPECIFIED, N.O.S.” or "(BIO) MEDICAL WASTE, N.O.S." or "REGULATED MEDICAL WASTE, N.O.S.".

Decontaminated medical or clinical wastes which previously contained infectious substances are not subject to dangerous goods regulations unless they meet the criteria for inclusion in another class.

The bulk transport of wastes of Division 6.2 (UN 3291) is permitted according to provisions not further considered in these guidelines.

Infected animals

Unless an infectious substance cannot be consigned by any other means, live animals shall not be used to consign such a substance. A live animal which has been intentionally infected and is known or suspected to contain an infectious substance shall only be transported under terms and conditions approved by the competent authority.

Animal material affected by pathogens of Category A or which could be assigned to Category A in cultures only, shall be assigned to UN 2814 or UN 2900 as appropriate. Animal material affected by pathogens of Category B other than those which would be assigned to Category A if they were in cultures shall be assigned to UN 3373.

The bulk transport of animal material containing infectious substances (UN 2814, 2900 and 3373) is authorized according to provisions not further considered in these guidelines.

General preparation of shipments for transport

Due to the different hazards posed by Category A infectious substances (UN 2814 and UN 2900) and Category B infectious substances (UN 3373), there are variations in the packaging, labelling and documentation requirements for the two categories. The packaging requirements are determined by UNCETDG and are set out as Packing Instructions P620 and P650, reproduced. The requirements are subject to change and regular upgrade by the organizations mentioned.

The current packaging requirements are described below.

Note 1: Hand carriage of Category A and Category B infectious substances and transport of these materials in diplomatic pouches are strictly prohibited by international air carriers.

Note 2: Inner packaging containing infectious substances shall not be consolidated with inner packagings containing unrelated types of goods.

Shippers of infectious substances shall ensure that packages are prepared in such a manner that they arrive at their destination in good condition and present no hazard to persons or animals during transport.

Basic triple packaging system

This system of packaging shall be used for all infectious substances. It consists of three layers as follows:

- **Primary receptacle**. A primary watertight, leak-proof receptacle containing the specimen. The receptacle is packaged with enough absorbent material to absorb all fluid in case of breakage or leakage.
- **Secondary packaging.** A second durable, watertight, leak-proof packaging to enclose and protect the primary receptacle(s). Several cushioned primary receptacles may be placed in one secondary packaging, but sufficient additional absorbent material shall be used to absorb all fluid in case of breakage or leakage.
- **Outer packaging.** Secondary packaging are placed in outer shipping packaging with suitable cushioning material. Outer packaging protect their contents from outside influences, such as physical damage, while in transit. The smallest overall external dimension shall be 10 x 10 cm.

Each completed package is normally required to be correctly marked, labelled and accompanied with appropriate shipping documents (as applicable). The requirements for these aspects are described below.

Packaging, labelling and documentation requirements for infectious substances in

Category A Packaging

An infectious substance category A which is transported in a form that, when exposure to it occurs, is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals.

Infectious substances in Category A may only be transported in packaging that meets the United Nations class 6.2 specifications and complies with Packing Instruction P620. This ensures that strict performance criteria are met; tests for compliance with these criteria include a 9-metre drop test, a puncture test, a pressure test and a stacking test. The outer packaging shall bear the United Nations packaging specification marking (Figure A2), which indicates that the packaging has passed the performance tests to the satisfaction of the competent authority.

The primary receptacle or the secondary packaging shall be capable of withstanding a pressure differential of not less than 95 kPa. The United Nations packaging specification marking alone does not indicate that a test for this has been undertaken, and packaging users should ask their suppliers whether the completed package meets this requirement. Carriers and forwarding agents shall supply details of local suppliers or local companies that can provide such information.

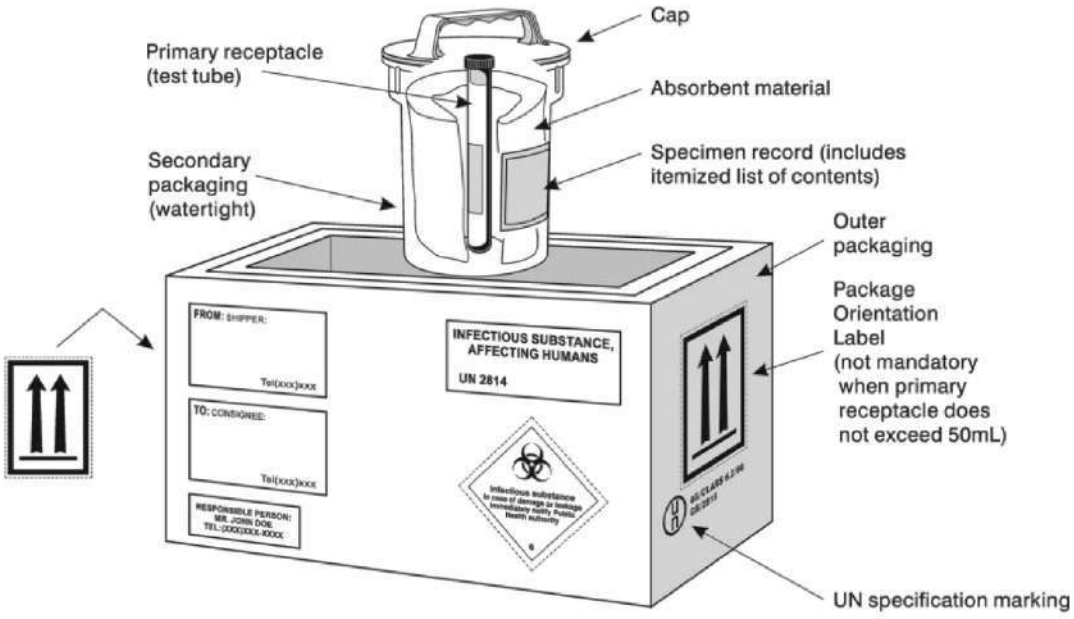


Figure A1. Example of triple packaging system for the packaging and labelling of Category A infectious substances

Marking

Packages are marked to provide information about the contents of the package, the nature of the hazard, and the packaging standards applied. All markings on packages or overpacks shall be placed in such a way that they are clearly visible and not covered by any other label or marking. Each package shall display the following information on the outer packaging or the overpack.

- the shipper's (sender's, consignor's) name and address
- the telephone number of a responsible person, knowledgeable about the shipment
- the receiver's (consignee's) name and address
- the United Nations number followed by the proper shipping name (UN 2814 "INFECTIOUS SUBSTANCE, AFFECTING HUMANS" or UN 2900 "INFECTIOUS SUBSTANCE, AFFECTING ANIMALS only", as appropriate). Technical names need not be shown on the package.
- temperature storage requirements (optional)
- when dry ice or liquid nitrogen is used: the technical name of the refrigerant, the appropriate United Nations number, and the net quantity.

Labelling

There are two types of labels:

1. hazard labels in the form of a square set at an angle of 45° (diamond- shaped) are required for most dangerous goods in all classes;

2. handling labels in various shapes are required, either alone or in addition to hazard labels, for some dangerous goods. Specific hazard label(s) shall be affixed to the outside of each package for all dangerous goods to be shipped (unless specifically exempted).

Figure A2. Hazard label for Category A infectious substances and for genetically modified microorganisms and organisms that meet the definition of an infectious substance, Category A

Minimum dimensions: 100 × 100 mm (for small packages: 50 × 50 mm) No. of labels per package: 1 Colour: Black and white The words “INFECTIOUS SUBSTANCE” shall be shown. The statement “In case of damage or leakage immediately notify a Public Health Authority” is required in some countries

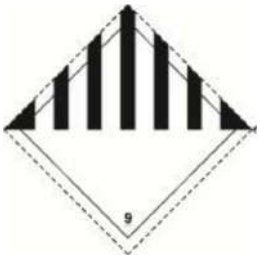
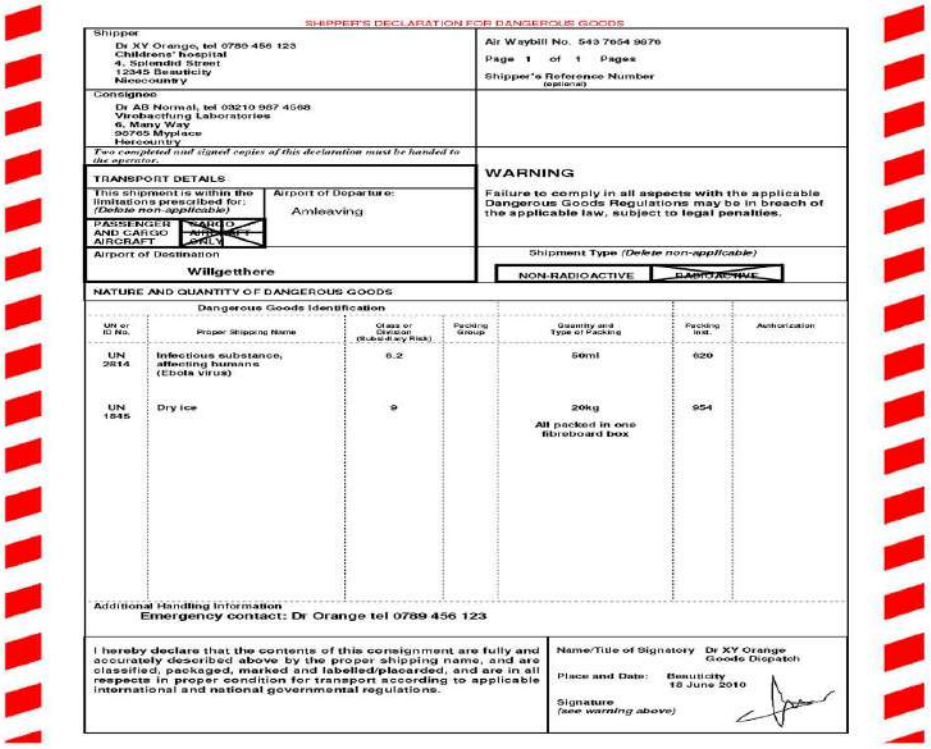


Figure A3 **.** Hazard label for certain noninfectious genetically modified microorganisms and organisms (UN 3245) and for carbon dioxide, solid (dry ice) (UN 1845); substances packed in dry ice (see section on Refrigerants) shall bear this label in addition to the primary risk label (e.g. the label shown in

Shipping empty packaging’

Before an empty package is returned to the shipper, or sent elsewhere, it must be appropriately disinfected or sterilized to nullify any hazard. Any label or marking indicating that it had contained an infectious substance shall be removed or covered.



SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper
Dr XY Orange, tel 0789 456 123
Childrens' hospital
4, Splendid Street
12345 Beautiicity
Nicecountry

Air Waybill No. 543 7654 9876
Page 1 of 1 Pages
Shipper's Reference Number (optional)

Consignee
Dr AB Normal, tel 03210 987 4568
Viralacting Laboratories
6, Many Way
99765 Myplace
Hercountry

Two completed and signed copies of this declaration must be handed to the operator.

TRANSPORT DETAILS
This shipment is within the limitations prescribed for: *(Delete non-applicable)*
PASSENGER AND CARGO AIRCRAFT
CARGO AIRCRAFT ONLY
Airport of Departure: Amleaving
Airport of Destination: Willgetthere

WARNING
Failure to comply in all aspects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties.

Shipment Type *(Delete non-applicable)*
NON-RADIOACTIVE
~~RADIOACTIVE~~

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification

UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing Group	Quantity and Type of Packing	Packing Inst.	Authorization
UN 2814	Infectious substance, affecting humans (Ebola virus)	6.2		50ml	620	
UN 1845	Dry ice	9		20kg All packed in one fibreboard box	954	

Additional Handling Information
Emergency contact: Dr Orange tel 0789 456 123

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Name/Title of Signatory: Dr XY Orange
Goods Dispatch
Place and Date: Beautiicity 18 June 2010
Signature *(see warning above)*

Figure A4. Example of a completed shipper's Declaration for Dangerous Goods

Documentation

The following shipping documents are required.

To be prepared and signed by the shipper:

- for air: the shipper's Declaration for Dangerous Goods
- a packing list/proforma invoice that includes the receiver's address, the number of packages, detail of contents, weight, value (Note: for international transport, a minimal value shall be indicated, for customs purposes, if the items are supplied free of charge)
- an import and/or export permit and/or declaration if required To be prepared by the shipper or the shipper's agent:
- an air waybill for air transport or equivalent documents for road, rail and sea shipments.

For UN 2814 and UN 2900, an itemized list of contents shall be enclosed between the secondary packaging and the outer packaging.

For the purposes of documentation, the proper shipping name shall be supplemented with the technical name. Technical names need not be shown on the package. When the infectious substances to be transported are unknown, but suspected of meeting the criteria for inclusion

in category A and assignment to UN 2814 or UN 2900, the words “suspected Category A infectious substance” shall be shown, in parentheses, following the proper shipping name on the transport document, but not on the outer packagings.

Packaging, labelling and documentation requirements for infectious substances in

Category B Packaging

An infectious substance which does not meet the criteria for inclusion in Category A. Infectious substances in Category B shall be assigned to UN 3373

The triple packaging system continues to apply, including for local surface transport. Testing documents are not required, however.

To ensure correct preparation for transport, packaging manufacturers and subsequent distributors shall provide clear instructions to the consignor or persons preparing packages (e.g. patients) on how the packaging should be filled and closed.

For surface transport there is no maximum quantity per package.

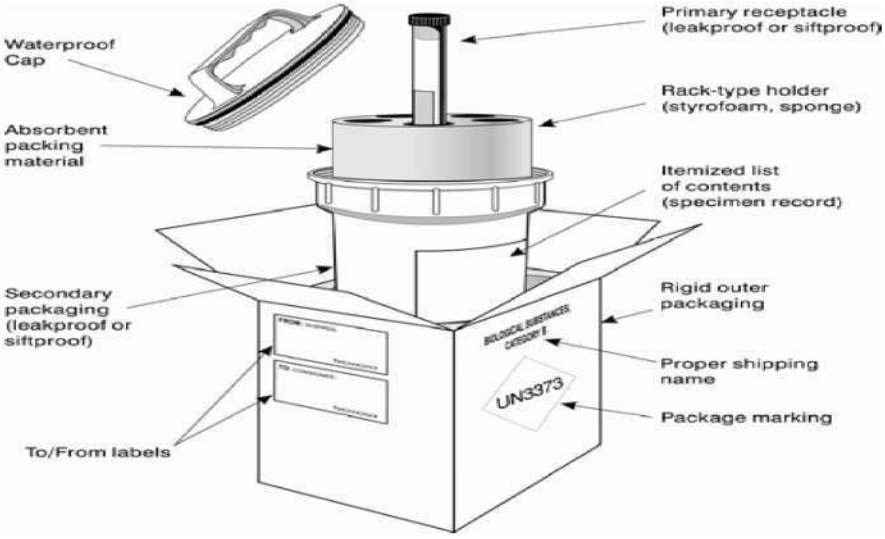


Figure A5: Example of the triple packaging system for the packing and labelling Category B infectious substances (adopted from WHO)

For air transport:

- no primary receptacle shall exceed 1 litre and the outer packaging must not contain more than 4 litres(for liquids)
- except for packages containing body parts, organs or whole bodies, the outer packaging must not contain more than 4 kg (for solids).

Provided all the requirements of P650 are met, there are no other transport requirements. P650 incorporates all that is needed to make a shipment for Category B infectious substances.

Marking

Each package shall display the following information:

- for air: the shipper's (sender's, consignor's) name, address and telephone number
- for air: the telephone number of a responsible person, knowledgeable about the shipment
- the receiver's (consignee's) name, address and telephone number
- the proper shipping name ("BIOLOGICAL SUBSTANCE, CATEGORY B") adjacent to the diamond-shaped mark
- temperature storage requirements (optional).

The marking shown in Figure A6 is used for shipments of Category B infectious substances.

Figure A6. Marking for infectious substances of Category B

- Minimum dimension: the width of the line forming the square shall be at least 2 mm, and the letters and numbers shall be at least 6 mm high. For air transport, each side of the square shall have a length of at least 50 mm
- Colour: none specified, provided the mark is displayed on the external surface of the outer packaging on a background of contrasting colour and that it is clearly visible and legible
- The words "BIOLOGICAL SUBSTANCE, CATEGORY B" in letters at least 6 mm high shall be displayed adjacent to the mark.

Note: For air transport:

- when dry ice (solid carbon dioxide) is used (see section on Refrigerants), the label shown in Figure A4 shall be applied
- for cryogenic liquids (see section on Refrigerants) the labels shown in Figures A5 and A6 shall also be affixed.

Documentation

Dangerous goods documentation (including a shipper's declaration) is not required for Category B infectious substances. The following shipping documents are required. To be prepared and signed by the shipper (sender, consignor):

- for international shipments: a packing list/proforma invoice that includes the shipper's and the receiver's address, the number of packages, detail of contents, weight, value (Note: the statement "no commercial value" shall appear if the items are supplied free of charge)
- an import and/or export permit and/or declaration if required.

To be prepared by the shipper or the shipper's agent:

- an air waybill for air transport or equivalent documents for road, rail and sea journeys.

Refrigerants

Refrigerants may be used to stabilize infectious substances in Categories A and B during transit.

- Packed infectious substances requiring cooling assigned to packing instructions P620 or P650 shall meet the appropriate requirements of that packing instruction.
- Ice, ice pads or dry ice shall be placed outside the secondary receptacle or in an outer packaging or in an overpack.
- Wet ice shall be placed in a leak-proof container; the outer packaging or overpack shall also be leak-proof.
- Dry ice must not be placed inside the primary or secondary receptacle because of the risk of explosions. A specially designed insulated packaging may be used to contain dry ice. The packaging must permit the release of carbon dioxide gas if dry ice is used. Packing instruction P003 (ICAO/IATA PI954) shall be observed.
- The secondary receptacle shall be secured within the outer package to maintain the original orientation of the inner packages after the refrigerant has melted or dissipated.
- If dry ice is used to ship infectious substances in Category A, the details shall appear on the shipper's Declaration for Dangerous Goods. If dry ice is used to ship infectious

substances in Category B or Exempt samples, the shipper's Declaration of Dangerous Goods is not required. In any case, the outermost packaging shall carry the hazard label for dry ice (see Figure A4), the appropriate markings, including the UN number and the proper shipping name followed by the words "AS COOLANT", *for example: UN 1845, CARBON DIOXIDE,SOLID, AS COOLANT*. and an indication of the net quantity of dry ice in kilograms.

- If liquid nitrogen is used as a refrigerant, special arrangements shall be made in advance with the carrier. Primary receptacles shall be capable of withstanding extremely low temperatures, and packaging and documentation requirements for liquid nitrogen shall be observed. In particular, the outermost packaging shall carry the hazard label for liquid nitrogen (see Figure A5). For air transport, the handling label for cryogenic liquids shall also be affixed (see Figure A6) – this is not considered further in these guidelines.
- When shipping with liquid nitrogen, "dry shippers" can be used. Correctly prepared "dry shippers" do not contain free liquid nitrogen. While liquid nitrogen is a regulated dangerous good, a properly prepared "dry shipper" is not. When shipping with "dry shippers", the dangerous goods label for class 2 (non-flammable, non-toxic gases) is NOT required. Shippers must properly mark and label the outside of dry shipper packages containing infectious substances. Appropriate documentation should discuss the presence of infectious substances. For Category A this information will be included in the Dangerous Goods Declaration. For Category B and Exempt packages this information should be provided on the Air Waybill.

Training

All personnel involved in transport shall undergo appropriate training. For the transport of Category A infectious substances, personnel must undergo training in accordance with the modal requirements. This shall involve attending approved courses and passing examinations.

For the transport of Category B infectious substances there is a requirement that clear instructions on the use of the packaging are supplied to the user; this is regarded as sufficient "training" for the shipping of these substances. However, if such specimens are consigned with other dangerous goods (e.g. flammable liquids, radioactive materials, liquefied gases, etc.), then personnel must be trained in the proper procedures for their transport. Training and awareness are important for all personnel involved in the transport of Category B infectious substances. Only through appropriate guidance and training can shippers ensure that the classification of the substance to be shipped is correct, and that proper packaging is selected and prepared.

Carriers and other employers of transport workers shall train their personnel in the appropriate procedures for recognizing and handling packages containing infectious substances and in how to address spills and protect themselves from exposure. Records of training received shall be kept by the employer and made available to the employee or competent authority, upon request.

Transport planning

The efficient transport and transfer of infectious substances requires good coordination between the sender, the carrier and the receiver to ensure that the material is transported safely and arrives on time and in good condition. Such coordination depends upon well-established communications and a good working relationship between the three parties.

The carriage of any goods whether dangerous or not, is a commercial matter for a carrier. The dangerous goods rules described in these guidelines reflect governmental legal requirements. If a carrier does not wish to carry particular goods is under no legal obligation to do so. Many carriers (airlines, haulers and shipping lines) are "private carriers" and have the right to refuse to carry goods or add additional requirements. Provided such conditions do not conflict with the legal requirements, this type of action is not illegal.

ICAO and IATA list the main carrier restrictions in force among airlines. Some airlines will not carry dangerous goods at all, while others will carry only a very limited range of goods. The shipper (sender, consignor), carrier and the receiver (consignee) have specific responsibilities in ensuring successful transportation.

The shipper (sender, consignor)

The shipper has the responsibility to ensure the correct classification, packaging, labelling, and documentation of all infectious substances destined for transport:

• Makes advance arrangements with the receiver including investigating the need for import/export permits

• Makes advance arrangements with the carrier to ensure: o that the shipment will be accepted for appropriate transport

o that the shipment (direct transport if possible) is undertaken by the most direct routing

• Prepares necessary documentation, including permits, dispatch and shipping documents

• Notifies the receiver of transportation arrangements once these have been made, well in advance of the expected arrival time.

The carrier

• Provides advice to the sender regarding the necessary shipping documents and instructions for their completion

• Provides advice to the sender about correct packaging

• Assists the sender in arranging the most direct routing and then confirms the routing

• Maintains and archives the documentation for shipment and transport.

The receiver (consignee)

• Obtains the necessary authorization(s) from national authorities for the importation of the material

• Provides the sender with the required import permit(s), letter(s) of authorization, or other document(s) required by the national authorities

• Arranges for the most timely and efficient collection on arrival

• Should acknowledge receipt to the sender.

Shipments should not be dispatched until:

• Advance arrangements have been made between the sender, carrier and receiver

• The shipper has confirmed with the national authorities that the material may be legally exported

• The receiver has confirmed with the national authorities that the material may be legally imported

• The receiver has confirmed that there will be no delay incurred in the delivery of the package to its destination.

Requirements for air mail

- Infectious substances in Category A will not be accepted for shipment through postal services.
- Infectious substances in Category B may be shipped by registered air mail, and the Universal Postal Union recommends the following procedure.
    i) The basic triple packaging system is used with the same requirements as for other means of transport

ii) . The address label shall display the word *"Lettre"* or "Letter" and the green Customs Declaration Label for Postal Mail is required for international mailing.

iii) "BIOLOGICAL SUBSTANCE, CATEGORY B" shall be identified with the white diamond label with black letters "UN 3373" (see Figure A6).

iv) Local/international restrictions may be in force. Prior contact should therefore be made with the national public operator to ascertain whether the packaged material will be accepted by the postal service in question.

Spill clean-up procedure

The appropriate response in the event of exposure to any infectious substance is to wash or disinfect the affected area as soon as possible, regardless of the agent. Even if an infectious substance comes into contact with non-intact skin, washing of the affected area with soap and water or with an antiseptic solution can reduce the risk of infection. Medical advice should be obtained any time there is a suspected exposure to infectious substances resulting from a damaged package. The following procedure for clean-up can be used for spills of all infectious substances including blood. The person must be trained on such procedure before performing these steps:

1. Wear gloves and protecting clothing, including face and eye protection if indicated.
2. Cover the spill with a cloth or paper towels to contain it.
3. Pour an appropriate disinfectant over the cloth or paper towels and the immediately surrounding area (5% bleach solutions are generally appropriate, but for spills on aircraft, quaternary ammonium disinfectants should be used).
4. Apply the disinfectant concentrically beginning at the outer margin of the spill area, working towards the centre.
5. After about 30 min, clear away the materials. If there is broken glass or other sharps are involved, use a dustpan or a piece of stiff cardboard to collect the materials and deposit them into a puncture-resistant container for disposal.
6. Clean and disinfect the area of the spillage (if necessary, repeat steps 2–5).
7. Dispose of contaminated materials into a leak-proof, puncture-resistant waste disposal container.
8. After successful disinfection, report the incident to the competent authority and inform them that the site has been decontaminated (see Incident reporting below).

Incident reporting

Reports of infections resulting from transport-related exposures shall be documented. Incidents shall be reported to the health authorities (safety officer and Laboratory Quality Manager) and transport authorities. This applies to both categories of infectious substances, but particularly to those in Category A.

ANNEX 8: OVERVIEW OF THE KAUNDA SQUARE STABILISATION PONDS

The LWSC Sewerage system is divided into five sewer-sheds namely: Western, Ngwerere, Manchinchi, Kaunda Square, and Chelston. Out of these, a larger percentage of the wastewater in Lusaka is treated at Manchinchi Wastewater Treatment Plant and Kaunda Square Wastewater Treatment Plant. The Kaunda Square sewer-shed system covers approximately 2,120 hectares in the southern and eastern portions of the city of Lusaka. The system is a gravity network comprised of sanitary sewers that drain into the Kaunda Square ponds. The system, currently serves a population equivalent of close to 50,000.

Kaunda Square Stabilisation Ponds

Kaunda Square Treatment Ponds, being the target for disposal of outoclaved wastewater from BSL-3 laboratory was firstly constructed in 1970 in what was then a remote part of Lusaka. The ponds were originally intended to provide waste stabilization (oxidation) sewage treatment for a population of less than 18,000, treating no more than 3,600 m^3/day of sewage. Since 1970, Lusaka's local government had neither expanded nor conducted major maintenance to the ponds, resulting in an overload of the ponds, collapse of the embankments separating the three treatment units, malfunctioning of the inlet works, and accumulated silt. By 2010, sewage flow to the ponds had increased to as much as 5,800 m^3/day, well in excess of their capacity. These conditions rendered the ponds ineffective in treating sewage.

The Kaunda Square sewershed rehabilitation, expansion and upgrade project which was implemented by the Millenium Challenge Account Zambia between 2015 and 2017 resulted in a higher level of performance of the pond system that reduced incremental loads of pollutants and thereby improve the deteriorated ambient conditions of the Ngwerere stream. The proposed improvements include:

- Introduction of anaerobic ponds for enhanced BOD removal.
- Larger facultative ponds resulting in increased BOD removal.
- Fencing off of ponds to reduce the risks associated with public contact.
- Improved exit channel for effluent to ensure spillage is avoided.
- Improved preliminary treatment facilities for better screening and grit removal. This will result in prolonged pond life.

The transition from on site (pit latrines) to piped sewage (currently being implemented) will result in improved sanitation conditions in Mtendere which will reduce poverty and promote economic growth by improving the standard of living for the residents and increasing property values, and removing the threat of groundwater contamination.

Some of the specific benefits anticipated as a result of the project are as follow:

- Employment for local community residents during the construction phase of the project.
- Reduced incidence/ prevalence of water borne and water related diseases.
- Reduced disease burden and need to care for the sick, thereby leaving enough time for households to engage in income generating activities.
- Better and more hygienic sanitation facilities, thereby improving the standard of living of Mtendere residents.
- Enhanced privacy during use of sanitary facilities
- Reduction in pollution/ contamination of the ground water aquifer.
- Improved safety around the ponds due to fencing.
- Reduction of odours and disease bearing vectors near the ponds and along the effluent delivery channel, improving living standards of downstream residents.
- Reduction of growth of water hyacinth in the effluent delivery channel, thereby eliminating the cause of occasional flooding on adjacent roads
- Improvement in LWSC asset management
- Reduction in pollution charges paid by LWSC to ZEMA due to reduced pollution levels, liberating funds for other activities.
- Reduced frequency of cleaning the treated effluent delivery channel and desludging the ponds thereby resulting in reduced maintenance costs.

The expansion of Kaunda Square Ponds has potential to have atleast 14,500 more LWSC customers in Mtendere. The ponds are able to treat up to 41,000 m^3/day—more than 8 times the original design—enough to serve the estimated 156,000 residents. The Sanitation Investment Master Plan calls for the construction of a new sewage treatment plant that will replace Kaunda Square and several other pond systems by 2035. MCC's investment in Kaunda Square was therefore an important bridging measure to cover acute sanitation needs.

The expansion and rehabilitation of the Kaunda Square Ponds, being an interim measure, has provided an opportunity boost efficient removal of sediments, and active management of the sewer treatment to ensure that short circuiting of the treatment process does not occur. Following

the rehabilitation and expansion of the Kaunda Sewer Treatment Ponds, there has been a general improvement in the quality of effluent discharge, according to ZEMA Effluent Standards. The legal framework for waste water management for Zambia is contained in the Environmental Management Act (EMA), No. 12 of 2011.

ANNEX 9: E-WASTE MANAGEMENT PLAN

Zambia National Public Health Institute
Ministry of Health
Lusaka, Zambia

Electronic Waste (E-waste) Management Plan (EWMP)

Africa CDC Regional Investment Financing Program (P167916)

Contents

LIST OF TABLES

ABREVIATIONS AND ACRONYMS

AFB	Acid Fast Bacilli
BFRs	Brominated Flame Retardants
BMW	Bio Medical Waste Management
BSC	Biological Safety Cabinets
BSL-1	Biosafety Level 1
BSL-2	Biosafety Level 2
BSL-3	Biosafety Level 3
CDC	Centre for Disease Control and Prevention
CFC	Chloro Fluoro Carbon
EEE	Electrical and Electronic Equipment
EMA	Environmental Management Act
ESH	Environmental Social and Health
ESHG	Environment Safety and Health Guidelines
EWMP	Electronic Waste Management Plan
GIIP	Good International Industry Practice
HCW	Health-Care Waste
HEPA	High Efficiency Particulate Air
ICT	Information and Communication Technology
IFC WBG	International Finance Corporation World Bank Guidelines
IPC	Infection and Prevention Control
MOH	Ministry of Health
NBA	National Biosafety Authority
NHRA	National Health Research Authority
OHS	Occupational Health and Safety
PBB	Poly Brominated Biphenyl's
PBD	Poly Brominated Diphenyl's
PBTs	Persistent Bio accumulative Toxins
PCB	Poly Chlorinated Biphenyl's
PCDD	Poly Chlorinated Dibenzo-p-Dioxins
PEP	Post Exposure Prophylaxes
PHL	Public Health Laboratory
PHEOC	Public Health Emergency Operations Centre
PPE	Personal Protective Equipment
PVC	Poly Vinyl Chloride
SOP	Standard Operating Procedures
TBBA	Tetrabromo-Biphenyls
TBBPA	Tetrabromo-Biphenyls-A
TCDD	Tetra Chloro Dibenzo –p- Dioxin
WBG	World Bank Guidelines
WHO	World Health Organisation
ZNPHI	Zambia National Public Health Institute
ZNPHL	Zambia National Public Health Laboratory
ZEMA	Zambia Environmental Management Agency
ZICTA	Zambia Information and Communications Technology Agency

1.0 Considerations on Waste Management

The Zambia National Public Health Institute (ZNPHI) commits to manage environmental and social risks and impacts of the project throughout the project life cycle in a systematic manner, proportionate to the nature and scale of the project and to the potential risks and impacts. The generation of all forms of waste is one of those risks that must be considered during preplanning, construction, operations, and the decommissioning phases of the project. Waste management planning for the project should be conducted early as possible to identify sound management practices and procedures all within the country's legal and environmental frameworks. Wastes include hazardous, solid, demolition or construction, clinical and electronic waste. The focus of this plan is on Electronic waste or E-waste that will potentially be generated from especially the ICT operations after complete construction of the infrastructure and during the operation phase. This E-waste management plan will be implemented throughout the project's lifecycle to protect the environment, safeguard the health of the local communities, and comply with The World Bank Group Environment, Safety and Health Guidelines (ESHG) and Good International Industry Practice (GIIP).

1.1 E-waste definition and general considerations

Electronic waste (E-waste) is a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded, irreparable or at the end of life. Although e-waste is a general term, it is considered to cover laptops, desktops, tablets, TV's, mobile phones, and household appliances. E-waste contains materials that, if mishandled, can be hazardous to human health and the environment, but, most importantly, also materials that are valuable and scarce.

1.2 Toxicity and radioactive nature of E-waste to human, water, soil and animals

Electrical and electronic equipment contain different hazardous materials, which are harmful to human health and the environment if not disposed of carefully. While some naturally occurring substances are harmless in nature, their use in the manufacture of electronic equipment often results in compounds, which are hazardous (e.g. chromium becomes chromium VI). Lead, mercury, cadmium, and polybrominated flame retardants are found in electronic equipment and are all persistent, bio-accumulative toxins (PBTs). They can create environmental and health risks when computers are manufactured, incinerated, landfilled, or melted during recycling. PBTs, in particular are a dangerous class of chemicals that have longevity in the environment and bio accumulate in living tissues. PBTs are harmful to human health and the environment and have been associated with cancer, nerve damage and reproductive disorders. Shown in Table 1 is a selection of the mostly found toxic substances in E-waste.

Table 1: Toxic Substances in E-waste

Substance	Occurrence in E-waste
Halogenated compounds	
PCB (polychlorinated biphenyls)	Condensers, Transformers
TBBA (tetrabromo-bisphenol-A) PBB (polybrominated biphenyls) PBDE (polybrominated diphenyl ethers)	Fire retardants for plastics (thermoplastic components, cable insulation) TBBA is presently the most widely used flame retardant in printed
Chlorofluorocarbon (CFC)	Cooling unit, Insulation foam
PVC (polyvinyl chloride)	Cable insulation
Heavy metals and other metals:	
Arsenic	Small quantities in the form of gallium arsenide within light emitting diodes
Barium	Getters in CRT
Beryllium	Power supply boxes which contain silicon-controlled rectifiers and x-ray lenses
Cadmium	Rechargeable NiCd-batteries, fluorescent layer (CRT screens), printer inks and toners, photocopying-machines (printer drums)
Chromium VI	Data tapes, floppy-disks
Lead	CRT screens, batteries, printed wiring boards
Lithium	Li-batteries
Mercury	Fluorescent lamps that provide backlighting in LCDs, in some alkaline batteries and mercury wetted switches
Nickel	Rechargeable NiCd-batteries or NiMH-batteries, electron gun in CRT
Rare Earth elements (Yttrium, Europium)	Fluorescent layer (CRT-screen)
Selenium	Older photocopying-machines (photo drums)
Zinc sulphide	Interior of CRT screens, mixed with rare earth metals

Arsenic

Arsenic is a poisonous metallic element, which is present in dust and soluble substances. Chronic exposure to arsenic can lead to various diseases of the skin and decrease nerve conduction velocity. Chronic exposure to arsenic can also cause lung cancer and can often be fatal.

Barium

Barium is a metallic element that is used in sparkplugs, fluorescent lamps, and "getters" in vacuum tubes. Being highly unstable in the pure form, it forms poisonous oxides when in contact with air. Short-term exposure to barium could lead to brain swelling, muscle weakness, damage to the heart, liver, and spleen. Animal studies reveal increased blood pressure and changes in the heart from ingesting barium over a long period of time. The long-term effects of chronic barium exposure to human beings are still not known due to lack of data on the effects.

Beryllium

Beryllium has recently been classified as a human carcinogen because exposure to it can cause lung cancer. The primary health concern is inhalation of beryllium dust, fume, or mist. Workers who are constantly exposed to beryllium, even in small amounts, and who become sensitized to it can develop what is known as Chronic Beryllium Disease (beryllicosis), a disease that primarily affects the lungs. Exposure to beryllium also causes a form of skin disease that is characterized by poor wound healing and wart-like bumps. Studies have shown that people can still develop beryllium diseases even many years following the last exposure.

Brominated flame retardants (BFRs)

The 3 main types of BFRS used in electronic and electrical appliances are Polybrominated biphenyl (PBB), Polybrominated diphenyl ether (PBDE) and Tetrabromobisphenol - A (TBBPA). Flame-retardants make materials, especially plastics and textiles, more flame resistant. They have been found in indoor dust and air through migration and evaporation from plastics. Combustion of halogenated case material and printed wiring boards at lower temperatures releases toxic emissions including dioxins, which can lead to severe hormonal disorders. Major electronics manufacturers have begun to phase out brominated flame-retardants because of their toxicity.

Cadmium

Cadmium components may have serious impacts on the kidneys. Cadmium is adsorbed through respiration but is also taken up with food. Due to the long half-life in the body, cadmium can easily be accumulated in amounts that cause symptoms of poisoning. Cadmium shows a danger of cumulative effects in the environment due to its acute and chronic toxicity. Acute exposure to cadmium fumes causes flu-like symptoms of weakness, fever, headache, chills, and sweating and muscular pain. The primary health risks of long-term exposure are lung cancer and kidney damage. Cadmium also is believed to cause pulmonary emphysema and bone disease (osteomalacia and osteoporosis).

CFCs (Chlorofluorocarbons)

Chlorofluorocarbons are compounds composed of carbon, fluorine, chlorine, and sometimes hydrogen. Used mainly in cooling units and insulation foam, they have been phased out because when released into the atmosphere, they accumulate in the stratosphere and have a deleterious effect on the ozone layer. This results in increased incidence of skin cancer in humans and in genetic damage in many organisms.

Chromium

Chromium and its oxides are widely used because of their high conductivity and anti-corrosive properties. While some forms of chromium are nontoxic, Chromium (VI) is easily absorbed in the human body and can produce various toxic effects within cells. Most chromium (VI) compounds are irritating to the eyes, skin and mucous membranes. Chronic exposure to chromium (VI)

compounds can cause permanent eye injury, unless properly treated. Chromium VI may also cause DNA damage.

Dioxins

Dioxins and furans are a family of chemicals comprising 75 different types of dioxin compounds and 135 related compounds known as furans. Dioxins is taken to mean the family of compounds comprising polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Dioxins have never been intentionally manufactured but form as unwanted by-products in the manufacture of substances like some pesticides as well as during combustion. Dioxins are known to be highly toxic to animals and humans because they bio-accumulate in the body and can lead to malformations of the foetus, decreased reproduction and growth rates and cause impairment of the immune system among other things. The best-known and most toxic dioxin is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

Lead

Lead is the fifth most widely used metal after iron, aluminium, copper, and zinc. It is commonly used in the electrical and electronics industry in solder, lead-acid batteries, electronic components, cable sheathing, in the glass of CRTs etc. Short-term exposure to high levels of lead can cause vomiting, diarrhoea, convulsions, coma or even death. Other symptoms are appetite loss, abdominal pain, constipation, fatigue, sleeplessness, irritability, and headache. Continued excessive exposure, as in an industrial setting, can affect the kidneys. It is particularly dangerous for young children because it can damage nervous connections and cause blood and brain disorders.

Mercury

Mercury is one of the most toxic yet widely used metals in the production of electrical and electronic applications. It is a toxic heavy metal that bio-accumulates causing brain and liver damage if ingested or inhaled. In electronics and electrical appliances, mercury is highly concentrated in batteries, some switches and thermostats, and fluorescent lamps.

Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are a class of organic compounds use in a variety of applications, including dielectric fluids for capacitors and transformers, heat transfer fluids and as additives in adhesives and plastics. PCBs have been shown to cause cancer in animals. PCBs have also been shown to cause a number of serious non-cancer health effects in animals, including effects on the immune system, reproductive system, nervous system, endocrine system and other health effects. PCBs are persistent contaminants in the environment. Due to the high lipid solubility and slow metabolism rate of these chemicals, PCBs accumulate in the fat-rich tissues of almost all organisms (bioaccumulation).

Polyvinyl chloride (PVC)

Polyvinyl chloride (PVC) is the most widely used plastic, used in everyday electronics and appliances, household items, pipes, upholstery etc. PVC is hazardous because contains up to 56 percent chlorine which when burned produces large quantities of hydrogen chloride gas, which combines with water to form hydrochloric acid and is dangerous because when inhaled, leads to respiratory problems.

Selenium

Exposure to high concentrations of selenium compounds cause selenosis. The major signs of selenosis are hair loss; nail brittleness, and neurological abnormalities (such as numbness and other odd sensations in the extremities).

1.3 Benefits from Sustainable E-Waste Management Practices

Sustainable e-waste management practices which include recycling operations, considerably contribute to reducing greenhouse gas emissions. Primary production of some metals that are constituent of e-waste usually contribute largely to greenhouse gas emissions. As an example, mining, concentrating, smelting, and refining, especially of precious and special metals have a significant carbon dioxide (CO_2) impact due to the low concentration of these metals in the ores and often difficult mining conditions. But, "mining" of old phones, servers, or old computers to recover the contained metals, if done in an environmentally sound or correct manner, need only a fraction of energy compared to mining ores in nature.

In addition, recycling of e-waste equipment reduces the amount of land that would be taken away if e-waste is disposed by encapsulation at a ZEMA licensed hazardous waste disposal site. Encapsulation entails use of cement to concrete line the pit implying that once encapsulation takes place, that piece of land affected is permanently taken away by this process. If recycling, reuse and recover methods are practiced, the piece of land that would otherwise be taken up for encapsulation will still be free and that would extend the life of the Hazardous Waste Disposal Site.

Recycling means that less money and energy has to be expended for the mining of the various minerals, which are consumed during the manufacturing process to produce E-Waste equipment. The environmental footprint of a phone, computer, or any other electronic device can be significantly reduced if treated in an environmentally sound manner. In this context, the recycling, reuse, and recover of e-waste will prevent hazardous emissions and ensure that a large part of the contained metal(s) is finally recovered for a new life. This E-Waste Management plan does not include or mandates for the establishment of an e-waste recycling infrastructure, but points in the direction that building a sustainable recycling infrastructure, creates jobs and contributes to

capacity building. The sustainable collection, sorting, manual dismantling, and pre-processing of e-waste could create a significant number of jobs in the country that would develop this activity.

2.0 E-Waste Management Plan

2.1 E-Wastes management during construction, operational and closure phase

This Electrical Waste Management Plan (EWMP) will be implemented throughout the project's lifecycle and is not limited to the amount of e-waste generated from the ICT operations, but this is inclusive of the e-waste to be generated from the laboratories and offices at the centre. Additionally, any e-waste that will be generated during the construction phase and at decommissioning (if the later will be applicable) will also be subjected to the specific management of e-waste as provided for, in this document. The plan is required to be adopted during project implementation period when project financed electrical equipment (BSL electrical equipment, computers, printers, toners, laptops etc.) are replaced, irreparable or at their end of life. This plan must comply with the existing Zambian legislation and regulations, WB ESHG and Good International Industrial Practice (GIIP).

2.2 Aims and Objectives of the EWMP

The aim is to achieve and maintain an integrated E-Waste management plan that is effective and efficient to ensure the generated e-waste is not indiscriminately disposed to the detriment of human health and the environment.

The overall objectives of the waste management plan are summarized below: (i) to assess the activities involved for the proposed project and determine the type, nature and estimated volumes of waste to be generated; (ii) to identify any potential environmental impacts from the generation of waste at the project sites; (iii) to recommend appropriate waste handling, storage and disposal measures in accordance with the current legislative requirements, WB ESHG and GIIP, (iv) to strengthen capacity building and raise awareness to communities and firms on e-waste management risks and impacts.

2.3 Electronic Products under the Project

To aid implementation of BSL-1, BSL-2 and BSL-3 laboratories, including the administration functions and operations, a number of electronic equipment's will be procured by the ZNPHI. These include various laboratory equipment, laptops, a desktop computers, printers, tablets, and flashy drives. The table 2 below lists the equipment's that will be procured on the project and the activities where they will be utilized.

Table 2: Type and Quantities of electronic devices to be procured

Types of Electronic Devices	**Activities**	**Quantity Estimates**
Laptops	Report writing, planning, electronic communications; trainings; physical and virtual meetings	20
Printers	Printing administrative material and reports, laboratory results, work plans and scanning	8
Projector	Used for presentation during meetings and trainings	4
FlashDrives	Store data	40+
Cameras	Capture videos and photos during project implementation	3
Desktops	Used as a central computer for data storage related to laboratory operations, including those for ICT operations	10
Refrigerators - Normal refrigerators - Refrigerated micro centrifuge - Table top refrigerated micro centrifuge	For sample preservation (2 to 8 degrees)	20
Light microscope	For sample examination	12
Incubators	provide a controlled, contaminant-free environment for safe and reliable work with cell and tissue cultures by regulating conditions such as temperature, humidity, and CO2	12

2.4 Current E-Waste Management in Zambia

2.4.1 Storage and Transportation

Zambia Environmental Management Agency (ZEMA) regulates the storage and transportation of generated e-waste using the same method that is applied to storage of hazardous waste materials. The general principal is that the e-waste must be stored in a storage facility with a concrete floor, appropriate ventilation and the storage facility must be well labeled (appropriate sign post) and should always be under lock and key.

As regards transportation of e-waste to any destination, only transporters with a ZEMA license to transport hazardous waste materials are allowed to transport and they must keep a record of amount of e-waste transported in form of a manifest.

2.4.2 Treatment and Disposal

Currently, there are no authentic method of reuse, recycling and recovering of electronic waste in Zambia. Additionally, it is illegal to dispose of e-waste at any disposal site, except in special cases, encapsulation of e-waste can be allowed at Chilanga Hazardous Disposal Site. Otherwise, the country is always transporting e-waste to Namibia for recycling. ZEMA has gone into partnership with the Namibia-based e-waste recycling firm NamiGreen.

Authorities such as ZEMA, ZITCA and the local councils remain concerned over the increase in e-waste volumes as a result of the fast-paced technological advancements which have resulted in

increased consumption of electrical and electronic equipment. ZICTA and ZEMA have urged local businesses to establish recycling plants in order to reduce on indiscriminate disposal of e-waste. According to a 2018 ICT survey conducted by the Zambia Information and Communications Technology Authority (ZICTA), the country disposes 90% of its e-waste in dumpsites and only 10% of the population using electronic devices are aware of the risk associated with careless disposal of e-waste. E-waste disposed at landfill triggers toxic materials seep into groundwater, affecting both land and aquatic life. Additionally, when e-waste is openly burnt, resultant toxic chemicals are released, polluting the air, and damaging the atmosphere thereby presenting a high risk to human health and the environment. These are some of the reasons disposal of e-waste is prohibited at disposal site or landfill, here in Zambia.

2.5 E-Waste Management Legal Framework, ESHG and GIIP

2.4.1 Zambian Law

The Environmental Management (Licensing) Regulations (SI. No 112 of 2013) implements the Environmental Management Act 2011 and concerns a wide variety of matters regarding environmental protection including air quality control, waste management, hazardous waste, and other substances harmful to the environment such as pesticides and ozone-depleting substances. E-Waste belongs to the fifth schedule, regulation 18 (1), list of hazardous wastes, 'Waste electronic or electronic assemblie.' There is no known method of disposal of e-waste in Zambia, except authorization by ZEMA to licensed transporters to transport e-waste to companies that are able to recycle the material. In this respect, any contractor that is contracted to treat, handle, transport, store, dispose of, transit, trade in shall hold a ZEMA hazardous waste license. Such contractors have special instructions never to dispose e-waste at any designated disposal site but to facilitate transportation and recycling means possible (reuse, recycle and recover). Record of amount disposed/transported will be kept for reference and monitoring purposes. It must be noted that Zambia has one known hazardous waste disposal site, approved by ZEMA, and it is specifically for disposal of Asbestos Containing Materials. The site is known as the Asbestos Disposal Site. However, there can be special arrangements to dispose of e-waste by encapsulation at this site, being the only known disposal site for hazardous waste in the country. A manifest must always be filled in and filed for reference each time there is movement of e-waste from one location to another

2.4.2 WBG ESHG

The WBG ESHG promotes waste prevention, reuse and recycling, good housekeeping, inventory control, avoidance of damage and instituting procurement measures that allow the return of reusable material. It requires the segregation of hazardous type wastes from other waste, its appropriate storage (labelled containers) and record keeping. It allows collection, transport, and

disposal in accordance with the Environmental Management (Licensing) Regulations (SI. No 112 of 2013). The ESHG also requires monitoring records for hazardous waste collected, stored, or shipped using the recommended procedures.

2.4.3 Good International Industry best Practice (GIIP)

GIIP promotes the use of an obligation on distributors to offer to consumers a take-back system where E-waste items can be disposed of free of charge. There are two types of take-back systems, and distributors of EEE items must offer one of these schemes to their customers. Examples include free in-store take-back scheme where distributors accept E-waste items from customers purchasing equivalent new items. Distributor take-back scheme where consumers can dispose of WEEE items free of charge at designated collection facilities. E-waste generators should manage and dispose of E-waste responsibly in ways already mentioned in the preceding paragraphs. In addition, when purchasing a new electrical item arrange with the retailer to collect the old one. Businesses and other users (i.e., schools, hospitals, and government agencies) of electrical and electronic goods (EEE) must ensure that all separately collected E-waste is treated and recycled.

2.5 E-Waste Mitigation Measures and Management/Disposal Plan

This E-waste management plan contains proposed mitigation measures through which all E-waste can be managed in accordance with Zambian law, WB ESF, WB ESHG and GIIP. The mitigation measures or guidelines have been designed in order to avoid, minimize, and reduce negative environmental and social impacts at the project level. The mitigation measures are presented in table 3 in a descriptive format.

2.5.1 Procurement of electronic items of a high quality

The first mitigation measure is to ensure that all electronic devices are procured from retailers and sources that are credible, that all devices will have a clear date of manufacture and warranty and the item is of a high quality. This will avoid procurement of poor quality, refurbished, or used second hand electronic devices with a shorter life cycle that leads to a rapid generation of E-waste. All items should be purchased where applicable, with protective covers and insurance. If possible, retailers or source of electronic items should be engaged where a repair, renewal, recycling or take back scheme option is offered. If the retailer of source does not offer some or all of these options, then the project is to locate legally licensed facilities that do repair or recycle electronic items.

2.5.2 Awareness and Sensitization

Awareness and sensitization of ZNPHI Laboratory workers and ICT personnel, including the members of staff at the new project site who will use the electronic devices, on the proper disposal of the same, once they become damaged, irreparable or at their end of life. Awareness and sensitization will also be extended the contractors, in the event that they generate e-waste during the construction period. The sensitization program will include the usefulness and significance of

E-waste recycling, and the need for returning back all electronic items procured by the project to a collection centre that should be established and managed by the ICT personnel, up to final transportation of the e-waste away from the premises by ZEMA Licensed transporter.

2.5.3 Disposal

The last option in the management of E-waste is disposal. All E-waste should be segregated from other waste, collected at a designated point which will be managed by an ICT personnel, who will properly store the waste in a well labelled container. When preparing for shipment the following should be implemented:

- Name and identification number of the material(s) composing the E-waste
- Physical state (i.e., solid, liquid, gaseous or a combination of one, or more, of these)
- Quantity (e.g., kilograms or liters, number of containers)
- Waste shipment tracking documentation to include, quantity and type, date dispatched, date transported, and date received, record of the originator, the receiver, and the transporter
- Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the E-waste
- Location of each e-waste within the facility, and the quantity at each location
- Transporter/Contractor must have a ZEMA hazardous waste license

In Zambia, safe disposal of e-waste is still a new phenomenon as most people dispose of their e-waste at dumpsites together with other solid waste materials. According to an ICT survey that was conducted by the Zambia Information and Communications Technology Authority (ZICTA) in 2018, the country disposes 90% of its e-waste in dumpsites and only 10% of the population using electronic devices are even aware of the risk associated with careless disposal of such materials. However, a good number of private companies have ventured into providing waste disposal services which also includes e-waste. Another initiative is where suppliers of electronic equipment have introduced a system of taking back defective products for recycling of proper disposal. Airtel Networks Zambia Plc for example in 2020 partnered with Ericsson on a 'Product Take-Back' program to minimize the potential environmental impact associated with the disposal of decommissioned electrical equipment. These initiatives have provided an opportunity for electronic equipment users to safely dispose of e-waste through reuse, recycle or recover or better still take it back to suppliers. Currently many non-government organizations dispose of their waste through these registered private companies offering such services. More awareness is still needed to sensitize communities on the dangers of careless disposal of e-waste at landfill and on the open environment. If the recycling, reuse and recover of the e-waste fails, the only option possible for disposal of e-waste in Zambia will be by encapsulation.

2.6 Monitoring Plans and Indicators

2.6.1 Monitoring of Environmental and Social Indicators

The goal of monitoring is to measure the success rate of the project, determine whether interventions have resulted in dealing with negative impacts, whether further interventions are needed, or monitoring is to be extended in some areas. Monitoring indicators will be very much dependent on specific project contexts.

2.6.2 Monitoring

The ZNPHI implementing this project will be responsible for overall monitoring and evaluation of this E-waste management plan. The results of the monitoring reports will be submitted to the Bank. Method of verification for compliance shall be "spot checks" to enhance adherence to the strict management of e-waste on the ACDCP / ZNPHI. In addition to the ACDCP Environmental Safeguards Specialist on the PIU, the Environmental Safeguards Specialist on the Quality Assurance Team shall also conducts "spot checks" compliance inspections as well.

2.6.3 World Bank's Monitoring Support

The Bank will provide second line of monitoring compliance and commitments made in the E-Waste Management Plans through supervision. The bank will further undertake monitoring during its scheduled project supervision missions. Specifically, for each year that the agreement is in effect, ACDCP PIU will be required to submit all the monitoring reports to the Bank as part of its reporting and the Bank supervision missions will review these reports and provide feedback.

2.7 Monitoring Roles and Responsibilities

2.7.1 Ministry of Health

The Ministry of Health will provide overall responsibility on the implementation of the ACDC Project and remain the World Bank's principal client for the delivery of the program.

2.7.2 ZNPHI

The Zambia National Public Health Institute that will procure all the electrical and electronic items under the ACDCP, for the offices, ICT and the three types of laboratories (BSL-1, BSL-2 and BSL-3) will be responsible for ensuring that the mitigation measures outlined in E-waste management plans are followed. During the construction period, any obsolete e-waste generated by the PIU, or the Engineer or the Contractor, will be managed as outlined and the PIU under the ZNPHI will provide quarterly reports to the World Bank on the status of implementation of the plans. During the operations of the constructed infrastructure, after complete commissioning of all the components, ZNPHI shall be responsible for ensuring the E-Waste Management Plan is adhered to, at all times.

Below is the E-Waste Management Plan (Table 3) proposed for implementation to ensure e-waste generated is not disposed in the open environment.

2.8. Public Consultation Mechanism

Scoping meetings were held prior to project approval, during this period the various stakeholders were involved and consulted. Before and during the implementation period, there will be stakeholder engagements from time to time. The information about e-waste management will be provided to the project staff and contractors (as applicable), as well as to the communities and all other relevant stakeholders, in the early stages of the project implementation period. Subsequent engagements shall follow as will be determined by the PIU. Other than the management of e-waste, other topics to be covered shall include labor ethics, responsibilities and rights, sustainable daily issues and behavior, care for nature and biodiversity and environmental management.

For information mechanisms to the workers, actual meetings, toolbox talks, posters and/or written information as channel for communication, will be considered. As regards the communities, actual meetings, fliers and posters will be considered. PIU shall ensure active participation of local stakeholders throughout all the project phases and update the management plans accordingly.

Table 3: E-Waste Management/Disposal Plan

Issue: Procurement and provision of Electronic Devices (laptops, refrigerators, incubators, desktops, etc.)				
Impact	**Mitigation**	**Monitoring**	**Responsibility**	**Budget (USD)**
Air Pollution through improper disposal which leads to release of toxic, hazardous and carcinogenic gaseous **Human Health** Impacts due to poor disposal. **Pollution of water bodies** Electrical and electronic equipment contain different hazardous materials,	Procure Electronic devices from credible manufactures to avoid purchasing second hand, refurbished or obsolete devices with a short shelf life or already categorized as E-Waste. If possible, select sources offering repair and take back schemes. Ensure insurance coverage and electronic physical protective devices are fitted. Reuse and recycle all E-waste where applicable and possible.	Warranty and take back schemes for Electronic Devices purchased Credibility of manufacturers supplying the electronic devices	ZNPHI	0.0 USD. The mitigation and monitoring activities will be undertaken alongside the routine project activities such as procurement, trainings, monitoring visits etc.

which are harmful to human health and the environment if not disposed of carefully.	Establish E-Waste collection points in all schools, including collection bins/receptacles. Conduct awareness and sensitization targeting the users of the electronic devices to ensure that they engage in best practice for E-waste management.	Availability of E-waste receptacles at the ICT premises Number of awareness and training conducted for users of electronic devices on E-waste E-waste certificates of disposal to be issued in the event that the e-waste is encapsulated at Chilanga Hazardous Waste Disposal Site.		
Pollution of land resources including landfills Electrical and electronic equipment contain different hazardous materials, which are harmful to human health and the environment if not disposed of carefully.	Reuse or Recycle all e-waste; Establish E-Waste Collection Centre for this project, which shall be at ICT premises; Use licensed hazardous waste contractors to transport e-waste for reuse, recycle and/or recover. If none of the above options is available for a particular e-waste product, encapsulation at Chilanga Hazardous Waste Disposal site or site degazatted by the local authority, will be the only disposal option. Create and maintain records of all E-waste items for disposal,	Warranty and take back schemes for Electronic Devices purchased Availability of E-waste receptacles at ICT premises E-waste certificates of disposal using licensed hazardous waste contractors and actual encapsulation where the latter is applied. Records in place for reference	ACDCP PIU during preparation & construction ZNPHI during operation phase	0.0 USD. The mitigation and monitoring activities will be undertaken alongside the routine project activities such as procurement, trainings, monitoring visits etc.

	securely store and prepare for shipment correctly. Conduct awareness and sensitization targeting the users of the electronic devices to ensure that they engage in best practice for E-waste management.	Number of awareness and training conducted for users of electronic devices on E-waste		
Growth of informal E-waste disposal centres. Improper and indiscriminate disposal of E-waste is likely to lead to the exponential increase of informal waste disposal sites in Silverest community, which further exacerbates the problem of E-waste	Procure Electronic devices from credible manufactures to avoid purchasing second hand, refurbished or obsolete devices with a short shelf life or already categorized as E-Waste. If possible, select sources offering repair and take back schemes. Ensure insurance coverage and electronic physical protective devices are fitted. Reuse or Recycle all e-waste. Establish E-Waste Collection Centres in all schools; including collection bins/receptacles. Use licensed hazardous waste contractors to move e-waste from point of generation for reuse/recycle/recover. If non of the options is available, the same licensed contractor should transport for encapsulation, as the last option.	Warranty and take back schemes for Electronic Devices purchased Credibility of manufacturers supplying the electronic devices Availability of E-waste receptacles at ICT premises E-waste certificates of disposal using licensed hazardous waste contractors	ACDCP PIU during preparation & construction ZNPHI during operation phase	0.0 USD. The mitigation and monitoring activities will on undertaken alongside the routine project activities such as procurement, trainings, monitoring visits etc.

	Create and maintain records of all E-waste items for disposal, securely store and prepare for shipment correctly. Conduct awareness and sensitization targeting the users of the electronic devices to ensure that they engage in best practice for E-waste management.	Record of e-waste moved from point of generation with final disposal method used. Number of awareness and training conducted for users of electronic devices on E-waste		