ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT STUDIES

FOR THE PROPOSED REHABILITATION AND UPGRADE OF THE 371KM ROAD BETWEEN MUTANDA AND KAOMA IN THE NORTH-WESTERN AND WESTERN PROVINCES OF ZAMBIA

BY

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EXECUTIVE SUMMARY

Project Background

The Government of the Republic of Zambia (GRZ) has entered into a concession agreement with Barotse Highway Limited Toll Concession (BHL-TC) for the rehabilitation and upgrading of the 371 km Mutanda to Kaoma Road, also known as the Western Corridor. This project, valued at over USD 326 million, will be implemented under a Public-Private Partnership (PPP) financing model. The road traverses the North-Western and Western Provinces of Zambia, connecting Mutanda to Kaoma, and will be upgraded to international bituminous standards. The project is expected to significantly enhance regional connectivity, stimulate economic activity, and contribute to sustainable infrastructure development.

Objectives of the Project

The primary objective of the project is to improve regional connectivity, reduce travel time, and lower transportation costs, thereby facilitating trade and economic growth in the North-Western and Western Provinces of Zambia. Specific objectives include:

- Improving road infrastructure to facilitate the movement of goods and people.
- Establishing a vital corridor linking Zambia's mineral-rich Northwestern Province to the Western Corridor and the West Coast regions of Africa.
- Generating revenue through toll plazas to fund ongoing maintenance.
- Creating employment opportunities during construction and operation phases.
- Supporting local industries and communities by improving access to markets, healthcare, and education.

Project Location

The proposed project is located in the North-Western and Western Provinces of Zambia, starting in Mutanda (Kalumbila District) and ending in Kaoma (Kaoma District). The road passes through Kasempa and Mufumbwe Districts, connecting to the Mongu-Sesheke Road and ultimately linking to Walvis Bay, Namibia. Apart from a short bypass around Kaoma, the route alignment follows the existing road as this is a rehabilitation and upgrade project. This has been designed to minimize project related environmental and social impacts and particularly the displacement of villages, markets, and agricultural fields, although some minor displacements will occur.

Shareholders

The project is being developed by Barotse Highway Limited Toll Concession (BHL-TC), a Special Purpose Vehicle (SPV) formed through a collaboration between public and private sector entities, including Buks Haulage Limited (BHL), First Quantum Minerals Operations Limited (FQM), Hotsheet (Pty) Limited, and the Zambian Government's Road Development Agency (RDA).

Investment Cost

The total investment cost for the project is estimated at USD 326 million. The project is expected to commence construction in the second quarter of 2025, pending the approval of the Environmental and Social Impact Assessment (ESIA).

Project Description

The proposed project involves the rehabilitation and upgrading of the 371 km Mutanda to Kaoma Road, which will be implemented in two phases:

- **Phase 1**: Mutanda to Kasempa (150 km)
- **Phase 2**: Kasempa to Kaoma (221 km)

Key components of the project include:

- Road upgrading to international bituminous standards.
- Installation of three toll plazas and three weighbridges.
- Widening and upgrading of the Lalafuta and Chibombo Bridges.
- Replacement of substandard culverts.
- Construction of auxiliary facilities, including BHL-TC headquarters, administration offices, maintenance yards, and staff villages.
- Upgrading of 10 km of township roads in Kasempa and Kaoma Districts with Kalumbila under consideration with the RDA.

Technology

The project will utilize modern road construction technologies, including bitumen road construction, which is cost-effective and suitable for the project's requirements. The construction will involve the use of heavy machinery such as bulldozers, graders, excavators, and compactors, as well as raw materials like cement, bitumen, gravel, and stone aggregates. The project will also incorporate sustainable practices, such as minimizing vegetation clearance and implementing wildlife protection measures.

Project Alternatives

The project considered several alternatives, including:

- **Do-nothing option**: This would lead to continued deterioration of the road, increased travel times, and higher maintenance costs.
- **Routine maintenance and minor upgrades**: This would provide only temporary solutions and not address the full capacity needs of the road network.
- **Rehabilitation and upgrade of the road**: This was chosen as the preferred option due to its long-term benefits, including improved safety, reduced travel times, and enhanced regional connectivity.

Once rehabilitation and upgrade were identified as the preferred option, additional alternatives under this broad category were considered. This included various route options including large scale bypass alternatives around Kasempa and Kaoma. These bypass routes were investigated during specialist environmental and social field visits. Ultimately the increased social and environmental impacts of the “green fields” sections were considered to be unacceptable and the decision to follow the current road was preferred.

Relevant Legislation

This study took into account the relevant legislations including the Environmental policies and framework. The following are the relevant legislations for the proposed project:

- National Conservation Strategy (NCS)
- Environmental Protection and Pollution Control Act (EPPCA)
- National Environmental Action Plan (NEAP)
- National Policy on Environment (NPE)
- National Resettlement Policy (NRP)
- Environmental Management Act, No. 12 of 2011 as amended by the Environmental Management (Amendment) Act No. 8 of 2023
- Environmental Impact Assessment Regulations (No. 28 of 1997)
- Environmental Management Licensing Regulations
- Lands Act No. 20 of 1996 read as one with the Lands Amendment Act No 20 of 2015
- Local Government Act No. 2 of 2019
- Urban and Regional Planning Act No. 3 of 2015
- Factories Act, Cap 441 of 1996
- Public Health Act, Cap 295 of 1995
- Public National Public Health Institute Act, No.19 of 2020
- Statutory Instrument No. 22 of 2020, the Public health (infected areas) (Corona Virus Disease) Regulations, 2020
- Statutory Instrument No. 21, Public Health (Corona Virus) infectious disease
- The Public Health (Notifiable Infectious Disease) (Declaration) Notice, 2020
- Petroleum Act No. 10 of 2008
- National Heritage Conservation Commission (Amendment) Act No. 13 of 1994
- The Forest Act No. 4 of 2015
- The Water Resources Management Act No. 21 of 2011
- The Zambia Wildlife Act No. 14 of 2015
- The Occupational Health and Safety Act No. 36 of 2010
- The Workers' Compensation Act No. 10 of 1999
- The Employment Code Act No 3 of 2019
- Roads and Road Traffic Act, Cap 464
- Chiefs Act, Cap 287
- The Energy Regulation Act No. 12 of 2019
- National Council for Construction Act No. 10 of 2020
- The Solid Waste Regulation and Management Act No. 20 of 2018
- National HIV/AIDS/STI & TB Council Act No. 10 of 2002
- United Nations Framework Convention on Climate Change, 1992
- The Paris Agreement
- Convention concerning the Protection of the World Cultural and National Heritage (1972)
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1992)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)

Potential Impacts

The project is expected to have both positive and negative environmental and social impacts. Key impacts include:

Negative Impacts:

- **Land and Soil Degradation**: Soil erosion and contamination due to construction activities.
- **Resettlement and Livelihood Disruption**: Minor displacements of villages, markets, and agricultural fields, with potential impacts on affected communities' livelihoods and social structures.
- **Air Quality and Dust Emissions**: Dust and exhaust emissions from construction machinery and vehicles (whilst this is a negative impact in the short term the long-term reduction in dust is considered positive).
- **Water Quality and Flow**: Potential contamination of surface and groundwater from construction activities.
- **Noise Pollution**: Noise from construction machinery and increased traffic.
- **Public Health and Safety**: Increased risk of accidents and spread of diseases such as HIV/AIDS.
- **Loss of Vegetation and Wildlife Habitat**: Clearing of vegetation and disturbance of wildlife corridors, particularly in Game Management Areas (GMAs) where the road passes through.
- **Direct loss of wildlife through construction and operational phase mortality**. Construction phase mortality includes poaching, vehicle collision and risks associated with excavations. Operational phase mortality primarily relates to vehicle collisions.

Positive Impacts:

- **Economic Benefits**: Creation of up to 1,000 jobs during construction and 250 long-term jobs during operations.
- **Improved Connectivity**: Enhanced regional connectivity and reduced travel time.
- **Social Development**: Improved access to healthcare, education, and other essential services for local communities.

Mitigation and Enhancement Measures

To mitigate negative impacts, the project will implement measures such as:

- **Land and Soil Degradation**: Implement erosion control measures, such as temporary drainage systems and re-vegetation of disturbed areas.
- **Air Quality and Dust Emissions**: Regularly water work sites and access roads to suppress dust.
- **Water Quality and Flow**: Implement silt traps and erosion control measures to prevent sedimentation of water bodies.
- **Noise Pollution**: Restrict noisy activities to daytime hours and provide ear protection for workers.
- **Public Health and Safety**: Conduct health and safety awareness campaigns and provide protective equipment for workers.
- **Wildlife Protection**: Minimize vegetation clearance and implement wildlife protection measures, such as speed limits, wildlife crossings, and rescue and induction programs for animals. Recognizing that critical wildlife habitats and migration corridors intersect with the road route, the project will prioritize the implementation of robust mitigation measures designed to minimize and prevent injury, accidents, and mortality of wildlife.

To enhance positive impacts, the project will:

- Prioritize the employment of local community members and provide skills training.
- Prioritize local contracting and supply of goods.
- Ensure the road is well-maintained and integrated into the national transport network.
- Upgrade access roads to schools, health centres, and traditional arenas.

Project Lifespan

The project is structured to span a total of 25 years, including a 2-year construction phase followed by 23 years of operations and maintenance. At the end of this concession period the upgraded road infrastructure will be formally handed over to the government ensuring its sustainability and integration into Zambia's national transport network. The road is expected to have a lifespan of 50 years.

Conclusion

The rehabilitation and upgrading of the 371 km Mutanda to Kaoma Road is a critical infrastructure project that will bring significant economic and social benefits to the North-Western and Western Provinces of Zambia. By adhering to the proposed mitigation measures and engaging with stakeholders, the project aims to minimize adverse environmental and social impacts while maximizing the benefits for local communities and the region as a whole. The successful implementation of this project will contribute to the long-term development and prosperity of the region, enhancing connectivity, trade, and quality of life for the people of Zambia. The project also demonstrates a commitment to environmental and social responsibility through the incorporation of modern construction standards and stakeholder engagement, ensuring that its implementation delivers broad-based benefits to the region and the nation as a whole.

NON-TECHNICAL SUMMARY (English)

Project Background

The Government of the Republic of Zambia (GRZ) has entered into a concession agreement with Barotse Highway Limited Toll Concession (BHL-TC) for the rehabilitation and upgrading of the 371 km Mutanda to Kaoma Road, also known as the Western Corridor. This project, valued at over USD 326 million, will be implemented under a Public-Private Partnership (PPP) financing model. The road traverses the North-Western and Western Provinces of Zambia, connecting Mutanda to Kaoma, and will be upgraded to international bituminous standards. The project is expected to significantly enhance regional connectivity significantly, stimulate economic activity, and contribute to sustainable infrastructure development.

DH Engineering Consultants Ltd has been appointed as the independent Environmental and Social Impact Assessment (ESIA) practitioner to compile the ESIA for this project. The ESIA process involved specialist data gathering, site visits, and consultation with affected stakeholders to identify issues of concern that need to be addressed as part of the ESIA.

Project Description and Components

The proposed project involves the rehabilitation and upgrading of the 371 km Mutanda to Kaoma Road, which will be implemented in two phases:

- **Phase 1**: Mutanda to Kasempa (150 km)
- **Phase 2**: Kasempa to Kaoma (221 km)

The key components of the project include:

- **Road Upgrading**: Rehabilitation and upgrading of the 371 km road to international bituminous standards.
- **Toll Infrastructure**: Installation of three toll plazas to generate revenue for ongoing maintenance.
- **Weighbridges**: Construction of three weighbridges to regulate vehicle weight and protect the road from premature wear.
- **Bridge Upgrades**: Widening and upgrading of the Lalafuta and Chibombo Bridges.
- **Culvert Replacement**: Replacement of all substandard culverts to ensure structural integrity and drainage efficiency.
- **Auxiliary Facilities**: Construction of BHL-TC headquarters, administration offices, maintenance yards, and staff villages.
- **Township Roads**: Upgrading of 10 km of township roads in Kasempa and Kaoma Districts with Kalumbila under consideration with the RDA.

The project will also include the construction of new bridges, traffic circles, and a bypass, as well as the establishment of operations and maintenance yards.

Objective of the Project

The primary objective of the project is to improve regional connectivity, reduce travel time, and lower transportation costs, thereby facilitating trade and economic growth in the North-Western and Western Provinces of Zambia. The upgraded road will serve as a critical gateway for commerce with Angola, Botswana, Namibia, and beyond, fostering economic integration with the western hemisphere.

Project Location

The proposed project is located in the North-Western and Western Provinces of Zambia, starting in Mutanda (Kalumbila District) and ending in Kaoma. The road passes through Kalumbila, Kasempa, Mufumbwe and Kaoma Districts, connecting to the Mongu-Sesheke Road and ultimately linking to Walvis Bay, Namibia.

Shareholders

The project is being developed by Barotse Highway Limited Toll Concession (BHL-TC), a Special Purpose Vehicle (SPV) formed through a collaboration between public and private sector entities, including Buks Haulage Limited (BHL), First Quantum Minerals Operations Limited (FQM), Hotsheet (Pty) Limited, and the Zambian Governments Road Development Agency (RDA).

Investment Cost

The total investment cost for the project is estimated at USD 326 million. The project is expected to commence construction in the second quarter of 2025, pending the approval of the ESIA.

Technology

The project will utilize modern road construction technologies, including bitumen road construction, which is cost-effective and suitable for the project's requirements. The construction will involve the use of heavy machinery such as bulldozers, graders, excavators, and compactors, as well as raw materials like cement, bitumen, gravel, and stone aggregates.

Identified Environmental and Social Impacts of the Project, Mitigation and Enhancement Measures

The proposed project is expected to have both positive and negative environmental and social impacts. The key impacts and proposed mitigation measures are summarized below:

Negative Impacts and Mitigation Measures

1. **Land and Soil Degradation**:
    - **Impact**: Soil erosion and contamination due to construction activities.
    - **Mitigation**: Implement erosion control measures, such as temporary drainage systems and re-vegetation of disturbed areas.
2. **Air Quality and Dust Emissions**:
    - **Impact**: Dust and exhaust emissions from construction machinery and vehicles.
    - **Mitigation**: Regularly water work sites and access roads to suppress dust.
3. **Water Quality and Flow**:
    - **Impact**: Potential contamination of surface and groundwater from construction activities.
    - **Mitigation**: Implement silt traps and erosion control measures to prevent sedimentation of water bodies.
4. **Noise Pollution**:
    - **Impact**: Noise from construction machinery and increased traffic.
    - **Mitigation**: Restrict noisy activities to daytime hours and provide ear protection for workers.
5. **Public Health and Safety**:
    - **Impact**: Increased risk of accidents and spread of diseases such as HIV/AIDS.
    - **Mitigation**: Conduct health and safety awareness campaigns and provide protective equipment for workers.
6. **Loss of Vegetation and Wildlife Habitat**:
    - **Impact**: Clearing of vegetation and disturbance of wildlife corridors and direct loss of wildlife
    - **Mitigation**: Minimize vegetation clearance and implement wildlife protection measures, such as speed limits, rescue and induction and wildlife crossings.

Positive Impacts and Enhancement Measures

1. **Economic Benefits**:
    - **Impact**: Creation of up to 1,000 jobs during construction and 250 long-term jobs during operations.
    - **Enhancement**: Prioritize the employment of local community members and provide skills training.
2. **Improved Connectivity**:
    - **Impact**: Enhanced regional connectivity and reduced travel time.
    - **Enhancement**: Ensure the road is well-maintained and integrated into the national transport network.
3. **Social Development**:
    - **Impact**: Improved access to healthcare, education, and other essential services for local communities.

- **Enhancement**: Upgrade access roads to schools, health centres, and traditional arenas.

Conclusion

The rehabilitation and upgrading of the 371 km Mutanda to Kaoma Road is a critical infrastructure project that will bring significant economic and social benefits to the North-Western and Western Provinces of Zambia. By adhering to the proposed mitigation measures and engaging with stakeholders, the project aims to minimize adverse environmental and social impacts while maximizing the benefits for local communities and the region as a whole.

Recommendations

1. **Strict Adherence to Environmental and Social Standards**: Ensure compliance with Zambian legislation, including the Environmental Management Act and the National Resettlement Policy.
2. **Stakeholder Engagement**: Maintain continuous engagement with affected communities and stakeholders to address concerns and foster positive relationships.
3. **Sustainable Development Practices**: Maximize the use of local resources and labour, and implement environmentally friendly construction methods.
4. **Monitoring and Evaluation**: Regularly monitor the project's environmental and social performance and provide reports to relevant authorities.

The successful implementation of this project will contribute to the long-term development and prosperity of the region, enhancing connectivity, trade, and quality of life for the people of Zambia.

NON TECHNICAL SUMMARY (KAONDE)
KWIPIPISHA KWAPEELA KUMVWA (Kikaonde)

NGIPISHILO – KATA

Ntendekelo Ya Mwingilo wa Bukomo/ Pulojekiti

Kafulumende wa kyalo kya Zambia (GRZ) wafwachika lumvwan'ano na kampanyi kateelwa amba *Barotse Highway Limited Toll Concession (BHL-TC* mu bwipi) pa mwingilo wa kubwezha manenekela pa lubaji lumo lwa mukwakwa waonaika apa kabiji ne kubiika manenekela pa lubaji lukwabo lwa mukwakwa mwabujile manenekela; mbaji ibiji ya mukwakwa kya pamo yaleepa makilomita 371, kufuma pa Mutanda kufika pa Kaoma, awo mukwakwa ukateelwa amba '**Kwenkwa waku Muzhika'**. Mwingilo wa uno mukwakwa yense, awo wasopelelwa kafwapo maali afika ku USD 326 milyonyi; ko kuuba amba maali 326 milyonyi a Madola a kina Meleka, ukengijiwa kupichila mu lunengezho lubeena kuteelwa amba *Public-Private Partnership* (PPP), nangwa amba, 'Kukwatankena pamo kwa Kafulumende na Busulu - kata bwiimena.' Uno mukwakwa walalankanya bibunji bibiji bya Zambia bya Buyeke – Muzhika ne Muzhika, kukwantankanya Mutanda ne Kaoma, kabiji ukabiikiwa manenekela pa kipimo kya mikwakwa ya manenekela yaitabizhiwa mu ntanda yonse. Mwingilo wa uno mukwakwa unvwe wapwa ubena kuketekelwa kusuntula paabaya bingi lukwatankanyo lwa bibunji bibiji, kutundaika mingilo ya busulu apa kabiji ne kununga ku bishimikwa bya bukomo bitwajijila pa kimye kyaleepa.

Ba DH Engineering Consultants Limited, kampanyi keimeena ka basendwe baapeya mu bya kupesapesa pa boono bubiwa ku buzhokoloke ne bwikalo bwa bantu beekala mu mapunzha mubiwa uno mutundu wa mwingilo; mwingilo uteelwa mu kizungu amba *Environmental and Social Impact Assessment,* mu bwipi amba *ESIA*, baatongolwa kunemba sawakya pa byo bakataana mu kupesapesa kwabo pa boono bukobiwa mu mapunzha mukengijiwa mwingilo wa mukwakwa. Ndonda ya mutanchi wa ESIA yavwangamo kwingijisha mpeyo ya kubungizha bishinka, kuya mu mapunzha mukengijiwa mwingilo wa uno mukwakwa ne kukepuzha-ipuzhanga na bangikazhi beekalamo pakuuba amba pa kekale kuyuuka makatazho akaketekelwa kusebezelwapo, ne pakuba amba abino byonse bikavwangiwe mu sawakya wa *ESIA* ye baatongwelwa kunemba.

Kulumbulula kwa Mwingilo wa Mukwakwa.

Uno mwingilo wa mukwakwa waipuzhiwa wavwangamo kubwezhiwa kwa manenekela pa lubaji lwa mukwakwa waonaika, apa kabiji ne kubika manenekela pa lubaji lukwabo lwa mukwakwa paabula manenekela, ayo mbaji yonse ya mukwakwa kya pamo yaleepa makilomita 371 kufuma pa Mutanda ne kukafika pa Kaoma. Uno mwingilo ukengijiwa mu bipungu bibiji:

- **Kipungu 1**. Kufuma pa Mutanda kufika pa Kasempa (makilomita 150).
- **Kipungu 2.** Kufuma pa Kasempa kufika pa Kaoma (makilomita) 221).

Mbaji ikatampe ya uno mwingilo wa bukomo:

- **Kusuntulwa kwa kipimo kya mukwakwa:** Kubwezhiwa kwa manenekela ne kubiikiwa kwa manenekela pa musinso yense wa mukwakwa waleepa makilomita 371; kumuwamisha ne kumukosesha pa kipimo kyaitabizhiwa ntaanda yonse kya mikwakwa ya manenekela.

- **Bishimikwa bya kusonkesha myotoka ikengijishanga mukwakwa:** Kubiikiwa kwa bishimikwa bisatu (3) byakusonkesha musonko wa myotoka ikengijishanga uno mukwakwa kukoobiwa na mulanguluko wa kusaka kukekalanga na nsabo ya kukatwajijilanga kuwamisha mukwakwa inge watendeka konaika.

- **Mashikeelo a mu mukwakwa a kupiminapo binemenezhi bya myotoka:** Kukabiikiwa mashikeelo – kata a kukapiminangako binemenezhi bya myotoka na mulanguluko wa kukeba kuzhikijila mukwakwa ku boono bukoonsha kubiwa ku mukwakwa bukiji-bukiji.

- **Kubayisha ne kukosesha byaabu:** Kubayisha ne kukosesha byaabu bya mikola Lalafuta ne Chibombo kukoobiwa.

- **Kuwamisha makalabachi**
  Kufumyapo makalachi a kala ne kubwezhapo makalabachi a kosa kabiji apisha meema bulongo.

- **Bishimikwa bya kukwasha mwingilo wa uno pulojekiti:** Kukatungiwa pa mpuzha imo ya maofweshi-kata a kampanyi waba *BHL-TC* apo pakatanyiwa maofweshi a buntangi bwa kampanyi, yaadi kwa kulamina bamashinyi ne bin'amban'amba bya kampanyi, apa kabiji ne mizhi yaba mingilo.

- **Mikwakwa ya mu maboma:** Kubiika manenekela makilomita jikumi (10) pa mikwakwa ya mu maboma a Kasempa ne Kaoma pa kipimo kyaitabilwa kya mikwakwa ya manenekela ya ntanda yonse.

Mingilo ya uno pulojekiti ikavwangamo kushimika byabu bipya, bizhingu pa kuzhokolokela myotoka, mikwakwa ya mupita-nzhooka ne kwikajikwa kwa mbaji ya mayadi kwa kulamina bing'ambang'amba bya kwingijisha ne kwa kulungingishisha bamashinyi.

Kiketekelo kikatampe kya mwingilo wa uno pulojekiti.

Kiketekelo-kata kya mwingilo wa uno pulojekiti ke kukeba kuwamishako lukwatankanyo lwa bibunji, kukeepeshako kimye kitayiwa pa kwenda/ kufika, kukepeshako maali atayiwa ku myotoka pa kusenda bipe, ne mu kyokyo kupeezhaako Mashinda mwa kubila busulu - kupotwanzhana ne kukomesha busulu mu bibunji bya Buyeke-Muzhika ne Muzhika wa Zambia. Uno mukwakwa pa kumuwamisha ne kumukosesha ukengila noobe kibelo kya nsakwa kya busulu ku byalo bya Angola, Botswana, Namibia, ne byalo bya kulutwe, mu kutundaika lukwatankanyo lwa kupotanzhanya na byalo bya bazungu.

Kwaikeela mwingilo wa uno pulojekiti

Mwingilo waipuzhiwa wa uno pulojekiti waikeela mu bibunji bya Buyeke-Muzhika ne Muzhika wa Zambia, kutendekela pa Mutanda mu nkambi ya Kalumbila ne kukapelela mu Kaoma. Uno mukwakwa wapita mu makambi a Kasempa ne Mufumbwe ne kukasanga mu mukwakwa wafuma ku Mongu kuya ku Sesheke, ne mu kupelako kukwatankanya Kito kya Walvis Bay mu Namibia.

Bajiimo na lubaji mu mwingilo wa uno pulojekiti

Mwingilo wa uno pulojekiti usa kukengijiwa naba Barotse Highway Limited Toll Concession (BHL-TC), kampanyi walengewatu na mambo a uno mwingilo wa mukwakwa (Special purpose vehicle) kabiji ukasebezela pamo na kafulumende ne makampanyi eimeena ao avwangako Buks Haulages Limited (BHL), be First Quantum Minerals Operations Limited Operations Limited. (FQM), Hotsheet (Pty) Limited, ne ba Zambian Government Road Development Agency (RDA).

Maali abiikwa mu uno pulojekiti

Tootala yense wa maali abiikwa mu mwingilo wa uno pulojekiti asopelelwa kufika ku USD 326 milyoni (a Madoola a kina Meleka). Mwingilo wa uno pulojekiti ubena

kuketekelwa kutendeka mu kimye kya ban'ondo basatu bakutwala pakachi ka mwaka wa 2025, kupembelela kuswishiwa kwa sawakwa wa ESIA.

Kashinshi ne Busendwe

Mwingilo wa uno pulojekiti, ukengijiwa mu mashinda apya a kashinshi ne busendwe a kulengelamo mikwakwa, kubiikapotu ne a kulengelamo mikwakwa ya manenekela, apo pafwa maali ayiila mu bukose bwa mwingilo waingijiwa mwayila nkebelo ya mwingilo wa pulojekiti. Mwingilo wa kusuntula buwame ne bukose bwa uno mukwakwa ukavwangamo kwingijisha bamasembe bakatampe nabiji bakatapila, baguleeda, ba ekusikaveta ne tumaama, kubiikapotu ne bingijisho bya kuuba noobe shamende, manenekela, balashi ne mabwe a kulala.

Boono bubeena kuketekelwa kubiwa ku buzhokoloke ne ku bantu ba mu mapunzha mukengijiwa uno mwingilo ne byo bukasebezelwapo

1. **Konaunwa kwa ntaanda ne mushiji**
    - **Boono:** Kukwemuka ne kukoweshiwa kwa mushiji na mambo a mwingilo wa kupaabula mukwakwa ne kubiika manenekela.
    - **Bikasebezewapo:** Kulenga mashinda a kukankenyamo mushiji kukwemuka nabiji kulenga mifoolo yapa kakimye kacheche ne kujimba bichi momwa mo byaonaunwa na mambo a mwingilo wa uno pulojekiti.

2. **Mweela ne kufukula lukungu:**
    - **Boono:** Lukungu ne bwishi kufuma ku myotoka ne bamasembe bakasebezanga.
    - **Byobikasebezewapo:** Kimye kyonse kukekala kutekezha mapunzha ne mikwakwa mu kukepesha lukungu.

3. **Meema ne kupita kwao:**
    - **Boono:** Kukoweshiwa kwa meema a peulu ne a panshi ya mushiji na mambo a uno mwingilo wa mukwakwa.
    - **Byo bikasebezewapo:** Kulenga mikiika ya nkwemu-nkwemu (biswaswa, mabuula ne byonse bisendwa na mukwe wa meema) ne mashinda kukankenyamo kukwemuka kwa mushiji mu kuzhikijila mikola ne mazhiba a meema kubula kuzhiikama.

4. **Kuvula kyongo:**
    - **Boono:** Kyongo kufuma ku myotoka yavujilako ne bamasembe.
    - **Byo bikasebezewapo:** Kupaana ku bamingilo bya kubiika mu matwi mu kukepeshako kyongo ne kulengela myotoka ne bamasembe kukasebezangatu kimye kya mute kwapwa.

5. **Butuntulu ne luzhikijilo lwa bwina-kengi:**
    - **Boono:** Kuvujilako kwa bizumba bya mapuso pa nkito ne kusambula kwa bikola byakuba nobe HIV/AIDS (KAKEBU ne Muzezempuya).
    - **Byo bikasebezewapo:** Kuuba tumpeenyi twa kujimuna pa bikola bisambukila mu mibiji ya bantu ne bya kwizhikijila, apa kabiji ne kupaana bing'ambang'amba bya kwizhikijila ku bikola bamingilo.

6. **Kuzhiya kwa bichi ne nsono mu buzhokoloke ne konaunwa kwa mwikala banyama.**
    - **Boono:** kukundaula bichi ne kusembulula nsono.
    - **Byo bikasebezewapo:** Kukepeshako kukundaula bichi ne kusembulula nsono na bamasembe, apa kabiji ne kwingijisha mashinda akuzhikijilamo banyama ba mungye nobe kubika bin'gamban'gamba bisopa myotoka yendela pa masekenyi abula kuswishiwa na mizhilo ya kyalo (*speed limits*, mu kizungu), kupulusha ne kuzhikijila pa kilang'enya banyama ba munye.

Byawama ne kutundaika

1. **Bukomo bwa kumwenamo**
    - **Buwame:** Kulengwa kwa makito kiumbi kimo (1,000) kimye kya uno mwingilo wa mukwakwa ne makito a kikupu 250 kimye kikatendeka kusebeza mukwakwa.
    - **Lutundaiko:** Kumona amba bangikazhi bamu bijiji mukobiwa mwingilo wa uno pulojekiti bo bakatwezhiwa makito ne kwiba funjisha busendwe bwapusana-pusana.

2. **Kuwaminako kwalukwatanyo:**
    - **Buwame:** kuwaminako kwa lukwatankanyo ne ku kepeshako kwa kimye kitayiwa pa kwenda/ kufika.S
    - **Lutundaiko:** kumona ambe mukwakwa watwajijila kulamiwa bulongo kasa akosa kabiji ne kuvwanjiwa kutangatanga kwa mikwakwa ya kyalo kyonse
3. **Bukomo mu bwikalo bwa bantu**
    - **Buwame:** kuwaminako kwa lubuko lwa mu bipatela, kwa lufundo ne bya kuwamishako bwikalo bikwabo mu bijiji mukapita auno mukwakwa.
    - **Lutundaiko:** kuwamisha ne kukosesha mikwakwa yaya kuma sukulu, ku bipatela, na kubibanza bya makayo.

Mpezho

Kubwezha manenekela pa lubaji lwa mukwakwa waonaika ne kubiika manenekela pa lubaji lukwabo lwa mukwakwa mwabula manenekela, apo kya pamo paji musinso walepa makilomita 371, kufuma pa Mutanda kukafika ku Kaoma, ke mwingilo wa pulojekiti wa kila mu kunema kabiji ukaleta bukomo ne bubile bwa bayilako ku bibunji bibiji bya Buyeke-Muzhika ne Muzhika wa Zambia. Kupichila mu kulondela mashinda a kukepeshako boono ku buzhokoloke ne ku kepuzha-ipuzhanga na boba uno mwingilo bo a kaletela bufinda, mwingilo wauno pulojekiti, awo waimeena pa kusaka kusebeza papela ngovu yonse mu kukepeshako boono bubiwa ku buzhiokoloke ne ku bufinda bukaletwa ku bwikalo bwa bantu bekala mu bijiji mukengijiwanga uno mwingilo, pa kimye kimotu kasa abena kuvuzha bya kumwenamo ku bangikazhi bamu byobyo bijiji ne mu bibunji byonse bibiji.

Bya kulondela

1. **Kulondela bipimo bya-alwa pa buzhokoloke ne bwikalo bwa bantu kwakubula kukankalwa:** Kukela kumona amba mizhilo ya Zambia yalondelwa nzolo kijoma, kubikapotu ne muzhilo wa kulaminamo buzhokoloke apa kabiji ne wa kuvilwilamo bantu

2. **Kwisamba pa kimye pa kimye na bantu bamu mapunzha mukengijiwanga mingilo ya uno pulojekiti:** Kutwajijila na kwisamba na bangikazhi ba mu bijiji mukengijiwanga uno mwingilo mu kusaka kuyuka makatazho oba katalan'gananga nao ne byo akasebezewapo, apa kabiji ne kulenga bulunda bwatwajijila nabo.

3. **Mingilo ya bukomo itwajijila:** Kuvuzha n'gingijisho ya bintu bya mu buzhokoloke ne ba mingilo batanyiwamo, ne kwingijisha mashinda a bulwamo bulembe a kuwamishishamo ne ku koseshamo mikwakwa.

4. **Kusopa, kupimapima ne kupimununa:** Kulonda-londa kwa pa kimye pa kimye kwa bikobiwanga ku buzhokoloke ne ku bwikalo bwa bantu apa kabiji ne kupaana sawakya kuba luusa baelelwa. Kupwisha na kutondwa kwa mwingilo wa uno pulojekiti kukanunga ku bukomo bwa kimye kyaleepa ne bubile bwa kibunji, kubayisha lukwatankanyo lwa mapunzha, kupotanzhana (busulu), apa kabiji ne kusuntula bwikalo bwa bena Zambia.

NON-TECHNICAL SUMMARY (SILOZI)
LITABA KABUKUSWANI

Mubuso wa naha ya Zambia (GRZ) ukeni mwa kutwano ni ba Barotse Highway Limited Toll Concession (BHL-TC) fa taba ya ku lukisa mukwakwa wa 371 km kuzwa Mutanda kufita mukwakwa wa Kaoma, ye bizwa Western Coorridor. Mutomo wo, wa teko ye fita USD 326 million, uka tomiwa ka Public Private Partnership (PPP). Mukwakwa ufita mwa North-Western ni mwa Western Province ya Zambia, kuzwa Mutanda kufita Kaoma, nikuli hape uka yahiwa kulikanela international bituminous standards. Mutomo wo ulukanela ku ngunganyeleza sibaka, ku kalisa likezo za zwelopili niku ekeza kwa miyaho ya zwelopili.

Ba DH Engineering Consultants Ltd batomilwe kuba bo independent Environmental and Social Impact Assessment (ESIA) practitioner ku ñola ESIA ya Mutomo wo. Musebezi waku panga ESIA kiwa ku ñola za butokwa ahulu, ku potela mabaka, ni ku ambolisana ni batu kaufela ku fumana litaba ze lukanela ku talimiwa mwa ESIA.

Taluso ya Mutomo ni Zabutokwa

Mutomo wo ki wa kulukisa ni ku yaha 371 km ya mukwakwa wozwelela kwa Mutanda kufita Kaoma, wo ka eziwa ka linako zepeli:

- **Nako ya makalelo (1):** Mutanda kufita Kasempa (150km).
- **Nako ya bubeli (2):** Kasempa kufita Kaoma (221 km).

Lika zabutokwa ahulu fa Mutomo wo ki ze:

- Kuyaha Mukwakwa: kulukisa ni ku yaha mukwakwa wa 371 km kulikanela ni ye bizwa ka sikuwa kuli international bituminous standards. Muyaho wa Toll: Kuyaha miyaho yemilalu ya ku lifisa limota ku fumana sheleñi ya ku belekisa.
- Ma Weighbridges: Ku yaha ma *weighbridge* amabeli ni ku sileleza mukwakwa kuli usike wa sinyeha kamaubebe.
- Kuzibisa kitana za ma Bridge: ku ekeza kwa muyaho wa bridge Lalafuta ni Chibombo.
- Kubeya ma Culvert amancha: Ku kutisa ma culvert ya sikaiketa ka mokulukanela nikulukisa hande linzila za mezi.
- Mabaka aku belekisa: Ku yaha muyaho wo mutuna wa ba BHL-TC, ma ofisi ya babeleki, mabaka ya ku lukiseza li meshini ni ku yaha minzi ya babeleki.
- Mikwakwa ya mwama tauni: Ku ekeza kwa mukwakwa wa 10 km mwa Likiliti za Kasempa ni Kaoma ku likanelela ni bituminous standards.

Mutomo wo uka yaha ma bridge, ni faku potolohela limota, ni linzila zemwi zakuitusisa kwanda mikwakwa yemituna, kubeya ni kutoma kwa mabaka ya ku belekela mwateñi.

Seukatisa Mutomo Wo

Mutomo wo ulukaneka ku tisa regional connectivity, kuisa kwa tasi nako yaku zamaya ka mota, niku kutisa teko ya ku zamaya ka kalimota, kuli kube trade ni zwelopili mwa North-Western ni mwa

Western Province ya Zambia. Mukwakwa ase uyahilwe uka kwalula nzila ni ba Angola, Botswana, Namibia ni manaha asili, kuli kube zwelopili ni sibaka sa Western.

Sibaka Sa Mutomo

Mutomo wo ukabela mwa North-Western ni mwa Western Province ya Zambia, kuzwela Mutanda (Kalumbila District) kufita Kaoma. Mukwakwa ufita mwa Likiliti za Kasempa ni Mufumbwe, ku kopanela mikwakwa ya Mongu-Sesheke mane kuyo fita Walvis Bay, mwa Namibia.

Baku Swalisana ni Bona

Mutomo wo uzamaiswa ki ba Barotse Highway Limited Toll Concession (BHL-TC), kona Special Purpose Vehicle (SPV), ye pangilwe ka kutwano ya ba Muso ni Private Sector inge bo Buks Haulage Limited (BHL), First Quantum Minerals Operations Limited (FQM), Hotsheet (Pty) Limited ni ba Road Development Agency (RDA).

Teko ya Mutomo

Teko kaufela ya Mutomo wo ki USD 326 million. Mutomo ulukanela ku kala fani pula hase ifelile mwa 2025, ku libelela ba ESIA.

Technology

Mutomo wo uka belekisa sebelezo yenca yaku yaha, kaufela ni kuyaha mikwakwa ya bitumen, ye sika tula ahulu ya butokwa ahulu fa Mutomo wo. Musebezi wa Kuyaha uka belekisa limeshini ze bukiti ahulu inge li bulldozer, ma graders, ze kata mubu kabuñata, ni ze mbambata mubu, ku beya ni za ku yahisa inge cement, bitumen, mubu waku beya mwa mukwakwa ni macwe.

Zeketilwe mwa sibaka ni za buino Zetiswa ki Mutomo, Zaku Sileleza niku Kondisa

Mutomo wo ulukanela kutisa zende ni ze sikaiketa fa sibaka ni ku batu. Za butokwa ahulu ze ka ezahala kubeya ni linzila zaku sileleza kize kabukuswani:

Zesikaiketa ni Silelezo Yateñi:

1. Kusinyeha kwa Sibaka ni Mubu

- **Zekaezahala:** Kusinyeha kwa mubu kabaka la misebezi ya kuyaha.
- **Silelezo:** Ku sileleza mununo wa mubu kuli usike wa sinyeha, kubelekisa linzila inge za kuminula mezi nikuchala licalo kasinca ze sinyehile.

2. Moya ni Liluli

- **Zekaezahala:** Liluli ni musi wa limeshini kubeya ni limota za ku yahisa.
- **Silelezo:** Ku selaela sibaka ni mikwakwa ka mezi nako ni nako ku sabisa liluli.

3. Mezi ni Zamaelo Yateñi

- **Zekaezahala:** Kusinyeha kwa mezi ya fahalimu ni kwatasi kabaka la ku yaha.

- **Silelezo:** Kubeya ma sefa ni linzila za ku sileleza mununo wa mubu kuli mezi asike asinyeha.

4. Lilata

- **Zekaezahala:** Lilata lelizwelela kwa li meshini ze yaha ni buñata bwa limota ze zamaya.
- **Silelezo:** Ku tokomela ku eza misebezi ya lilata ka nako ya musihali ni ku sileleza babeleki.

5.Buino bwa Macaba ni Silelezo

- **Zekaezahala:** Ku ekeheza kwa mifilifili ya limota ni butuku bwa HIV/AIDS.
- **Silelezo**: Kufa lituto za buino ni Silelezo kubeya ni libyana za silelezo za babeleki.

6. Kusinyeha kwa Lichalo ni Lofolofolo

- **Zekaezahala:** Kupumaka licalo ni ku sinanisa lifolofolo.
- **Silelezo**: Ku kutisa kwatasi zaku pumaka lichalo ni ku sileleza lifolofolo kakubeya lisupo mwa nzila kuli balimota ba zamaise katokomelo kubeya ni tuso, ni ku supa nzila ya lifolofolo.

Zende Zekaezahala ni Linzila zaku Zwelapili:

1. Bunde bwa Zwelopili

- **Zekaezahala:** Kukaba misebezi ye kuma 1000 kanako yakuyaha ni misebezi ye kuma 250 kanako yaku beleka.
- **Bunde:** Kukalela kufa misebezi baba ina mwa sibaka nikufa lituto za buchaziba.

2. Ku Kondisa zaku Ngunganyeleza

- **Zekaezahala:** Kukopanya mabaka niku kutisa kwatasi nako ya ku zamaya ka limota.
- **Bunde:** Kumamela kuli nzila ibabalelwa hande niku kopanela ni mikwakwa ya naha kaufela.

3. Zwelopili ya Buino

- **Zekaezahala:** Buino, lituto, ni lituso zemwi za machaba likafumaneha ka bunolo.
- **Bunde:** Kulukisa mikwakwa ya kwa likolo, lipatela, ni kwa mabaka koakopanela machaba.

Mafelelezo:

Ku lukisa ni kuyaha 371 km mukwakwa wa Mutanda kuyofita Kaoma ki mutomo wa butokwa ahulu kutisa zwelopili yetuna ni buino bo bunde mwa North-Western ni Western Province ya naha ya Zambia. Kabaka laku latelela linzila zaku sileleza ni swalisano ni batu kaufela, mutomo wo ulukanela ku isa kwatasi sinyehezo ya mabaka ni buino kubeya ni bunde kabuñata bobuka tela machaba ni mabaka abona.

Kelezo

1. Kulatelela la Tokomelo Milao ya Pabalelo ya Sibaka ni Buino:

Ku mamela milao ya naha ya Zambia, kubeya ni ya ba Environmental Management Act ni ba National Resettlement Policy

2. Kopano ni baku Swalisana ni Bona

Kanako ni nako kuno ambolisana ni machaba ya sinyehezwi ni baku swalisana nibona ku utwa maikutwo ya bona ni ku tiisa kutwano.

3. Likezo za Zwelopili ze Konahala:

Kubelekisa lipelekiso ni babeleki ba mwa sibaka, niku babalela sibaka haba yaha.

4. Ku Bonisisa niku Pima:

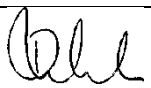
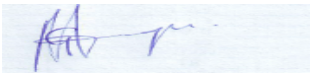
Kanako ni nako kubona zamaelo ya sibaka ni buino kabaka la Mutomo.

Zwelopili ya Mutomo wo ika ekeza kwa zwelopili ni kukonda kwa mabaka, ku ngunganyeleza, zakulekisa ni buino bobunde ku batu ba naha ya Zambia.

The ESIA Team

The Environmental Impact Assessment study for the proposed Mutanda – Kaoma Road was undertaken by the Environmental Consultants' Team and other professional consultants shown in the table below:

Table 1: ESIA Study Team

Name	Qualification	Signature
Danny Holmes	Lead Consultant. Environmental Engineer and Water quality Specialist / EIA Specialist	
Tobias Muyaba	Social Economic Specialist	
Joseleene Makoni	Environmental and Social Specialist	
Mubanga Fwambo	Environmental and Stakeholder Engagement Specialist	
Tiwine Mwanza	Environmental and Specialist	
Godfrey Mulenga	Environmental and Air Quality Specialist	
Jacob Tembo	Flora and Fauna and Wildlife Specialist (Ecologist)	
Geoffrey Mwanza	Cultural and Heritage Specialist	
Kagosi Mwamulowe	Heritage Management and Environmental Expert	

Management Statement

We trust that the above provides a fair and accurate Executive Summary of the Environmental and Social Impact Assessment (ESIA) FOR THE PROPOSED REHABILITATION AND UPGRADE OF THE 371KM ROAD BETWEEN MUTANDA AND KAOMA IN THE NORTH-WESTERN AND WESTERN PROVINCES OF ZAMBIA BY BAROSTE HIGHWAY LIMITED TOLL CONCESSION (BHL - TC).

Chris Dijkstra

Director

Barotse Highway Limited Toll Concession (BHL-TC)

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ABREVIATIONS AND ACRONYMS

AMSL	Above Mean Sea Level
BHL	Buks Haulage Limited
BHL-TC	Barotse Highway Toll Concession
BRE	Barotse Royal Establishment
CBD	Central Business District
CS	Council Secretary
DC	District Commission
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMMP	Environmental Management and Monitoring Plan
EPB	Environmental Project Brief
EPPCA	Environmental Protection and Pollution Control Act
ESIA	Environmental and Social Impact Assessment
E&SS	Environmental and Social Specialist
FQM	First Quantum Minerals Operations Limited
GPS	Global Positioning System
GIZ	Government of the Republic of Zambia
HIV/AIDS	Human Immune Viruus/ Acquired Immune deficiency Syndrome
NHCC	National Heritage Conservation and Commission
NAPSA	National Pensions Scheme Authority
NCS	National Conservation Strategy
NEAP	National Environmental Action Plan
NISIR	National Institute for Scientific and Industrial Research
PAYE	Pay As You Earn
PPE	Personal Protective Equipment
SI	Statutory Instrument
TOR	Terms of reference
UNCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
ZABS	Zambia Bureau of Standards
ZEMA	Zambia Environmental Management Agency
ZESCO	Zambia Electricity Supply Corporation
ZRA	Zambia Revenue Authority

1.0 INTRODUCTION

1.1 Background of the Project

The Government of the Republic of Zambia (GRZ) has entered into a concession agreement valued at over USD 326 million with Barotse Highway Limited Toll Concession (BHL-TC) for the rehabilitation and upgrading of the 371 km Mutanda to Kaoma Road, also known as the Western Corridor, to international bituminous standards. This project will be implemented under a Public-Private Partnership (PPP) financing model.

BHL-TC, a Special Purpose Vehicle (SPV) comprising Buks Haulage Limited (BHL), First Quantum Minerals Operations Limited (FQM), and Hotsheet (Pty) Limited, has signed a concession for this crucial 371-kilometer road connecting Mutanda to Kaoma. This strategic development is poised to unlock logistics and trade in Zambia, addressing the significant challenges posed by the current road infrastructure. The proposed project is known as the Barotse Highway Limited Toll Concession.

The project is structured to span a total of 25 years, including a 2-year construction phase followed by 23 years of operations and maintenance. At the end of this concession period, the upgraded road infrastructure will be formally handed over to the government, ensuring its sustainability and integration into Zambia's national transport network.

The proposed construction and rehabilitation of the 371 km road traversing the North-Western and Western Provinces of Zambia will be implemented in two sections: Section 1 will cover the Mutanda to Kasempa section (150 km), while Section 2 will extend from Kasempa to Kaoma (221 km). This project forms a critical connection to the Mongu-Sesheke Road, ultimately linking to Walvis Bay.

Key components of the project include:

- Toll Infrastructure: Installation of three toll plazas to generate revenue and fund ongoing maintenance.
- Weighbridges: Construction of three weighbridges to regulate vehicle weight, enforce load limits, and protect the road from premature wear.
- Bridge Upgrades: Widening and upgrading of the Lalafuta and Chibombo Bridges.
- Culvert Replacement: Replacement of all substandard culverts to ensure structural integrity and drainage efficiency.
- Auxiliary Facilities: Construction of BHL-TC headquarters, administration offices, maintenance yards, and staff villages.

- Additionally, the Project will support the Upgrading of 10 km of township roads in Kasempa and Kaoma Districts with Kalumbila under consideration with the RDA.

The implementation of the proposed project is expected to create significant economic and social benefits. During the construction phase, up to 1,000 labour opportunities will be generated, while operations and maintenance will provide approximately 250 long-term employment opportunities.

Moreover, the road will establish the fastest route connecting Zambia's mineral-rich Copperbelt and North-western Provinces to the West Coast regions of Africa, enhancing regional and international trade. It will serve as a critical gateway for commerce with Angola, Botswana, Namibia, and beyond, fostering economic integration with the western hemisphere.

In addition to these economic advantages, the road is poised to drive development in Zambia's Western and North-western Provinces. It will promote economic growth by facilitating the movement of goods and services and improving accessibility. Health benefits will also be realized through reduced dust pollution and improved access to healthcare facilities, including hospitals, enhancing the quality of life for communities along the corridor.

Once completed, this road will seamlessly integrate with the proposed Lumwana–Kambimba road, which will connect Zambia to Kolwezi in the Lualaba Province of the Democratic Republic of Congo (DRC). This integration will create an unbroken traffic flow from Lumwana to Mutanda and onwards to Walvis Bay, Namibia.

By linking Kolwezi in the DRC to Walvis Bay via Zambia, the project will form the Western Corridor, a key trade route anticipated to become operational by 2035. This corridor will not only facilitate regional connectivity but also position Zambia as a strategic hub for international trade.

The BHL-TC Project is supported by its potential to significantly enhance regional connectivity, stimulate economic activity, and contribute to the development of sustainable infrastructure. By addressing critical transportation challenges, the project will provide a reliable and efficient road network that reduces travel times, enhances safety, and facilitates the seamless movement of goods and people.

These improvements align with Zambia's long-term goals of fostering economic growth, enhancing trade, and driving social development. Moreover, the integration of revenue-generating toll plazas and weighbridges will ensure the availability of dedicated funds for ongoing maintenance, making the project financially sustainable over the long term. This self-sustaining model not only alleviates pressure on public finances but also sets a benchmark for future infrastructure investments under the Public-Private Partnership (PPP) framework.

The upgraded road will serve as a vital corridor linking Zambia's mineral-rich Northwestern Province to the Western Corridor and the West Coast regions of Africa. This strategic connectivity will unlock new opportunities for trade and investment, while also supporting local industries and communities by improving access to markets, healthcare, and other essential services.

Furthermore, the project demonstrates a commitment to environmental and social responsibility through the incorporation of modern construction standards and stakeholder engagement, ensuring that its implementation delivers broad-based benefits to the region and the nation as a whole.

1.2 Summary Description of the Project Including Project Rationale

The proposed construction and rehabilitation of the 371 km road traversing the North-Western and Western Provinces of Zambia will be implemented in two sections: Section 1 will cover the Mutanda to Kasempa section (150 km), while Section 2 will extend from Kasempa to Kaoma (221 km).

This project forms a critical connection to the Mongu-Sesheke Road, ultimately linking to Walvis Bay.

Key components of the project are as follows:

- Mutanda to Kasempa – 150 km
    - Construction of Weighbridge 1no., located after Mutanda (+- 6 km)
    - Construction of Toll Plaza 1no., located after Mutanda (+- 30 km);
    - Construction of Toll Plaza 2no. and Weighbridge, located North of Kasempa Town (+- 130 km after Mutanda and Weighbridge);
    - Construction of Traffic Circle in Kasempa Town; and,
    - Construction of BHL – TC Headquarters, Administration Offices and Operation and Maintenance Yard.
- Kasempa to Kaoma – 221 km
    - Construction of Toll Plaza 3no., located (+- 25 km before Kaoma Town);
    - Construction of Weighbridge 2no., located (+- 20 km before Kaoma Town);
    - Establishment of Operations and Maintenance Yard;
    - Construction of Kaoma Western Bypass (4.44km); and,
    - Construction of 2no. new Bridges.
        - One at Lalafuta River and one at Luena River.

Summary of the project component are as follows:

- Road
    - 371 km stretch of Road to be rehabilitated and upgraded to international bituminous standards.
    - Road cross-section
        - Total Road Width (10 m);
        - 3.5 m travel lane;
        - 2 m surfaced shoulders;
        - 0.3 m gravel shoulders.
    - Structures and Drainages
        - Upgrading all Armco drains;
        - Replacing all substandard culverts;
        - Construction of 3no. toll plazas;
        - Construction of 3no. weighbridges;

- Construction of 2no. bridges (widening and upgrading of the Lalafuta and Chibombo Bridges;
- Traffic circles;
- and,
- Construction of Administrative facilities and operations and maintenance yards.

To reach the 2-year construction target, the project will be done in sections. The proposed project will be done in three phases namely: preparation phase, construction phase and operation phase.

In terms of technology and raw material implementation, the proposed project will be constructed in accordance with all relevant Zambia Standards. Specialised local contractor(s) will be engaged for construction work. As far as possible, priority will be given by the contractor to the employment of labour from local communities around the project area, although a number of the Contractors permanent skilled staff may be brought in from other areas.

The BHL-TC Project is supported by its potential to significantly enhance regional connectivity, stimulate economic activity, and contribute to the development of sustainable infrastructure.

By addressing critical transportation challenges, the project will provide a reliable and efficient road network that reduces travel times, enhances safety, and facilitates the seamless movement of goods and people. These improvements align with Zambia's long-term goals of fostering economic growth, enhancing trade, and driving social development. Moreover, the integration of revenue-generating toll plazas and weighbridges will ensure the availability of dedicated funds for ongoing maintenance, making the project financially sustainable over the long term. This self-sustaining model not only alleviates pressure on public finances but also sets a benchmark for future infrastructure investments under the Public-Private Partnership (PPP) framework. The upgraded road will serve as a vital corridor linking Zambia’s mineral-rich North-western Province to the Western Corridor and the West Coast regions of Africa.

This strategic connectivity will unlock new opportunities for trade and investment, while also supporting local industries and communities by improving access to markets, healthcare, and other essential services. Furthermore, the project demonstrates a commitment to environmental and social responsibility through the incorporation of modern construction standards and stakeholder engagement, ensuring that its implementation delivers broad-based benefits to the region and the nation as a whole.

1.3 Objectives of the Project

The primary objective of the proposed project is to rehabilitate and upgrade the 371km road between Mutanda and Kaoma in the North-Western and Western Provinces of Zambia to international bituminous standards. This will enhance transportation efficiency, improve connectivity, and foster economic growth in the region and beyond.

Specific objectives of the project include:

- Improve the road infrastructure to facilitate the seamless movement of goods and people, reducing travel times and enhancing safety.

Establish a vital corridor linking Zambia's mineral-rich Northwestern Province to the Western Corridor and the West Coast regions of Africa, unlocking new opportunities for trade and investment.

- Support local industries and communities by improving access to markets, healthcare, education, and other essential services.
- Generate revenue through the installation of toll plazas to fund ongoing maintenance and ensure the project's financial sustainability.
- Regulate vehicle weight and enforce load limits through the construction of weighbridges to protect the road from premature wear.
- Upgrade and widen bridges and replace substandard culverts to ensure structural integrity and drainage efficiency.
- Construct auxiliary facilities, including BHL-TC headquarters, administration offices, maintenance yards, and staff villages, to support the project's operations.

- Support the upgrading of 10 km of township roads in Kasempa and Kaoma Districts with Kalumbila under consideration with the RDA, contributing to local infrastructure development.

- Create employment opportunities during the construction and operation phases, stimulating socio-economic development in the region.
- Integrate with the proposed Lumwana–Kambimba road to create an unbroken traffic flow from Lumwana to Mutanda and onwards to Walvis Bay, Namibia, forming a key trade route.

The project is expected to result in national, regional, and local economic benefits, including reduced travel time, lower operating costs, improved road safety, and increased access to markets, healthcare, and education. The project will also create employment opportunities, stimulate trade, and generate other multiplier effects that contribute to socio-economic development in the region.

1.4 Brief Description of the Location

The proposed construction and rehabilitation of the 371 km road project is situated within Zambia's North-Western and Western Provinces. The project commences in Mutanda, traverses through Kasempa, and concludes in Kaoma. This strategic route is designed to enhance regional connectivity and support socio-economic development. The figure below illustrates the full stretch of the road.

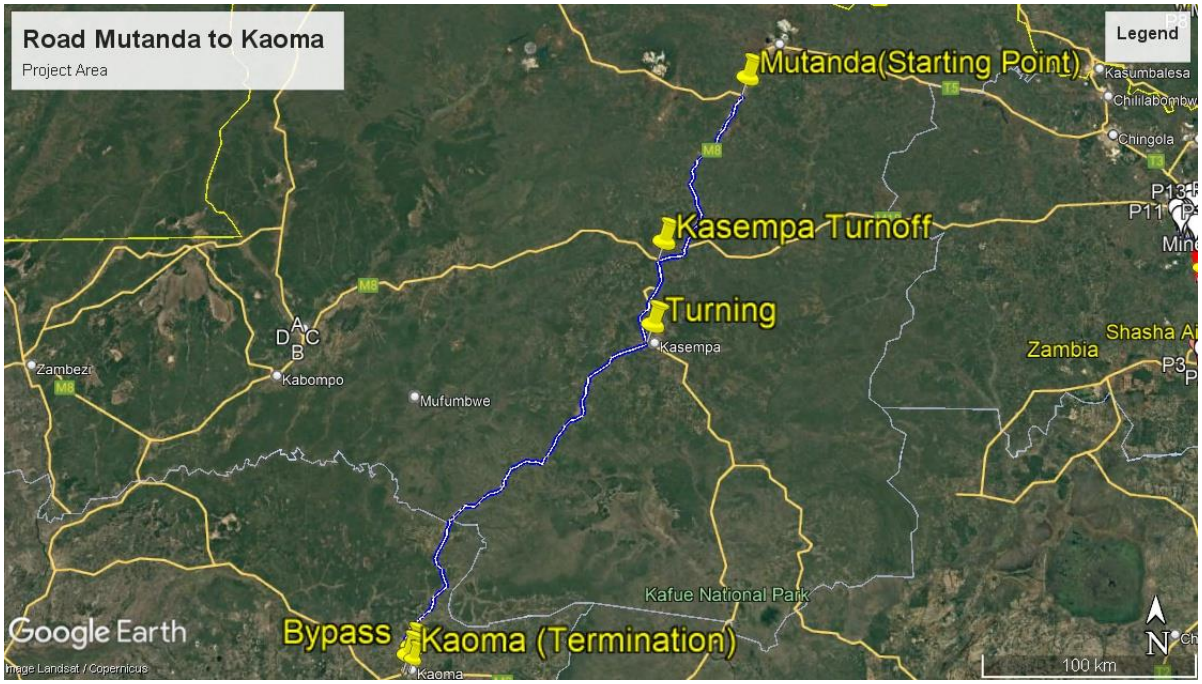

Figure 1: Satellite Map of Mutanda to Kaoma Stretch

Table 2: GPS Coordinates of the Project Site

Distance of the Proposed Road – 371 km			
Label	**Coordinates**		
Name	**Latitude**	**Longitude**	**Elevation**
Mutanda (Starting Point)	-12.395174°	26.238039°	1341m
Kasempa Turnoff	-13.106404°	25.871485°	1314m
Turning Point	-13.458360°	25.823192°	1270m
Bypass	-14.797049°	24.794861°	1136m
Kaoma (Termination)	-14.830529°	24.779147°	1178m

1.5 Particulars of Shareholders/Directors

The proposed project follows the Public- Private Partnership mode, a collaboration between the public and private sectors such as Buks Haulage Limited (BHL), First Quantum Minerals Operations Limited (FQM), Hotsheet (Pty) Limited and the Road Development Agency.

BHL-TC, the Special Purpose Vehicle (SPV) for this initiative, comprises Buks Haulage Limited (BHL), First Quantum Minerals Operations Limited (FQM), and Hotsheet (Pty) Limited.

The Road Development Agency (RDA) is the agency responsible for the planning, management, and coordination of the road network in Zambia.

Directors

Table 3: Directors

Name	Position	Nationality	Identity	Physical Address
Nicholaas Marthinus Jansen van Rensburg	Director	Zambian	670887/10/1	Lusaka
Christian Jacobus Dijkstra	Director	South African	M00390887	Lusaka

1.6 Percentage of Shareholding by Each Shareholder

Table 4: Shareholders

Business Number	Name of Business	Secretary	Shareholder /Member/%	Amount	Share Class
120040057165	Buks Haulage Limited		Member 50%	1.00	Ordinary
201787	ViaBAHN Africa Limited		Member 50%	1.00	Ordinary

1.7 The Developer's Physical Address and the Contact Person and His/Her Details

Contact Person: Chris Dijkstra
Contact Line: +260776688774
Designation: Director
Email: chris@hotsheet.co.za
Physical Address: Office 1, Princess Villas Estate (Sandy's Creations), Off Kafue Road, Lilayi, Lusaka.

Environmental Consultants' Details

DH Engineering Consultants
226A Napsa Housing Complex, Nyumba Yanga, Off Leopards Hill Road
PO Box 37928, Lusaka, Zambia

Tel: 260 21 1 227176
Fax: 260 21 1 229555
Mobile: 260 977874162
Email: dholmes@dhengcon.com

1.8 Track Record/Previous Experience of Enterprise Elsewhere

The proposed rehabilitation and upgrade of the 371 km Mutanda to Kaoma Road will be undertaken by Barotse Highway Limited Toll Concession (BHL-TC). BHL-TC is a Special Purpose Vehicle (SPV) created specifically for the purpose of implementing this project. The members and key

partners of BHL-TC bring together a wealth of relevant experience to ensure the successful execution of this significant infrastructure development.

Buks Haulage Limited (BHL)

Buks Haulage Limited (BHL) is a key member of the BHL-TC consortium. BHL is primarily a haulage company that has been providing logistical support to First Quantum Minerals Operations Limited (FQM) for many years, particularly along the proposed project route. This longstanding experience in the region has provided BHL with valuable insights into the specific transportation challenges and requirements of the area. BHL Group was granted Preferred Bidder Status for the Mutanda to Kaoma PPP Project. This demonstrates the confidence placed in BHL's capabilities to undertake and deliver on large-scale infrastructure projects.

Hotsheet (Pty) Limited

Hotsheet is another vital partner in the BHL-TC SPV. Hotsheet is a Civil Engineering, Project and Construction Management, and infrastructure Quantity Surveying professional services company operating throughout Southern Africa, along with Business Intelligence (BI) solutions. Their team of experienced engineers, together with specialist partners, possesses expertise in large-scale civil engineering infrastructure, Public-Private Partnership (PPP) projects, and EPC Contracting. Hotsheet also offers clients a unique combination of world-class project management services combined with their in-house Hotsheet Dashboards BI solution, and implements BI systems specifically tailored for the engineering and heavy infrastructure construction industry.

Other Partners

The BHL-TC also includes First Quantum Minerals Operations Limited (FQM) as a partner.

First Quantum Minerals Ltd. (FQM) is a global mining company with extensive operations in Zambia, where it operates two of Africa's most significant copper mines:

- **Kansanshi Mine** (Solwezi) - Zambia's largest copper producer
- **Sentinel Mine** (Kalumbila) - One of the world's most technologically advanced copper mines

As a key shareholder in **Barotse Highway Limited Toll Concession (BHL-TC)**, FQM demonstrates its commitment to:

1. **Infrastructure Development**: Supporting critical transport corridors to enhance mineral logistics
2. **Public-Private Partnerships**: Collaborating with Zambian authorities on sustainable infrastructure
3. **Economic Integration**: Facilitating regional trade through improved road connectivity between mining areas and export routes

FQM's participation in BHL-TC aligns with its Zambian investment strategy, combining mining operations with supporting infrastructure to maximize local economic benefits. The company brings

extensive Zambian operational experience and commitment to responsible resource development to this transportation initiative.

Nyeleti Consulting - is identified as a majority black-owned civil engineering consultancy, operating in the Built Environment industry. They specialize in structural engineering, municipal infrastructure, roads and transportation, and also provide services in forensic engineering, project and construction management. As a medium-sized, B-BBEE Level 1 contributing 100% South African-owned, multi-disciplinary engineering company, Nyeleti has played a significant role in the development of South Africa's infrastructure.

The Road Development Agency (RDA) - is the agency responsible for the planning, management, and coordination of the road network in Zambia and is a key public sector partner in this Public-Private Partnership.

Figure 2 Public Private Partnership for the BHL-TC

This collaboration of experienced entities, including BHL (with its strong regional presence and logistics expertise), Hotsheet, FQM, Nyeleti, and the RDA, combines to provide BHL-TC with the necessary expertise and capacity to successfully deliver the Mutanda to Kaoma Road rehabilitation and upgrade project.

1.9 Proposed Project Cost and Implementation Date

The total investment cost for the project is estimated at USD 326 million. The project is expected to commence construction in the second quarter of 2025, pending the approval of the ESIA.

2.0 POLICY, INSTITUTION AND ORGANIZATIONAL FRAMEWORK

2.1 Policy, Legal and Institutional Framework Relevant to the Project

2.1.1 Zambia Environmental Policy

Zambia's environmental policy is guided by the following:

- **The National Conservation Strategy (NCS):** The National Conservation Strategy (NCS) was adopted as a policy document by the government in 1985 to harmonize environmental management in the country. The adoption of NCS led to the establishment of environmental legislation and institutions.
- **Environmental Protection and Pollution Control Act (EPPCA):** In 1990, the Environmental Protection and Pollution Control Act (EPPCA) was passed to provide for the protection of the environment. The Act also provided for the establishment of the Environmental Council of Zambia (ECZ) to implement the provisions of the Act and to harmonize and coordinate all issues related to environmental management in the country.
- **National Environmental Action Plan (NEAP):** The National Environmental Action Plan (NEAP) was formed in 1994 as a means to review the existing economic framework and policy measures, and identify the relationship between the environment and the economy. NEAP provides an overview of Zambia's environmental problems, existing legislation and institution, and strategy options for improving environmental quality. The NCS and NEAP are the precursors of the overall policy on the environment.
- **The National Policy on Environment (NPE):** The National Policy on Environment (NPE) which was adopted in 2007 (and officially launched in 2009) provides environment and natural resources management policies to address current and future threats to the environment and to human livelihoods and provides policy guidelines for sustainable development.

The policy is premised on the basic principle of "Polluter to pay and the need to conserve resources, reduce consumption and recycle and reuse material to the maximum extent possible" while the main purpose of the policy is "to create an umbrella policy for the welfare of the Nation's environment so that socio-economic development will be achieved effectively without damaging the integrity of the environment or its resources".

Specific objectives of the NPE include but are not limited to:

- Promote the sound protection and management of Zambia's environment and natural resources in their entirety, balancing the needs for social and economic development and environmental integrity to the maximum extent possible, while keeping adverse activities to the minimum;
- And accelerate environmentally and economically sustainable growth in order to improve the health, sustainable livelihoods, income and living conditions of the poor majority with greater equity and self-reliance.

Other strategies relevant to the proposed Project include:

- Ensure that plans for development and construction of industries have adequate and appropriate waste disposal and pollution control facilities organized to meet international standards;
- Ensure that plans and incentives for voluntary waste disposal are enshrined in the production plans of all industries;
- And promote the use of environmental guidelines and EIA before sites are developed and ensure application of a monitoring and auditing system for operating industries, commercial and institutional sites.

Relevance to the Project: The proposed project will bring about positive impacts and will also bring about negative impacts that present future threats to the environment. These impacts should be addressed according to the National Policy on Environment as it provides guidelines for sustainable development.

Compliance: The proposed development will be done in accordance with the National Policy on Environment guidelines, to ensure sustainable development which includes Environmental Impact Assessment and monitoring of the environment. The developer will obtain all necessary approvals and permits as stipulated under the Act. The EIA studies for the proposed road construction works will be carried out in accordance with the EIA procedures laid out in the Environmental Impact Assessment Regulations. An environmental impact assessment has been carried out to identify the impacts on the environment and also to put up measures to mitigate the negative impacts the project will have on the Environment. The developer has hired a consultant to liaise with Zambia Environmental Management Agency on ensuring that the best environmental management practices are incorporated in the design and that the report from the study is presented to ZEMA for review according to the environmental project brief report format set by the Zambia Environmental Management Agency.

2.1.2 The National Resettlement Policy

The National Resettlement Policy (NRP) was adopted in 2015 to guide the implementation of the resettlement programme which empowers citizens who may not have the capacity to purchase land on the open market.

The policy is aimed at supplementing Government's efforts in reducing poverty as well as uplifting the standards of living of the resettled people and populations. The NRP is also aimed at assisting Government in creating stable and sustainable human settlements on the principles of equity and growth by facilitating the creation of human settlements which are economically productive, socially just and environmentally sustainable. The Policy has put in place operational instruments to guide resettlement and compensation of Internally Displaced Persons (IDPs) in the country in line with the African Union Convention for the Protection and Assistance of IDPs in Africa (Kampala Convention) which Zambia is Party to.

Specific objectives of the NRP include but are not limited to:

- To effectively manage the resettlement schemes and protect against the illegal allocation of land in resettlements.
- To improve access to public social services by creating viable settlements as opposed to unplanned scattered settlements.
- To create new growth points for rural investment and development by providing social and economic infrastructure thereby stimulating economic growth.
- To ensure the security of tenure for the land allocated to the settlers
- To mitigate adverse and socio-economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets and/ or livelihoods to those that have been displaced in accordance with the law.
- To provide resettlement assistance to persons displaced by natural disasters.
- To ensure that resettlement activities are implemented with disclosure of relevant information, consultation and informed participation of those affected.

The office of the Vice President through the Department of Resettlement is the lead institution in the implementation of the NRP with an established framework which includes NGOs, various government ministries and government departments/institutions including the Zambia Environmental Management Agency (ZEMA).

Relevance to the Project: Rehabilitation and upgrading of Mutanda to Kaoma road will require extending the road width and construction of detours which may result into displacement of villages, markets and agricultural fields.

Compliance: The road alignment has been designed to avoid displacement of villages, markets and agricultural fields. However, should any unforeseen displacements result, BHL - TC will ensure full compensation for resettling of the affected individuals.

2.1.3 Zambian Environmental Legislation

The following sections detail legislation which is relevant to the Project and which needs to be complied with; however, the legislation described here should not be seen as an extensive legal register which covers all the laws applicable to the Project.

2.1.3.1 Environmental Management Act, No. 12 of 2011 as amended by the Environmental Management (Amendment) Act No. 8 of 2023

The Zambian Environmental Management Act (EMA), 2011 is the superior Act on matters relating to environmental protection and management. Its superiority is outlined in Section 3 of the Act.

The Act sets out a framework for Environmental Impact Assessments (EIAs) and mandates ZEMA to do all such things as are necessary to ensure the sustainable management of natural resources and the protection of the environment, and the prevention and control of pollution. The EMA outlines principles governing environmental management and provides for, among other things, Environmental Impact Assessment and regulations relating to environmental assessments. The Act

has also spelt out offenses relating to failure to prepare and submit an EIA report for projects that require such reports.

The projects that require preparation of EIA reports must be approved by ZEMA prior to implementation. Section 29 of the Act specifically states that "a person shall not undertake any project that may have an effect on the environment without the written approval of the Agency, and except in accordance with any conditions imposed in that approval".

Relevance: The proposed road construction project represents activities which require EIA studies as per requirements of the Environmental Management Act No 12 of 2011 read together with the Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997. One of the roles of the Zambia Environmental Management Agency is to review Environmental Impact Assessment (EIA). This report is an Environmental Project Brief report compiled from Environmental Impact Assessment study findings. The report should be reviewed by ZEMA. The proposed development will produce waste which should be collected, transported and disposed of in accordance with this Act.

Compliance: The developer will obtain all necessary approvals and permits as stipulated under the Act. The EIA studies for the proposed road construction works will be carried out in accordance with the EIA procedures laid out in the Environmental Impact Assessment Regulations. An environmental impact assessment has been carried out to identify the impacts on the environment and also to put up measures to mitigate the negative impacts the project will have on the Environment. The developer has hired a consultant to liaise with Zambia Environmental Management Agency on ensuring that the best environmental management practices are incorporated in the design and that the report from the study is presented to ZEMA for review according to the environmental project brief report format set by the Zambia Environmental Management Agency. Solid waste will be collected in bins at various locations on site and then disposed of by an approved local council licensed transporter.

2.1.3.2 Environmental Impact Assessment Regulations

The Environmental Impact Assessment Regulations (No. 28 of 1997) prohibits the implementation of a project without undertaking an EIA and the subsequent preparation of an Environmental Project Brief or an Environmental Impact Statement.

The nature of the project determines whether the developer should prepare a Project Brief or Environmental Impact Statement.

2.1.3.2.1 Stakeholder Engagement

The EMA and EIA Regulations are the key legislation that provide the requirements for stakeholder engagement in Zambia.

The EMA states that the public has the right to be informed of the intention of public authorities to make decisions affecting the environment and of available opportunities to participate in such decisions.

The EIA Regulations require that stakeholder engagement involves government agencies, local authorities, non-governmental, community-based organizations and interested and affected parties (affected communities, for example) and specifically states the following:

"The developer shall, prior to the submission of the EIS….take all measures necessary to seek the views of the people in the communities which will be affected by the Project.

In seeking the views of the community in accordance with sub-regulation, the developer shall:

(a) Publicise the intended Project, its effects and benefits, in the mass media, in a language understood by the community, for a period not less than fifteen days and subsequently at regular intervals throughout the process;

And

(b) After the expiration of the period of fifteen days….hold meetings with the affected communities to present information on the Project and to obtain the views of those consulted".

Relevance: The proposed road construction project falls under the second schedule of the EIA regulations which requires full ESIA studies.

Compliance: The Developer will undertake ESIA studies for the project and prepare and submit an Environmental Impact Statement report to ZEMA through its appointed Environmental Consultant.

2.1.3.3 Environmental Management Licensing Regulations

The Regulations deals with pollution prevention and control relating to air, water, waste (both hazardous and non-hazardous), pesticides and toxic substances as well as ozone-depleting substances.

It was formulated in 2013 under the EMA, 2011.

The Environmental Management (Licensing) Regulations have provided for the repeal of the following legislation:

- The Waste Management (Licensing of Transporters of Wastes and Waste Disposal Sites) Regulations, S.I. No. 71 of 1993;
- The Water Pollution Control (Effluent and Waste Water) Regulations, S.I. No. 72 of 1993;
- The Pesticides and Toxic Substances Regulations, S.I. No. 20 of 1994;

- The Air Pollution Control (Licensing and Emission Standards) Regulations, S.I. No. 141 of 1996;
- The Environmental protection and Control (Ozone Depleting Substances) Regulations, S.I. No. 27 of 2001;
- And The Hazardous Waste Management Regulations, S.I. No. 125 of 2001.

2.1.4 Other Acts Reviewed

Other than the EMA which is the principal Act on environmental management, Zambia is broadly covered with legislation relating to the protection of the environment. Presently about 28 pieces of legislation are related to the environment and were considered in the environmental assessment process. Among others the relevant legislation applicable to this project are discussed below:

2.1.4.1 The Lands Act No. 20 of 1996 read as one with the Lands Amendment Act No 20 of 2015

This Act was enacted in 1995 following the repeal of the Land (Conversion of Titles) Act of July 1975. It provides for the continuation of leaseholds and allows the conversion of customary tenure into leasehold tenure.

Section 7(1) of the Act allows holding of land under customary land tenure, while section 8(1) provides for conversion of customary land into leasehold tenure.

Relevance / Compliance: The proposed road route is expected to follow the alignment of existing gazetted roads, which are under the jurisdiction of the Road Development Agency (RDA), and correspondence with RDA has already been initiated by the Developer.

2.1.4.2 Local Government Act No. 2 of 2019

The Act provides for the establishment of Councils in Districts which function as Local Authorities. The Act defines the functions of Local Authorities. Some of their tasks related to control of the development, use of land and buildings, erection of structures, conservation of natural resources, prevention of soil erosion, protection of life, property and natural resources from age by fire, control of grass weeds and wild vegetation, and maintenance of environmental health services.

Other functions include oversight of the storage, sale, and use of petroleum, extermination of insects, rodents and snakes, dealing with all kinds of refuse and effluent, controlling the provision of drains and sewers, and conservation and the prevention of the pollution of supplies of water (Local Government Act Cap 281,).

Part II of the Act provides for the establishment of the Councils within Zambia, while Part III provides for the functions of the local authorities. Section 17 of the Act indicates that the local authorities are the agents of the government in delivering development within the areas of their jurisdiction.

Relevance: The proposed project (road upgrade) passes through Kalumbila, Kasempa, Mufumbwe and Kaoma Districts under the auspices of a District Councils created through the Local Government Act.

Compliance: BHL - TC and its contractors will, therefore, coordinate with the local Councils in ensuring that all road construction works are implemented in line with the mandate of the Council.

2.1.4.3 The Urban and Regional Planning Act No. 3 of 2015

The Act provides for development, planning and administration principles, standards and requirements for urban and regional planning processes and systems.

The Act also ensures sustainable urban and rural development by promoting environmental, social and economic sustainability in development initiatives and controls at all levels of urban and regional planning.

Section 3 (c) of the Act provides the principal physical, economic, environmental and social characteristics that must be included by the regional planning authorities appointed by the Minister.

Section 19 (4) (e) also provides for environmental management, protection of ecologically sensitive areas, heritage and cultural sites as some of the key issues for consideration in developmental planning.

Relevance: Project implementation will require approval from regional planning authorities to ensure that the project is not in conflict with area development plans.

Compliance: The necessary documentation will be submitted to the office of Permanent Secretary, North – Western and Western Provinces, and the Regional Planning Authorities for approval.

2.1.4.4 Factories Act, Cap 441 of 1996

The Factories Act provides a framework for the setting of regulations to ensure the safety, health, and welfare of persons employed in construction worksites and in factories.

In particular, section 69 of the Act provides for protection of persons employed at any given workplace against inhalation of dust or fumes or any other impurities.

In addition, section 71 of the Act provides for issuance of protective attire to employees at a workplace, which include suitable clothing, equipment or appliances, e.g. work suits, safety goggles, etc.

Relevance: The project's construction and operational activities will be subjected to the provisions of this Act.

Compliance: All work procedures and workers Personal Protective Equipment (PPE) will be required to meet the provisions of this Act. Inspection procedures for the operation of all plant and equipment during construction will be governed by this Act.

2.1.4.5 The Public Health Act, Cap 295 of 1995

The Act provides for and regulates all matters connected with public health in the country under the local authority of each District as the enforcement agency.

Section 6 (3) of the Act provides that no person shall cause or permit any subsoil, surface, storm or rain-water or any drain for the conveyance of such water to discharge into or communicate with any drain or sewer for the conveyance of such water to discharge into or communicate with any drain or sewer for the conveyance of sewage or waste water, or into any cesspool, septic tank or other receptacle for drainage, except with the written permission or by the direction of the Local Authority, and then only on the condition that such subsoil, surface, storm or rain-water drain shall discharge directly into the open air over a trapped gully and above the level of the water therein, and no person shall cause or permit any sewage or waste water drain to discharge into or communicate with any drain or sewer for the conveyance of subsoil, surface, storm or rain-water except with the written permission or by the direction of the Local Authority.

Relevance: The Act will apply in an overarching context, especially where waste management in construction camps is concerned.

Compliance: The proponent will engage relevant stakeholders to ensure the management of waste is being handled in accordance with the stipulated requirements of the Public Health Act.

2.1.4.6 Public National Public Health Institute Act, No. 19 of 2020

The Act provides for the coordination of public health security; continue the existence of the Zambia National Public Health Institute and provide for its functions; establish the Public Health Emergency Operations Centre; establish the National Public Health Laboratory and establish the National Public Health Emergency Fund.

The sections of the Act relevant to the proposed project are part ii section 4 which provides for functions of the Zambia National Public Health Institute. The functions of the institute relevant to this project are: educate the public-on-public health and develop, publish and disseminate information on public health.

Relevance: The development will involve the handling of hazardous waste which if not disposed of properly may result in environmental contamination which has potential to affect the environment to include members of the public negatively.

Compliance: The developer will have a system of managing hazardous waste from the construction works. The site will also have controlled access. The developer will ensure that they put in place all guidelines provided on public health.

2.1.4.6.1 Statutory Instrument No. 22 of 2020, the Public health (infected areas) (Corona Virus Disease) Regulations, 2020

These regulations provide for the response and measures to address the Corona Virus Disease Pandemic.

The section of these regulations relevant to the proposed project is section 8 which states that a person who becomes aware or has reason to suspect that another person has died or is suffering from Covid 19 shall immediately inform the nearest authorized officer in a local authority or a public health facility.

Relevance: The proposed development will employ people who may or may not be immune to Covid 19.

Compliance: The developer will ensure that measures to prevent the spread of the corona virus are put in place according to the Ministry of Health guidelines.

2.1.4.6.2 Statutory Instrument No. 21, Public Health (Corona Virus) infectious disease

This is a notice declaring that the Corona Virus is an infectious disease.

The sections of this notice relevant to the proposed project are: section 5 (1) which sate that a person shall not enter or leave an infected area without permission of an authorized officer in a local authority of the infected area and complying with any directions given by an authorized officer in a local area;

and section 8 which states that a person who becomes aware or has reason to suspect that another person has died or is suffering from Covid 19 shall immediately inform the nearest authorized officer in a local authority or a public health facility.

Relevance: The proposed development will employ people who may enter areas that may be declared as infected areas by the Ministry of Health. Because Covid 19 is an infectious disease, there is a possibility for people on site to catch the disease.

Compliance: The developer will ensure that measures to prevent the spread of the corona virus are put in place according to the Ministry of Health guidelines.

2.1.4.6.3 The Public Health (Notifiable Infectious Disease) (Declaration) Notice, 2020

Regulation 3: The ministry responsible for health may convert a suitable building to a hospital, observation camp or station for the purpose of placing a person suffering or suspected to be suffering from, or who has been in contact with a person suffering from COVID – 19.

Regulation 5 (2): Subject to sub - regulation (1) a person who intends to enter or leave an infected area may, before entering or leaving the infected area, be required to undergo the following;

- Medical examination;
- Disinfection; or
- Remain for a specified period in a hospital, an observation camp or station converted under regulation 3.

Regulation 6: The body of a person who has died from COVID – 19 shall be disposed of in conformity with the directions of an authorized officer.

Regulation 7: An authorized officer may enter premises to search for a case of COVID – 19 or to enquire whether there is or has been a case of COVID – 19.

Regulation 8: A person who becomes aware or has reason to suspect that another person has died or is suffering from COVID -19 shall immediately inform the nearest authorized officer in a local authority or public health facility.

Regulation 9: A public ceremony or gathering of more than five persons, not being a family shall not be held in an infected area without the written permission of a local authority or Medical Officer of Health.

Relevance: The implementation of the Project is subject to provisions of the Public Health (Notifiable Infectious Disease) Notice, 2020.

Compliance: The developer will ensure that measures to prevent the spread of the corona virus are put in place according to the Ministry of Health guidelines.

2.1.4.7 Petroleum Act No. 10 of 2008

The Act provides for the regulation of the importation, conveyance, and storage of petroleum products and other inflammable oil and liquids (e.g. petrol and diesel) for the protection of the public and the environment.

Section 3(e) prescribes the safety and environmental requirements for the operation of all equipment, vessels, vehicles, trucks, and receptacles used in the processing, storage and sale of petroleum by establishing and enforcing the required codes for such, and licensing of the operators;, while regulation 3 prescribes the issuance of permits or licenses for transportation and storage of petroleum products.

Relevance: The project will involve the acquisition, transportation, and storage of petroleum products which are subject to the provisions of the Act.

Compliance: Acquisition and storage of petroleum products will be done in accordance with the provisions of this Act.

2.1.4.8 National Heritage Conservation Commission (Amendment) Act No. 13 of 1994

The Act provides for the conservation of ancient, cultural and natural heritage, relics and objects of aesthetic, historical, prehistoric, archaeological or scientific interest by preservation, restoration, rehabilitation, reconstruction, adaptive use, and good management.

The Commission also provides regulations for archaeological excavation and export of relics.

If development is unable to proceed without affecting an item of heritage, permission must be sought from the NHCC as outlined in Section 35 and 36 of the National Heritage Conservation Commission Act.

Relevance: Although not located within a gazetted national heritage site, the Project site passes animal corridor with the potential of harbouring historical or cultural sites.

Compliance: All measures will be undertaken to protect and conserve the cultural and natural heritage of the Project area.

Should any new discoveries be made of items of historical or archaeological interest during the implementation of the project, the provisions of the NHCC Act shall apply, and the required procedures for the reporting of such discoveries shall be followed.

2.1.4.9 The Forest Act No. 4 of 2015

The Act concerns the management and conservation of forest resources and, to some extent, the protection of biological diversity and generally the environment in Zambia.

The Act provides for the establishment and declaration of National Forests, Local Forests, joint forest management areas, botanical reserves, private forests, and community forests; provide for the conservation and use of forests and trees for the sustainable management of forests ecosystems and biological diversity; provides for implementation of international treaties and agreements relating to forest management and conservation and other matters relating to forest management.

Part II of the Forest Act establishes the Forestry Department within the government system as well as its functions.

Part III provides for the management and development of the forests – National, Local Forests and Botanical reserves.

Relevance: The road route passes through GMAs, and Project implementation will be subject to the provisions of this Act.

Compliance: The Developer should ensure sustainable use and preservation of existing wildlife and forest resources at all Project phases.

2.1.4.10 The Water Resources Management Act No. 21 of 2011

The Act defines the functions and powers; provide for the management, development, conservation, protection, and prevention of water resources and its ecosystem.

It also provides for the equitable, reasonable and sustainable utilization of water resources (Water Resource Management Act, 2011).

Section 72 (3) states that a land owner who requires the use of water for commercial or industrial purposes, shall make an application to the authorizing agency, setting out the volume of water required, the nature of the proposed use and such other information as may be prescribed.

Section 72 (4) states that the Authorizing Agency shall cause an inquiry to be made into the merits of the application, made under subsection (3) and shall thereafter forward the application with comments and recommendations to the catchment Council, sub-catchment Council or water users association for consideration.

Relevance: Construction and operational activities of the proposed project have the potential to disrupt and pollute underground and surface water resources.

Compliance: Construction and operational activities of the proposed project will be conducted in a way that minimizes pollution of underground and surface water courses.

2.1.4.11 The Zambia Wildlife Act No. 14 of 2015

An Act to provide for the winding up of the affairs of the Zambia Wildlife Authority; establish the Department of National Parks and Wildlife in the Ministry responsible for tourism; provide for the appointment of a Director and other officers responsible for National Parks and Wildlife; provide for the sustainable use of wildlife and the effective management of the wildlife habitat in Game Management Areas; The Act repeals and replaces the Zambia Wildlife Act, 1998; and provide for matters connected with, or incidental to, the foregoing.

Part II of the Act provides for the establishment of the Department of National Parks and Wildlife.

Section 16 of the Act provides for the granting of mining and other rights in National Parks and GMAs.

Section 30 provides for the Restriction on exercise of mining and other rights within Game Management Areas.

Relevance: The road route falls under GMAs which provide a habitat for wildlife.

Compliance: The Developer will promote its conservation awareness among the site workforce to ensure compliance with the Act.

2.1.4.12 The Occupational Health and Safety Act No. 36 of 2010

The Act to establish the Occupational Health and Safety Institute, and provides for its functions.

Provide for the establishment of health and safety committees at workplaces and for the health, safety and welfare of persons at work; provide for the duties of manufacturers, importers and suppliers of articles, devices, items and substances for use at work; provide for the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work; and provide for matters connected to events at work.

Section 4 of the Act establishes the Occupational Health and Safety Institute while Section 6 provides for the functions of the institute that include conducting medical examinations for occupational health and safety purposes in workplaces.

Section 11 under Part III states that, an employer of ten or more persons at any workplace shall establish a health and safety committee.

Relevance: A sizable workforce will be employed during the project construction phase and their work conditions will be subject to the provisions of this Act.

Compliance: The developer will endeavour to comply with the provision of this Act in as far as occupational health and safety of workers is concerned.

2.1.4.13 The Workers' Compensation Act No. 10 of 1999

The Act for the law relating to the compensation of workers for disabilities suffered or diseases contracted during employment and providing for the payment of compensation to dependents of workers who die because of accidents or illnesses at workplaces.

Section 41 under Part V of the Act provides that if an accident to a worker arising out of and during his employment happens after the date of commencement and results in such worker's disablement or death, he, or if he dies, his dependants, shall become entitled to compensation in accordance with the provisions of this Act.

Relevance: As a workplace, construction sites might record work incidences/accidents which might require compensating the parties involved.

Compliance: All incidences or accidents occurring on construction sites will be handled in accordance with the provisions of the Act and all necessary documentation will be submitted to Workers' Compensation Fund Control Board (WCFCB) to ensure that workers are provided with a social security scheme.

2.1.4.14 The Employment Code Act No 3 of 2019

The Act to provide legislation relating to the employment of persons; to make provision for the engagement of persons on contracts of service and to provide for the form of an enforcement of agreements of service; to make provision for the appointment of officers of the Labour Department and for the conferring of powers on such officers and upon medical officers; to make provision for the protection of wages of employees; to provide for the control of employment agencies.

Part III of the Act provides for the employment relationship subdivided into divisions – contract of employment, minimum employment benefits, suspension/termination of employment, employment of expatriates and skills advisory committee.

The Act repeals and Replaces the Employment Act, 1965, the Employment (Special Provisions) Act, 1966, the Employment of Young Persons and Children Act, 1933, and the Minimum Wages and Conditions of Employment Act, 1982.

Relevance: The project will employ some persons to perform some functions during all project stages.

These employees will need to be protected in line with the provisions of the Act.

Compliance: BHL - TC and its Contractors will follow all the necessary procedures required for employment.

2.1.4.15 Roads and Road Traffic Act, Cap 464

An Act to make provision for the care, maintenance, and construction of roads in Zambia, this Act also provides for the establishment of the highway authority (i.e. the Road Development Agency) as the agency responsible for the planning, management, and coordination of the road network in Zambia.

Part II of the Act provides for the classification of roads as main roads, District or rural roads.

It also provides guidance on discharge of storm water from roads and road construction sites.

Sections 33 and 34 of the Act provides for compensation of individuals displaced as a result of road construction and stipulates situations where compensations shall not be paid in the case of bare land falling within the width of a road reserve.

Relevance: The road route will pass near settlements with potential to cut through some agricultural fields which might fall within the road reserve.

Compliance: The consultant has made recommendations to the developer (BHL – TC) on how they should deal with any properties or structures found in both the road reserve and the construction width.

2.1.4.16 Chiefs Act, Cap 287

This is an Act to make provision for the recognition, appointment, and functions of Chiefs and Deputy Chiefs, for the exclusion of former Chiefs and Deputy Chiefs from specified areas in the interests of public order, for the appointment and functions of Chief's Retainers and for matters incidental to or connected with the foregoing.

The chief has customary authority over the land of the Project area as provided for under Section 4(a) of the Act which states "area; about a Chief, means the area in Zambia within which recognition is accorded to the Chief under this Act".

Relevance: The road route for the Project road falls under customary land tenure under Chiefs Mumena, Kasempa, Ingwe and Mutondo.

Compliance: BHL - TC has made all necessary consultations with the traditional leadership in the Project area concerning the Project.

2.1.4.17 The Energy Regulation Act No. 12 of 2019

This Act provides for the An Act to provide for the licensing of enterprises in the energy sector.

The sections of this Act relevant to the proposed project are part II section 4 which provides for functions of the Energy Regulation Board (ERB) to: issue licenses and investigate and monitor operations of businesses in the energy sector; regulate and review charges and tariffs in the energy sector; stipulate conditions for an energy facility or installation and formulate measures to minimize the environmental impact of activities carried out in the energy sector.

Relevance: The project will require the use of fuel for running construction machinery which is subject to the provisions of the Act.

Compliance: Transportation and handling of fuel required during the project construction will be done in line with the Act.

2.1.4.18 National Council for Construction Act No. 10 of 2020

An Act to provide for the establishment of the National Council for Construction and to define its functions :to provide for the promotion and development of the construction Industry in Zambia, to provide for the registration of contractors and to provide for the affiliation to the Council of professional bodies or organizations whose members are engaged in activities related to the construction Industry.

Section 6 of the Act empowers the NCC to monitor projects and ensure compliance with applicable standards, including environmental standards.

Section 7, requires a mandatory registration of all participants (contractors) in the construction industry and prohibition of unregistered contractors to undertake construction projects.

Section 15 provides for registration of all construction projects with the NCC for them to understand the nature of the project and offer appropriate advice, while section 16 establishes the best practice project assessment scheme for awarding construction projects to any given contractor.

Relevance: The road construction will involve construction works and all construction workers/contractors will have to be registered with the National Council for Construction.

Compliance: All contractors engaged on-site will be registered and compliant with the National Council for Construction terms and conditions.

2.1.4.19 The Solid Waste Regulation and Management Act No. 20 of 2018

An Act to provide for the sustainable regulation and management of solid waste; and matters connected with, or incidental to the foregoing.

Part III of the Act sets out environmental and public health standards and responsibilities of property owners or occupiers with regards to solid waste management, while Part IV of the Act prescribes the licensing of waste transporters and permits for operating waste disposal sites.

Relevance: The road construction activities will generate solid waste whose management is subject to the provisions of the Act.

Compliance: BHL - TC and its contractors will ensure that all solid waste generated during the project construction phase is handled in compliance with the provisions of the Act.

2.1.4.20 National HIV/AIDS/STI & TB Council Act No. 10 of 2002

This is an Act to establish the National HIV/AIDS/STI/TB Council, define its functions and provide for its composition and to constitute the Secretariat of the Council, define its functions and provide for its composition.

The provision relevant to the proposed project is Provision 4: The functions of the Council shall be to coordinate Council and support the development, monitoring and evaluation of the multi-sectoral national response for the prevention and combating of the spread of HIV, AIDS, STI AND TB in order to reduce the personal, social and economic impacts of HIV, AIDS, STI and TB.

Relevance: The proposed project will involve people with different medical health conditions.

Compliance: The developer will promote health education on site.

2.2 Organisational Framework

A number of institutions will have a regulatory and monitoring role directly or indirectly under their respective pieces of legislation. However, the following will be key institutions whose requirements will need to be complied with.

- **Zambia Environmental Management Agency (ZEMA)**

ZEMA is an independent environmental regulator and coordinating body. It is governed by a board which provides strategic direction, develops policies as well as monitoring its functions as it relates to the administration of the EMA. With respect to the proposed Project, ZEMA is responsible for reviewing the proposed Project Environmental Project Brief and make a decision on whether the proposed Project should be implemented or not.

- **Town Council(s)**

The ministry of local government is charged with the responsibility of promoting a decentralized and good local governance system, facilitating the delivery of quality municipal services in order to contribute to sustainable social economic development. Local government is an institution, which deals with matters concerning the people living in a particular locality. It represents the microscopic interests of the locality leading to the broader concept of welfare and happiness of its people. The local government institutions have allowed effective participation and involvement of local people in their affairs.

- **Water Resource Management Agency (WARMA)**

The Water Resources Management Authority (WARMA), established under the Water Resources Management Act No. 21 of 2011, serves as Zambia's regulatory body for managing and developing the nation's water resources. Its mandate encompasses ensuring equitable access to water for all stakeholders while promoting sustainable and efficient utilization of these vital resources to support socio-economic development and environmental conservation.

- **Road Development Agency (RDA)**

The principal function of the Road Development Agency (RDA) is to plan, manage, and coordinate Zambia's road network. This includes maintaining roads, preparing and awarding contracts for road construction and maintenance, certifying road works, and reviewing road design standards, classifications, and traffic signage to ensure a safe and efficient transportation system.

The developer will ensure compliance with institutional provisions and guidelines issued by the above institutions in the process of implementing the project.

2.3 International Agreements and Conventions

Zambia is a signatory to a number of international and regional conventions; below are some of them which are relevant to the proposed project:

2.3.1 United Nations Framework Convention on Climate Change, 1992

The Convention rallies parties to take action to reverse anthropogenic factors responsible for the agreed accelerated climatic variations seen through changing temperatures due to an accelerated build-up of Green House Gases (GHGs) resulting from unsustainable industrialization models or technologies.

Relevance: The project has potential to generate greenhouse gases through vehicle exhaust fumes during the delivery of material at construction and vehicle exhaust during operation phase.

These exhaust fumes have potential to cause global warming which leads to climate change.

During operation, expected emissions from the process will be; CO, Nox and SO2.

Carbon monoxide reacts with hydroxyl (OH) radicals in the atmosphere, reducing their abundance.

As OH radicals help to reduce the lifetimes of strong greenhouse gases, like methane, carbon monoxide indirectly increases the global warming potential of these gases.

NOx and SO2 are indirect greenhouse gases that have an effect on atmospheric warming through either chemical reaction or changing the Earth's capability to balance radiative energy.

This causes climate change.

Compliance: Material will be brought to and from the site in bulk; and this will reduce the frequency of delivery vehicles moving to and from the site.

This also reduces on the exhaust fumes released.

Also, all vehicles that will be used during the construction phase will have a maintenance routine to ensure that the same are as clean as possible.

2.3.2 The Paris Agreement

The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change, dealing with greenhouse-gas-emissions mitigation, adaptation, and finance, starting in the year 2020.

Relevance: Part of the proposed project site where the bypass will be made is bush land which Act as carbon sinks preventing climate change.

Compliance: The developer will ensure that unnecessary cutting down of trees is prohibited.

2.3.3 Convention concerning the Protection of the World Cultural and National Heritage (1972):

The Convention aims at ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage.

Cultural and natural heritage sites that may be identified during the proposed project implementation will be protected and conserved in accordance with the provisions of the Convention to which Zambia is party to.

Relevance: The proposed project passes through a Game Management Area.

As the ESIA studies commence, possible cultural/ heritage finds of significance might be encountered.

Compliance: The developer will ensure that if finds of heritage/cultural finds are encountered, relevant authorities (NCC) will be contacted.

2.3.4 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1992)

The Basel Convention is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries.

It does not, however, address the movement of radioactive waste.

Relevance: The proposed development will result in the generation of hazardous waste such as material used to mop up fuel in case of fuel spills during construction/operation; and fluorescent tubes that stop working, grease from the kitchen sinks grease traps, empty containers of cleaning chemicals during operation phase.

Compliance: The hazardous waste generated will not be moved across borders.

Hazardous waste generated will be managed by local licensed hazardous waste management companies.

The proponent will not at any phase of the project import/export hazardous waste to comply with this convention.

2.3.5 Montreal Protocol on Substances that Deplete the Ozone Layer (1987)

The agreement regulates and identifies chemical substances that are implicated or have potential to contribute to the depletion of the Ozone layer.

Relevance: The proposed development will require use of cleaning products, to have air conditioning and will also require the use of refrigerators and freezers.

All of which if not procured with care may contain Ozone depleting substance such as chlorofluorocarbons and halons.

Compliance: The proponent will only buy cleaning products from local suppliers approved in Zambia.

Since Zambia is a signatory to the Montreal Protocol, it is expected that imported cleaning products, refrigerators and freezers comply with the Montreal Protocol.

The proponent will also install modern air conditioners in which the ozone depleting substances are reduced.

3.0 PROJECT DESCRIPTION

3.1 Location

The proposed 371 km road traverses Kalumbila, Kasempa, Mufumbwe, and Kaoma Districts located in Zambia's North- Western and Western provinces. The road commences in Mutanda, traverses through Kasempa and Mufumbwe, and concludes in Kaoma. This strategic route is designed to enhance regional connectivity and support socio-economic development. The figure below illustrates the full stretch of the road.

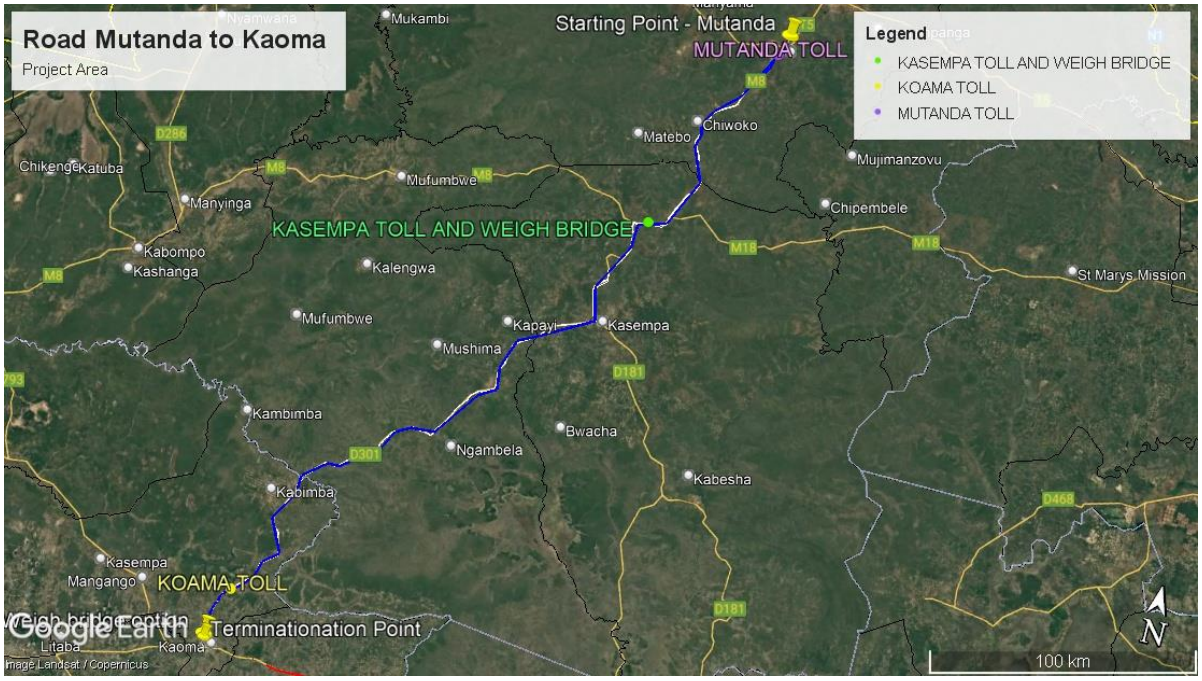

Figure 3: Satellite Map of Mutanda to Kaoma Stretch

Table 5: GPS coordinates of the project site

Distance of the Proposed Road – 371 km			
Label	**Coordinates**		
Name	**Latitude**	**Longitude**	**Elevation**
Mutanda (Starting Point)	-12.395174°	26.238039°	1341m
Kasempa Turnoff	-13.106404°	25.871485°	1314m
Turning Point	-13.458360°	25.823192°	1270m
Bypass	-14.797049°	24.794861°	1136m
Kaoma (Termination)	-14.830529°	24.779147°	1178m

3.2 Nature of the Project

The road construction project falls within the transportation sector and entails the rehabilitation and upgrade of a 371-kilometer road connecting Mutanda and Kaoma in Zambia's North-Western and Western Provinces.

The proposed construction and rehabilitation of the **371 km** road traversing the North-Western and Western Provinces of Zambia will be implemented in two sections: **Section 1** will involve the rehabilitation of the Mutanda to Kasempa section (150 km), while **Section 2** will be the upgrade of the Kasempa to Kaoma section (221 km). This project forms a critical connection to the Mongu-Sesheke Road, ultimately linking to the international port of Walvis Bay.

Key components of the project include:

- **Road rehabilitation and upgrade:** Mutanda to Kasempa– **150 km**
    - Construction of one toll plaza, located approximately 5 km from Mutanda;
    - Construction of a second toll plaza, located east of Kasempa Town, approximately 110 km from Mutanda;
    - Construction of first weighbridge in close proximity to the second toll plaza;
    - Construction of a Traffic Circle in Kasempa Town; and,
    - Construction of BHL–TC Headquarters, administration offices and operation and maintenance yard;

- **Road rehabilitation and upgrade:** Kasempa to Kaoma – **221 km**
    - Construction of a third toll plaza located at approximately 25km from Kaoma Town;
    - Construction of a second weighbridge located at approximately 3km from the M9 junction;
    - Establishment of operations and maintenance yard;
    - Construction of Kaoma western by-pass (4.44km); and,
    - Widening and upgrading of the existing bridges. One at Lalafuta River and the second one at Chilombo River.

Summary of the project component are as follows:

- Road
    - 371 km stretch of Road to be rehabilitated and upgraded to international bituminous standards.

- Road Cross-section
    - Single carriageway (10 m);
    - 3.5 m travel lane;
    - 2 m surfaced shoulders; and,

- 0.3 m gravel shoulders.

- Structures and Drainages

  - Upgrading all Armco drains.
  - Replacing all substandard culverts.
  - Construction of three toll plazas.
  - Construction of two weighbridges.
  - Widening and upgrading of the existing bridges—one at Lalafuta River and one at Chilombo River.
  - Construction of traffic circles.
  - Construction of administrative facilities and operation and maintenance yards.

The proposed project will be implemented in three phases: the preparation phase, the construction phase, and the operation phase. The project will be executed in compliance with all relevant Zambian standards.

Specialized local contractors will be engaged for the construction work. Whenever possible, priority will be given to employing labour from local communities around the project area. However, some of the contractor's permanent skilled staff may be sourced from other areas.

Generally, major activities of this project will include:

- Clearing of the site;
- Rehabilitating and upgrade of the road including upgrading of the existing drainages and replacement of the substandard culverts;
- Construction of toll infrastructure, construction of two weighbridges and upgrading of the two already existing Lalafuta bridge and Chilombo bridge;
- Setting up of auxiliary structures such as BHL-TC headquarter offices, administration offices, maintenance yards, and staff villages;

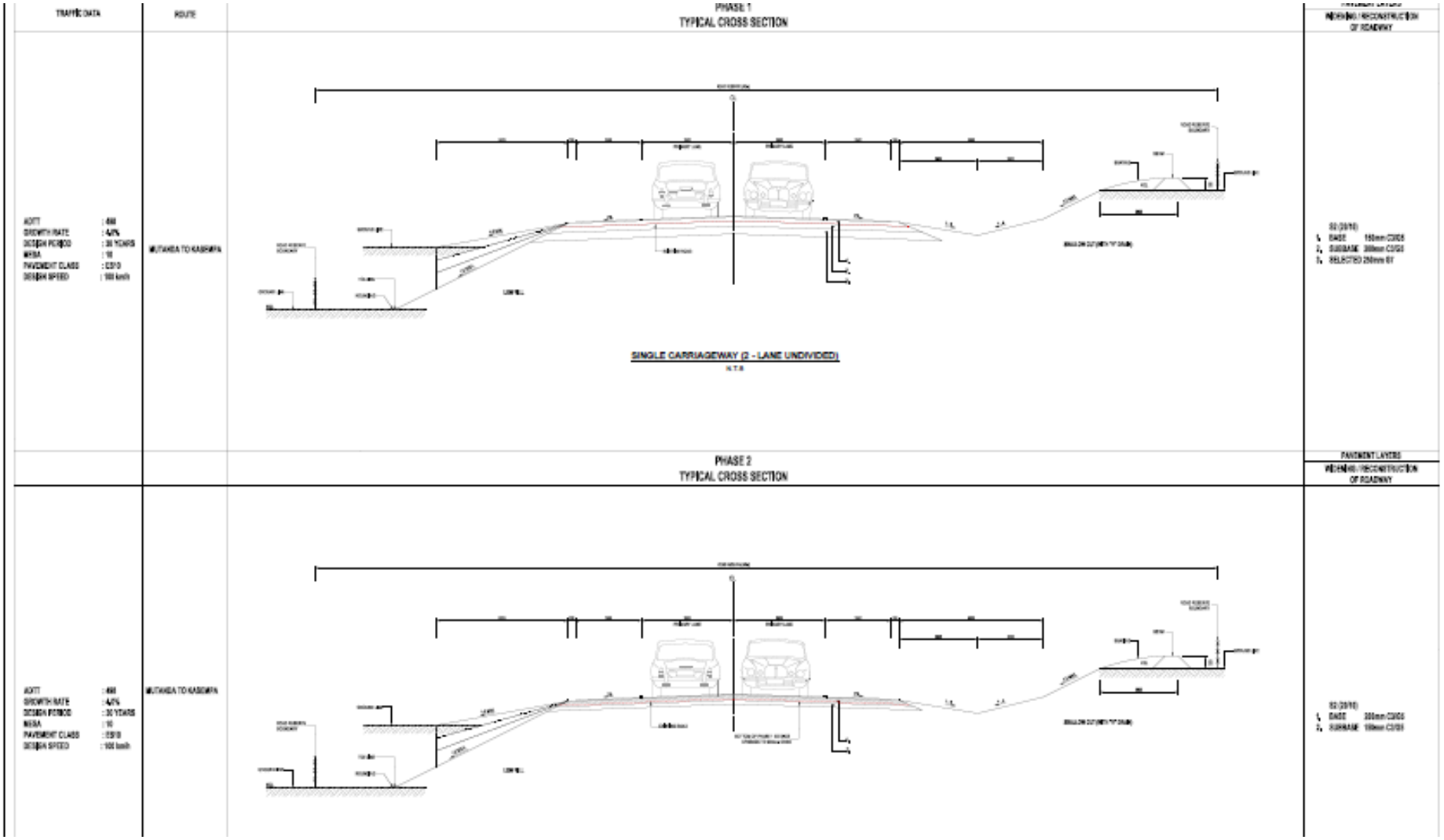

Figure 4: Showing Phase One & Phase Two of the Single Carriageway from Mutanda to Kasempa

3.2.1 Raw Materials

Raw Materials Input During Preparation and Construction

The raw materials that are expected to be used during the preparation / construction phase of the project will include the following:

Table 6: Raw Materials to be used in Construction Phase & Operation Phase

	Material	Source	Storage on Site	Mode of Delivery
CONSTRUCTION PHASE				
1	River and building sand	Local suppliers	Heaped on an area of site	Road truck
2	Aggregates and laterite	Local approved suppliers and ZEMA approved Borrow pits	Heaped on an area of site	Road truck
3	Cement	Local	Stored in a temporal storage container on site	Road truck
4	Concrete blocks, ground stone and bricks	To be manufactured off and on site and from local approved suppliers.	Heaped on an area of site	Road truck
5	Diesel, petrol and oil (for operation of the generator and machinery)	Local approved suppliers	Bulk bowser on a concreted/impermeable floor in a bunded area enclosed in a well-ventilated temporary shed under lock and key	Road truck. The fuel will be brought to site by licensed fuel transporter.
6	Water	Nearby WARMA approved surface water bodies	Water storage tanks	Submersible pumps and water bowsers Water pipe network
7	General building materials (e.g. Steel bars or mesh, timber for shuttering, steel, window and door frames, polythene sheeting, uPVC pipes, control valves hydrants, meters, tees,	Local approved suppliers	Storage container	Road truck

	bends, pumps, switches PVC pipes, overhead tanks, reinforcing steel etc)			
OPERATION PHASE				
1	Water for domestic use, fire- fighting and for irrigation of the landscaped areas	WARMA approved Site boreholes	Water reserve tanks	Water reticulation system and electrical pump
2	Electricity; for lighting, operation of equipment/pumps, electricity will be provided by ZESCO from the main existing power supply	ZESCO power supply	Various storage rooms within project buildings	ZESCO power reticulation
3	Groceries	Local approved suppliers	Storage rooms within project buildings	Road truck
4	Furniture	Local and international suppliers	Store rooms within project buildings	Road truck
5	Spare parts, administrative and office supplies	For repair and maintenance of equipment and machinery, and for administrative use	Store rooms within project buildings	Road truck

3.2.2 Equipment and Machinery

The project will utilize a variety of equipment and machinery to ensure efficient road construction.

Earthmoving equipment, such as excavators, bulldozers, graders, loaders, scrapers, and trenchers will be used for site preparation and grading. Paving equipment will include bituminous pavers, concrete pavers, and rollers to create a smooth and durable road surface. To ensure proper compaction, vibratory compactors will be used. Material handling equipment, including dump trucks, conveyor systems, and material transfer vehicles, will facilitate the transportation of construction materials.

Road maintenance equipment, such as crack sealing machines, pothole patching machines, and road sweepers, will help maintain the road during and after construction. For safety and traffic control, the project will employ traffic control and safety equipment, including traffic cones, barricades, traffic signs, and road markers. Surveying and measurement equipment, such as GPS devices and levels, will ensure accurate alignment and grading. Additionally,

miscellaneous equipment, like water trucks for dust control, lighting towers for nighttime work, and portable generators will support various construction activities.

3.2.3 Process and Technology

3.2.3.1 Construction

The road will be built using standard road construction techniques, which include:

i. Clearing and grubbing

Clearing and grubbing is the first step in the road rehabilitation and upgrade process. This stage involves the removal of vegetation, trees, and other obstructions from the area where the road will be improved, ensuring proper sight distances and road safety. However, since the proposed alignment follows the existing road, minimal clearing and grubbing are anticipated. Most of the vegetation and trees within the current road corridor will remain intact, with only targeted areas being cleared to accommodate the new design, especially the temporal road bypass, road widening, or safety requirements.

ii. Sub-base construction

The sub-base construction for the rehabilitation and upgrading of the road involves the removal of the existing soil, followed by leveling the ground to prepare for the placement of gravel. During this process, the road is widened to meet the required specifications, including adequate drainage and shoulders. The soil is mixed with water and then compacted to achieve the desired strength and stability for the new road structure.

iii. Sub-base layer

This stage of construction closely follows the previous one and focuses on improving the first layer by adding additional gravel and mixing it with water to achieve the desired thickness. During this process, cement is applied to the soil in intervals and mixed with another layer of gravel. The mixture is then compacted firmly to stabilize the road, creating a stronger, more durable foundation. This stage ensures that the road meets the required standards and regulations set by international and national road construction guidelines, ensuring the road is of high quality and built to last.

iv. Bituminous layer

This stage will involve the addition of a bituminous seal to the stabilized base, followed by the application of the binder course. The binder course consists of smaller aggregates mixed with a bituminous binder. It provides a smooth and stable surface for the road while also protecting the base course from water damage, ensuring durability and longevity.

v. Aggregates

The final step in the road construction process will be adding the surface course. The surface course is made up of smaller aggregates mixed with a bituminous binder and is the layer that comes in direct contact with traffic. It provides a smooth and durable driving surface, protecting

the road from wear and tear. This layer is designed to withstand the weight of vehicles and includes a designated carriageway along with a lane for motorbikes and bicycles.

vi. Drainage and Culverts

The project will include the installation of drainages and culverts along the road to ensure proper water flow and prevent damage. The existing substandard culverts will be replaced with modern ones that meet the required road standards, and larger culverts will be installed in areas prone to high water levels. Additionally, major bridges within the project scope will be equipped with appropriately sized box culverts to meet the modern standards of a trunk road. The drainage system will also be upgraded by constructing concrete drains in towns and residential areas, while other areas will have their drainage systems improved to enhance water flow and protect the road structure. Mitre drains will be constructed to efficiently manage water runoff and prevent erosion.

vii. Toll Gate Construction

The project will include the construction of three toll gates within the 371km road stretch, located in Mutanda District, old Kalulushi Turnoff, and Kaoma District. These toll gates will undergo a comprehensive structural analysis to ensure durability and efficiency.

The construction process will involve:

- Ground Preparation: The area will be leveled and stabilized with gravel before being compacted firmly to provide a strong foundation.
- Concrete Casting: A concrete base will be cast at the site to enhance durability and withstand heavy traffic loads.
- Toll Booth Installation: Toll booths will be strategically placed to facilitate smooth traffic flow and efficient toll collection.
- Canopy and Infrastructure: A canopy will be installed to provide shelter, and necessary facilities such as lighting, barriers, and security installations will be set up.
- Drainage System and Road Markings: Proper drainage systems, including concrete drains, will be integrated to prevent water accumulation and damage to the road infrastructure.
- Office Facilities: The toll gate will also include an administrative building for operational and security personnel, a small workshop, storage and facilities for solar backup power as well as other necessary amenities for efficient toll management.

The construction of the toll gates will adhere to the required engineering standards to ensure durability and effective traffic management.

viii. Weighbridge Infrastructure

The project will involve the construction of three weighbridges along the 371km Mutanda-Kaoma road to monitor vehicle axle loads, ensuring compliance with road safety regulations and preventing road wear. The construction phase will include land clearing, leveling, and compacting the ground to create a stable foundation. Drainage systems will be integrated to prevent water damage. The weighbridge platforms will be installed with reinforced concrete,

equipped with load cells for accurate weight measurement. Control offices will be constructed for operators, and security measures like fencing and surveillance will be implemented. Finally, the weighbridges will undergo testing and calibration to ensure proper function, helping to extend the road's lifespan and maintain compliance with transport regulations on the 371km road.

ix. Upgrade of the Bridges

The proposed project will also involve upgrading the existing bridges along the 371km Mutanda-Kaoma road, specifically Lalafuta Bridge, which borders Mufumbwe and Kaoma districts, and Chilombo Bridge in Kaoma District. These bridges will be widened and improved to enhance their structural capacity, ensuring they meet modern safety and load-bearing standards. The upgrades will improve traffic flow, accommodate larger vehicles, and enhance overall road safety, contributing to the long-term durability of the transport network.

x. Construction and Purpose of Auxiliary Facilities

As part of the proposed Mutanda-Kaoma Road rehabilitation and upgrade project, auxiliary facilities will be constructed to support road operations and maintenance. These include the BHL-TC headquarters, administration offices, maintenance yards, and staff villages.

- BHL-TC Headquarters and Administration Offices:

The headquarters and administration offices will be constructed using durable materials to ensure longevity and functionality. The buildings will include office spaces, meeting rooms, and facilities for project management teams. These offices will serve as the central hub for overseeing road operations, coordinating activities, and managing administrative tasks related to the project. They will also house administrative staff responsible for road maintenance, monitoring, and compliance with regulatory requirements.

- Maintenance Yards:

The maintenance yards will be developed on stable, well-leveled ground and will include workshops, storage facilities for equipment and materials. These yards will serve as key operational centers for servicing and maintaining road construction machinery, vehicles, and other essential equipment. They will also store spare parts, construction materials, and fuel supplies to ensure smooth operations and reduce downtime.

- Staff Camp:

Dedicated staff camp will be constructed to provide accommodation for project workers and personnel overseeing the road upgrade. The houses will be built with sustainable materials, and the villages will include essential amenities such as water supply, electricity, and sanitation facilities. This setup will enhance the well-being of workers, improve productivity, and ensure their availability for efficient project implementation.

The construction of these auxiliary facilities will play a crucial role in supporting the rehabilitation and upgrade of the 371km Mutanda-Kaoma Road, ensuring smooth operations, effective project management and long-term maintenance of the road infrastructure.

SERVICES

- Water Supply

Water for the project's needs will be sourced from nearby streams and rivers. This option offers a readily available and cost-effective solution, minimizing transportation costs and providing large volumes of water for construction needs along the 371km stretch. However, this approach requires careful environmental management to prevent over-extraction and pollution, as well as potential treatment to ensure water quality.

To ensure compliance with water resource management regulations, the developer will obtain the required water permits from WARMA for both the surface water bodies and any drilled boreholes. To obtain this permit, the developer will provide WARMA with necessary information, including the specific water source, the volume of water required, and the nature of the proposed use. The developer will adhere to all guidelines and regulations provided by WARMA and obtain the necessary water rights. Where necessary, boreholes will also be developed to supplement water sources.

- Sanitation

For sewage management the project will utilize their own sewage package plants designed to prevent contamination of the natural resources.

- Electricity Supply

The site can easily be connected to ZESCO for power supply. The supply is adequate to meet the project power requirements. The proposed project will also have solar power as a backup that will be used in case of a ZESCO power outage.

- Safety

All workers on site will have knowledge of occupational health and safety requirements and on wildlife awareness i.e. what to do/not to do when an animal is in close proximity. All construction and installations will be according to the ZABS standards to ensure safety. The proposed development will have a police post and a DNPW office.

3.2.4 Products and By-products

3.2.4.1 Products of the Project

The main product of this project will be a modern fully engineered bitumen road that has the capacity to withstand the effect of harsh weather and heavy traffic. It is, however, likely that the project will also produce by-products. These by-products may include pollutants such as used oils and toxic fumes (CO, CO_2, NOx, SOx, aromatic compounds, particulate matter, and other volatile compounds) from hot asphalt and engines, dust, noise, silt, vibrations, strong lights, smells, spoils of soil and rock from excavation works, plastics, medical waste at the construction camp and sanitary waste.

3.2.4.2 By-products during Preparation and Construction

The various waste products expected to be generated during the project preparation and construction phase and their disposal or management methods are as follows:

- **Vegetative waste**: This will include trees and grass that will be cleared to pave way for development. This will be treated as solid waste.
- **Topsoil**: this will be used on the site for landscaping;
- **Solid waste**: this will include material such as scrap timber and various off cuts and refuse such as discarded packaging (e.g. cement bags), workers garbage and domestic waste from workers. Solid waste will be managed by the use of mobile colour coded bins (drums) that will be placed at various locations on the construction site and the waste from these bins will be regularly collected and disposed according to the council waste management practices in place.
- **Sewage disposal**: this is sanitary waste generated by the construction workforce. This waste will be managed by the use of hired chemical toilets.
- **Dust**: this will be generated from the site due to the nature of various construction activities. The active work sites/exposed work areas will be watered daily to suppress dust by use of a water bowser and in some areas a water hose will be used. All fine material capable of being raised by the wind and causing air nuisance will be stock piled wholly within the construction site and where possible in bags until the time for use.
- **Hydrocarbon waste**: the developer will ensure that contractor(s) on site will have well trained supervisors who will ensure proper maintenance and handling machinery to prevent spills/leakages of hydrocarbons to the environment. There will be no hydrocarbon waste. Should there be hydrocarbon waste, this will be temporarily disposed of in a drum that will be clearly marked as hazardous waste and will be covered at all times. This hazardous waste bin will be collected by an approved hazardous waste collection company and disposed of at a ZEMA approved disposal site.
- **Exhaust emissions**: This will be from operation of vehicles and machinery on site. To minimise exhaust emissions the developer will ensure that contractor(s) on site will have well trained supervisors who will ensure proper maintenance and handling of machinery.
- **Concrete rubble**- this will be crushed and reused for road sub-base or disposed of at approved sites.

3.2.4.3 By-Products during Operation

- **Solid waste** will be collected on site in color coded bins and skips and disposed of by licensed solid waste service providers. At all phases of the project there shall be no burning of waste and the bins to be used for waste will be leak proof and in areas where the animals cannot scatter the waste.
- **Litter from road users** such as plastic, food wrappers and paper will be managed through waste bins at rest stops and regular roadside cleaning
- **Fats/oils** from the kitchen will be trapped by grease traps that will be located into the floor under the kitchen sinks before the water goes into the sewage management system.

- **Storm water** runoff with pollutants will be managed through regular road monitoring and the use of oil interceptors in drainage systems.
- **Sewage and grey water** from the development will be managed by the use of new modern flushable toilets that will be constructed on site and connected to a well serviced septic tank and pump out system.
- **Vehicle exhaust emissions** such as CO_2, NO_X, SO_2, particulates will be reduced through vehicle emission regulations and awareness campaigns

3.2.5 Schedule and Lifetime of the Project

The project is scheduled to commence as soon as the approvals are obtained. The construction works are expected to be completed over a period of 24 months. The project is expected to have a lifespan of 100 years

Table 7: Project Schedule

Phase	Duration	Main Activities
Preparation Phase	3 months	• Obtaining all relevant approvals
Construction Phase	2 years	• Road rehabilitation and upgrade
Operation Phase by Developer	23 years	• Developer operates the road
Operation Phase by Government	77 years	• Government operates the road
Decommissioning Phase	3 months	• Restoring the site to pre-project status

3.3 Project Activities

The proposed project will essentially have four phases namely; preparation, construction operation and decommissioning phases.

3.3.1 Activities during Site Preparation

The following will be done during site preparation:

- Appointment of project team.
- Site survey and marking – Conducting a topographical survey to map out the existing road alignment and set out the new design.
- Architectural road Plans.
- Concern/commitment/approval from relevant institutions.
- Obtaining of approvals/permits from relevant authorities including ZEMA.

3.3.2 Activities during Construction

The main activities envisaged during construction will include:

i. Preparation of the Site

- Clearing of vegetation (trees, shrubs and grass) within the right of way (as necessary).
- Stripping of topsoil and vegetative material for access roads and building foundations.

- The foundation which will be constructed after basic earthworks are done.
- Basic earthworks to establish required access road and foundation levels and falls, Basic earthworks mean digging a little deeper after stripping off topsoil and the existing vegetation. This will be done to have a strong foundation. Processes during basic earthworks include: removal of material to spoil, filling, compacting and trimming.

ii. Construction

a. Road rehabilitation and upgrade

Excavation works

- Removal of weak soils and replacement with suitable materials
- Disposal of excavated materials in designated area

Earthworks

- Grading of the road to achieve the required vertical alignment
- Compacting after topsoil is removed.

Subgrade preparation, compaction and base course placement

- 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 and parking areas for bitumen surface and preparation, pouring and compaction of concrete for concrete surfaced areas.

Bitumen/concrete paving and compaction

Shoulder construction and stabilization

- Establishing road shoulders for vehicle recovery

b. Toll Infrastructure

Site Preparation and Foundation Works

- Land clearing and levelling for toll plazas
- Excavation and laying of foundations

Construction of toll booths and plaza structures:

- Building of toll booths, canopies, and vehicle lanes

Installation of automated toll collection systems

- Setting up of electronic tolling equipment
- Implementing cash and electronic payment systems

Power and communication system integration

- Connecting to the electricity grid or installing solar backup,
- Installing communication links for toll operations

c. Weighbridges

Grading of the site and foundation preparation

- Land clearing and leveling surfaces

Installation of weighbridge platforms

- Placing heavy-duty weighing scales at key points

Construction of weighbridge control buildings

- Building administration offices and staff accommodation

Traffic management system implementation:

- Setting up signage, barriers, and traffic control measures.

d. Upgrading of armco drains and Culvert Replacement

Excavation and removal of old culverts

- Dismantling and disposing of damaged drainage structures

Installation of new reinforced concrete culverts

- Placing box and pipe culverts at designated locations

e. Auxiliary facilities

BHL- TC headquarters and administration offices:

- Foundation and structural works
- Roofing, windows, and finishing
- Electrical and plumbing installations
- Office furnishing
- Maintenance yards

3.3.3 Activities during Operation

This phase occurs once all the road rehabilitation and upgrading works have been completed, and the road has been commissioned for use. Commissioning will be conducted in a phased process on sections of the road as they are completed. In the operation phase, the main activities will include routine and emergency maintenance, such as pothole patching, maintenance of shoulders and drainage, placement of signage, road markings, and vegetation clearing along the sides of the road to maintain sight distance. Other activities will involve regulating the maximum permissible weight for vehicles on the road, providing a system for road safety and traffic management, and promoting road safety

In the operation phase, the main activities will include routine and emergency maintenance, such as pothole patching, maintenance of shoulders and drainage, placement of signage, road markings, and vegetation clearing along the sides of the road to maintain sight distance. Other activities will involve regulating the maximum permissible weight for vehicles on the road, permissible for transmission on the road, providing a system for road safety and traffic management, and promoting road safety.

3.3.4 Activities during Decommissioning

This phase focuses on addressing the negative impacts associated with the project. Decommissioning will occur only if the project is no longer economically viable or if its structural integrity is significantly compromised.

4.0 PROJECT ALTERNATIVES

Need for the Project

The project is necessary as it has potential to significantly enhance regional connectivity, stimulate economic activity, and contribute to the development of sustainable infrastructure. By addressing critical transportation challenges, the project will provide a reliable and efficient road network that reduces travel times, enhances safety, and facilitates the seamless movement of goods and people. These improvements align with Zambia's long-term goals of fostering economic growth, enhancing trade, and driving social development. The upgraded road will serve as a vital corridor linking Zambia's mineral-rich Northwestern Province and Copperbelt to the Western Corridor and the West Coast regions of Africa. This strategic connectivity will unlock new opportunities for trade and investment, while also supporting local industries and communities by improving access to markets, healthcare, and other essential services.

4.1 Project Alternatives

The proponent had three project alternatives, which is the do-nothing option, routine maintenance and minor upgrades or rehabilitation and upgrade of the road to implement the proposed project.

4.1.1 Identification and Justification/analysis of Alternatives

i. Do nothing option- This alternative involves making no significant changes to the current state of the Mutanda-Kaoma Road. The road would continue to deteriorate over time, leading to longer travel times, increased wear and tear on vehicles, and heightened safety risks. It would also fail to address the growing transportation demands in the region. Although this option avoids initial costs, the long-term impacts would likely be negative, contributing to higher maintenance costs and slower economic growth in the area. However, this option does not align with the developer's objectives, as they aim to rehabilitate and upgrade the road to the enhance regional connectivity, stimulate economic activity, and contribute to the development of sustainable infrastructure.

ii. Routine maintenance and minor upgrades- This alternative focuses on performing basic maintenance tasks such as patching potholes, resurfacing damaged sections, and upgrading small portions of the road that are in particularly poor condition. While it could improve some road conditions in the short term, it would not address the underlying infrastructure challenges or the full capacity needs of the road network. It may also fail to adequately enhance safety and connectivity. This alternative would provide only temporary solutions and would not fully unlock the road's economic potential or contribute to long-term development.

iii. Rehabilitation and upgrade of the road- This alternative involves the comprehensive rehabilitation and upgrading of the entire 371km stretch of the Mutanda-Kaoma road. It would include resurfacing, strengthening weak sections, improving drainage systems, and enhancing road safety features such as signage and road markings. The project would address the road's structural

issues, improve traffic flow, and provide long-term benefits such as reduced travel times, improved safety, and better regional connectivity. This alternative aligns with the broader goals of supporting economic growth, enhancing trade, and fostering social development in the region. Although more expensive than routine maintenance, it would offer a sustainable solution with greater long-term impact.

4.1.2 List of Chosen Alternatives in Order of Preference

i. Rehabilitation and upgrade of the road
ii. Routine maintenance and minor upgrades
iii. The no-action alternative

4.1.3 Reasons for choosing the preferred alternatives and rejecting the other alternatives

The rehabilitation and upgrade of the Mutanda-Kaoma Road is the best alternative due to its long-term benefits. Unlike the do nothing alternative**,** which would worsen road conditions and increase safety risks, or routine maintenance**,** which provides only temporary fixes, the upgrade will improve road safety, reduce travel times, and support regional economic growth. The rehabilitation and upgrade will enhance connectivity between key regions, facilitating trade and access to markets, healthcare, and services. Additionally, the upgraded road will meet future traffic demands and provide a more cost-effective solution over time, making it the most suitable option for sustainable development.

4.2 Technology and / or Design Alternatives

The proponent considered two primary pavement surfacing alternatives for road construction: hot-mix asphalt and bitumen surface treatment.

4.2.2 Identification and Justification/analysis of Alternatives

i. Hot- mix asphalt- this involves heating, drying, and mixing aggregates, sand and bitumen to create a hot asphalt (HMA). The HMA is then placed compacted onto the prepared road surface using a paver, resulting in a durable and smooth pavement with a relatively long service life. HMA pavement generally requires a higher initial investment due to the materials, equipment, and skilled labour involved.

ii Bitumen surface treatment - this technique, often referred to as chip seal or double surface treatment, involves spraying a layer of bitumen binder onto the prepared road surface, which is then covered with a layer of aggregate chips. A second layer of binder and chips is typically applied to create a more durable wearing surface. Bitumen surface treatment is generally less expensive upfront and requires less specialized equipment compared to HMA, but it will require more frequent maintenance.

4.2.3 List of Chosen Alternatives in Order of Preference

i. Bitumen surface treatment
ii. Hot- mix asphalt

Reasons for choosing the preferred alternatives and rejecting the other alternatives

While HMA pavement offers a higher level of performance and durability, bitumen surface treatment has been selected as the preferred technology for the rehabilitation and upgrading of the Mutanda to Kaoma road. This decision is based on the following factors:

Cost-effectiveness: Bitumen surface treatment offers a lower initial cost and utilizes locally available materials, making it a more economical option for this project.

Construction simplicity: The construction process is less complex and requires less specialized equipment, making it suitable for the project's context and available resources.

Suitability for project requirements: Given the traffic volume and loading conditions anticipated on this road, bitumen surface treatment is considered an appropriate and adequate solution.

Maintenance considerations: While recognizing the potential need for more frequent maintenance, the simplicity of repair and patching for bitumen surface treatments makes it a manageable approach for the long term.

4.3 Route Alternatives

The developer considered two alternative routes for the rehabilitation and upgrade of the 371 km Mutanda to Kaoma Road:

4.3.1 Identification and Justification/analysis of Alternatives

i. Option 1- A route starting from Mutanda, passing through Kasempa and Kaoma towns, and terminating at the M9 (Lusaka-Mongu Road).
ii. Option 2- A route bypassing both Kasempa and Kaoma towns and directly connecting to the M9.
iii. Option 3- A route starting from Mutanda, passing through Kasempa on the current road alignment towards Kaoma before following a short western bypass around Kaoma, and terminating at the M9.

4.3.2 List of Chosen Alternatives in Order of Preference

i. Option 3
ii. Option 1
iii. Option 2

4.3.3 Reasons for choosing the preferred alternatives and rejecting the other alternatives

After careful evaluation, the developer selected Option 3, which limits the opening of new routes and bypasses most of the central business areas of Kaoma, as the currently preferred option. This option, based on current social and environmental information, is considered preferable from an environmental and social perspective and aligns with sustainable development principles. Key considerations for this decision include:

- **Environmental Impact:** Bypassing the towns minimizes urban congestion and emissions by diverting heavy mining and freight traffic away from Kaoma's CBD, thereby lowering localized air pollution (NOx, PM) and noise exposure for residents. By prioritizing the existing road corridor where feasible, it minimizes vegetation clearance in urban areas. Additionally, the bypass improves water quality by reducing risks of urban runoff contamination (e.g., oil, heavy metals) into nearby watercourses, as heavy vehicle traffic is redirected away from town centers.
- **Social Impact:** The chosen route mitigates potential challenges such as traffic congestion, trading disturbances, and increased risks of road traffic accidents within the towns. This approach also ensures minimal disruption to local livelihoods and urban social dynamics.
- **Technical and Economic Viability:** The bypass route is more aligned with the developer's operational objectives, reducing the complexity of construction within densely populated areas, leading to cost efficiencies and streamlined project execution.

The selected alignment avoids Kaoma's central business district (CBD) entirely through a short western bypass, while in Kasempa the route passes through a less congested peripheral section of the CBD rather than its busiest center. This balanced approach minimizes environmental and social impacts by: reducing displacement of businesses and residents in Kaoma; limiting traffic disruptions in Kasempa to less densely populated areas; and avoiding the most ecologically sensitive zones near both urban centers. The design reflects extensive community consultations and environmental studies, prioritizing minimal disturbance while maintaining efficient connectivity - key to the developer's commitment to socially and environmentally responsible infrastructure.

4.5 Water Supply

Two alternatives for water supply were considered as follows:

4.5.1 Identification, Justification and Analysis of Alternatives

i. Nearby surface water bodies (stream and rivers) – Sourcing water from nearby streams and rivers would offer a readily available and cost-effective solution, as it minimizes transportation costs and would provide large volumes of water for

construction needs along the entire 371km stretch. However, this option would require careful environmental management to prevent over-extraction and pollution, as well as potential treatment to ensure water quality. Additionally, a water permit would be obtained from the Water Resources Management Authority (WARMA) to ensure legal compliance and sustainable water use.

ii. Municipal water supply – this would involve sourcing water from existing town water systems along the route. While this option ensures treated and reliable water, it will not be feasible due to the long stretch of the project, as municipal supply is not available throughout the entire 371km corridor. Additionally, relying on municipal sources could be costly and place additional strain on local water systems.

4.5.2 List of Chosen Alternatives in Order of Preference

i. Nearby surface water bodies (stream and rivers)
ii. Municipal water supply

4.5.3 Reasons for choosing the preferred alternatives and rejecting the other alternatives

After evaluating the outlined alternatives, water for the project water needs will be sourced from nearby surface water bodies such as streams and rivers. This option offers a readily available and cost-effective solution, as it minimizes transportation costs and can provide large volumes of water for construction needs along the entire 371km stretch. However, this option requires careful environmental management to prevent over-extraction and pollution, as well as potential treatment to ensure water quality. Proper measures, include obtaining a WARMA permit. To obtain the necessary water permit from the Water Resources Management Authority (WARMA) and ensure legal compliance and sustainable water use, the developer will provide WARMA with required information, including the specific water source, the volume of water required, and the nature of the proposed use. Where necessary, boreholes will be developed as well. The developer will adhere to all guidelines and regulations provided by WARMA and obtain the necessary water rights.

4.6 Sewage Management

The alternatives for sewage management were considered as follows:

4.6.1 Identification and Justification/analysis of Alternatives

The alternatives for sewage management were:

i. Septic tank and soak away- This option meant having an onsite sewage management system onsite with a capacity large enough to allow the solids to break down preventing contamination of ground water sources. This system is effective if the sizing is done correctly and there is adequate maintenance. However, the proposed project involves the construction of a 371km road**,** which extends across diverse landscapes and is not confined to a single, fixed location. Given the nature of the project, the developer opted against using septic tanks

and soak ways as they are a permanent, stationary solution unsuitable for a linear infrastructure project like a road. Additionally, the project is being set up in an area characterized by rich biodiversity, necessitating a wastewater management approach that minimizes environmental impact and ensures groundwater protection along the entire stretch of the road.

ii. On site Portable Chemical toilets- These toilets typically consist of a seat and a holding tank. The tank contains chemicals that break down waste, reduce odour, and disinfect. This chemical process is crucial for controlling bacteria and ensuring a more sanitary environment.

Portable chemical toilets are widely used in a variety of situations:

- **Construction Sites:** As mentioned in the documents, these are ideal for construction sites, providing workers with necessary facilities.
- O**utdoor Events:** They are commonly found at concerts, festivals, and other large gatherings held outdoors.
- **Camping and Recreational Areas:** Portable toilets offer a convenient sanitation solution in areas where permanent restrooms are unavailable.
- **Emergency Situations:** They can be deployed in disaster relief scenarios to provide sanitation when regular facilities are compromised.

iii. Conservancy tank/Pump out- A pump-out system is a variation of a septic system, primarily used when site conditions are not suitable for a traditional drain field. In a pump-out system, the septic tank functions similarly to a traditional system in the initial treatment of wastewater. However, instead of the effluent being discharged to a drain field, the tank is periodically pumped out by a professional service. The collected wastewater is then transported to an off-site treatment facility.

4.6.2 List of Chosen Alternatives in Order of Preference

i. On site Portable Chemical toilets
ii. Conservancy tank/Pump out
iii. Septic tank and soak away

Reasons for choosing the preferred alternatives

The developer will use On site Portable Chemical toilets, during construction and on-site. The benefits of portable chemical toilets include their mobility, ease of installation, and ability to function independently of external water or sewer connections. Regular servicing is essential to pump out the waste and replenish the chemicals, ensuring continued cleanliness and functionality. During operation and specifically at the Toll Gates and Weigh bridges, Conservancy tank/Pump out will be used.

4.7 Power Supply

The project, which includes road construction and installation of toll gates and weighbridges, will require a permanent power supply at those facilities. Connection to the ZESCO power grid will provide an adequate power source for these sites (toll gates and weighbridges). Solar power will also be implemented as a backup system for use during ZESCO power outages.

5.0 ENVIRONMENTAL BASELINE STUDY

5.1 Climate

Zambia experiences a predominantly sub-tropical climate characterized by three distinct seasons: a hot and dry season (mid-August to mid-November), a wet rainy season (mid-November to April) and a cool dry season (May to mid-August). Rainfall is strongly influenced by the movement of the Inter-Tropical Convergence Zone (ITCZ) as well as the El Niño/Southern Oscillation (ENSO) phenomenon and varies from an annual average of 600 mm in the lower south up to 1,300 mm in the upper north of the country. Climate is tropical by location near the equator. The annual rainfall in Zambia averages between 700 mm in the south and 1,400 mm in the north. The hot months are very dry, receiving almost no rainfall between May and August. The wet season (September-April) rainfall is controlled by the passage of the tropical rain belt (also known as the Inter-Tropical Conversion Zone, ITCZ) which oscillates between the northern and southern tropics over the course of a year, bringing rain between October and April of 150-300 mm per month.

Regarding the project area, the proposed road route begins at Mutanda in Kalumbila District and traverses through Kasempa, Mufumbwe, and Kaoma Districts, ultimately terminating at the M9 (Lusaka–Mongu Road). Consequently, the description of the weather patterns relevant to the project area will be provided for each district along the route.

5.1.1 Climate in Mutanda, Kalumbila District

Mutanda, where the proposed project will start is in the Kalumbila district. The climate of Kalumbila District is typical of the regional climatic conditions for Zambia, defined by three major seasons: a cool dry season from April to August, a hot dry season from August to November and a warm wet season from November to April. For Mutanda, climate is tropical. The quantity of rainfall during summers surpasses that of winters.

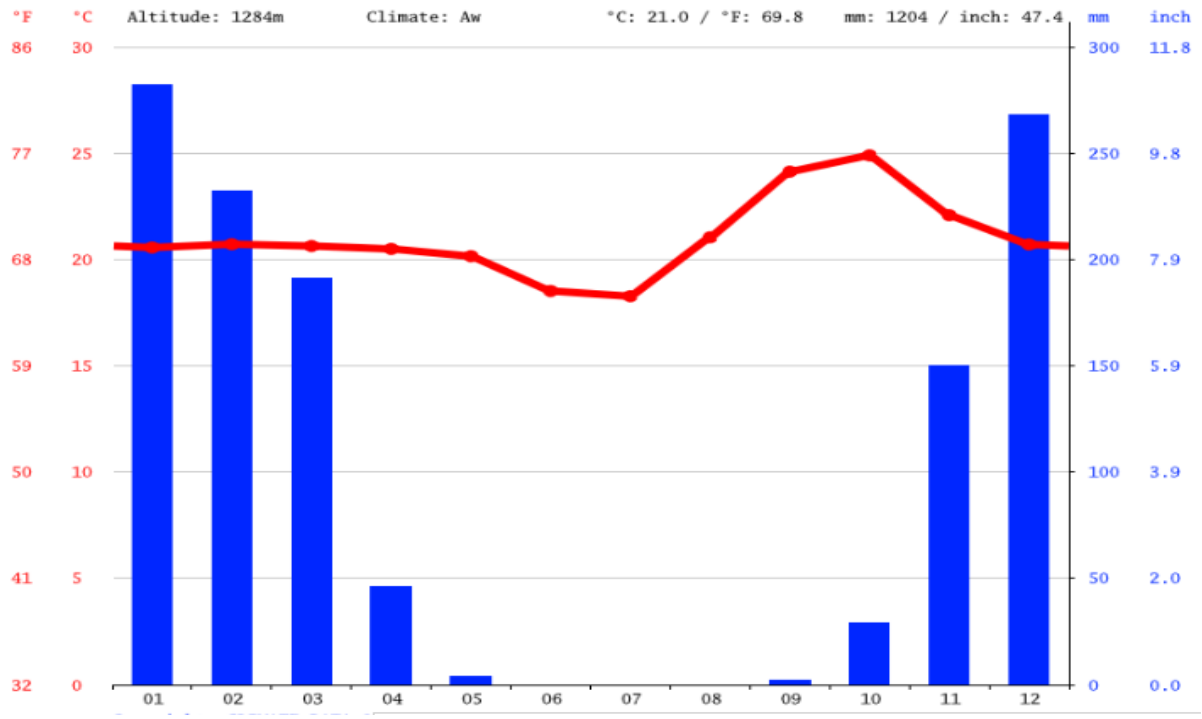

Figure 5: Climate/Weather by Month – Mutanda
Source: https://en.climate-data.org/africa/zambia/north-western-province/mutanda-991497/

Temperature

Kalumbila experiences slightly higher temperature ranges compared to neighbouring districts, partly due to extensive land clearance for mining activities. Daytime temperatures typically range between 25–34°C, with October being the hottest month (averaging 24.9°C in Mutanda). Nighttime lows are moderated by the district's elevation, generally remaining above 12°C even in the coldest month of July (where Mutanda averages 18.3°C). Mining operations have contributed to localized heat islands, where temperatures can be 2–3°C higher than surrounding areas. The average annual temperature in the Mutanda area is 21.0°C.

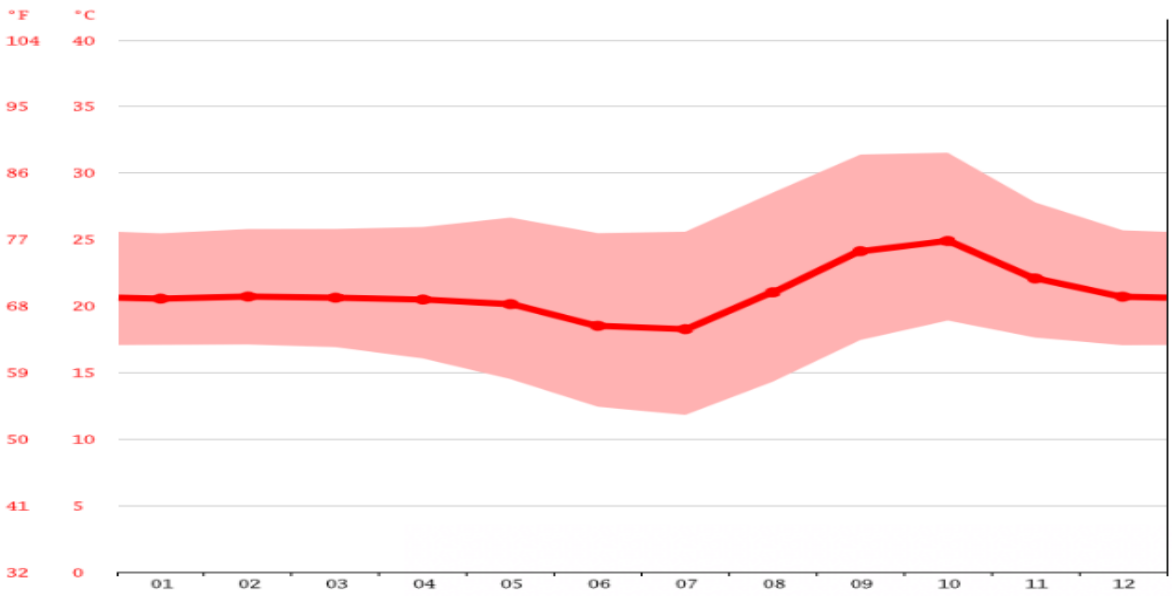

Figure 6: Graph Showing Temperature by Month – Mutanda
Source: https://en.climate-data.org/africa/zambia/north-western-province/mutanda-991497/

Rainfall

The Mutanda, which is in Kalumbila district has aannual precipitation ranges from 800-1,100 mm, with a slightly extended wet season lasting until April. The rainfall distribution is uneven, with 70% occurring in just three months (January-March). High-intensity storms frequently cause erosion around mining sites and temporary flooding in low-lying areas. The dry season is particularly harsh, with seven consecutive months receiving less than 50mm of rainfall.

Humidity

Humidity patterns follow the rainfall regime, with 50-85% relative humidity during the wet season (November-April) dropping sharply to 20-45% in the dry season. The rapid humidity decline after April contributes to increased dust generation from mining operations and unpaved roads. Early morning fog is common in river valleys during the cool dry season (June-August).

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	20.6 °C (69) °F	20.7 °C (69.3) °F	20.6 °C (69.1) °F	20.5 °C (68.9) °F	20.2 °C (68.3) °F	18.5 °C (65.3) °F	18.3 °C (64.9) °F	21 °C (69.9) °F	24.1 °C (75.4) °F	24.9 °C (76.8) °F	22.1 °C (71.7) °F	20.7 °C (69.3) °F
Min. Temperature °C (°F)	17.1 °C (62.8) °F	17.1 °C (62.8) °F	16.9 °C (62.5) °F	16.1 °C (60.9) °F	14.5 °C (58.1) °F	12.4 °C (54.4) °F	11.8 °C (53.3) °F	14.3 °C (57.8) °F	17.5 °C (63.4) °F	18.9 °C (66.1) °F	17.6 °C (63.7) °F	17.1 °C (62.7) °F
Max. Temperature °C (°F)	25.5 °C (77.9) °F	25.8 °C (78.4) °F	25.8 °C (78.4) °F	25.9 °C (78.7) °F	26.7 °C (80) °F	25.5 °C (77.9) °F	25.6 °C (78.1) °F	28.5 °C (83.4) °F	31.4 °C (88.5) °F	31.5 °C (88.8) °F	27.8 °C (82) °F	25.7 °C (78.3) °F
Precipitation / Rainfall mm (in)	282 (11)	232 (9)	191 (7)	46 (1)	4 (0)	0 (0)	0 (0)	0 (0)	2 (0)	29 (1)	150 (5)	268 (10)
Humidity(%)	83%	82%	82%	68%	49%	44%	40%	33%	29%	38%	70%	82%
Rainy days (d)	20	18	17	6	1	0	0	0	1	4	15	20
avg. Sun hours (hours)	8.1	7.7	7.1	7.9	9.9	10.1	10.2	10.5	10.8	10.8	9.4	7.8

Figure 7: Summary of the Weather Pattern by Month – Mutanda
Source: https://en.climate-data.org/africa/zambia/north-western-province/mutanda-991497/

5.1.2 Climate in Kasempa District

The climate of Kasempa is typical of the regional climatic conditions for Zambia, defined by three major seasons: a cool dry season from April to August, a hot dry season from August to November and a warm wet season from November to April. For Kasempa, climate is tropical. The summers are much rainier than the winters.

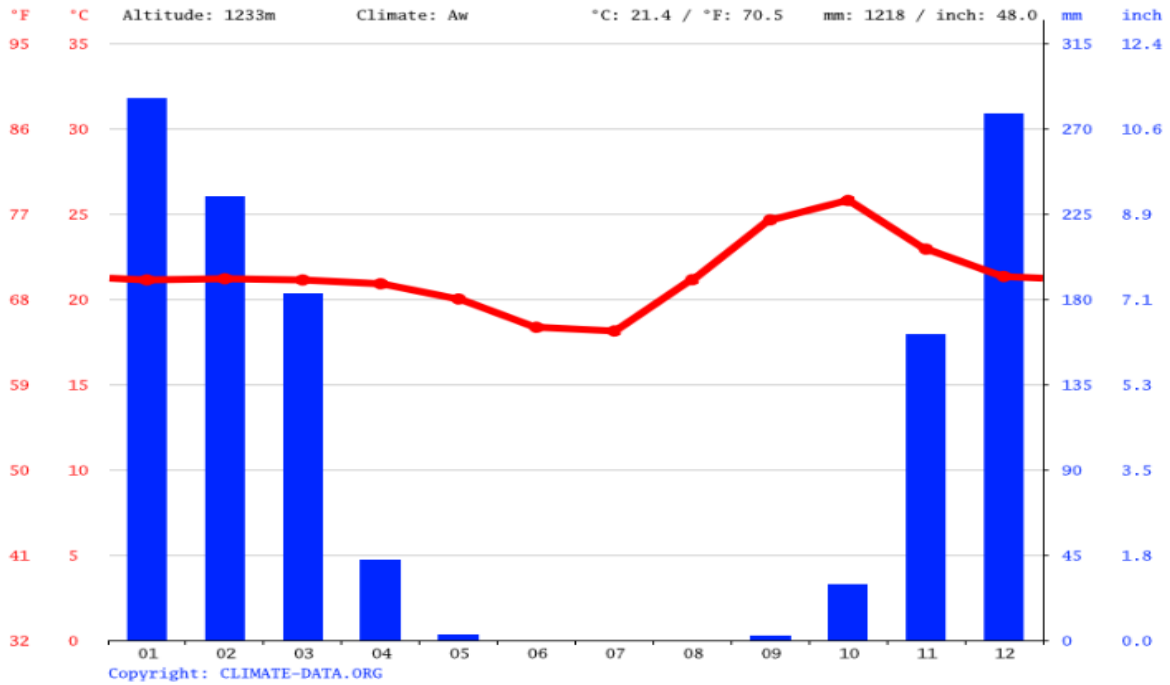

Figure 8: Climate/Weather by Month –Kasempa
Source: https://en.climate-data.org/africa/zambia/north-western-province/Kasempa-991497/

Temperature

Kasempa exhibits the most moderate temperatures in the region, attributable to its higher forest cover and elevation. Daytime temperatures typically range between 23–30°C annually, rarely exceeding 32°C, while nighttime temperatures are the coolest in the region, often dropping to

8–12°C during the coldest months of June and July. The dense miombo woodland plays a significant role in microclimate regulation, mitigating temperature extremes.

The district's average annual temperature is 21.4°C, with October being the warmest month (averaging 25.8°C) and July the coolest (averaging 18.1°C).

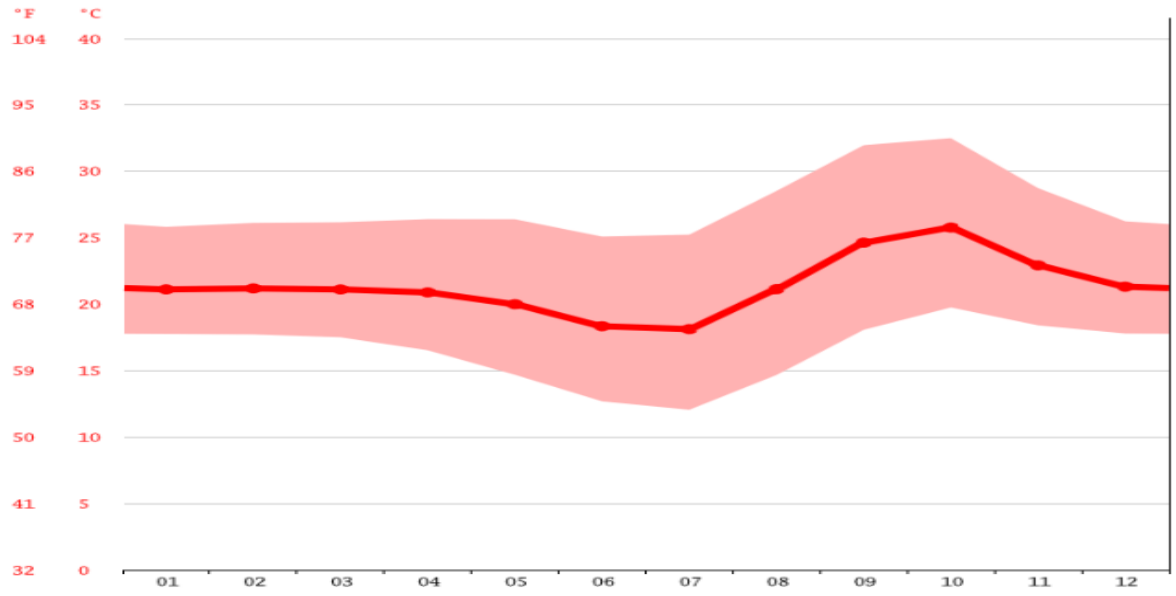

Figure 9: Graph Showing Temperature by Month – Kasempa
Source: https://en.climate-data.org/africa/zambia/north-western-province/Kasempa-991497/

Rainfall

Kasempa receives the highest rainfall in the region, with an average annual precipitation of 1,218 mm (ranging 1,000–1,300 mm). The wet season is prolonged, typically lasting until April, and rainfall distribution is more reliable compared to neighbouring districts, with fewer dry spells during the growing season. The dense vegetation plays a key role in regulating water flow, mitigating flood risks despite the high precipitation volumes.

Monthly rainfall peaks in January (averaging 286 mm), while June is the driest month, often recording negligible precipitation (0 mm).

Humidity

Kasempa maintains relatively stable humidity levels compared to other districts, with an annual average relative humidity of 58%. Seasonal variations are evident, ranging from 60–85% during the wet season to 40–60% in dry months. The district's persistent forest cover helps regulate atmospheric moisture, resulting in more frequent morning dew and less dusty conditions than neighbouring areas.

Monthly extremes occur in January (highest humidity at 83%) and September (lowest at 28%). Notably, humidity rarely falls below 40% except during the driest periods, underscoring the moderating influence of vegetation on local microclimates.

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	21.1 °C (70) °F	21.2 °C (70.1) °F	21.1 °C (70) °F	20.9 °C (69.6) °F	20 °C (68) °F	18.3 °C (65) °F	18.1 °C (64.6) °F	21.1 °C (70) °F	24.6 °C (76.4) °F	25.8 °C (78.4) °F	22.9 °C (73.3) °F	21.3 °C (70.4) °F
Min. Temperature °C (°F)	17.8 °C (64) °F	17.7 °C (63.9) °F	17.5 °C (63.5) °F	16.5 °C (61.8) °F	14.7 °C (58.4) °F	12.7 °C (54.8) °F	12.1 °C (53.7) °F	14.7 °C (58.4) °F	18.1 °C (64.5) °F	19.8 °C (67.6) °F	18.4 °C (65.1) °F	17.8 °C (64) °F
Max. Temperature °C (°F)	25.8 °C (78.5) °F	26.1 °C (79) °F	26.2 °C (79.1) °F	26.4 °C (79.5) °F	26.4 °C (79.5) °F	25.1 °C (77.2) °F	25.2 °C (77.4) °F	28.5 °C (83.4) °F	32 °C (89.6) °F	32.5 °C (90.5) °F	28.7 °C (83.7) °F	26.2 °C (79.2) °F
Precipitation / Rainfall mm (in)	286 (11)	234 (9)	183 (7)	42 (1)	3 (0)	0 (0)	0 (0)	0 (0)	2 (0)	29 (1)	161 (6)	278 (10)
Humidity(%)	83%	82%	81%	66%	51%	47%	42%	34%	28%	35%	66%	82%
Rainy days (d)	20	18	16	5	1	0	0	0	1	4	14	20
avg. Sun hours (hours)	7.9	7.8	7.3	8.4	10.0	10.0	10.1	10.5	10.8	10.9	9.7	8.0

Figure 10: Summary of the Weather Pattern by Month – Kasempa
Source: https://en.climate-data.org/africa/zambia/north-western-province/Kasempa-991497/

5.1.3 Climate in Mufumbwe District

The climate in Mufumbwe District is typical of the regional climatic conditions for Zambia, defined by three major seasons: a cool dry season from April to August, a hot dry season from August to November and a warm wet season from November to April. Mufumbwe has a humid subtropical, dry winter climate.

Temperature

Mufumbwe exhibits a typical tropical savannah climate with pronounced seasonal and diurnal temperature variations. The district maintains an annual average temperature of 23.9°C, with daytime temperatures generally ranging between 24–32°C throughout the year. October is the warmest month, averaging 29.2°C and frequently exceeding 35°C just before the rains, while June is the coolest, with average temperatures of 20.2°C and nighttime lows often dropping to 10–15°C. These fluctuations are most extreme during the dry season, when clear skies promote rapid nighttime cooling, resulting in significant daily temperature ranges. The climate reflects the characteristic patterns of tropical savannah ecosystems, combining moderate annual averages with seasonal extremes.

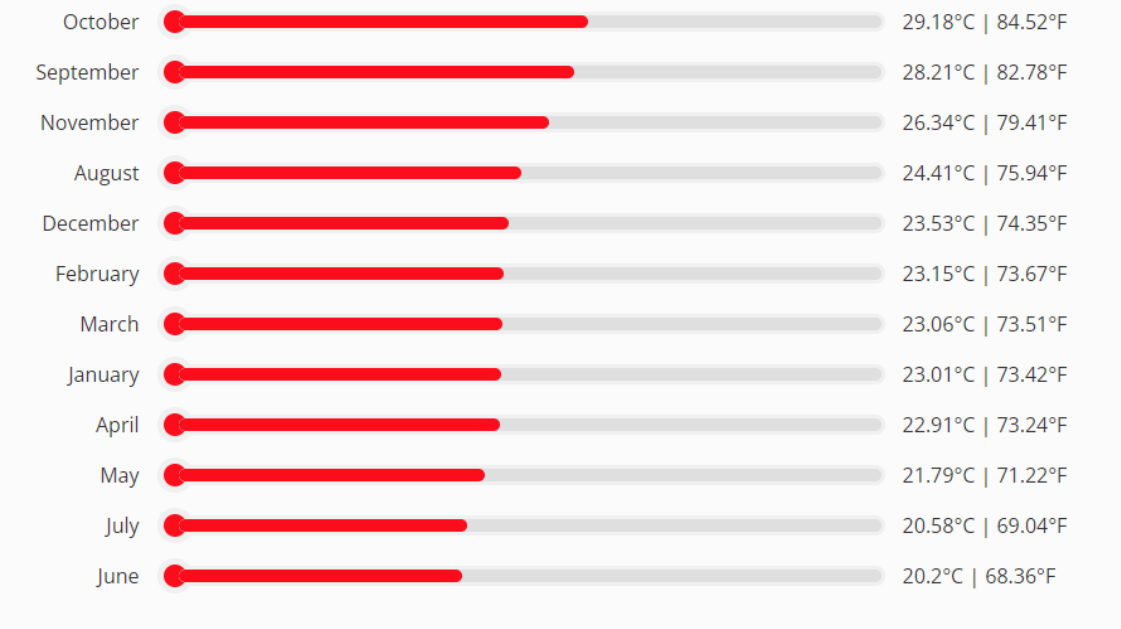

Figure 11: Graph Showing Temperature by Month – Mufumbwe
Source: https://weatherandclimate.com/zambia/north-western-zambia/mufumbwe

Rainfall

The district receives 900-1,200 mm of annual rainfall, with a unimodal pattern concentrated between November and March. December through February account for nearly 60% of total precipitation, with intense convective storms often causing short-duration, high-intensity rainfall events. The dry season is absolute, with virtually no rainfall from May to September, leading to severe moisture deficits that affect both natural ecosystems and agricultural activities.

Mufumbwe District receives an average annual rainfall of approximately 2,158.37 mm. August records the lowest precipitation levels, with no measurable rainfall, while December experiences the highest precipitation, averaging 464.17 mm per month.

Humidity

Mufumbwe exhibits strong seasonal variations in relative humidity, with an annual average of 60%. Humidity levels range from 60–80% during the rainy season (November–March), peaking in February at 84%, while the dry season (April–October) sees lower levels of 30–50%, reaching their minimum in September at 27%. The transitional months of April and October experience rapid humidity shifts, often resulting in uncomfortable conditions. The early rainy season combines high temperatures and humidity to create a muggy environment, contrasting with the dry season's characteristic dusty and arid conditions. These patterns reflect the district's tropical savannah climate, where humidity fluctuations align closely with precipitation cycles.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Oct	Dec	Year
Record high °C (°F)	35.5 (95.9)	32.54 (90.57)	32.54 (90.57)	32.54 (90.57)	31.56 (88.81)	32.54 (90.57)	34.51 (94.12)	40.43 (104.77)	44.37 (111.87)	44.37 (111.87)	41.42 (106.56)	34.51 (94.12)	44.37 (111.87)
Average high °C (°F)	26.41 (79.54)	26.63 (79.93)	26.59 (79.86)	27.12 (80.82)	26.82 (80.28)	25.76 (78.37)	26.67 (80.01)	30.9 (87.62)	34.77 (94.59)	34.85 (94.73)	30.95 (87.71)	27.03 (80.65)	28.71 (83.68)
Daily mean °C (°F)	23.01 (73.42)	23.15 (73.67)	23.06 (73.51)	22.91 (73.24)	21.79 (71.22)	20.2 (68.36)	20.58 (69.04)	24.41 (75.94)	28.21 (82.78)	29.18 (84.52)	26.34 (79.41)	23.53 (74.35)	23.86 (74.95)
Average low °C (°F)	17.49 (63.48)	17.66 (63.79)	17.27 (63.09)	15.56 (60.01)	13.09 (55.56)	10.56 (51.01)	10.0 (50.0)	12.44 (54.39)	15.35 (59.63)	17.71 (63.88)	17.89 (64.2)	17.59 (63.66)	15.22 (59.4)
Record low °C (°F)	14.79 (58.62)	13.81 (56.86)	13.81 (56.86)	10.85 (51.53)	8.87 (47.97)	5.92 (42.66)	5.92 (42.66)	6.9 (44.42)	9.86 (49.75)	11.83 (53.29)	12.82 (55.08)	14.79 (58.62)	5.92 (42.66)
Average precipitation mm (inches)	408.35 (16.08)	400.72 (15.78)	329.37 (12.97)	79.76 (3.14)	3.44 (0.14)	0.23 (0.01)	0.01 (0.0)	0.0 (0)	2.61 (0.1)	43.32 (1.71)	260.36 (10.25)	464.17 (18.27)	166.03 (6.54)
Average precipitation days (≥ 1.0 mm)	28.77	26.62	26.18	11.66	0.63	0.0	0.0	0.0	0.9	8.24	22.59	28.95	12.88
Average relative humidity (%)	83.03	83.55	82.41	73.15	58.38	51.59	43.64	31.79	26.69	37.82	63.89	81.07	59.75
Mean monthly sunshine hours	10.52	10.31	10.47	10.99	11.42	11.43	11.44	11.44	11.44	12.26	12.37	11.99	11.34

Figure 12: Summary of the Weather Pattern by Month – Mufumbwe
Source: https://weatherandclimate.com/zambia/north-western-zambia/mufumbwe

5.1.4 Climate for Kaoma District

The climate of Kaoma District is typical of the regional climatic conditions for Zambia, defined by three major seasons: a cool dry season from April to August, a hot dry season from August to November and a warm wet season from November to April. Kaoma has a Tropical wet and dry or savanna climate

Temperature

Kaoma experiences the most extreme temperature variations in the region, with an annual average of 25.6°C. The district's lower elevation and open terrain contribute to pronounced heat conditions, particularly from September to November when daytime highs typically range between 26-36°C. October represents the peak of thermal stress, with average temperatures reaching 31.2°C and regularly exceeding 35°C. Nighttime cooling during this period remains limited, with lows only dropping to 14-22°C, creating sustained thermal discomfort that impacts both human wellbeing and livestock productivity. In contrast, July provides the coolest respite with average temperatures of 21.0°C, though even this coolest month maintains relatively moderate conditions compared to other districts in the region.

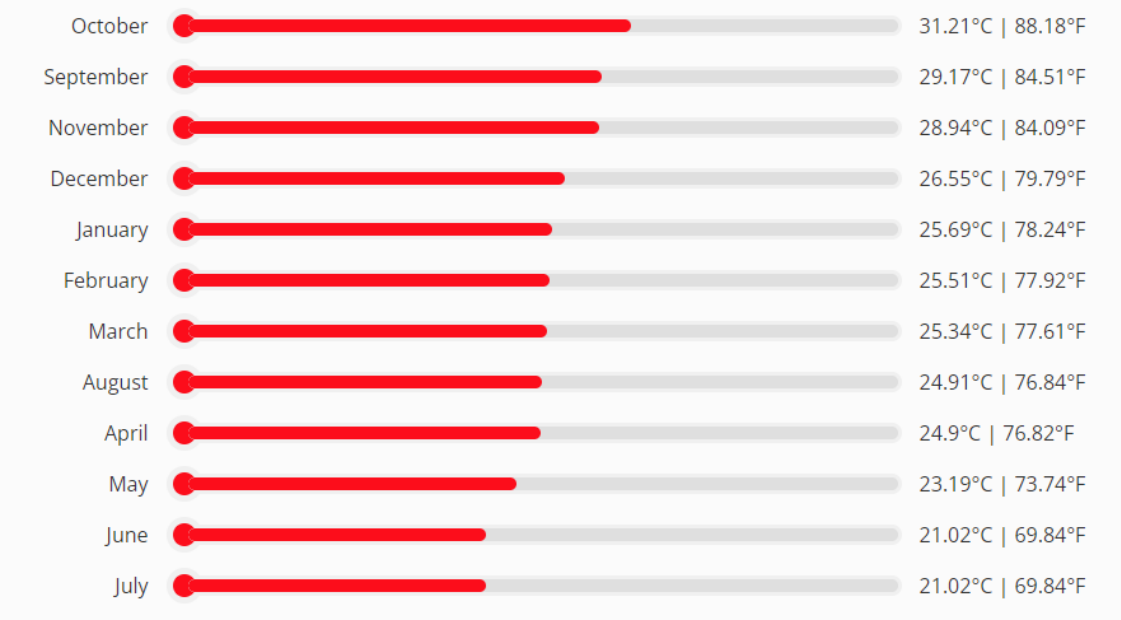

Figure 13: Graph Showing Temperature by Month – Kaoma
Source: https://weatherandclimate.com/zambia/north-western-zambia/kaoma

Rainfall

With only 700-1,000 mm of annual rainfall, Kaoma is the driest of the four districts. The rainy season (November-March) is unreliable, with frequent false starts and mid-season droughts. About 25% of years experience rainfall below 750mm, causing crop failures. Rainfall intensity is high when it occurs, leading to significant runoff and soil erosion on unprotected lands.

Humidity

Kaoma District experiences significant seasonal humidity variations, with an annual average relative humidity of 50%. During the wet season, humidity levels typically range between 40-75%, peaking in February at 73%. The dry season brings markedly drier conditions, with humidity frequently dropping below 30% and reaching its lowest point in September at 22%. These extreme dry conditions, among the most severe in western Zambia, lead to rapid vegetation drying that fuels widespread bushfires between July and October. While morning dew provides some moisture, it offers minimal relief during the peak dry months. The combination of low humidity and high temperatures creates challenging environmental conditions that significantly impact both ecosystems and human activities in the region.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Oct	Dec	Year
Record high °C (°F)	41.58 (106.84)	36.63 (97.93)	36.63 (97.93)	34.65 (94.37)	32.67 (90.81)	32.67 (90.81)	35.64 (96.15)	39.6 (103.28)	43.56 (110.41)	43.56 (110.41)	39.6 (103.28)	37.62 (99.72)	43.56 (110.41)
Average high °C (°F)	29.12 (84.42)	29.17 (84.51)	28.96 (84.13)	29.23 (84.61)	28.17 (82.71)	26.61 (79.9)	26.94 (80.49)	31.2 (88.16)	35.35 (95.63)	36.3 (97.34)	32.85 (91.13)	29.85 (85.73)	30.31 (86.56)
Daily mean °C (°F)	25.69 (78.24)	25.51 (77.92)	25.34 (77.61)	24.9 (76.82)	23.19 (73.74)	21.02 (69.84)	21.02 (69.84)	24.91 (76.84)	29.17 (84.51)	31.21 (88.18)	28.94 (84.09)	26.55 (79.79)	25.62 (78.12)
Average low °C (°F)	19.91 (67.84)	19.59 (67.26)	19.27 (66.69)	17.44 (63.39)	14.72 (58.5)	11.5 (52.7)	10.86 (51.55)	13.34 (56.01)	16.66 (61.99)	20.22 (68.4)	21.01 (69.82)	20.4 (68.72)	17.08 (62.74)
Record low °C (°F)	17.82 (64.08)	15.84 (60.51)	15.84 (60.51)	12.87 (55.17)	9.9 (49.82)	4.95 (40.91)	4.95 (40.91)	5.94 (42.69)	9.9 (49.82)	12.87 (55.17)	16.83 (62.29)	16.83 (62.29)	4.95 (40.91)
Average precipitation mm (inches)	373.78 (14.72)	324.42 (12.77)	228.74 (9.01)	44.11 (1.74)	1.02 (0.04)	0.06 (0.0)	0.62 (0.02)	0.02 (0.0)	0.69 (0.03)	24.6 (0.97)	151.94 (5.98)	355.27 (13.99)	125.44 (4.94)
Average precipitation days (≥ 1.0 mm)	25.74	21.87	21.42	8.1	0.27	0.0	0.18	0.0	0.27	5.04	16.02	24.66	10.3
Average relative humidity (%)	72.34	73.18	71.01	59.36	45.32	43.16	38.35	27.73	21.78	27.57	49.88	67.58	49.78
Mean monthly sunshine hours	10.91	10.64	10.66	11.27	11.45	11.38	11.42	11.48	11.46	12.07	12.56	12.42	11.47

Figure 14: Summary of the Weather Pattern by Month – Kaoma
Source: https://weatherandclimate.com/zambia/north-western-zambia/kaoma

5.1.5 Agro Ecological Zone

Zambia is divided into three major agro-ecological regions (**Regions I, II and III**), which are primarily based on rainfall amount but also incorporate soils and other climatic characteristics. The project site lies in region III and IIb of the agro-ecological zones of Zambia.

Region III:

- Receives between 1,000 mm and 1,500 mm of rainfall annually
- Constitutes 46% of the country's total land area

Region II

- Receives between 800 mm and 1,000mm of annual rainfall
- Covers 42% of the country.
- Sub – divided into IIa and IIb. The site is in region IIb

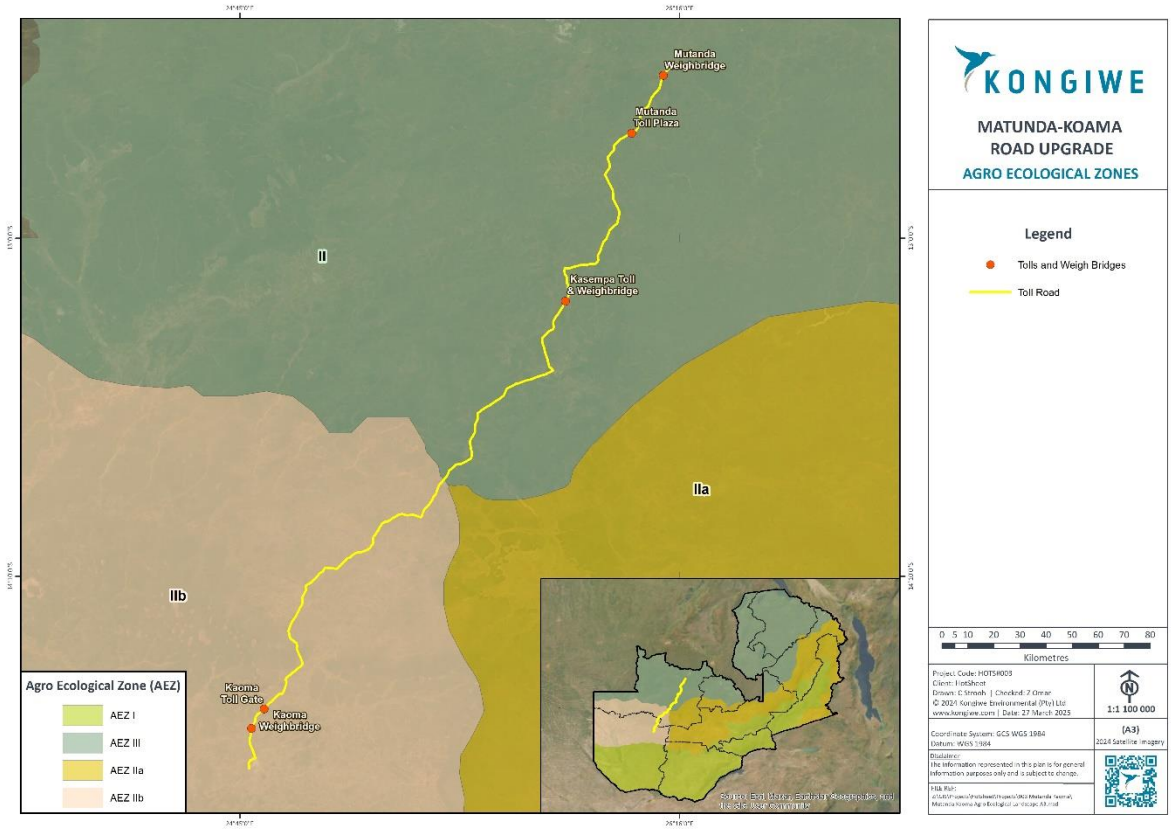

Figure 15 Proposed Project Route and Traversing III and IIb Agro-Ecological Zone

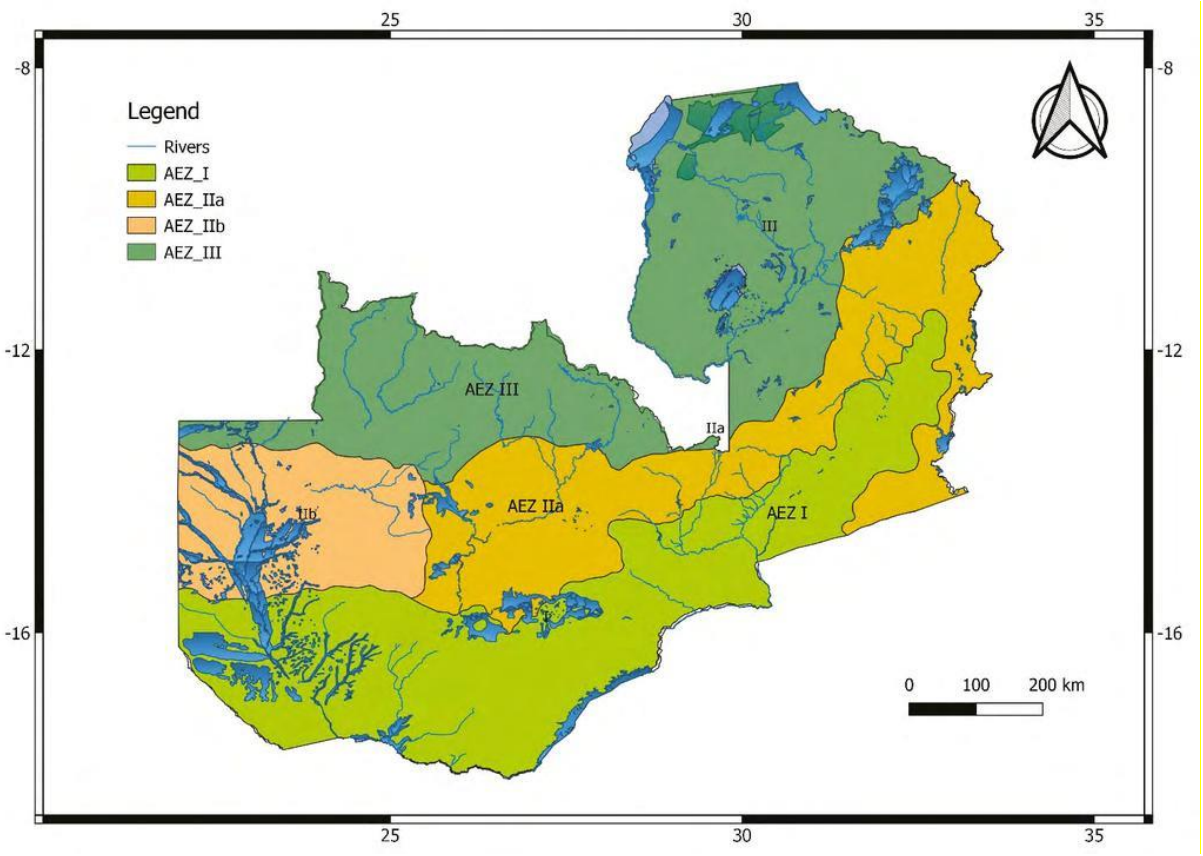

Figure 16: Agro Ecological Zones

5.2 Air Quality/Noise Levels

Ambient air sampling was carried out using a portable air quality monitoring machine manufactured by *Aeroqual* ('Aeroqual Series 500') which can be configured with interchangeable gas and particle sensors for Sulphur dioxide (SO_2), Ozone (O_3), Carbon Monoxide (CO), and Particulate Matter ($PM_{2.5}$ and PM_{10}). Additionally, noise levels were recorded and analyzed in comparison with both ZEMA and WHO/IFC guidelines.

Air quality data was collected from twelve sampling locations at different time intervals throughout the survey period. For the purposes of this study, the average of the measurements taken during the daily survey period (07:00–17:00) was considered a reasonable approximation of the 24-hour average.

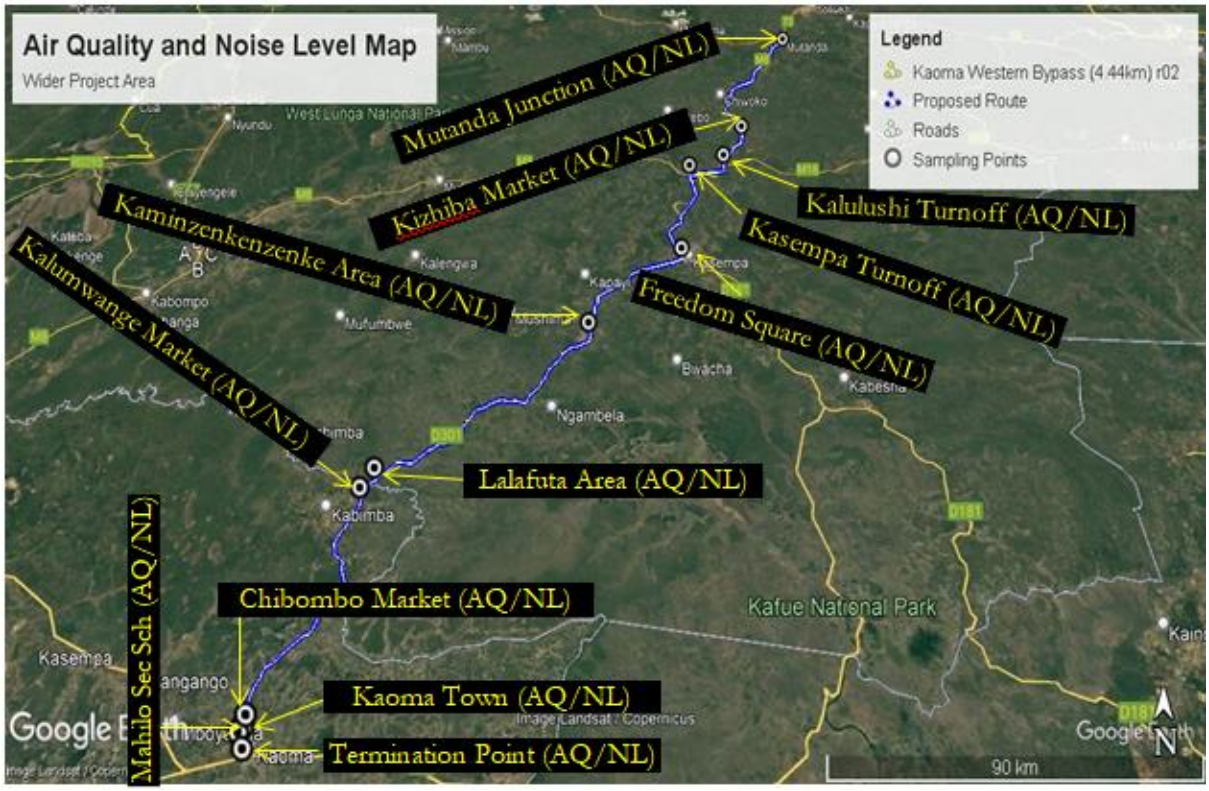

Figure 17: Air Quality / Noise Level Monitoring Points

Table 8: Air Quality & Noise Sampling Location

Label	Coordinates		
Sampling Point	**Latitude**	**Longitude**	**Elevation**
Mutanda Junction Area - Q/NL1	12°25'52.05"S	26°15'14.37"E	1282m
Kizhiba Market - AQ/NL2	12°54'51.00"S	26° 3'31.00"E	1300m
Kalulushi Turnoff - AQ/NL3	13° 3'16.30"S	25°59'13.30"E	1329m
Kasempa Turnoff - AQ/NL4	13° 6'14.00"S	25°52'15.00"E	1314m
Freedom Square - AQ/NL5	13°27'24.50"S	25°49'45.00"E	1250m
Kaminzenkenzenke Area - AQ/NL6	13°44'5.00"S	25°32'50.00"E	1189m
Lalafuta Area - AQ/NL7	14°11'16.00"S	24°59'43.00"E	1189m
Kalumwange Market - AQ/NL8	14°14'30.50"S	24°57'57.30"E	1183m

Chilombo Market - AQ/NL9	14°46'20.00"S	24°47'45.00"E	1172m
Kaoma Town - AQ/NL10	14°47'46.00"S	24°47'42.00"E	1166m
Mahilo Day Sec School - AQ/NL11	14°48'25.70"S	24°47'12.34"E	1168m
Termination Point (M9)- AQ/NL12	14°50'22.51"S	24°48'13.71"E	1174m

The results of the ambient air test obtained were compared with ZEMA standards for ambient air emissions and IFC/WHO ambient air quality guidelines. Measured parameters that fell below guideline values of either of the standards were considered non-polluting at the time of the baseline study. The ZEMA standards and IFC/WHO guidelines are presented in the following tables:

Figure 18 Air/Noise Data Collection

Table 9: ZEMA Standards for Ambient Air Emissions

Parameter	ZEMA Standard ($\mu g/m^3$)	Averaging duration
SO_2	500 350	10-minutes 1-hour
NO_2	150	24-hour
O_3	120	8-hour
$PM_{2.5}$	70	24-hour
PM_{10}	70	24-hour

Table 10: WHO Ambient Air Quality Guidelines (2005)

Parameter	IFC/ WHO guideline value (µg/m^3)	Averaging duration
SO_2	20 500	24-hours 10 Minute
NO_2	200	1-hour
O_3	100	8-hour daily maximum
$PM_{2.5}$	25	24-hours
PM_{10}	50	24-hours

5.2.1 Air Quality Results and Particular Matter Results

The air quality and Particular Matter results are presented in the table below for each site grouped under the respective parameters sampled.

Table 11: Air Quality Results

Mutanda Junction Area - **No. 1** – 12°25'52.05"S , 26°15'14.37"E				**ZEMA Standards (µg/m³)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m³)**	**Averaging Duration**
Parameter (µg/m³)	**Results**						
	Min	**Max**	**Ave**				
SO_2	0	0	0	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	0	0	0	30 **mg/m³**	1 - hour	30 **mg/m³**	1 -hour
O_3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	22	33	26	70	24 - hour	25	24 - hours
PM_{10}	48	119	84	70	24 - hour	50	24 - hour
Kizhiba Market - **No. 2** – 12°54'51.00"S , 26° 3'31.00"E				**ZEMA Standards (µg/m³)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m³)**	**Averaging Duration**
Parameter (µg/m³)	Results						
	Min	Max	Ave				
SO2	0	0	0	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	0	0	0	30 **mg/m³**	1 - hour	**30 mg/m³**	1 -hour
O3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	5	6	5	70	24 - hour	25	24 - hours
PM_{10}	10	47	31	70	24 - hour	50	24 - hour
Kalulushi Turnoff - - **No. 3** –13° 3'16.30"S ,25°59'13.30"E				**ZEMA Standards (µg/m³)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m³)**	**Averaging Duration**
Parameter (µg/m³)	Results						
	Min	Max	Ave				
SO_2	0	0	0	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes

CO	0	0	0	30 **mg/m³**	1 - hour	30 **mg/m³**	1 -hour
O_3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	4	10	7	70	24 - hour	25	24 - hours
PM_{10}	8	27	17	70	24 - hour	50	24 - hour
Kasempa Turnoff - **No. 4 –** 13° 6'14.00"S **,** 25°52'15.00"E				**ZEMA Standards (µg/m³)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m³)**	**Averaging Duration**
Parameter (µg/m³)	Results						
	Min	Max	Ave				
SO_2	200	400	300	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	14	24	18	30 **mg/m³**	1 - hour	30 **mg/m³**	1 -hour
O_3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	60	75	66	70	24 - hour	25	24 - hours
PM_{10}	81	90	86	70	24 - hour	50	24 - hour
Freedom Square - **No. 5 –** 13°27'24.50"S **,** 25°49'45.00"E				**ZEMA Standards (µg/m³)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m³)**	**Averaging Duration**
Parameter **(µg/m³)**	Results						
	Min	Max	Ave				
SO_2	0	0	0	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	0	0	0	30 **mg/m³**	1 - hour	30 **mg/m³**	1 -hour
O_3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	2	97	31	70	24 - hour	25	24 - hours
PM_{10}	7	716	165	70	24 - hour	50	24 - hours

Kaminzenkenzenke Area - **No. 6** – 13°44'5.00"S , 25°32'50.00"E				**ZEMA Standards (µg/m³)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m³)**	**Averaging Duration**
Parameter	**Results**						
	Min	**Max**	**Ave**				
SO_2	200	200	200	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	0	0	0	30 **mg/m³**	1 - hour	30 **mg/m³**	1 -hour
O_3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	2	3	2	70	24 - hour	25	24 - hours
PM_{10}	6	16	10	70	24 - hour	50	24 - hour
Lalafuta Area - **No. 7** – 14°11'16.00"S , 24°59'43.00"E				**ZEMA Standards (µg/m³)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m³)**	**Averaging Duration**
Parameter (µg/m³)	Results						
	Min	Max	Ave				
SO2	0	0	0	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	0	0	0	30 **mg/m³**	1 - hour	30 **mg/m³**	1 -hour
O3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	2	16	4	70	24 - hour	25	4 - hours
PM_{10}	3	40	29	70	24 - hour	50	24 - hour
Kalumwange Market - **No. 8** – 14°14'30.50"S , 24°57'57.30"E				**ZEMA Standards (µg/m³)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m³)**	**Averaging Duration**
Parameter (µg/m³)	Results						
	Min	Max	Ave				
SO_2	0	0	0	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	0	0	0	30 **mg/m³**	1 - hour	30 **mg/m³**	1 -hour
O_3	0	0	0	0	8 - hour	100	8 - hour
$PM_{2.5}$	1	3	2	70	24 - hour	25	24 - hours

PM_{10}	4	38	23	70	24 - hour	50	24 - hour

Chilombo Market - **No. 9** – 14°46'20.00"S , 24°47'45.00"E				**ZEMA Standards ($\mu g/m^3$)**	**Averaging Duration**	**IFC/WHO Guideline Value ($\mu g/m^3$)**	**Averaging Duration**
Parameter ($\mu g/m^3$)	**Results**						
	Min	**Max**	**Ave**				
SO_2	0	0	0	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	0	0	0	30 **mg/m^3**	1 - hour	30 **mg/m^3**	1 -hour
O_3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	3	6	4	70	24 - hour	25	24 - hours
PM_{10}	6	18	10	70	24 - hour	50	24 - hour

Kaoma Town - **No. 10**– 14°47'46.00"S , 24°47'12.34"E				**ZEMA Standards ($\mu g/m^3$)**	**Averaging Duration**	**IFC/WHO Guideline Value ($\mu g/m^3$)**	**Averaging Duration**
Parameter ($\mu g/m^3$)	Results						
	Min	Max	Ave				
SO2	0	200	200	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	0	0	0	30 **mg/m^3**	1 - hour	30 **mg/m^3**	1 -hour
O3	0	0	0	120	8 - hour	100	8 - hour
$PM_{2.5}$	3	4	3	70	24 - hour	25	4 - hours
PM_{10}	5	17	10	70	24 - hour	50	24 - hour

Mahilo Day Sec School - **No. 11** – 14°48'25.70"S , 24°47'12.34"E				**ZEMA Standards ($\mu g/m^3$)**	**Averaging Duration**	**IFC/WHO Guideline Value ($\mu g/m3$)**	**Averaging Duration**
Parameter ($\mu g/m^3$)	Results						
	Min	Max	Ave				
SO_2	0	0	0	500	10 - minutes	20	24 - hour

				350	1 -hour	500	10 - minutes
CO	9.25	11.17	10.17	30 **mg/m^3**	24 - hour	30 **mg/m^3**	1 -hour
O_3	0	0	0	0	8 - hour	100	8 - hour
$PM_{2.5}$	2	8	5	70	24 - hour	25	24 - hours
PM_{10}	6	23	14	70	24 - hour	50	24 - hour

Termination Point (M9)- No. 12 – 14°50'22.51"S **,** 24°48'13.71"E				**ZEMA Standards (µg/m^3)**	**Averaging Duration**	**IFC/WHO Guideline Value (µg/m^3)**	**Averaging Duration**
Parameter (µg/m^3)	Results						
	Min	Max	Ave				
SO_2	0	0	0	500	10 - minutes	20	24 - hour
				350	1 -hour	500	10 - minutes
CO	2.12	2.15	2.12	30 **mg/m^3**	1 - hour	30 **mg/m^3**	1 -hour
O_3	0	0	0	0	8 - hour	100	8 - hour
$PM_{2.5}$	3	4	3	70	24 - hour	25	24 - hours
PM_{10}	19	32	27	70	24 - hour	50	24 - hour

Air quality measurements conducted at twelve sampling points indicate generally low levels of particulate matter. $PM_{2.5}$ concentrations ranged from 3 to 97 µg/m³, while PM_{10} levels varied between 11 and 716 µg/m³. Most sampling locations complied with both the WHO guidelines and the ZEMA standards. However, elevated levels were observed at Mutanda Junction, Kasempa Turnoff, and Freedom Square, where concentrations exceeded both WHO and ZEMA thresholds.

The increased $PM_{2.5}$ and PM_{10} concentrations at these locations are likely due to dust emissions from vehicular traffic along the M8 highway and the gravel road connecting Freedom Square to Kaoma.

Sulphur dioxide (SO_2) levels were generally within national and international standards, except at Kasempa Turnoff, where a concentration of 400 µg/m³ was recorded, exceeding both ZEMA and WHO limits. This exceedances are potentially attributed to the site's proximity to a smelting plant, approximately five kilometres away.

Ozone (O_3) was not detected at any of the twelve sampling points, with all readings registering 0 µg/m³.

Carbon monoxide (CO) concentrations ranged from 0 to 24 mg/m³ across all sampling locations, remaining within both national and international guideline limits.

Overall, air quality across the majority of sampling locations meets regulatory standards. However, the elevated levels of particulate matter at specific points highlight the impact of vehicular activity on air quality, while the exceedance of SO_2 at Kasempa Turnoff underscores the influence of industrial emissions.

5.2.2 Noise Level Results

To ensure that across the entire survey period, data was collected for a sufficient range of hours so as to be representative of a full 24-hour period. Below is the IFC Noise Level Guidelines for residential; institutional; educational and, industrial; commercial receptors.

Table 12: IFC Noise Level Guidelines

Receptor	One Hour LAeq* (dBA)	
	Daytime (07:00 - 22:00)	Night-time (22:00 - 07:00)
Residential; institutional; educational	55	45
Industrial; commercial	70	70

*Equivalent Continuous Level over 1 Hour (in effect, the average sound energy level over 1 hour)

Noise levels were measured using a handheld Tasi TA8151 Digital Sound Level Meter conducted on various time intervals. Data for noise levels was collected from twelve sampling at the exact air quality monitoring points. Noise levels are presented in the ensuing table below.

Each table represents noise levels measured for a particular site. Data collected for noise as permitted by weather conditions:

Table 13: Noise Level Results

GPS Coordinates of the Location	Noise level reading – dB (A)		
	Minimum	Maximum	Average
Mutanda Junction – 12°25'52.05"S, 26°15'14.37"E	58.2	74.5	71.8
Kizhiba Market - 12°54'51.00"S, 26° 3'31.00"E	49.5	59.5	53.0
Kalulushi Turnoff - 13° 3'16.30"S , 25°59'13.30"E	44.0	69.8	53.3
Kasempa Turnoff - 13° 6'14.00"S, 25°52'15.00"E	61.8	78.0	70.2
Freedom Square - 13°27'24.50"S, 25°49'45.00"E	46.0	72.2	49.2
Kaminzenkenzenke Area - 113°44'5.00"S. 25°32'50.00"E	42.8	59.4	43.2
Lalafuta Area - 14°11'16.00"S, 24°59'43.00"E	40.4	52.9	48.9
Kalumwange Market - 14°14'30.50"S, 24°57'57.30"E	49.8	74.3	51.6
Chilombo Market - 14°46'20.00"S, 24°47'45.00"E	47.5	73.0	51.7
Kaoma Town - 14°47'46.00"S, 24°47'42.00"E	71.0	76.3	73.7
Mahilo Day Sec School - 14°48'25.70"S, 24°47'12.34"E	39.6	44.2	52.1
Termination Point (M9)- 13° 0'27.62"S, 28°35'10.12"E	56.4	68.5	62.3

The baseline noise assessment reveals an acoustic environment where intermittent human activity hotspots significantly elevate noise levels above expected rural benchmarks. Along the proposed route, sporadic commercial nodes—particularly trading areas, markets, and their associated activities (including bars, loading zones, and informal workshops)—create localized pockets of noise pollution. These are superimposed on a baseline of vehicular noise from the Mutanda-Kaoma Road, which remains the dominant continuous noise source.

Key findings demonstrate:

1. **Activity-Driven Peaks**: Noise levels reach 78.0 dB near markets/trading areas during peak hours, with auxiliary activities (generator use, music from bars, public address systems) contributing impulsive noise bursts.
2. **Spatial Variability**: The 38.9–78.0 dB range reflects the patchwork nature of development, where quiet rural stretches (40–50 dB) abruptly transition near commercial clusters.
3. **Regulatory Exceedances**: The 73.7 dB average noise level—driven by both vehicular traffic and these activity nodes—consistently surpasses ZEMA's:
    - Residential standards (55 dB) by 18.7 dB
    - Commercial thresholds (65 dB) by 8.7 dB
4. **Temporal Patterns**: Weekend evenings show particular degradation due to amplified social/commercial activities.

This establishes an already-compromised soundscape where rural communities experience urban-grade noise pollution. Future developments must:

- Model cumulative impacts accounting for existing hotspots
- Prioritize mitigation at activity nodes (e.g., market sound barriers)
- Preserve remaining quiet zones through strategic routing
- Enforce nighttime noise controls near entertainment venues

The findings underscore the need for context-sensitive noise management in this transitional corridor, where sporadic commercialization has disproportionately affected residential noise exposure.

Figure 19 Setting up and Collection of Noise level Data

5.3 Geology

The geological landscape of Zambia features a diverse range of formations, with the oldest rocks consisting of gneisses, schists, quartzites, phyllites and granites comprising the basement complex. These are overlain in the central part of the country by metasediments (quartzites, phyllites, talc schists and dolomites) of the Upper Proterozoic Katanga System. The Katanga is overlain by a sequence of shales, sandstones and limestones of the Upper Proterozoic Kundelungu Series. During the Carboniferous–Early Jurassic, tillites, sandstones, shales and lavas of the Karoo System were deposited and preserved in down-faulted trough-like structures mostly aligned in a northeasterly direction. Notable examples are the Zambezi valley in the Lake Kariba area and the Luano– Luangwa valley system in the eastern part of the country.

The Lower Karoo comprises basal sandstone overlain by mudstones, including some coal seams. This is followed unconformably by the Escarpment Grit of the Upper Karoo, a coarse pebbly arkose that forms prominent ridges parallel to trough alignments. The overlying sandstones are locally capped by the Batoka basalts of the Stormberg Formation, the uppermost unit of the Karoo Group.

In the extreme west of the country, where outcrops are largely obscured by duricrusts (ferricrete, calcrete, silcrete) and wind-blown sand, the Karoo Group rocks are overlain by Kalahari sands. Quaternary and Recent deposits occur in depressions in the plateau surface and in basins on the floor of the rift valleys.

For North-western Province, the geology is underlain mainly by metasediments of the Katanga System, the lowest of which, the Roan Formation, being the host of the Copperbelt mines in Zambia. The principal copper operations in the Zambian Copperbelt are the Chililabombwe, Chingola, Mufulira, Kitwe, Ndola and Luanshya mines. A minor amount of uranium usually accompanies the copper ore (the average grade of the copper ore is 0.004% U). Copper and uranium mineralization are found in the Roan, which was subjected to tectonism during the Lufilian Orogeny and metamorphism related to, and post-dating, the tectonism. As a result, vein uranium deposits were formed by repeated mobilization and deposition. Supergene processes resulted in further redistribution and concentration. In the Domes area of north-western Zambia, the mineralization occurs mainly in a mica schist underlying a quartzite bed, near the base of the Lower Roan at the margins of the Kabompo, Mwombeshi and Solwezi domes. The Roan dips outwards from the basement cores of the domes at about 15–20°. The mineralization occurs as pitchblende, disseminated or in veins, and as secondary uranium minerals. The pitchblende occurs in discrete masses, generally up to a few centimetres in diameter, although exceptionally large masses have been encountered.

The geology surrounding the project area is a basement complex-undifferentiated from the period mainly older Precambrian. The lithology is metamorphosed rocks; gabbro, basalt, granite, dolerite, aplite, andesite. The structure is quartz veins; faulted, folded and jointed. The lithology of the project site is metamorphic rock – gneiss and granite –gneiss.

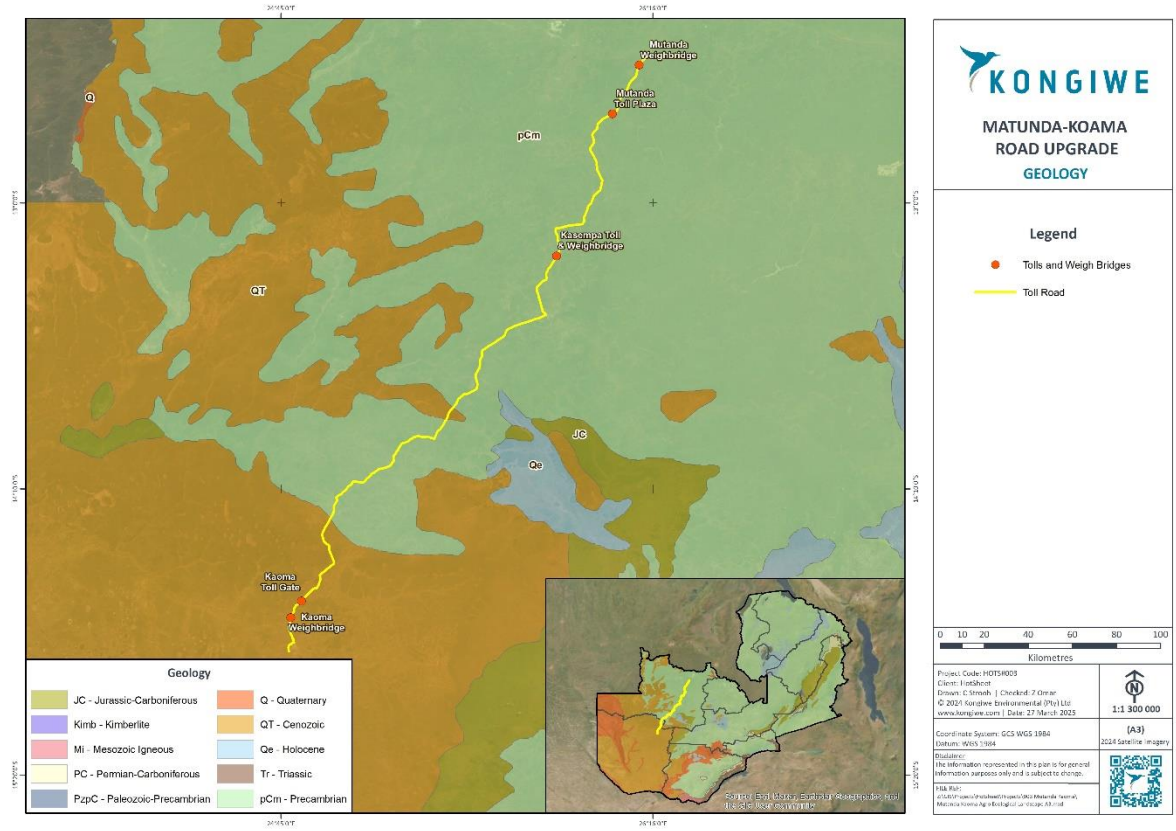

Figure 20 Proposed Route within the Geological Make up of the landscape

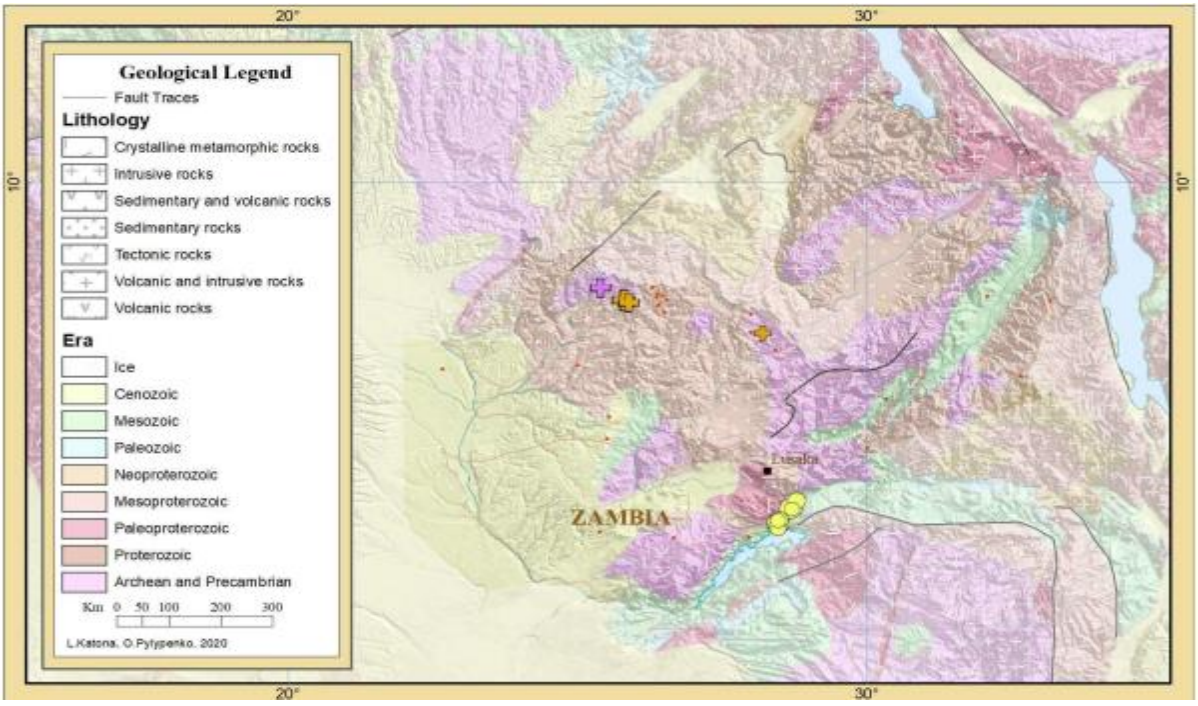

Figure 21: Regional Geological Setting of Zambia
Source: IAEA, 2020

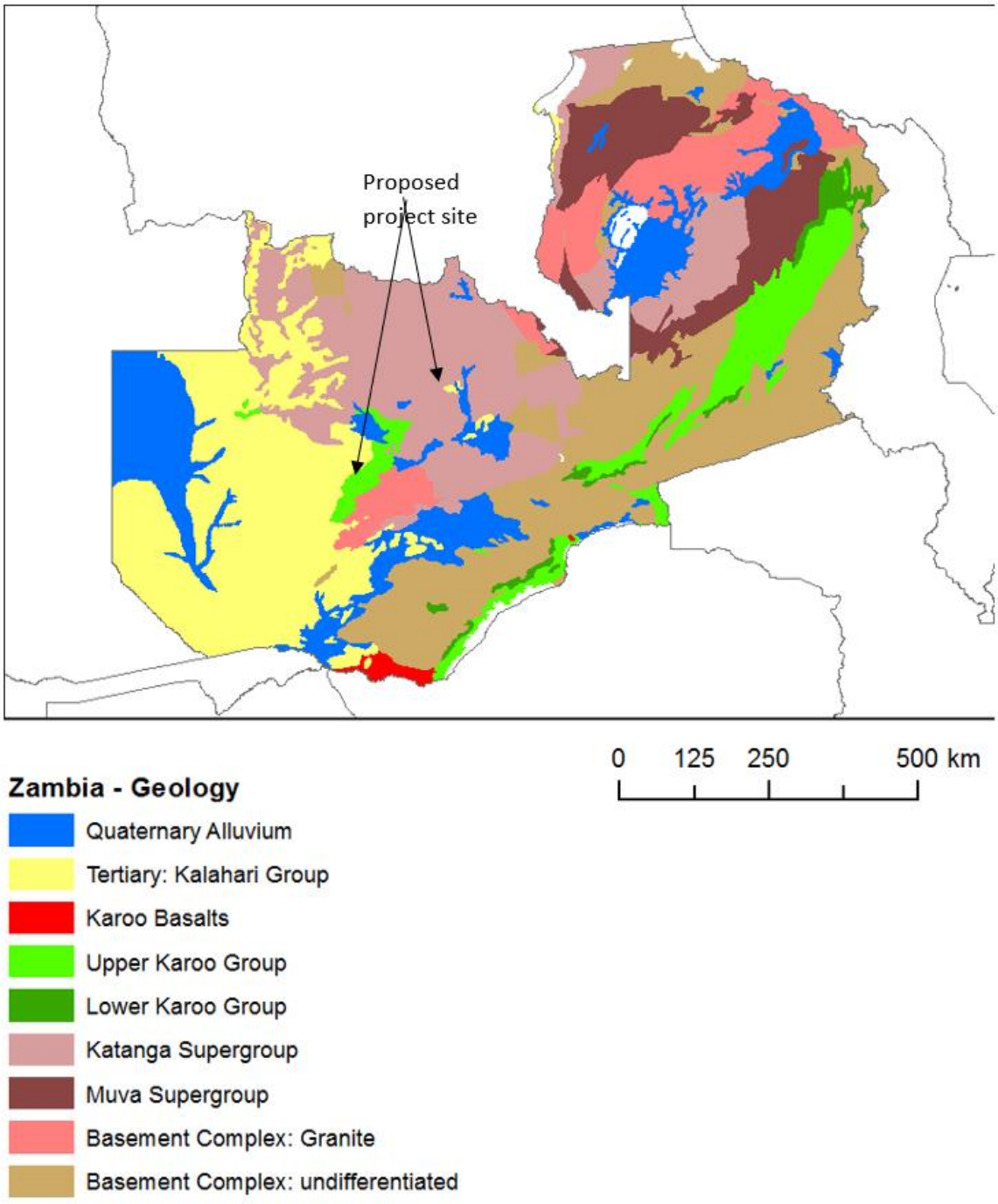

Figure 22: Geology of the Project Site (*Source – British Geological Survey*)

5.4 Hydrogeology

The proposed construction and rehabilitation of the 371 km road traversing the North-Western and Western Provinces of Zambia will be implemented with careful consideration of the region's hydrogeological characteristics. In the North-Western Province, the hydrogeology is dominated by the Upper Roan Dolomite and Kundelungu Limestone of the Katanga Supergroup, which form highly productive aquifers where fractures provide the primary permeability and storage. These aquifers typically range in thickness from 15 to 50 meters,

with water tables generally located 20 to 35 meters below the ground surface, and borehole depths averaging between 50 and 60 meters.

In the Western Province, the hydrogeology is characterized by the Kalahari Supergroup, subdivided into the Barotse and Zambezi formations. The aquifer consists of 20 to 40 meters of unconsolidated sands, which are usually unconfined. Groundwater flow and storage are intergranular, with water tables typically at depths of 10 to 20 meters below the ground surface, although in some areas, depths may reach up to 30 meters.

5.5 Hydrology

The hydrology of Zambia's North-Western and Western Provinces is primarily defined by the Zambezi River, which dominates the water systems in both regions. In North-Western Province, key tributaries include the Kabompo, Lunga, and Lungwebungu Rivers, with the area falling within the Upper Zambezi Catchment, characterized by dendritic drainage patterns due to gently undulating terrain. Aquifers are generally shallow, formed in lateritic soils, with fractured rock aquifers offering limited but essential water for rural communities. The region experiences high annual rainfall (1,200–1,500 mm) between November and April, leading to seasonal flooding and waterlogging, compounded by limited groundwater recharge due to low-permeability soils.

In Western Province, the Zambezi River also dominates, forming the extensive Barotse Floodplain, a vital wetland ecosystem supporting water regulation, biodiversity, and agriculture. Other important rivers include the Luena, Lui, and Lungwebungu. The province features alluvial aquifers with high water tables in floodplain areas and sandy soils in uplands, promoting good infiltration but limiting water retention. Annual rainfall ranges from 900–1,200 mm, contributing to seasonal flooding, with the Zambezi frequently inundating its floodplain. Challenges in both provinces include seasonal flooding, disrupted infrastructure, and limited water retention or recharge in some areas. Together, these regions significantly contribute to Zambia’s water resources, supporting agriculture, fisheries, and biodiversity, with their floodplains, wetlands, and aquifers serving as crucial water storage and regulation systems. Understanding and managing this hydrology is vital for sustainable development, flood control, irrigation, and water supply.

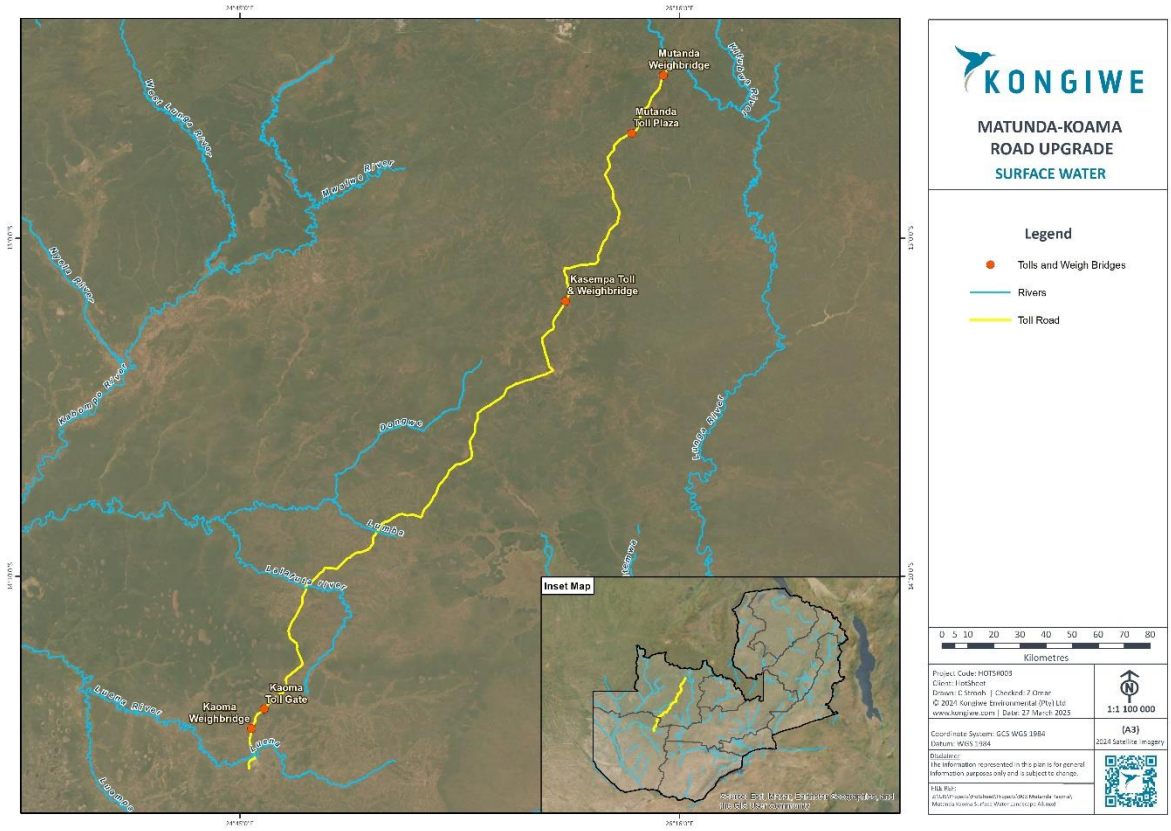

Figure 23 Proposed Route and Surface Water Features

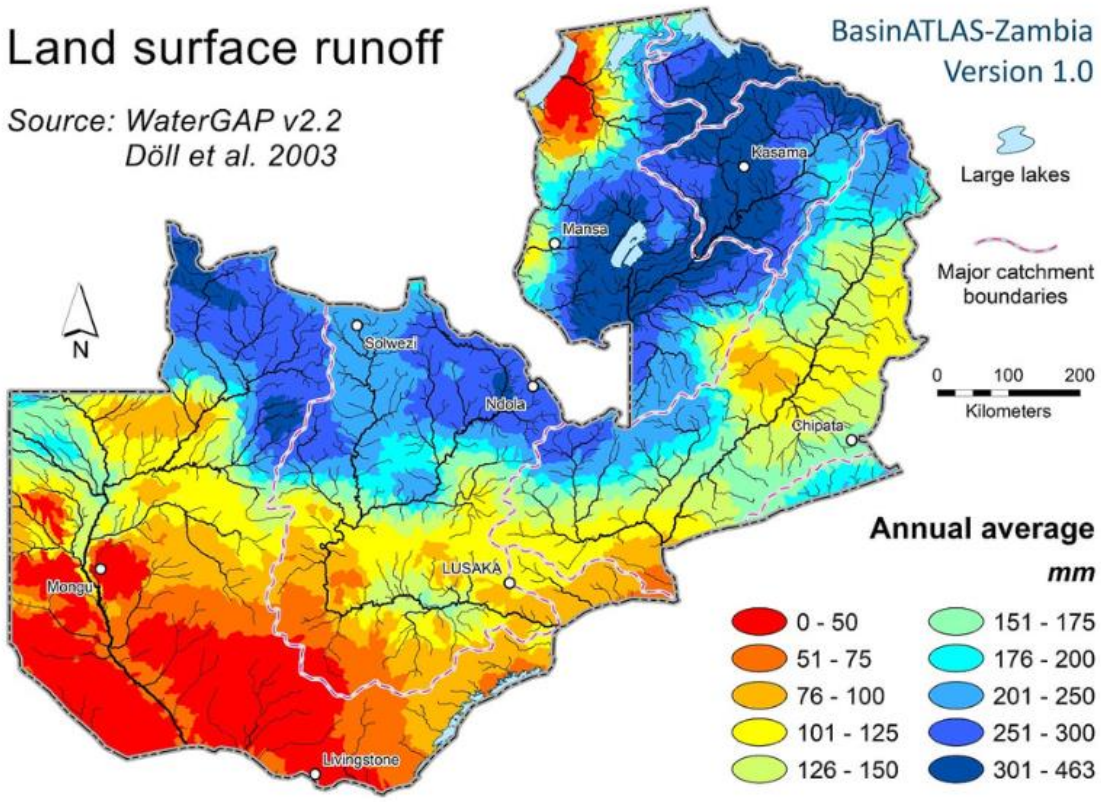

Figure 24: Hydrology Map for Zambia showing Land Surface Runoff

14 Water samples were collected from various surface water bodies along the proposed project route, starting in Kalumbila and proceeding through Kasempa and Mufumbwe, and ending in Kaoma. Some water results are shown in the tables below, with the full report in the Annex;

Table 14: Mutanda River Laboratory Results

Parameter	**Mutanda River**	**Zambian Standards** (Maximum Permissible Limit)	**WHO Guideline** (Maximum Permissible Value)
pH	7.14	6.5 – 8.0	6.5 – 8.5
Turbidity (NTU)	1.98	5.0	5.0
Conductivity	380	1500	1500
Total Dissolved Solids (mg/l)	190	1000	1000
Total hardness (as mg $CaCO_3$/l)	220	500	500
Total Suspended Solids (mg/l)	<1.0	-	-
Calcium hardness (as mg $CaCO_3$/l)	136	500	500
Alkalinity (as mg $CaCO_3$/l)	216	500	500
Iron (mg/l)	0.12240	0.30	0.30

Ammonia (as NH_4Nmg/l)	<0.0001	1.5	1.50
Sulphates (mg/l)	0.9901	400	250
Chlorides (mg/l)	17.0	250	250
Nitrites (as NO_2-Nmg/l)	<0.0001	1.0	3.0
Nitrates (as NO_3-Nmg/l)	<0.0124	10	10
Acidity (as mg $CaCO_3$/l)	Nil	500	500
Total Phosphates (mg/l)	<0.0001	5.0	5.0
Magnesium (mg/l)	20.16	150	-
Calcium (mg/l)	54.4	200	200
Fluorides (mg/l)	0.14	1.50	1.50
Potassium (mg/l)	3.70	-	-
Sodium (mg/l)	11.22	200	200
Manganese (mg/l)	<0.01	0.10	0.50
Hydrocarbons	<0.005	-	-
Bacteriological Results			
Total coliforms (≠/100ml)	65	0	0
Faecal coliforms (≠/100ml)	40	0	0

NB – *Water Quality Results are appended to this document*

Table 15: Dengwe Stream Laboratory Results

Parameter	**Dengwe Stream**	**Zambian Standards** (Maximum Permissible Limit)	**WHO Guideline** (Maximum Permissible Value)
pH	6.77	6.5 – 8.0	6.5 – 8.5
Turbidity (NTU)	230.00	5.0	5.0
Conductivity	402	1500	1500
Total Dissolved Solids (mg/l)	201	1000	1000
Total hardness (as mg $CaCO_3$/l)	160	500	500
Total Suspended Solids (mg/l)	98.2	-	-
Calcium hardness (as mg $CaCO_3$/l)	104	500	500
Alkalinity (as mg $CaCO_3$/l)	152	500	500
Iron (mg/l)	4.7256	0.30	0.30
Ammonia (as NH_4Nmg/l)	<0.0001	1.5	1.50
Sulphates (mg/l)	45.421	400	250
Chlorides (mg/l)	30.0	250	250
Nitrites (as NO_2-Nmg/l)	0.0277	1.0	3.0
Nitrates (as NO_3-Nmg/l)	1.0312	10	10
Acidity (as mg $CaCO_3$/l)	Nil	500	500

Total Phosphates (mg/l)	<0.0001	5.0	5.0
Magnesium (mg/l)	13.44	150	-
Calcium (mg/l)	41.6	200	200
Fluorides (mg/l)	0.15	1.50	1.50
Potassium (mg/l)	6.53	-	-
Sodium (mg/l)	19.80	200	200
Manganese (mg/l)	<0.01	0.10	0.50
Hydrocarbons	<0.005	-	-
Bacteriological Results			
Total coliforms (≠/100ml)	68	0	0
Faecal coliforms (≠/100ml)	54	0	0

NB – *Water Quality Results are appended to this document*

Table 16: Lalafuta River Laboratory Results

Parameter	**Lalafuta River**	**Zambian Standards** (Maximum Permissible Limit)	**WHO Guideline** (Maximum Permissible Value)
pH	7.09	6.5 – 8.0	6.5 – 8.5
Turbidity (NTU)	7.41	5.0	5.0
Conductivity	808	1500	1500
Total Dissolved Solids (mg/l)	404	1000	1000
Total hardness (as mg $CaCO_3$/l)	220	500	500
Total Suspended Solids (mg/l)	3.8	-	-
Calcium hardness (as mg $CaCO_3$/l)	108	500	500
Alkalinity (as mg $CaCO_3$/l)	210	500	500
Iron (mg/l)	0.2756	0.30	0.30
Ammonia (as NH_4Nmg/l)	<0.0001	1.5	1.50
Sulphates (mg/l)	171.01	400	250
Chlorides (mg/l)	104.0	250	250
Nitrites (as NO_2-Nmg/l)	<0.0001	1.0	3.0
Nitrates (as NO_3-Nmg/l)	1.8924	10	10
Acidity (as mg $CaCO_3$/l)	Nil	500	500
Total Phosphates (mg/l)	<0.0001	5.0	5.0
Magnesium (mg/l)	26.88	150	-
Calcium (mg/l)	43.2	200	200
Fluorides (mg/l)	0.19	1.50	1.50
Potassium (mg/l)	22.65	-	-
Sodium (mg/l)	68.64	200	200
Manganese (mg/l)	<0.01	0.10	0.50

Hydrocarbons	<0.005	-	-
Bacteriological Results			
Total coliforms (≠/100ml)	90	0	0
Feacal coliforms (≠/100ml)	74	0	0

NB – *Water Quality Results are appended to this document*

Table 17: Luena River Laboratory Results

Parameter	**Luena River**	**Zambian Standards** (Maximum Permissible Limit)	**WHO Guideline** (Maximum Permissible Value)
pH	6.39	6.5 – 8.0	6.5 – 8.5
Turbidity (NTU)	5.88	5.0	5.0
Conductivity	91	1500	1500
Total Dissolved Solids (mg/l)	46	1000	1000
Total hardness (as mg $CaCO_3$/l)	28	500	500
Total Suspended Solids (mg/l)	2.8	-	-
Calcium hardness (as mg $CaCO_3$/l)	16	500	500
Alkalinity (as mg $CaCO_3$/l)	26	500	500
Iron (mg/l)	0.1726	0.30	0.30
Ammonia (as NH_4Nmg/l)	<0.001	1.5	1.50
Sulphates (mg/l)	2.6129	400	250
Chlorides (mg/l)	12.0	250	250
Nitrites (as NO_2-Nmg/l)	<0.0001	1.0	3.0
Nitrates (as NO_3-Nmg/l)	<0.0001	10	10
Acidity (as mg $CaCO_3$/l)	10	500	500
Total Phosphates (mg/l)	<0.0001	5.0	5.0
Magnesium (mg/l)	2.88	150	-
Calcium (mg/l)	6.4	200	200
Fluorides (mg/l)	0.03	1.50	1.50
Potassium (mg/l)	0.03	-	-
Sodium (mg/l)	7.92	200	200
Manganese (mg/l)	<0.01	0.10	0.50
Hydrocarbons	<0.005	-	-
Bacteriological Results			
Total coliforms (≠/100ml)	110	0	0
Feacal coliforms (≠/100ml)	84	0	0

NB – *Water Quality Results are appended to this document*

The water quality assessment reveals significant concerns regarding the potability of water resources along the project area. While most chemical parameters complied with Zambian

Standards (ZS 190) and WHO guidelines, critical exceedances of iron and turbidity levels were observed in the Luena River, Lalafuta River, and Dengwe Stream. More alarmingly, bacteriological contamination rendered all sampled water sources non-compliant with drinking water standards in their natural state.

Figure 25 Water Sample collection at Luena River along the proposed Route

Key findings demonstrate:

1. **Universal Non-Potability**: All water sources tested failed bacteriological standards, making them unsafe for direct human consumption
2. **Specific Chemical Concerns**: Elevated iron and turbidity levels in three major watercourses indicate localized water quality degradation
3. **Required Interventions**: Basic remedial measures including:
    - Chlorination to address biological contamination
    - Boiling as minimum household-level treatment
    - Additional filtration for iron and turbidity reduction where applicable

These results underscore the necessity of implementing water treatment protocols for any project-related water use, while simultaneously highlighting existing water security challenges for local communities. The findings suggest that:

- Project water supply systems must incorporate robust treatment solutions
- Community water infrastructure improvements should be considered as part of CSR initiatives
- Regular monitoring should be instituted to track both baseline conditions and project impacts

The water quality baseline establishes that without treatment, no naturally occurring water sources in the study area meet minimum standards for human consumption - a critical factor for both public health protection and project planning purposes.

5.6 Topography and Landscape

Topography

The proposed 371km road project spans two provinces, namely North-Western Province and Western Province. The topography along the route varies, featuring undulating terrain, river crossings, and flat plains characteristic of the region.

North–Western Province features a general topography dominated by uplifted plantation surfaces and a plateau landscape with an average elevation of approximately 1,199 metres above sea level. The region's elevation trends from higher ground in the west, near the Kalahari Basin, with a gradual decline towards the east. This gradient is part of a larger national pattern where land falls from the upper Congo Basin in the north toward the Zambezi Depression in the south, forming an expansive plateau. The terrain's undulating nature contributes to distinct drainage patterns and hydrological systems, including significant rivers such as the Zambezi and its tributaries. The province’s elevation and plateau characteristics are essential in shaping its climate, vegetation, and water resources.

For Western Province, the topography is dominated by the extensive Barotse Floodplain, a flat and expansive low-lying area along the Zambezi River, which serves as a key geographical feature. The floodplain lies at an elevation of approximately 1,000–1,150 metres above sea level and spans a vast area that is seasonally inundated during the rainy season.

Outside the floodplain, the terrain transitions to sandy uplands characterized by gently undulating hills and ridges formed by aeolian deposits. These upland areas, with elevations averaging around 1,200 metres, provide a contrast to the flat floodplain and are critical for settlements and agriculture during the flooding season. The province topographical features, including the Zambezi River and its tributaries, significantly influence its hydrology, ecosystem, and land use patterns.

The described topography is specific to the North-Western and Western Provinces. With respect to the proposed road rehabilitation and upgrade project, it is important to note that the key geographical features, including the Barotse Floodplains and the Zambezi River, will not be directly impacted by the project activities.

Landscape

The proposed 371km Mutanda-Kaoma road traverses diverse landscapes across Kalumbila, Kasempa, Mufumbwe, and Kaoma districts. It begins in flat to gently undulating terrain in Kalumbila, covered with miombo woodlands and seasonal wetlands. In Kasempa, the landscape becomes more undulating, featuring rolling hills, river crossings, and sandy-clay soils. Mufumbwe presents a moderately hilly terrain with woodlands, agricultural areas, and erosion-prone soils. Finally, in Kaoma, the road enters flat floodplains and dambos, dominated by grasslands, a high-water table, and sandy soils, requiring special engineering considerations.

5.7 Soils

The Mutanda-Kaoma road upgrade project, spanning 371km across the North-Western and Western Provinces of Zambia, traverses diverse soil types that significantly influence construction, drainage, and agricultural activities along the route. The predominant soil types include:

- Sandy Soils – Common in upland areas, these soils are well-drained but have low water-holding capacity and limited nutrient retention. They are suitable for crops that tolerate dry conditions but may present challenges for road stability due to their loose nature and susceptibility to erosion.
- Loamy Soils – A balanced mix of sand, silt, and clay, these soils offer good fertility, water retention, and drainage. They support a variety of agricultural activities, including maize, legumes, and vegetables. From a construction perspective, loamy soils provide a relatively stable foundation but may require compaction for road durability.
- Kalahari Sands – Dominating much of the Western Province, these deep, loose, and highly porous soils offer excellent drainage but are nutrient-deficient and prone to shifting under pressure. Their low bearing capacity presents a challenge for road construction, requiring soil stabilization techniques such as gravel layering or chemical treatment to enhance strength.
- Clayey Soils – Found in low-lying areas, particularly near floodplains, these soils have high water-holding capacity but poor drainage. They are suitable for moisture-loving crops like rice but can cause difficulties in road construction due to their tendency to expand when wet and shrink when dry, leading to potential cracking and instability.

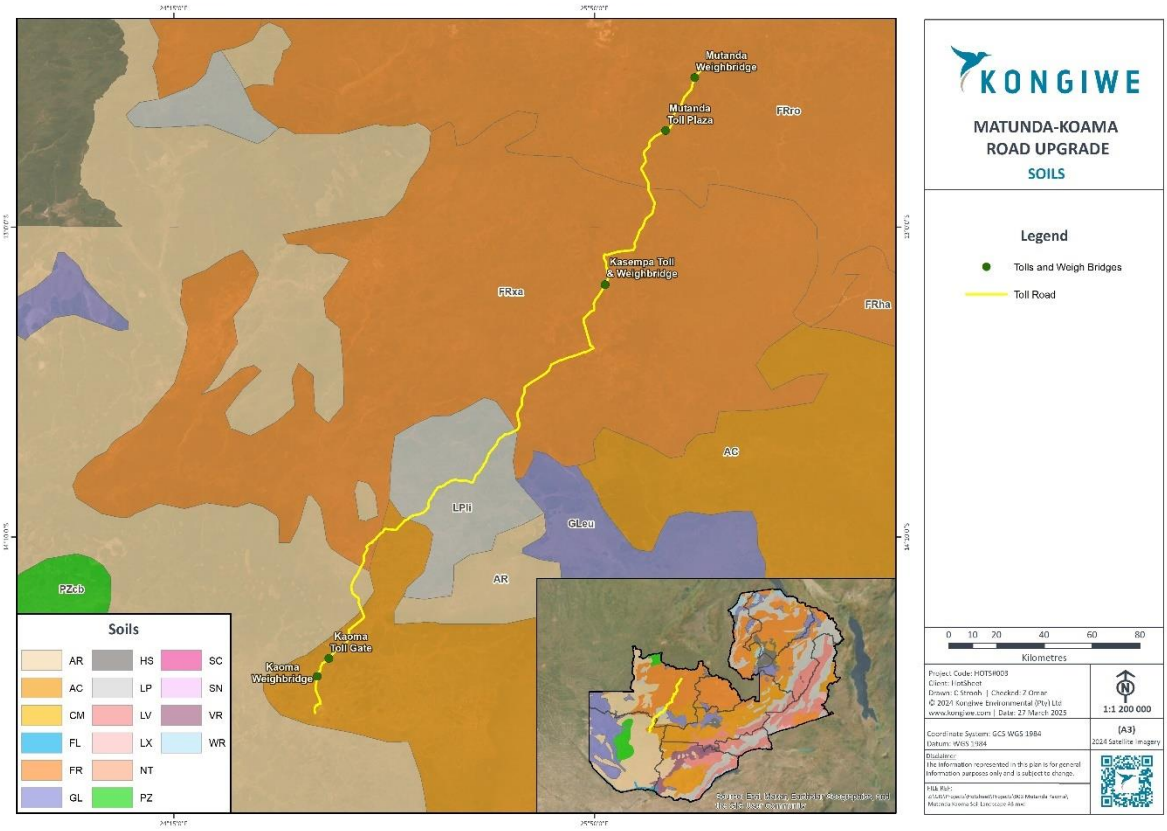

Figure 26: Soil Map of Zambia

5.8 Land Use and Tenure

5.8.1 Land Use

The land use of the project site is biodiversity conservation; the project site is in the National Park falling under public land managed by the Department of National Parks and Wildlife.

5.8.2 Land Tenure

There are three categories of land tenure systems in the district: customary, public and private leasehold land:

- **Customary Land -** This is land belonging to the people and which is held in trust and administration by traditional authority.
- **Public Land -** Public land is that land which government set aside through appropriate legislation for specific reasons like national development, security and tourism. This type of land is designated for forest reserves, roads and building plots.
- **Private Leasehold Land -** This is land formally leased from customary and private land. Land under this category, which includes private estates, must be leased for up to 99 years.

The proposed project route traverses predominantly public state land, encompassing the existing road footprint and current reserve under government jurisdiction. However, the

required 200 km reserve widening will necessitate additional land acquisition involving areas potentially under the custodianship of local councils or traditional authorities. Given the scale of this expansion, the implementation of a Relocation Action Plan (RAP) becomes inevitable to address potential resettlement requirements.

The RAP Framework annexed to this ESIA document establishes the fundamental benchmarks and guidelines for conducting the relocation process, providing the operational foundation for all land acquisition activities. This framework, developed in alignment with Zambian legislation and international best practices, outlines comprehensive procedures for compensation, livelihood restoration, and community engagement. It serves as the primary reference document for managing all project-related land access and resettlement processes.

All land acquisition procedures will be implemented in strict accordance with both the RAP Framework and the legal requirements detailed in the Legal Chapter of this report. The project will adopt a proactive approach to land access, prioritizing early identification of tenure claims and potential impacts. By integrating the RAP Framework's guidelines with statutory obligations, the project ensures a transparent, equitable process that respects customary land governance systems while meeting infrastructure development objectives. The framework's provisions for grievance redress and monitoring will further safeguard community interests throughout the project lifecycle.

5.9 Built Environment and Resettlement Action Plan Framework

The proposed rehabilitation and upgrade of the Mutanda-Kaoma Road will traverse a diverse built environment, requiring careful consideration of interactions with existing structures, land uses, and communities. Spanning 371 km, the corridor cuts through rural homesteads, agricultural lands, and peri-urban commercial zones, each presenting unique challenges for project implementation. Given the need for road widening and infrastructure improvements, the project must systematically address potential impacts on adjacent properties, businesses, and social infrastructure.

5.9.1 Built Environment Characteristics and Potential Impacts

The existing road alignment passes through varying settlement patterns, with higher-density development near towns such as Kasempa and Kaoma. Rural areas consist primarily of scattered homesteads and small-scale farms, while roadside trading centers host markets, shops, and service providers dependent on road access. Key infrastructure, including the Lalafuta and Chilombo bridges, will require upgrades to accommodate increased traffic loads.

Figure 27 Typical Infrastructure on the side of existing road.

The project's expansion may necessitate land acquisition, affecting approximately 988 structures, with the highest concentration in Kaoma (36%) and Kasempa (28%). Among these, trading outlets (70%) dominate, followed by homesteads (13%) and water stands (11%). While most social infrastructure (schools, clinics) will not require relocation, construction activities may temporarily disrupt access, necessitating mitigation measures such as alternative routes and traffic management plans.

5.9.2 Resettlement Policy Framework: Principles and Implementation

To manage these impacts, the project has developed a Resettlement Policy Framework (RPF) in alignment with Zambian legislation and international best practices. The RPF establishes a structured approach to involuntary resettlement, ensuring that affected persons receive fair compensation and livelihood restoration support.

5.9.3 Legal and Policy Foundations

The framework adheres to Zambia's Lands Act (1995), Lands Acquisition Act (1970), and National Resettlement Policy (2015), which govern land rights and compulsory acquisition for public projects. Additionally, it incorporates safeguards from international financiers, including the IFC Performance Standards and AfDB Involuntary Resettlement Policy, to ensure compliance with global best practices.

5.9 4 Key Components of the RPF

1. **Minimizing Displacement**
   - Where feasible, the road design has been optimized to reduce the need for physical relocation. However, in densely populated areas, some displacement is unavoidable, particularly for roadside traders and farmers.
2. **Compensation and Entitlements**
   - Affected landowners and leaseholders will receive compensation at full replacement cost, determined through market-based valuations.

- Displaced households will be provided with relocation assistance, including temporary housing and transport support.
- A cut-off date for eligibility will be established based on orthophoto documentation to prevent speculative claims.

3. **Livelihood Restoration**
   - Given the reliance of local communities on agriculture and trade, livelihood restoration programs will be a priority. These may include:
   - Agricultural support (alternative land allocation, inputs, training).
   - Business grants for affected traders to re-establish enterprises.
   - Skills development programs to diversify income sources.
4. **Vulnerable Groups**
   - Special provisions will be made for female-headed households, the elderly, and persons with disabilities, ensuring they receive tailored assistance throughout the resettlement process.

5.9.5 Stakeholder Engagement and Grievance Redress

A participatory approach has been adopted to ensure affected communities are adequately consulted. Early-stage engagements have already been conducted with local authorities, traditional leaders, and residents to identify concerns and integrate feedback into planning.

A Grievance Redress Mechanism (GRM) has been established to provide an accessible platform for dispute resolution. Complaints will be logged, investigated, and resolved through community-based committees, with an escalation process for unresolved cases. Regular updates will be disseminated via public meetings, radio announcements, and collaboration with local leaders to maintain transparency.

5.9.6 Monitoring and Adaptive Management

The success of resettlement efforts will be tracked through a robust Monitoring & Evaluation (M&E) system, assessing key indicators such as:

- Timeliness of compensation payments.
- Effectiveness of livelihood restoration programs.
- Resolution of grievances.

Independent audits will be conducted periodically to verify compliance with the RPF, and adaptive management strategies will be employed to address unforeseen challenges.

5.9.7 Conclusion and Next Steps

The Resettlement Policy Framework provides a comprehensive and equitable approach to managing displacement and land acquisition along the Mutanda-Kaoma Road corridor. By prioritizing minimization of impacts, fair compensation, and livelihood restoration, the project aims to mitigate adverse effects while delivering long-term socio-economic benefits.

The next phase will involve finalizing the Resettlement Action Plan (RAP), including detailed asset inventories, compensation valuations, and implementation timelines. Continuous engagement with affected communities will remain a cornerstone of the process, ensuring that resettlement is conducted with transparency, fairness, and respect for the rights of all stakeholders.

This structured yet flexible approach ensures that infrastructure development proceeds in a socially sustainable manner, aligning with both national development goals and international safeguards.

5.10 Fauna

The assessment of fauna along the proposed Mutanda Kaoma road corridor is a critical component of the biodiversity evaluation, as it provides insight into the ecological integrity, conservation value, and potential environmental sensitivities of the landscape. Fauna contributes significantly to ecosystem functioning through roles such as pollination, seed dispersal, nutrient cycling, pest regulation, and maintaining trophic dynamics. Understanding the composition, diversity, and abundance of faunal communities is therefore essential for informing sustainable land-use planning, mitigating adverse impacts, and ensuring compliance with environmental regulations.

The project area is situated within a miombo woodland ecosystem—a dominant vegetation type in Zambia. Miombo woodlands are known for their relatively low faunal biomass compared to other tropical ecosystems, yet they support a high level of species richness and endemicity in several groups. This paradoxical ecological trait highlights the importance of examining multiple taxonomic groups, including mammals, birds, reptiles, amphibians, and invertebrates, to obtain a comprehensive picture of biodiversity.

The fauna survey focused on both direct observation and indirect evidence, such as tracks, droppings, burrows, calls, and other signs of animal activity. Due to the elusive or nocturnal nature of many species, indirect indicators are often more reliable for assessing presence, especially for small mammals and cryptic species.

This section presents the findings of the faunal assessment conducted within the project area, organized by major faunal groups. The results are discussed in the context of existing ecological knowledge, previous literature, and conservation considerations specific to miombo woodland environments.

5.10.1 Terrestrial Species

Mammals

There were no mammals observed during the site assessments, however, tracks, burrows and droppings of small mammals were observed. These signs indicate the occurrence of species that are typically nocturnal, elusive, or sensitive to human presence. The lack of direct sightings is likely attributed to dense vegetation, diurnal limitations, and disturbances from road and human activity in certain sections of the project area.

Further, interviews with key informants and local inhabitants of the project area also indicated that some small and large mammals were present in the project area especially in Kasonso

Busanga the GMAs. The mammals known to exist in the project area are shown in the table below:

Table 18: Some of the Mammals Found in the Project Area

Common Names	**Scientific Name**	**IUCN Status**
Vervet Monkeys	*Cercopithecus pygerythrus*	Data Deficiency
Elephant	*Loxodonta Africana*	Endangered
Impalas	*Aepyceros melampus*	Least Concern
Bushbuck	*Tragelaphus scriptus*	Least Concern
Waterbuck	*Kobus ellipsiprymnus*	Least Concern
Warthog	*Phacochoerus africanus*	Least Concern
Common Duiker	*Sylvicapra grimmia*	Least Concern
Hartebeest	*Alcelaphus buselaphus*	Least Concern
Rats	*Rattus*	Least Concern
Mole Rat	*Fulkomys Amatus*	Not Found
Common Shrews	*Sorex araneus*	Least Concern
Elephant shrews	*Rhynchocyon cirnei*	Least Concern
Bush babies	*Galago senegalensis*	Least Concern
Cane rats	*Thryonomys swinderianus*	Least Concern
Squirrel	*Sciuridae (family)*	Least Concern

Table 19: Locally Protected and Endangered Mammal Species

Common Name	**Scientific Name**	**IUCN Red List Status**	**Zambia Protection Status**	**Notes**
African Elephant	*Loxodonta africana*	Endangered	Protected under Zambia Wildlife Act	Threatened by poaching and habitat loss. Keystone species.
Lion	*Panthera leo*	Vulnerable	Listed Protected Species	Conflict with humans and trophy hunting are major concerns.
Leopard	*Panthera pardus*	Vulnerable	Listed Protected Species	Protected under Zambian law; declining due to poaching and trade.
Roan Antelope	*Hippotragus equinus*	Least Concern	Game Species (strictly	Conservation concern due to population decline in some areas.

			controlled hunting)	
Sable Antelope	*Hippotragus niger*	Least Concern	Game Species	Locally significant for biodiversity and tourism.
African Wild Dog *(if present)*	*Lycaon pictus*	Endangered	Protected species	Rare in GMAs, but occasionally recorded; highest protection status.
Puku	*Kobus vardonii*	Least Concern	Protected (near-endemic to Zambia)	Important regional species; habitat loss is a concern.
Cheetah *(rare)*	*Acinonyx jubatus*	Vulnerable	Protected	Very rare in this region but fully protected under Zambian law.
Honey Badger	*Mellivora capensis*	Least Concern	Protected	Protected due to ecological role and risk of local persecution.

Figure 28: Droppings of a Common Duiker within the Project Area

Figure 29: Droppings of a Hare within the Project Area

Biodiversity Indicators

Biodiversity indicators are measurable components of biological systems that reflect the condition, trends, and sustainability of ecosystems. They are essential tools for understanding the health, integrity, and resilience of natural environments and are particularly valuable in environmental assessments where human development, such as road infrastructure, intersects with ecologically sensitive areas.

For the Mutanda–Kasempa–Kaoma road corridor, biodiversity indicators help to assess the ecological value of habitats, the presence and abundance of key species, and the sensitivity of ecosystems to disturbance. These indicators also serve as early warning signs of ecosystem degradation and provide a scientific basis for designing mitigation measures, conservation strategies, and sustainable land-use planning.

Key biodiversity indicators assessed in this study include the presence of endemic, threatened, or protected species, species richness and abundance, habitat diversity, ecosystem functions, and the presence of invasive alien species. They also take into account ecological roles of species (e.g., keystone, umbrella, or indicator species), and their contribution to livelihoods and ecosystem services such as pollination, seed dispersal, water purification, and soil stabilization.

Assessing biodiversity indicators along the project corridor is therefore critical for maintaining ecological balance, ensuring compliance with national and international environmental standards, and informing responsible decision-making during project implementation and operation.

Table 20: Biodiversity Indicator for Mammals in the Project Area

Indicator Name	Description	Interpretation from Species List
Species Richness	Total number of mammal species recorded.	20 species observed – indicates high faunal diversity, suggesting rich and varied ecosystems.
IUCN Threatened Species Index	Number of species listed as *Vulnerable* or *Endangered*.	3 species: Elephant (*Endangered*), Lion and Leopard (*Vulnerable*) – high conservation value.
Large Mammal Presence Index	Number of large-bodied mammals (>100kg), important for ecosystem functioning.	8 large mammals (e.g., Elephant, Buffalo, Roan) – shows a healthy large herbivore/predator guild.
Apex Predator Index	Presence of top predators (e.g., Lion, Leopard).	2 apex predators – indicates intact trophic structure, though vulnerable to human conflict.
Herbivore Functional Group Diversity	Representation of both grazers and browsers.	Strong presence of grazers (e.g., Hartebeest) and browsers (e.g., Kudu) – reflects habitat mosaic.
Endemism Indicator	Presence of regionally endemic or range-restricted species.	*Puku* is near-endemic to Zambia and surrounding areas – underscores regional conservation value.
Habitat Generalist Indicator	Number of species known to adapt across multiple habitats.	10 generalist species (e.g., Warthog, Duiker) – useful for tracking habitat modification trends.
Small Mammal Diversity Index	Presence of small mammals indicating ecological complexity.	6 species including Scrub Hare, Squirrels, and Civet – shows functional richness at lower trophic levels.
Carnivore Diversity Index	Presence of both small and large carnivores.	Carnivores range from Honey Badger to Lion – indicates top-down ecological regulation.
Habitat Integrity Proxy	Inference based on species sensitive to habitat loss (e.g., Sable, Roan).	Continued presence suggests semi-intact habitat corridors – though increasing human influence may threaten this.

Reptiles and Amphibians

The Mutanda–Kaoma road corridor traverses diverse ecosystems within the Kasonso Busanga and Kalumwange Game Management Areas (GMAs), adjacent to Kafue National Park. This landscape consists of miombo woodlands, riparian zones, and seasonal wetlands—offering a

variety of microhabitats suitable for a broad range of herpetofauna, including both reptiles and amphibians.

Herpetofauna are essential components of ecosystem health and function. Reptiles serve as both predators and prey in food chains and contribute to pest regulation, while amphibians are sensitive to changes in moisture, temperature, and pollution, making them excellent bioindicators of environmental conditions. Together, they provide insight into habitat integrity, ecological connectivity, and the effects of human disturbance.

Field observations conducted during the ecological survey, combined with consultations with local communities and DNPW officers, confirmed the presence of several herpetofaunal species in the project area. A total of 19 reptile species and 7 amphibian species were recorded, representing a diversity of ecological functions, behaviors, and habitat preferences.

Among reptiles, commonly observed or reported species include the Flap-necked Chameleon (*Chamaeleo dilepis*), Southern Tree Agama (*Acanthocercus atricollis*), African Rock Python (*Python sebae*), and Nile Monitor (*Varanus niloticus*). These species were most frequently encountered in wooded areas, near stream banks, or in rocky habitats. Additionally, venomous snakes such as the Puff Adder (*Bitis arietans*) and Boomslang (*Dispholidus typus*) are known to inhabit the region, especially during the rainy season.

Amphibians were primarily detected in or near ephemeral pools, grassy pans, and under vegetative cover. Species such as the African Bullfrog (*Pyxicephalus edulis*), Plain Grass Frog (*Ptychadena anchietae*), and Tree Frogs (*Leptopelis* spp.) were reported. Their presence correlates with the seasonal rains, which create temporary breeding grounds that are crucial for amphibian life cycles.

While most herpetofauna recorded are listed as Least Concern on the IUCN Red List, some species such as chameleons, frogs, and fossorial lizards are highly sensitive to habitat alteration, particularly due to deforestation, fire, agricultural encroachment, and road development. Additionally, poaching and illegal pet trade, particularly targeting chameleons and pythons, pose localized threats.

The following table summarizes the herpetofauna species recorded in the project area, including their scientific names, conservation status, and ecological notes.

Table 21: Herps Found and Reported in the Project Area

Common Name	**Scientific Name**	**Class**	**IUCN Status**	**Ecological Notes**
Nile Crocodile	*Crocodylus niloticus*	Reptile	Least Concern	Apex aquatic predator; thrives in rivers and wetlands
African Rock Python	*Python sebae*	Reptile	Least Concern	Largest snake in Africa; non-venomous constrictor

Common Name	Scientific Name	Class	IUCN Status	Ecological Notes
Puff Adder	*Bitis arietans*	Reptile	Least Concern	Common and venomous; important in rodent control
Boomslang	*Dispholidus typus*	Reptile	Least Concern	Venomous tree snake; widespread in woodlands
Black Mamba	*Dendroaspis polylepis*	Reptile	Least Concern	Highly venomous; found in savannas and open woodland
Monitor Lizard (Nile)	*Varanus niloticus*	Reptile	Least Concern	Scavenger and predator; found near water
Leopard Tortoise	*Stigmochelys pardalis*	Reptile	Least Concern	Terrestrial herbivore; common in dry savanna and scrublands
Helmeted Terrapin	*Pelomedusa subrufa*	Reptile	Least Concern	Aquatic; often found in temporary ponds during the rainy season
Striped Skink	*Trachylepis striata*	Reptile	Least Concern	Widespread lizard; insectivorous
Rainbow Lizard (Agama)	*Agama agama*	Reptile	Least Concern	Males are brightly colored; found on rocks and termite mounds
Branch's Agama	*Acanthocercus branchi*	Reptile	Least Concern	Common in rocky or open woodland areas; active during the day
Peter's Ground Agama	*Agama armata*	Reptile	Least Concern	Found in open areas; displays territorial behavior during breeding
Southern Tree Agama	*Acanthocercus atricollis*	Reptile	Least Concern	Arboreal lizard; prefers trees and shrubs in savanna and woodland
Common Rough-scaled Lizard	*Ichnotropis squamulosa*	Reptile	Least Concern	Ground-dwelling insectivore; found in dry, open areas
Blunt-tailed Worm Lizard	*Dalophia pistillum*	Reptile	Least Concern	Fossorial species; rarely seen above ground, lives in sandy soils

Common Name	Scientific Name	Class	IUCN Status	Ecological Notes
Kalahari Purple-glossed Snake	*Amblyodipsas ventrimaculata*	Reptile	Least Concern	Mildly venomous, fossorial snake; feeds on small vertebrates
Flap-necked Chameleon	*Chamaeleo dilepis*	Reptile	Not Evaluated	Common arboreal species; good indicator of undisturbed woodland
Rhombic Night Adder	*Causus rhombeatus*	Reptile	Least Concern	Venomous but shy; widespread in Zambia; found in moist habitats
African Bullfrog	*Pyxicephalus edulis*	Amphibian	Least Concern	Large burrowing frog; emerges after heavy rains
Mascarene Ridged Frog	*Ptychadena mascareniensis*	Amphibian	Least Concern	Found near water bodies and grassy margins
Banded Rubber Frog	*Phrynomantis bifasciatus*	Amphibian	Least Concern	Found in moist areas; secretes toxins as a defense mechanism
Foam Nest Frog	*Chiromantis xerampelina*	Amphibian	Least Concern	Builds foam nests in tree branches above water; breeds during rainy season
Plain Grass Frog	*Ptychadena anchietae*	Amphibian	Least Concern	Common after rains; prefers open grasslands and cultivated fields
Bocage's Tree Frog	*Leptopelis bocagei*	Amphibian	Not Evaluated	Arboreal frog; typically found near temporary pools during rainy seasons
Tree Frog	*Leptopelis parbocagii*	Amphibian	Least Concern	Nocturnal frog; lays eggs in ephemeral pools and temporary wetlands

Table 22: Locally Protected and Endangered Herptofauna

Common Name	Scientific Name	IUCN Status	Zambian Legal Status	Notes
Nile Crocodile	*Crocodylus niloticus*	Least Concern	Protected Species	Protected under the Zambia Wildlife Act due to its ecological

				role and risk of human conflict.
African Rock Python	*Python sebae*	Least Concern	Protected Species	Fully protected in Zambia; illegal to kill, hunt, or trade without a special permit.
Flap-necked Chameleon	*Chamaeleo dilepis*	Not Evaluated	Protected Species	All chameleons in Zambia are protected due to sensitivity to habitat loss and illegal collection.
Monitor Lizard (Nile)	*Varanus niloticus*	Least Concern	Protected/Game Species	Often protected due to trophy hunting restrictions and ecological importance.
African Bullfrog	*Pyxicephalus edulis*	Least Concern	Not explicitly listed, but regionally monitored	Threatened locally by habitat loss and collection for bushmeat or pet trade.

Key Notes on Zambian Protection Status:

- The Zambia Wildlife Act No. 14 of 2015 governs wildlife protection.
    - Species are classified as Protected, Game, or Dangerous.
    - Hunting, capturing, trading, or harming protected species is prohibited without a license.
    - Amphibians are not comprehensively covered under national protection but may be indirectly protected through habitat laws and environmental regulations.
- Protected reptile species are often targeted for enforcement due to:
    - Poaching for traditional medicine or bushmeat
    - Illegal pet trade (especially chameleons and snakes)
    - Human-wildlife conflict (crocodiles)

Summary:

While none of the listed reptiles or amphibians are globally endangered, several are protected under Zambian law due to:

- Ecological importance,
- Cultural exploitation risks,
- And vulnerability to illegal trade or habitat loss.

Table 23: Biodiversity Indicators for Reptiles and Amphibians in the Project Area

Indicator Name	**Description**	**Interpretation from the Species List**
Species Richness	Total number of species recorded (amphibians + reptiles).	26 species recorded (19 reptiles, 7 amphibians) — indicates moderate-high diversity.
Threatened Species Indicator	Number of species listed as *Vulnerable*, *Endangered*, or *Critically Endangered* on the IUCN Red List.	None recorded — all species are Least Concern or Not Evaluated.
Data Deficiency/Not Evaluated Rate	Number of species with insufficient IUCN data.	2 species (*Chamaeleo dilepis*, *Leptopelis bocagei*) — calls for local monitoring.
Amphibian Representation Index	Proportion of amphibians in the total herpetofauna.	27% amphibians — good seasonal indicator group due to sensitivity to water and climate.
Habitat Specialist Ratio	Proportion of species with strict habitat preferences (e.g., fossorial, arboreal, aquatic).	>60% of species are specialists — signals habitat heterogeneity and ecological complexity.
Trophic Diversity Index	Presence of different feeding guilds (e.g., insectivores, carnivores, herbivores).	High — includes insectivores (skinks, frogs), carnivores (snakes, crocodile), and herbivores (tortoises).
Functional Role Indicator	Presence of species with key ecological functions (e.g., pest control, nutrient cycling).	Includes rodent controllers (puff adder, boomslang) and indicator species (frogs, chameleons).
Seasonal Activity Indicator	Species that appear or increase in detectability during rainy season.	All amphibians and some reptiles (e.g., terrapin, bullfrog) — reflects seasonal ecosystem response.
Human Disturbance Tolerance	Proportion of species known to persist in disturbed/agricultural habitats.	~30–40% (e.g., *Agama agama*, *Trachylepis striata*) — the rest are more sensitive.

Bioindicator Presence	Species sensitive to pollution, habitat change, or hydrology.	Presence of frogs (*Leptopelis*, *Ptychadena*) and chameleons = good ecosystem quality.

Insects

Insects are a fundamental component of terrestrial ecosystems, playing critical roles in pollination, decomposition, pest control, and serving as prey for higher trophic levels. During the field assessment conducted along the Mutanda–Kaoma road corridor, both direct insect sampling and local knowledge were used to document commonly occurring species.

A total of 108 insect species were either captured directly using sweep nets and pitfall traps or reported by local community and farmers as frequently occurring in the area. These species are consistent with those found in miombo woodlands. The majority of species identified belong to orders Lepidoptera, Orthoptera, Hymenoptera, Coleoptera, Hemiptera, and Diptera. Although most are not formally assessed under the IUCN Red List, their presence provides key insight into the ecological dynamics and health of the landscape. Importantly, the diversity includes pollinators, herbivores, crop pests, and vectors of disease, indicating a functional and varied insect community.

The figure below shows one of the insects that were captured in the project area.

Figure 30: Millipede as captured in the proposed site

Table 24: Insects Captures and Reported

Sp. No.	Scientific Name	Common Name	Order	IUCN Status	Ecological Notes
1	*Glossina fusca*	Tsetse Fly	Diptera	Not Evaluated	Vector of sleeping sickness; occurs in riverine habitats
2	*Eurema brigitta*	Grass Yellow Butterfly	Lepidoptera	Not Evaluated	Widespread in grassland and open woodland

3	*Spodoptera exigua*	Small Mottled Willow Moth	Lepidoptera	Not Evaluated	Widespread pest on crops; larvae feed on leaves
4	*Meranoplus bicolor*	Ant	Hymenoptera	Not Evaluated	Common savanna ant; nests underground and is ecologically aggressive
5	*Melanotus* spp.	Click Beetle	Coleoptera	Not Evaluated	Larvae known as wireworms; found in soils of woodland and farmland
6	*Riptortus pedestris*	Bean Bug	Hemiptera	Not Evaluated	Agricultural pest; common in legume fields, also found in open woodland
7	*Chrotogonus* spp.	Grasshopper	Orthoptera	Not Evaluated	Common in dry grassland and light woodland
8	*Oxyacris* spp. *(corrected)*	Short-horned Grasshopper	Orthoptera	Least Concern	Common savanna grasshopper; feeds on grasses

Table 25: Locally Protected and Endangered Insects Species

Common Name	**Scientific Name**	**IUCN Status**	**National Protection Status**	**Remarks**
African Monarch Butterfly	*Danaus chrysippus*	Least Concern	Not formally protected	Regionally common; culturally significant; sensitive to pesticide exposure.
Citrus Swallowtail Butterfly	*Papilio demodocus*	Least Concern	Not formally protected	Larvae feed on citrus; often persecuted despite ecological value.
African Giant Swallowtail	*Papilio antimachus*	Data Deficient	Recommended for protection	One of the largest butterflies in Africa; rare in Zambia; threatened by habitat loss.
Giant Stick Insect	*Bactrododema spp.*	Not Evaluated	Not protected	Found in mopane/miombo forests; fragile and vulnerable to fire regimes.

Common Name	Scientific Name	IUCN Status	National Protection Status	Remarks
Atlas Moth *(local reports)*	*Attacus atlas* (or local *Imbrasia* spp.)	Not Evaluated	Not protected	Rare; may occur in riverine thickets; ecologically important silk moth.
Tsetse Flies	*Glossina spp.*	Not Evaluated	Managed/Veterinary control	Significant due to disease transmission; targeted by control campaigns.
Antlion species	*Palpares spp.*	Not Evaluated	Not protected	Occur in sandy soils; sensitive to habitat degradation.

Key Notes:

- Zambia does not have a formal protected species list for insects under the Wildlife Act, unlike for mammals, birds, and reptiles.
- However, several species are considered ecologically or culturally important and may be indirectly protected through:
    - Habitat protection regulations (e.g., within GMAs and National Parks),
    - Forest reserve legislation, or
    - Environmental regulations (EIA/ESMP conditions).
- Species like *Papilio antimachus* and large silk moths are flagship insects and are often proposed for local conservation awareness efforts.
- Pollinator species (e.g., butterflies, bees) are increasingly being recognized in biodiversity monitoring frameworks due to their importance for ecosystem functioning.

Table 26: Biodiversity Indicator for Insects in the Project Area

Indicator Name	Description	Interpretation from Species List
Species Richness	Total number of insect species documented in the area.	8 species — indicates moderate insect diversity, typical of a mixed savanna–miombo ecosystem.
Trophic Group Diversity	Variety of feeding roles represented (e.g., pollinators, herbivores, predators, decomposers).	Present: pollinators (butterflies, ants), herbivores (grasshoppers, bugs), decomposers (beetles), and vectors (tsetse fly) — reflects ecological balance.
Pest Species Presence Indicator	Number of known agricultural pests in the area.	3 species (*Spodoptera exigua*, *Riptortus pedestris*, *Chrotogonus spp.*) — implies potential agro-ecological challenges.
Disease Vector Indicator	Presence of insect species known to transmit zoonotic or human diseases.	1 species (*Glossina fusca*, tsetse fly) — signals a public and veterinary health concern.

Indicator Name	Description	Interpretation from Species List
Functional Group Abundance Indicator	Proportion of captured individuals belonging to dominant functional groups.	Ants (Meranoplus bicolor) made up ~70% of captured insects — suggests healthy soil activity or savanna dominance.
Habitat Integrity Indicator	Presence of species sensitive to land use change (e.g., forest/grassland insects).	Mix of savanna-woodland generalists and specialists — suggests semi-intact habitat structure.
Pollinator Presence Indicator	Representation of butterflies, bees, or ants important to pollination.	Present (*Eurema brigitta*, *Meranoplus bicolor*) — supports plant regeneration and biodiversity.
Invasive/Non-native Species Indicator	Detection of any non-native or potentially invasive insects.	None detected — suggests low alien species pressure at the time of study.
IUCN Conservation Status Index	Count of species with global threat status.	All species are Not Evaluated or Least Concern — no immediate global conservation priority, but data gaps exist.

5.10.2 Aquatic Species

The Kasempa–Kaoma road corridor traverses an ecologically diverse landscape, encompassing seasonal and perennial streams, ephemeral wetlands, floodplain fringes, and riparian woodlands, particularly within the Kasonso Busanga and Kalumwange GMAs. These aquatic systems play a crucial role in sustaining the ecological balance of the area by supporting a range of aquatic and semi-aquatic fauna, including birds, reptiles, amphibians, and fish.

Although the proposed project site lies outside major gorge zones and permanent river systems, seasonal water bodies and drainage lines along the corridor provide important habitats for aquatic biodiversity, particularly during the rainy season. These areas serve as feeding, nesting, breeding, and migratory stopover sites for many aquatic birds and are equally vital for sustaining populations of fish and other freshwater-dependent animals.

During the field survey, both direct observations and records from the DNPW confirmed the presence of a variety of aquatic species. Physical evidence such as nests, bird droppings, and direct sightings supported the presence of several aquatic bird species, while community knowledge and DNPW records further expanded the species list to include fish and semi-aquatic reptiles.

The aquatic bird community includes species such as the African Jacana, Goliath Heron, Pied Kingfisher, Sacred Ibis, and Rock Pratincole, which are characteristic of seasonally flooded or marshy areas. Some of these birds, such as the Cattle Egret, were found to be abundant, indicating the presence of feeding grounds and shallow wet habitats.

In addition to birds, semi-aquatic reptiles such as the Nile Crocodile (*Crocodylus niloticus*), Water Monitor Lizard (*Varanus niloticus*), and African Rock Python (*Python sebae*) were either observed or reported in the project area. These species are known to occupy stream banks

and wetland margins where they serve as important predators and scavengers within the aquatic food web.

The ichthyofauna (fish community) of the area, as compiled from FAO, Department of Fisheries, and regional data, includes typical species of Zambia's upper catchments and wetland systems. This includes tilapias, catfish, tigerfish, pike, and cyprinids (barbs). Among these, the Three-spot Tilapia (*Oreochromis andersonii*), listed as Near Threatened by the IUCN, holds ecological and local economic importance, particularly for artisanal fishing communities.

The table below provides a consolidated list of aquatic species observed or reported along the Kasempa–Kaoma corridor, including their scientific names, taxonomic group, IUCN conservation status, and ecological notes.

Table 27: Aquatic Species Observed or Reported along the Kasempa – Kaoma Road Corridor

No.	Common Name	Scientific Name	Group	IUCN Status	Notes
1	Goliath Heron	*Ardea goliath*	Bird	Least Concern	Largest heron; prefers undisturbed wetlands
2	Grey Heron	*Ardea cinerea*	Bird	Least Concern	Widespread; found near streams and floodplains
3	Purple Heron	*Ardea purpurea*	Bird	Least Concern	Inhabits reedbeds and swamps
4	Squacco Heron	*Ardeola ralloides*	Bird	Least Concern	Small heron found near marsh edges
5	Cattle Egret	*Bubulcus ibis*	Bird	Least Concern	Most abundant; often follows cattle
6	Green-backed Heron	*Butorides striata*	Bird	Least Concern	Small heron along stream margins
7	African Green-backed Heron	*Butorides striata atricapilla*	Bird	Least Concern	Regional variant of green-backed heron
8	Reed Cormorant	*Microcarbo africanus*	Bird	Least Concern	Dives for fish; commonly seen perched
9	Pied Kingfisher	*Ceryle rudis*	Bird	Least Concern	Hovers above water to catch fish
10	Rock Pratincole	*Glareola nuchalis*	Bird	Least Concern	Breeds on river rocks in dry season
11	Common Sandpiper	*Actitis hypoleucos*	Bird	Least Concern	Migrant; forages along shores

12	Hamerkop	*Scopus umbretta*	Bird	Least Concern	Noted for large stick nests
13	African Jacana	*Actophilornis africanus*	Bird	Least Concern	Walks on floating plants
14	African Open-bill Stork	*Anastomus lamelligerus*	Bird	Least Concern	Specializes in aquatic snails
15	Sacred Ibis	*Threskiornis aethiopicus*	Bird	Least Concern	Common wader in wetlands
16	Hadeda Ibis	*Bostrychia hagedash*	Bird	Least Concern	Noisy ibis seen near moist grassland
17	Egyptian Goose	*Alopochen aegyptiaca*	Bird	Least Concern	Often found in and around water bodies
18	Black Crake	*Zapornia flavirostra*	Bird	Least Concern	Skulking species of swampy edges
19	Nile Crocodile	*Crocodylus niloticus*	Reptile	Least Concern	Apex predator in freshwater ecosystems
20	Water Monitor Lizard	*Varanus niloticus*	Reptile	Least Concern	Feeds on aquatic prey; found near rivers
21	African Rock Python	*Python sebae*	Reptile	Least Concern	Semi-aquatic; may be found near wetlands
22	Leopard Tortoise	*Stigmochelys pardalis*	Reptile	Least Concern	Occasionally near water; mostly terrestrial
23	Three-spot Tilapia	*Oreochromis andersonii*	Fish	Near Threatened	Important local fish; found in slow streams
24	Red-breasted Tilapia	*Coptodon rendalli*	Fish	Least Concern	Found in vegetated waters; herbivorous
25	Sharp-toothed Catfish	*Clarias gariepinus*	Fish	Least Concern	Adaptable; common in low-oxygen water
26	Southern Mouthbrooder	*Pseudocrenilabrus philander*	Fish	Least Concern	Small cichlid; occurs in shallow, clear water
27	Banded Tilapia	*Tilapia sparrmanii*	Fish	Least Concern	Small native tilapia; common in floodplains

28	African Pike	*Hepsetus odoe*	Fish	Least Concern	Predatory fish; prefers quiet pools
29	Tigerfish	*Hydrocynus vittatus*	Fish	Least Concern	Large predator; prefers deeper streams
30	Barbs (small cyprinids)	*Enteromius* spp.	Fish	Least Concern	Abundant in seasonal streams and headwaters

Summary:

- Total aquatic species listed: 30
  - Birds: 18
  - Reptiles: 4
  - Fish: 8
- The species listed reflect a functionally rich aquatic ecosystem supporting predators, grazers, scavengers, and bioindicators.
- Most species are classified as Least Concern, but some (e.g., *Oreochromis andersonii*) are Near Threatened due to overfishing and habitat change.

5.11 Avifauna (Birds)

The Kasempa–Kaoma road corridor lies within an ecologically diverse landscape, forming part of the greater Kafue ecosystem, which is internationally recognized as an Important Bird Area (IBA). The corridor traverses miombo woodland, open savanna, seasonal wetlands, and riverine thickets, offering a mosaic of habitats that support a wide variety of bird species.

Birds play vital ecological roles as pollinators, seed dispersers, insect regulators, scavengers, and ecological indicators. Their diversity and abundance are often used as proxies to assess the overall health of terrestrial ecosystems. This assessment integrates both direct field observations and local ecological knowledge to identify common, migratory, and conservation-important avifauna along the road corridor, particularly in the Kasonso Busanga and Kalumwange GMAs, which buffer the Kafue National Park to the east.

During the field survey, a total of 25 bird species were recorded representing a diversity of feeding guilds, habitat preferences, and taxonomic groups. However, it is expected that more birds' species could be present especially that Zambia boasts a rich avian diversity, with approximately 790 to 860 bird species recorded across the country. Within Zambia, 42 Important Bird Areas (IBAs) have been identified as priority sites for conservation, encompassing various habitats that support this diverse birdlife. While specific species counts for each IBA vary, these areas collectively contribute to the nation's overall avifaunal richness. These include raptors, insectivores, seed-eaters, frugivores, and scavengers, as well as species of global and regional conservation concern.

Notably, the area supports species such as the African Fish Eagle (*Haliaeetus vocifer*), Helmeted Guineafowl (*Numida meleagris*), Fork-tailed Drongo (*Dicrurus adsimilis*), and

Lilac-breasted Roller (*Coracias caudatus*), which are emblematic of Zambia's woodlands and savanna ecosystems. Additionally, vulnerable species such as the Crowned Crane (*Balearica regulorum*) and Martial Eagle (*Polemaetus bellicosus*) have been historically recorded in the greater Kafue system and are expected to utilize parts of the corridor seasonally, especially near wetlands.

The diversity and functionality of the avian community in the project area reflect healthy ecosystem processes, although human pressures such as habitat modification, hunting, and fire regimes can pose risks if left unmanaged.

The following table summarises the bird species observed within the project area:

Table 28: Bird Species in the Project Area as Observed and Reported

Sp. No.	Scientific Name	Common Name	Order	Reported/Observed	IUCN Status
1	*Phalacrocorax lucidus*	White-breasted Cormorant	Suliformes	Observed (3)	Least Concern
2	*Pandion haliaetus*	Osprey	Accipitriformes	Observed (4)	Least Concern
3	*Scopus umbretta*	Hamerkop	Pelecaniformes	Observed (3)	Least Concern
4	*Halcyon senegalensis*	Woodland Kingfisher	Coraciiformes	Reported	Least Concern
5	*Merops apiaster*	European Bee-eater	Coraciiformes	Observed (5)	Least Concern
6	*Tockus leucomelas*	Southern Yellow-billed Hornbill	Bucerotiformes	Reported	Least Concern
7	*Motacilla alba*	White Wagtail	Passeriformes	Observed (1)	Least Concern
8	*Pycnonotus barbatus*	Common Bulbul	Passeriformes	Observed (9 + 4)	Least Concern
9	*Numida meleagris*	Helmeted Guineafowl	Galliformes	Observed (7)	Least Concern
10	*Melaenornis fischeri*	White-eyed Slaty Flycatcher	Passeriformes	Reported	Least Concern
11	*Bias musicus*	Black-and-white Shrike-flycatcher	Passeriformes	Observed (1)	Least Concern
12	*Hedydipna collaris*	Collared Sunbird	Passeriformes	Observed (1)	Least Concern

Sp. No.	Scientific Name	Common Name	Order	Reported/Observed	IUCN Status
13	*Zosterops senegalensis*	Northern Yellow White-eye	Passeriformes	Observed (3)	Least Concern
14	*Lanius collaris*	Southern Fiscal (corrected from "Northern")	Passeriformes	Reported	Least Concern
15	*Dicrurus adsimilis*	Fork-tailed Drongo	Passeriformes	Reported	Least Concern
16	*Tyto capensis*	African Grass Owl	Strigiformes	Reported	Least Concern
17	*Colius striatus*	Speckled Mousebird	Coliiformes	Reported	Least Concern
18	*Turdus pelios*	African Thrush	Passeriformes	Observed (3)	Least Concern
19	*Acrocephalus palustris*	Marsh Warbler	Passeriformes	Reported	Least Concern
20	*Cisticola juncidis*	Zitting Cisticola	Passeriformes	Observed (1)	Least Concern
21	*Buphagus erythrorhynchus*	Red-billed Oxpecker	Passeriformes	Reported	Least Concern
22	*Plocepasser mahali*	White-browed Sparrow-Weaver	Passeriformes	Observed (2)	Least Concern
23	*Estrilda astrild*	Common Waxbill	Passeriformes	Observed (2)	Least Concern
24	*Crithagra striolata*	Streaky Seedeater	Passeriformes	Observed (5)	Least Concern
25	*Passer griseus*	Grey-headed Sparrow	Passeriformes	Observed (10)	Least Concern

Table 29: Locally Protected and Endangered Avifauna in the Project Area

Common Name	Scientific Name	IUCN Red List Status	National Protection Status	Habitat	Remarks
Martial Eagle	*Polemaetus bellicosus*	Endangered	Protected under	Wooded savanna, open plains	Largest eagle in Africa; threatened by

			Wildlife Act		habitat loss and persecution
Bateleur	*Terathopius ecaudatus*	Near Threatened	Protected	Open woodland, savanna	Declining due to poisoning and habitat degradation
Southern Ground Hornbill	*Bucorvus leadbeateri*	Vulnerable	Protected	Miombo woodland, open savanna	Ground-nesting species; vulnerable to disturbance and hunting
Grey Crowned Crane	*Balearica regulorum*	Endangered	Protected (CITES & ZAWA)	Wetlands, floodplains	Charismatic wetland bird; sensitive to disturbance and land conversion
African Grass Owl	*Tyto capensis*	Least Concern	Protected (Habitat-sensitive)	Floodplains, moist grasslands	Localized and rare in Zambia; highly sensitive to burning and disturbance
Shoebill *(historical range)*	*Balaeniceps rex*	Vulnerable	Strictly Protected	Wetlands, papyrus swamps	Rare, likely extirpated locally; once found in nearby wetlands
Wattled Crane *(rare visitor)*	*Bugeranus carunculatus*	Vulnerable	Strictly Protected	Seasonally flooded plains	Low numbers recorded in Busanga; Zambia holds globally significant population

Key Points:

- All species listed above are fully protected under Zambia's Wildlife Act, meaning they cannot be hunted, captured, or traded without express authorization.
- Many are also listed under CITES Appendix I or II, affording international protection.
- The Kafue ecosystem, including the GMAs traversed by the Kasempa–Kaoma road, forms a critical refuge and migratory corridor for several of these threatened birds.

Summary:

- The project area supports or lies near habitat for at least 7 locally protected and/or globally threatened bird species.
- Wetlands, open woodland, and floodplains are particularly important for these species.
- Development and land use activities in the corridor must include conservation-sensitive planning, including buffer zones, seasonal timing of activities, and biodiversity offsets if necessary.

Table 30: Biodiversity Indicator of Avifauna Species in the Project Area

Indicator Name	**Description**	**Interpretation from Survey Data**
Species Richness	Total number of bird species recorded (observed and reported).	26 species recorded — indicates moderate-high avian diversity typical of savanna–woodland mosaics.
Feeding Guild Diversity	Presence of various feeding types (insectivores, granivores, raptors, frugivores, scavengers).	Well represented — includes raptors (osprey, martial eagle), insectivores, seed eaters, omnivores, and scavengers.
Habitat Representation Index	Range of habitat types utilized (woodland, riparian, wetland, open grassland).	Birds reflect use of miombo woodland, floodplain, and riparian habitats, indicating habitat heterogeneity.
Trophic Role Indicator	Presence of birds with key ecosystem functions (pollination, pest control, scavenging).	High — includes insect controllers (drongo, flycatchers), scavengers (oxpecker), and pollinators (sunbirds).
Migratory Species Indicator	Presence of Afro-Palearctic or intra-African migrants.	Includes migrants like *Merops apiaster* (European bee-eater) and *Motacilla alba* (white wagtail).
Threatened Species Indicator	Number of species listed as Vulnerable, Endangered, or Near Threatened by IUCN.	2 species of concern expected in region: Martial Eagle (Endangered) and Bateleur (Near Threatened).
Endemism/Regional Rarity Indicator	Presence of regionally endemic or range-restricted species.	No true endemics recorded, but several southern African specialties (e.g., *Lanius collaris*, *Zosterops senegalensis*).
Indicator Species Presence	Occurrence of species that are sensitive to environmental changes.	Grass owls, sunbirds, cisticolas, and thrushes act as bioindicators of habitat quality and disturbance.

Human Influence Tolerance Index	Presence of birds tolerant to human-modified environments.	Species like *Passer griseus* (grey-headed sparrow) and *Pycnonotus barbatus* (common bulbul) show high tolerance.
Conservation Priority Value	Species of high ecological or cultural value warranting special protection.	Martial Eagle, Southern Ground Hornbill, and Bateleur are conservation priority species in the region.

5.12 Flora Species

5.12.1 Terrestrial Species

Generally, the proposed road stretch falls under western drier Miombo and Northwestern wetter Miombo (Chidumayo, 1987a) which is dominated by *Brachystegia spiciformis - Julbernardia paniculata woodlands with Burkea africana as a common canopy co-dominant and Diplorhynchus condylocarpon* as a common understorey taxon. North-Western wetter miombo is dominated by *Brachystegia (B. spiciformis - B. longifolia)* woodlands with *Isoberlinia angolensis and Julbernardia paniculata* as common canopy co-dominants and *Anisophyllea boehmii, Diplorhynchus condylocarpon, S.guineense macrocarpum and Uapaca spp*. as common understorey taxa.

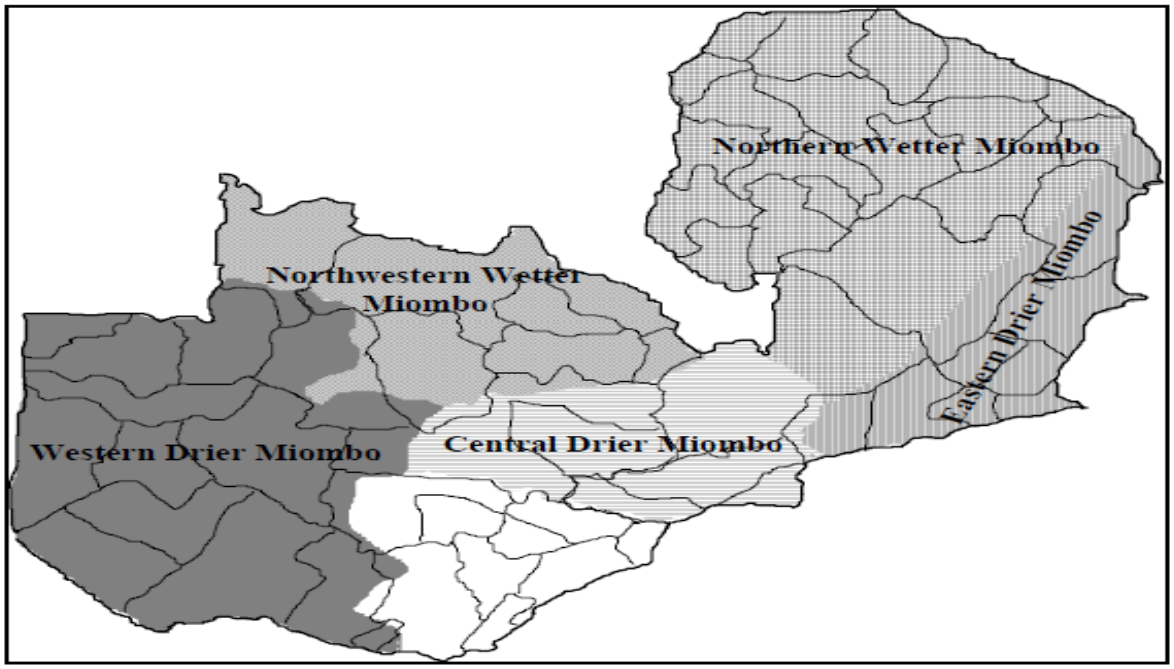

Figure 31: Ecological Classification of Miombo Woodlands (Including Kalahari Sand Miombo) in Zambia. *Source: Chidumayo, 1987a*

Miombo trees are frost sensitive and do not tolerate temperatures of less than 4^{o}c. Temperature seems to mark the boundary of miombo. Dambos are also found within miombo, they are grassland experiencing low temperature; there is usually a sharp demarcation between miombo woodland and Dambos. Miombo is divided into two groups' wet miombo and dry miombo.

Wet miombo are taller, denser and rich in diversity while dry miombo are short, sparse and not rich in diversity.

Miombo vegetation also shows a catenary sequence in relation to topographic gradient. Scrub miombo is associated with embedded drainage on dambo edges and where a ratalytic pan is close to the surface. Miombo woodland is a stable and resilient vegetation type that grows back and change after a disturbance caused by fire, logging and cultivation. Regrowth Miombo occurs through vegetative regeneration from reproduce of stumps and roots.

5.12.1.1 Mutanda – Kaoma Stretch

During field investigations along the proposed Mutanda–Kaoma road corridor, three main habitat types were identified: tree cover, rangeland, and cropland. This observation was further confirmed through high-level mapping of broad habitat structure classes using 2020 remote sensing imagery, which assessed vegetation density within the project area. The analysis, based on a 50-meter buffer on either side of the road for better visibility, revealed that tree cover dominates the corridor, accounting for approximately 77.75% of the area. Rangeland follows with 21.89%, while cropland comprises only 0.36% of the corridor. Although small portions of built-up environments were observed during the field assessment, they occupied an insignificant area and were therefore not reflected in the high-level habitat mapping.
The table and figures below present the statistical breakdown and spatial representation of the habitat types along the road corridor.

Table 31: Land Cover Statistics for the Entire Road

Landcover Class	**Area_sqkm**	**Percentage (%)**
Treecover	29.99	77.75
Cropland	0.14	0.36
Rangeland	8.44	21.89
Total	38.57	**100.00**

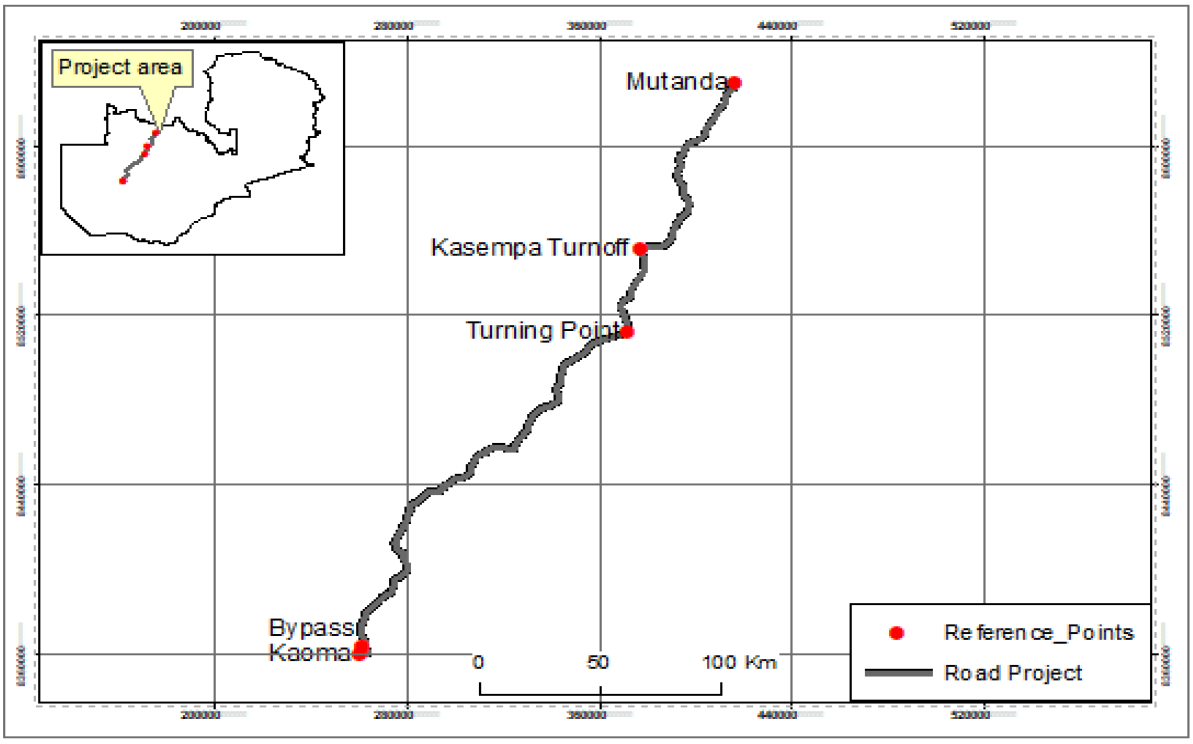

Figure 32: Overview of the Entire Road Stretch Mutanda to Kaoma

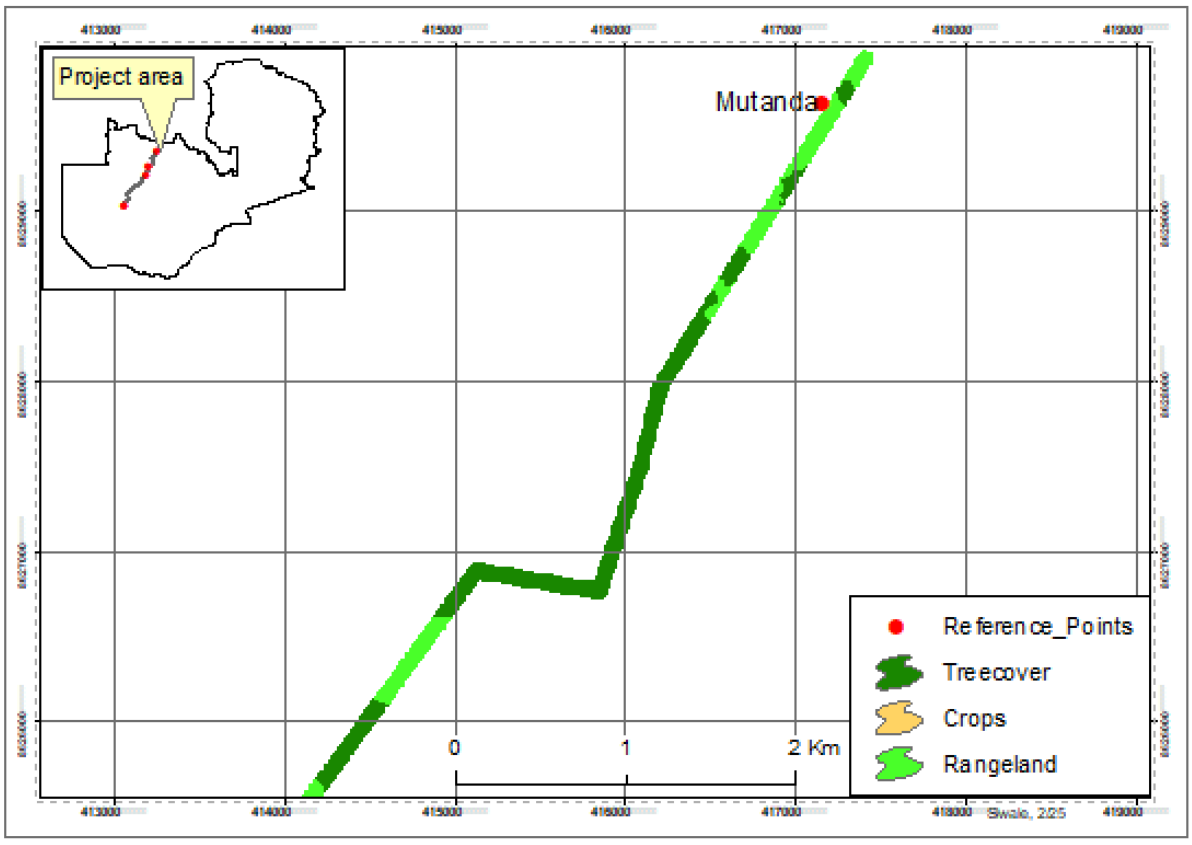

Figure 33: Land Cover Type from Mutanda to Kasempa

Brief Map interpretation

The map illustrates the vegetation structure along the proposed Mutanda to Kasempa road corridor using a 50-meter buffer on either side of the alignment. The classified habitat types include **tree cover**, **rangeland**, and **cropland**, with reference points indicated by red dots.

- **Tree cover** (dark green) dominates most of the corridor, especially near Mutanda and other slightly denser patches.
- **Rangeland** (light green) appears interspersed throughout, particularly in the southern sections, indicating open grasslands or sparsely vegetated zones.
- **Cropland** (yellow) is minimal and scattered, confirming field observations that agricultural activity occupies a very small portion of the corridor.
- The inset map shows the **project area location** in Zambia, highlighting the alignment in relation to national geography.

This spatial analysis supports field findings that although tree cover exists along this stretch, the density is relatively low compared to the Kasempa–Kaoma section due to human activity and development along the existing road alignment.

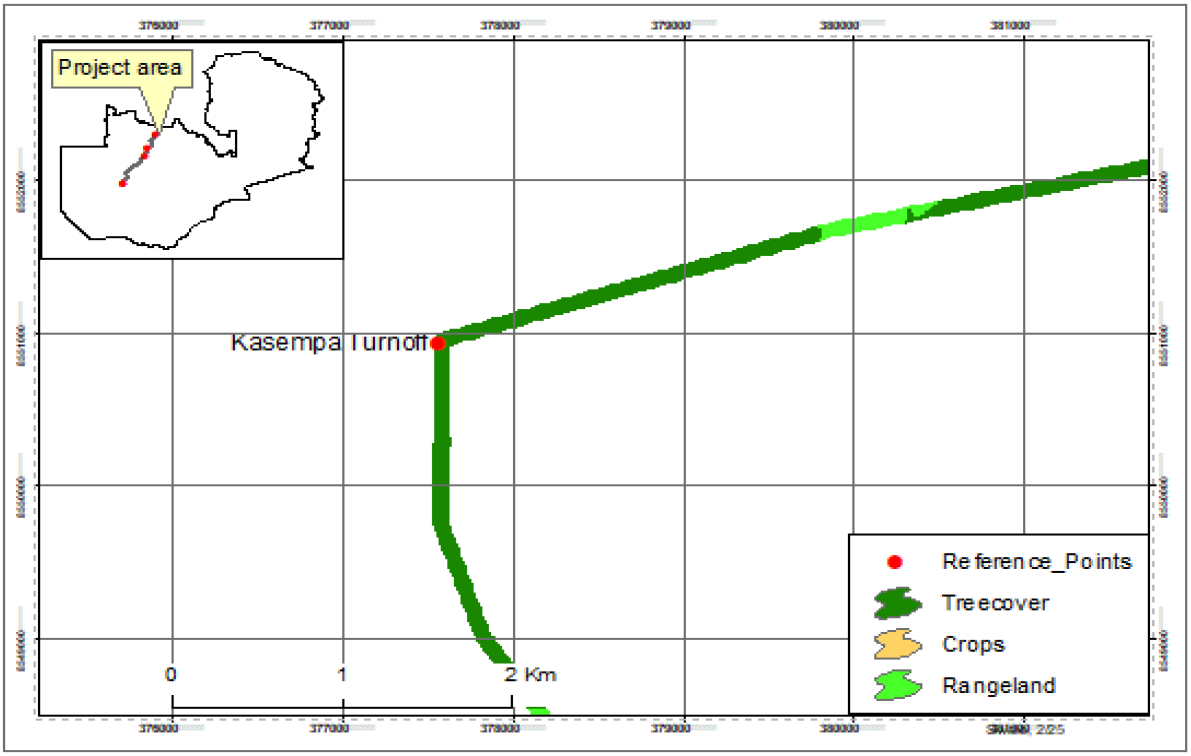

Figure 34: Land Cover Type from Kasempa Turnoff to Kaoma Bypass

Brief Map Description

The road stretch from Kasempa Turnoff to Kaoma Bypass is predominantly characterized by extensive tree cover, as clearly illustrated on the map. The habitat structure reveals dense woodland typical of Miombo ecosystems, with tree cover (dark green) being the dominant land cover type throughout the alignment. Rangeland (light green) appears in scattered patches along the corridor, indicating areas with open grasslands and less dense vegetation, while

cropland (yellow) is virtually absent, consistent with field observations that agricultural activity is minimal in this section.

This section traverses areas of relatively undisturbed natural vegetation, with fewer human developments compared to the Mutanda–Kasempa stretch. The corridor plays a critical role in ecological connectivity and supports a wide range of biodiversity. The inset map further contextualizes the project's location within Zambia, while red dots denote reference points used during ecological and geospatial assessments.

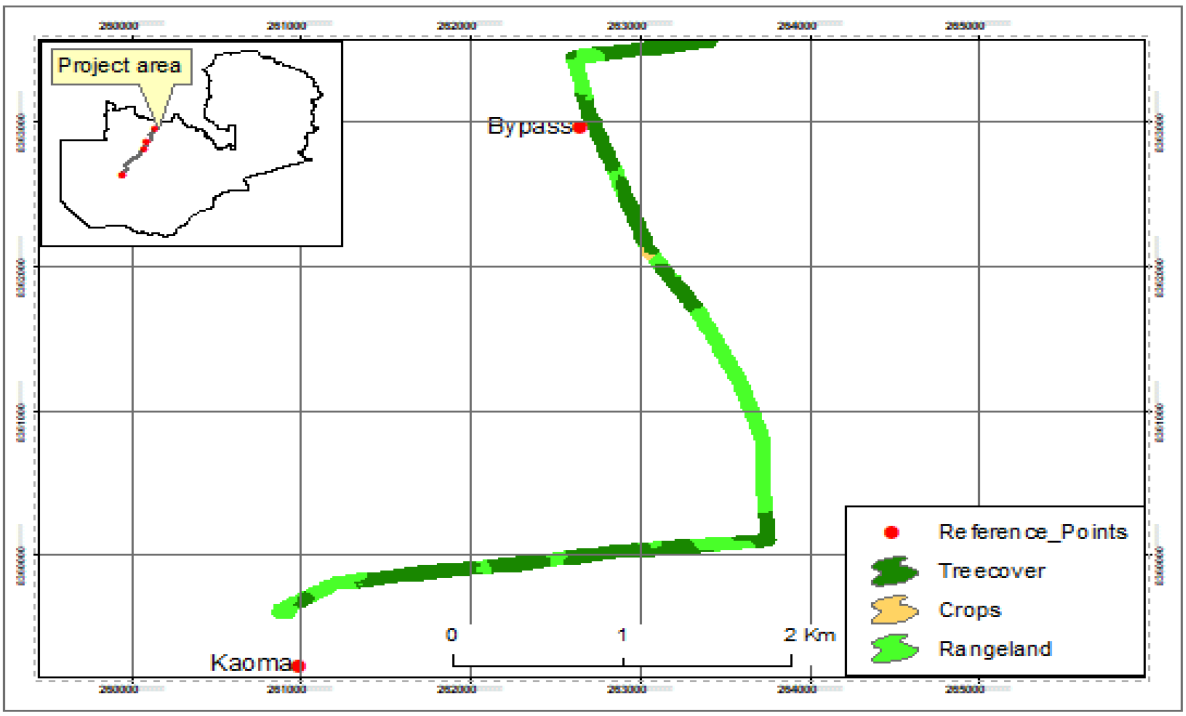

Figure 35: Land Cover Type from the Bypass in Kaoma to Termination Point

Brief Map Description

The stretch from the Kaoma Bypass to the Termination Point shows a diverse landscape, with the predominant land cover being **rangeland** (light green), followed by patches of **tree cover** (dark green) and minor occurrences of **cropland** (yellow). This distribution suggests a transition from woodland-dominated habitats into more open grassland and grazing zones, which may support livestock and low-density farming activities.

The tree cover observed is relatively less dense compared to the Kasempa–Kaoma central stretch, likely due to increased anthropogenic influence as the corridor approaches Kaoma town. Nonetheless, pockets of natural vegetation still persist, especially in the midsection of this stretch. The red dots indicate reference points used during field mapping, while the inset map shows the location of the project area within Zambia.

The spatial patterning along this route underscores the ecological gradient from denser woodland systems to semi-open rangelands, reflecting both natural and human-modified land uses near the project's terminal zone.

5.12.1.2 Tree Cover

Along the Mutanda–Kasempa road stretch, tree cover was observed; however, the density of trees is notably lower compared to the Kasempa–Kaoma section. This is primarily because the proposed road alignment follows the existing road, which passes through areas with visible human development, including shops, schools, residential housing, and commercial facilities. As a result, much of the vegetation comprises secondary growth, with many of the trees appearing more like shrubs. Despite this, patches of mixed woodland species persist, some with relatively dense tree clusters. Dominant species identified within these patches include *Erythrophleum africanum*, *Pterocarpus angolensis*, *Diplorhynchus condylocarpon*, *Combretum collinum*, *Khaya nyasica*, *Albizia adianthifolia*, *Ficus* spp., *Boscia angustifolia*, *Securidaca longepedunculata*, *Rothmannia whitefieldii*, *Uapaca kirkiana*, *Julbernardia globiflora*, *Uapaca nitida*, *Ipomoea* spp., *Lonchocarpus capassa*, and *Swartzia madagascariensis*. These species, though scattered, still play a vital role in maintaining the ecological balance within the increasingly fragmented landscape.

Between Kasempa and Kaoma, the landscape transitions into expansive tracts of mature primary forests, predominantly characterized by Miombo woodlands. These woodlands are ecologically significant, serving as vital habitats that support biodiversity, maintain ecological balance, and sustain local livelihoods. While sections of the landscape contain secondary vegetation, grasslands, shrubs, and exotic eucalyptus plantations, the primary Miombo forest remains the dominant habitat type. However, the area is increasingly under pressure from deforestation driven by agricultural expansion, logging, and charcoal production, all of which are gradually altering the natural landscape.

Tree heights along this stretch range from 6 to 30 meters, with diameters varying between 5 and 40 centimeters. Field assessments recorded more than 40 different tree species, among the most common being *Pterocarpus angolensis*, *Combretum zeyheri*, *Diplorhynchus condylocarpon*, *Khaya nyasica*, *Combretum collinum*, and *Albizia adianthifolia*. Other notable species include *Ficus spp.*, *Boscia angustifolia*, *Securidaca longepedunculata*, *Rothmannia whitefieldii*, *Uapaca kirkiana*, *Julbernardia globiflora*, *Uapaca nitida*, *Ipomoea spp.*, *Lonchocarpus capassa*, *Swartzia madagascariensis*, *Anisophylus boehmii*, *Marquesia macroura*, *Pericopsis angolensis*, *Afzelia quanzensis*, *Monotes spp.*, *Isoberlinia angolensis*, *Strychnos cocculoides*, *Maranthes floribunda*, *Albizia antunesiana*, *Pseudolachnostylis maprouneifolia*, *Brachystegia boehmii*, *Brachystegia longifolia*, *Memecylon flavovirens*, *Pterocarpus chrysothrix*, *Erythrophleum africanum*, and *Hexalobus monopetalus*.

Several of these species possess high commercial and economic value, notably *Erythrophleum africanum* (Kaimbi), *Pericopsis angolensis* (Mubanga), *Combretum collinum* (Munondwe), *Pterocarpus angolensis* (Mulombwa), *Julbernardia paniculata* (Mutondo), *Swartzia madagascariensis* (Ndale), and *Parinari curatelifolia* (Mupundu). The figure and table below show some of the mature trees within this road stretch

Figure 36: Mature Primary Tree Cover along Kasempa – Kaoma Stretch

Table 32: Listing the Tree Species Identified Between Kasempa and Kaoma, along with their Common Names and IUCN Red List Status

Common Name	**Scientific Name**	**IUCN Red List Status**
African Teak	*Pterocarpus angolensis*	Near Threatened
Large-fruited Bushwillow	*Combretum zeyheri*	Not Evaluated
Horn Pod Tree	*Diplorhynchus condylocarpon*	Not Evaluated
East African Mahogany	*Khaya anthotheca*	Vulnerable
Variable Combretum	*Combretum collinum*	Not Evaluated
Flat-crown Albizia	*Albizia adianthifolia*	Not Evaluated
Fig Species	*Ficus* spp.	Not Evaluated
Shepherd's Tree	*Boscia angustifolia*	Not Evaluated
Violet Tree	*Securidaca longepedunculata*	Not Evaluated
Rothmannia	*Rothmannia whitfieldii*	Not Evaluated
Sugar Plum	*Uapaca kirkiana*	Not Evaluated
Copper Pod	*Julbernardia globiflora*	Not Evaluated
Uapaca	*Uapaca nitida*	Not Evaluated
Morning Glory Species	*Ipomoea* spp.	Not Evaluated
Rain Tree	*Lonchocarpus capassa*	Not Evaluated
Snake Bean Tree	*Swartzia madagascariensis*	Not Evaluated
Anisophyllea	*Anisophyllea boehmii*	Not Evaluated

Common Name	Scientific Name	IUCN Red List Status
Marquesia	*Marquesia macroura*	Not Evaluated
Mubanga	*Pericopsis angolensis*	Not Evaluated
Pod Mahogany	*Afzelia quanzensis*	Not Evaluated
Monotes	*Monotes* spp.	Not Evaluated
Isoberlinia	*Isoberlinia angolensis*	Not Evaluated
Monkey Orange	*Strychnos cocculoides*	Not Evaluated
Maranthes	*Maranthes floribunda*	Not Evaluated
Albizia	*Albizia antunesiana*	Not Evaluated
Kudu Berry	*Pseudolachnostylis maprouneifolia*	Not Evaluated
Brachystegia	*Brachystegia boehmii*	Not Evaluated
Brachystegia	*Brachystegia longifolia*	Not Evaluated
Memecylon	*Memecylon flavovirens*	Not Evaluated
African Rosewood	*Pterocarpus chrysothrix*	Not Evaluated
Erythrophleum	*Erythrophleum africanum*	Not Evaluated
African Dogrose	*Hexalobus monopetalus*	Not Evaluated

Table 33: Locally Protected and Endangered Tree Species

Scientific Name	Common/Local Name	Status in Zambia	IUCN Red List Status	Notes
Pterocarpus angolensis	African Teak (Mulombwa)	Locally protected	Near Threatened	Highly valued for timber; regulated under Forest Act and CITES App. II
Pericopsis angolensis	Mubanga	Locally protected	Not Evaluated	Valuable timber species; protection enforced by Forest Department
Afzelia quanzensis	Pod Mahogany	Locally protected	Not Evaluated	Overexploited for commercial timber
Khaya anthotheca	East African Mahogany	Locally protected	Vulnerable	One of the most threatened mahoganies in Africa
Julbernardia paniculata	Mutondo	Customarily protected	Not Evaluated	Dominant Miombo canopy species; valued for ecological functions
Brachystegia spp.	Miombo (various)	Customarily protected	Not Evaluated	Foundational woodland species; often protected in traditional systems

Erythrophleum africanum	Kaimbi	Culturally significant	Not Evaluated	Used in traditional medicine; some regional protection

Explanation of Local Protection Categories

- Locally Protected: Protected under Zambia's Forest Act, 2015 and regulated by the Forestry Department. These trees may require a permit for harvesting or export.
- Customarily Protected: Trees respected or preserved under traditional governance systems due to ecological or cultural value.
- Culturally Significant: Widely used in traditional medicine or rituals; sometimes protected by communities through taboos or beliefs.
- IUCN Status: Internationally recognized conservation status; used to gauge risk of extinction.

Summary

- Most endangered: *Khaya anthotheca* (Vulnerable)
- High exploitation risk: *Pterocarpus angolensis*, *Pericopsis angolensis*, and *Afzelia quanzensis* due to logging
- Culturally and ecologically vital: *Julbernardia*, *Brachystegia*, and *Erythrophleum africanum*

Table 34: Biodiversity Indicators of Key Tree Species

Scientific Name	**Common Name**	**Biodiversity Indicator**
Pterocarpus angolensis	African Teak (Mulombwa)	Keystone species; supports insects, provides timber, aids in nitrogen fixation.
Combretum zeyheri	Large-fruited Bushwillow	Fruit source for birds and mammals; fire-resistant; helps stabilize soil.
Diplorhynchus condylocarpon	Horn Pod Tree	Supports butterfly larvae; dense foliage provides nesting habitat.
Khaya anthotheca	East African Mahogany	High canopy species; carbon sequestration; nesting habitat for birds.
Combretum collinum	Variable Combretum (Munondwe)	Supports dry woodland ecology; browsing material for herbivores.
Albizia adianthifolia	Flat-crown Albizia	Nitrogen fixer; enhances soil fertility; supports pollinators and birds.
Ficus spp.	Fig Trees	Keystone fruiting species; year-round food for birds, primates, bats.
Boscia angustifolia	Shepherd's Tree	Drought-resistant; food and medicinal uses; pollinator-supporting.
Securidaca longepedunculata	Violet Tree	Medicinal importance; supports insect diversity.

Scientific Name	Common Name	Biodiversity Indicator
Rothmannia whitfieldii	Rothmannia	Ornamental and ecological value; bird nesting and seed dispersal.
Uapaca kirkiana	Sugar Plum	Wild fruit source for humans and wildlife; seed disperser-dependent.
Julbernardia globiflora	Copper Pod (Mutondo)	Dominant canopy species; carbon storage; soil stabilizer.
Pericopsis angolensis	Mubanga	Timber value; supports biodiversity through shaded undergrowth.
Swartzia madagascariensis	Ndale	Supports pollinators; medicinal uses.
Afzelia quanzensis	Pod Mahogany	Important timber tree; supports insect biodiversity; nitrogen fixer.
Monotes spp.	Monotes	Part of Miombo woodland matrix; maintains canopy integrity.
Isoberlinia angolensis	Isoberlinia	Major Miombo species; carbon sink; habitat structure contributor.
Strychnos cocculoides	Monkey Orange	Edible fruit; supports mammals, birds, and pollinators.
Pseudolachnostylis maprouneifolia	Kudu Berry	Fall coloring attracts pollinators; supports woodland diversity.
Brachystegia boehmii	Brachystegia	Foundation species of Miombo; key for nutrient cycling, carbon storage.
Erythrophleum africanum	Kaimbi	Medicinal and cultural significance; controls erosion.
Pterocarpus chrysothrix	African Rosewood	Soil fertility enhancer; insect habitat.

5.12.1.3 Rangeland Habitat Description

Rangeland represents the second largest habitat type along the proposed Mutanda–Kasempa–Kaoma road corridor, covering approximately 8.44 km², which accounts for 21.89% of the total area within the 50-meter buffer on either side of the road. These areas primarily consist of grassland ecosystems, observed especially near stream banks and in cleared agricultural fields. Rangelands are ecologically and economically important, serving as grazing grounds for livestock, supporting biodiversity, acting as natural water catchments, and functioning as carbon sinks that help mitigate greenhouse gas emissions.

The dominant grass species identified in these areas include *Hyparrhenia spp.* (commonly known as thatching grass), *Dactylocterium aegyptium*, *Cynodon dactylon*, *Digitaria ternata*, *Eleusine indica*, *Setaria spp.*, *Eragrostis spp.*, and *Bidens schimperi*. Among these, *Hyparrhenia spp.* is especially valuable to local communities due to its widespread use in thatching traditional houses. However, despite its economic and ecological benefits, *Hyparrhenia spp.* has also been linked to *Hyparrhenia* grass white leaf disease, a condition caused by plant pathogenic nematodes and bacterial infections that adversely affect *Pennisetum*

purpureum (Napier grass) (Obura et al., 2011). Additionally, it has shown invasive tendencies in certain ecosystems, as noted by Simoes & Baruch (1991).

Figure 37: Grassland Habitat along Kasempa – Kaoma Stretch

5.12.1.3 Cropland Habitat Description

Cropland was the smallest land cover type observed along the Mutanda–Kasempa–Kaoma road corridor, covering an estimated area of 0.14 km², which accounts for only 0.36% of the total buffer area. Agricultural activity was minimal and scattered, often found in proximity to settlements or previously cleared areas. The dominant crops cultivated along the corridor include cassava, groundnuts, maize, and sunflower, which reflect the typical smallholder farming practices in the region. Despite its limited extent, cropland plays a vital role in supporting local food security and household incomes, particularly in subsistence farming communities. However, its low spatial footprint indicates that natural vegetation and rangelands remain the prevailing land cover types along the proposed road alignment.

5.12.1.4 Alien Invasive species

An invasive alien shrub, *Lantana camara*, was observed in some sections especially Mutanda Kasempa stretch road corridor. It was found growing both as individual clumps and dense thickets, where it aggressively crowds out native and desirable plant species. *Lantana camara* is a highly variable ornamental shrub native to the Neotropics, initially introduced into many

tropical and subtropical regions, including Zambia, as an ornamental hedge plant due to its colorful flowers and use in landscaping. Over time, it has spread beyond cultivated areas and has become naturalized and invasive in many parts of the country, particularly along roadsides, disturbed lands, and abandoned agricultural fields.

Globally, *Lantana camara* is known for its invasive and weedy behavior, and is recognized by the IUCN as one of the world's 100 worst invasive alien species, and among the top 10 most problematic weeds (Prasad, 2006). It thrives on a wide range of well-drained soils and within diverse climatic zones, from seasonal dry forests to rainforests, and is also notably drought-resistant. These adaptive traits allow it to form dense understory thickets, suppress natural regeneration, and reduce native plant biodiversity. In heavily infested areas, it becomes the dominant ground cover, blocking ecological succession and altering fire regimes by increasing flammable biomass.

In addition to ecological threats, *Lantana camara* poses agricultural and economic risks. It is toxic to livestock, harbors pests and plant pathogens, and is difficult to control, often requiring integrated mechanical, chemical, and biological management approaches. Its introduction and spread in Zambia—originally for ornamental use—now necessitate proactive management measures to limit its ecological footprint along development corridors like the proposed road.

Figure 38: Invasive Species (Lantana Camara) along the Mutanda – Kasempa Stretch

Figure 39: Grassland Habitat along Kasempa - Kaoma Stretch

5.12.2 Aquatic flora species

Several streams were identified within the project area during field assessments, and these supported a range of aquatic and semi-aquatic plant species. Notable aquatic macrophytes observed included *Typha capensis* and *Phragmites* spp., along with various aquatic herbs that thrive in shallow water environments. Along riverbanks and in moist zones adjacent to water bodies, additional species such as *Nymphaea, Nymphoides* spp., *Digitaria milanjiana, Aristida* spp., and *Heteropogon contortus* were recorded.

Despite the presence of these species, most streams within the corridor were dry at the time of the survey, likely due to seasonal fluctuations or prolonged dry periods, which limited the extent and diversity of aquatic plant growth. Nevertheless, the presence of these species in wetter patches indicates the potential for richer aquatic ecosystems during the rainy season or in permanently saturated zones.

Aquatic macrophytes are vital for the functioning and stability of freshwater ecosystems. They provide food and shelter for aquatic organisms, stabilize sediments, enhance water quality, and influence both chemical and physical properties of aquatic habitats. Their presence in the project area, though limited, underscores the importance of preserving stream integrity to maintain ecological functions, especially in downstream catchments.

Figure 40: Aquatic floral vegetation with water Lilies along Kasempa - Kaoma Stretch

Locally Protected and Endangered Species

Although grasses are often overlooked in conservation discussions compared to trees, several species play critical ecological and socio-economic roles in Zambia. Some are culturally valued, ecologically important, or increasingly threatened by land degradation, overgrazing, and unsustainable harvesting. Below are notable grass species observed or expected in the project area, with notes on local protection status, endangerment, and ecological significance.

Table 35: Locally Protected and Endangered Species

Scientific Name	**Common/Local Name**	**Protection/Status**	**Remarks**
Hyparrhenia spp.	Thatching grass	**Customarily protected** in some chiefdoms	Widely used for thatching; ecologically valuable but can become invasive

Eragrostis spp.	Love grass	Not formally protected, but ecologically important	Grazing value; helps in soil stabilization
Heteropogon contortus	Spear grass	**Locally protected** in some conservation areas	Key forage grass; fire-adapted; supports grazing systems
Digitaria milanjiana	Finger grass	Increasingly rare in overgrazed lands	High-quality forage; used in pasture improvement
Setaria spp.	Foxtail grass	Not formally protected, but under pressure from overgrazing	Common in wetlands and floodplains; important for erosion control
Cymbopogon spp.	Lemon grass (wild)	**Culturally significant**; traditionally protected	Used in traditional medicine and rituals
Pennisetum purpureum	Napier grass (Elephant grass)	Cultivated and protected in agricultural settings	Key fodder crop; susceptible to white leaf disease linked to *Hyparrhenia*
Andropogon gayanus	Gamba grass	Potentially invasive; monitored in conservation areas	Aggressive colonizer; alters fire regimes; limited protection

Key Points:

- *Hyparrhenia spp*. is the most economically important grass in the area, especially for thatching. In some traditional communities, it is conserved through local customs that prohibit harvesting immature clumps.
- *Heteropogon contortus* and *Digitaria milanjiana* are considered ecologically sensitive, especially in degraded grazing lands, and are disappearing in areas of high grazing pressure.
- Some grasses, like *Andropogon gayanus*, while native to Africa, are becoming invasive when introduced into new areas or disturbed ecosystems, warranting monitoring rather than protection.
- Grasses like *Pennisetum purpureum* are protected mainly for their economic value in fodder systems but are vulnerable to disease pressure in monoculture.

5.13 Archaeological and Cultural Environment

Archaeological Sites of Interest

During the site visit no archaeological remnants were found in the proposed road area, as the land has already been disturbed due to previous clearing for the construction of a gravel road. Additionally, the section of the tarred road from Mutanda to Kasempa, although in poor condition, is part of an existing route, meaning the road project is not a Greenfield development.

Traditional/anthropological heritage resources

In recent years, the practice of rainmaking ceremonies has faced challenges due to modernization, shifts in religious beliefs, and environmental changes. Nevertheless, efforts are underway to preserve and document these vital cultural traditions to ensure their continuation as part of the people's heritage. No sites of concern have been identified within the project area

There are no documented historical graves within the study area; however, the possibility of unmarked graves cannot be ruled out. The nearest notable graves are those of Chief Matebo XII and XIII, located in close proximity to the road alignment.

Figure 41 Chief Matebo signage to Palace

During the study no geomorphological heritage resources were recorded in the project area. However notable geomorphological heritage resources in the wider North-western province include: Mutanda Falls National Monument, Yambweso limestone (Caverns & Fissures), Nyambwezyu Falls, Bushingwe Waterfalls, Wisaki hotspring Chibesha Suncken Lake and Zambezi

Cultural Environment

The cultural environment of North-Western and Western Provinces of Zambia is diverse and deeply rooted in the traditions and heritage of the indigenous communities. North-Western Province is home to ethnic groups such as the Kaonde, Lunda, Luvale, Chokwe, and Luchazi, while Western Province is predominantly inhabited by the Lozi people, who have a well-established traditional governance system under the Litunga, the King of Barotseland. Traditional leaders play a significant role in decision-making, land management, and cultural preservation in both regions. In Western Province, the Barotse Royal Establishment (BRE)

holds considerable influence over social and environmental matters, ensuring that cultural values are upheld in the face of development.

Communities in these regions have strong spiritual and cultural connections to the land, rivers, and forests. Many areas hold sacred significance, including burial sites, shrines, and royal palaces, which must be respected during development projects. Traditional beliefs in ancestral spirits remain prevalent, and many people rely on traditional healers for guidance in health and environmental matters. Various cultural ceremonies and festivals form an essential part of the social fabric, with events such as the Kuomboka Ceremony in Western Province, which marks the seasonal migration of the Litunga, and the Likumbi Lya Mize Ceremony in North-Western Province, which showcases the Makishi masquerade tradition of the Luvale people. These festivals not only celebrate heritage but also reinforce communal identity and social cohesion.

5.14 Social-Economic Set up

5.14.1 Land Tenure and Zoning of the Project Site

Zambia has two categories of land, designated as either State Land or Customary Lands. Customary Lands make up 90% of the country. These are mostly the rural areas of Zambia governed under traditional system of tenure with chiefs playing the role of custodians of the land. The rest of the land (10%) is designated as State Land. These Lands are governed under a formal system of 99-year leasehold tenure granted by the state. The current proposed site falls both under customary and state land.

The proposed road route is expected to follow the alignment of existing main and district roads, which are under the jurisdiction of the RDA. Further, the RDA is an active partner in the project and extensive engagement has been conducted.

5.14.2 Land Uses in the Area

The proposed route traverses a diverse range of land uses, reflecting the socio-economic and ecological characteristics of the region. These land uses include:

1. **Agricultural Fields**: The area is characterized by agricultural activities, which serve as the primary livelihood for local communities. These fields are used for cultivating a variety of crops, contributing to both subsistence farming and commercial agriculture.
2. **Kasonso Busanga GMA:** The proposed route does not directly traverse the Game Management Area (GMA) but instead follows its administrative boundary, running adjacent to independently managed game blocks. While this alignment avoids direct intrusion into the GMA's core ecological zones, its proximity remains significant given the area's role as a critical wildlife corridor. GMAs are essential for animal movement and migration, supporting regional biodiversity and ecological balance.
3. **Trading and Markets**: The route also passes through zones with active trading activities and local markets. These areas are hubs for economic exchange, where goods such as agricultural produce, artisanal products, and other commodities are bought and sold, supporting the local economy.

4. **Healthcare Facilities**: Several health care facilities are located along the proposed route. These facilities provide essential medical services to the surrounding populations, addressing both preventative and curative healthcare needs.
5. **Educational Institutions**: Schools of varying levels, including primary and secondary institutions, are situated near the proposed route.
6. **Cultural Land Use:** It is crucial to recognize the importance of cultural land uses, particularly cemeteries, which often hold significant historical, spiritual and social value for local communities.

5.14.3 Transport / Communication

The project site is well serviced by access roads which connects it to other towns within the province and the rest of the country. The site has good reception for the three mobile cell networks (Airtel, MTN and ZAMTEL).

5.15 Demography for Kalumbila, Kasempa, Mufumbwe and Kaoma Districts

5.15.1 Population and Settlement

Table 36: Population and Settlement for the Four Districts

District	Total Population	Females	Males	Population Density (people/km²)	Annual Population Growth Rate (2010–2022)	Settlement Pattern
Kalumbila	177,067	89,352	87,715	10.1	8.1%	Clustered (houses close together)
Kasempa	111,272	56,257	55,015	5.1	2.2%	Clustered (houses close together)
Mufumbwe	98,217	49,688	48,529	5.2	4.5%	Clustered (houses close together)
Kaoma	146,690	75,421	71,269	17.6	3.0%	Clustered (houses close together)

5.16: Socio-Economic Profile for Kalumbila District

5.16.1 Available Labor and Skills

Kalumbila District benefits from a diverse workforce, including skilled, semi-skilled, and unskilled individuals. The proposed project will tap into this labour pool, with roles such as

construction workers, craftsmen, security guards, engineers, and cleaners being filled by eager local residents. The presence of large-scale mining operations, particularly

First Quantum Minerals Operations Limited' Sentinel Mine, has significantly contributed to the development of a skilled labour force in fields such as construction, engineering, and mining. Vocational training centres and community-based programs have further enhanced the skills of local residents, particularly in technical and agricultural sectors, making the workforce adaptable to various economic activities.

5.16.2 HIV/AIDS in the Project Area

Kalumbila District, part of the North-Western Province, has an HIV prevalence rate of 6.9% (Zambia Demographic and Health Survey, 2018). The increase in prevalence rates is attributed to limited access to counselling services, risky behaviours, and inadequate sexual reproductive health education. Youth are particularly vulnerable due to peer pressure and traditional gender roles.

Measures Taken to Address HIV/AIDS Prevalence Rates:

- **HIV Testing and Treatment Campaigns:** Nationwide campaigns have been introduced to increase awareness and access to antiretroviral therapy (ART).
- **HIV Self-Testing:** Pilot programs for self-testing are being implemented in selected districts.
- **Media Campaigns:** Radio and TV programs focus on HIV prevention and education.
- **Voluntary Counselling and Testing (VCT):** Free VCT services are available at health centres.
- **Public Awareness:** Posters and billboards promote safe sexual practices.

5.16.3 Economic Activities

Kalumbila District's economy is driven by mining, agriculture, and tourism.

- **Agriculture and Agro-processing:** The increase in the district population has led to a higher demand for agricultural products. However, the majority of farmers (80%) are small-scale, leading to a supply shortage. The district has only one commercial farm, Mutanda Farms, located approximately 40km from Solwezi. This shortage forces large consumers like mines to source food from other regions such as Central Province.
- **Mining:** The district is endowed with mineral resources, primarily copper, mined through open pit operations. Currently, two mines operate in the district, offering significant investment opportunities.
- **Manufacturing and Processing Industry:** The district has potential to expand the food processing sector, leveraging its agricultural competitive advantage.
- **Tourism:** Kalumbila hosts four traditional ceremonies—Kufukwila, Lubinda Ntongo, Kuvuluka Kishakulu, and Nkisu ya Nzambi—which play a crucial role in cultural tourism. The district also boasts several tourism sites, including Mumbezhi and Matukula Falls, Mutanda Site, and the Musele-Matebo Game Management Area.

5.16.4 Social Amenities

- **Education:** Kalumbila District has 105 schools, including 15 secondary schools, 66 primary schools, 19 community schools, 5 registered private schools, and 53 early childhood education centers. The district serves a student population of 62,029, supported by 1,008 teachers.
- **Health:** Healthcare infrastructure includes 1 Level One Hospital, 38 Rural Health Centers, 16 Health Posts, and 2 private clinics.
- **Water and Sanitation:** Access to clean water is limited, with many rural communities relying on boreholes and rivers. Sanitation is primarily through pit latrines.
- **Power and Energy:** Access to electricity is low, with most households relying on firewood and charcoal for energy.

5.16.5 Traditional and Religious Practices

The Kaonde People: A Detailed Cultural and Historical Overview

The Kaonde people are one of Zambia's prominent ethnic groups, primarily found in the North-Western Province, particularly in districts such as Solwezi, Kalumbila, Kasempa, and Mufumbwe. They are also present in parts of the Democratic Republic of Congo (DRC). The Kaonde are known for their rich cultural heritage, traditional practices, and historical significance. Below is a detailed exploration of their history, cultural practices, and traditional ceremonies.

Historical Background

The Kaonde people trace their origins to the Luba-Lunda Kingdom in the Katanga region of the Democratic Republic of Congo (DRC). They migrated into present-day Zambia during the 17th and 18th centuries as part of the larger Bantu expansion. The Kaonde settled in the North-Western Province, where they established their chiefdoms and developed a distinct cultural identity.

The Kaonde were historically organized into chiefdoms, each led by a chief (Mwene) who served as both a political and spiritual leader. The most prominent Kaonde chiefdoms include Mumena, Kasempa, Mushima, and Mumbwa, which remain central to their cultural and political organization today. These chiefdoms have preserved their autonomy and cultural practices despite colonial and post-colonial influences.

Cultural Practices and Beliefs

The Kaonde people have a deep connection to their ancestral heritage, which is reflected in their traditional practices, rituals, and ceremonies. Their culture is a blend of spiritual beliefs, communal values, and artistic expression.

1. **Spiritual Beliefs:**
    - The Kaonde are traditionally **animists**, believing in the presence of spirits in natural elements such as rivers, trees, and mountains. They also believe in a supreme being called **Lesa**, who is revered as the creator and sustainer of life.
    - Ancestral worship is a key aspect of their spirituality. The Kaonde believe that the spirits of their ancestors (mizhimo) play an active role in their daily lives,

offering protection, guidance, and blessings. Rituals and offerings are made to honour these spirits, particularly during ceremonies and significant life events.

2. **Traditional Ceremonies:**
   The Kaonde are renowned for their vibrant traditional ceremonies, which serve as a means of preserving their cultural identity and fostering community cohesion. The most significant ceremonies include:

1. Kufukwila Ceremony

- **Presided over by:** The Senior Chief (e.g., **Chief Kasempa, Chief Mushima, Chief Kapijimpanga**)
- **Purpose:** To give thanks to **Lesa (God)** and the ancestors for a bountiful harvest.
- **Key Features:**
  - Sacred drumming (**Ngoma**) symbolizing the link between the living and ancestral spirits.
  - Traditional dances (**Kankanga, Chiyeng'i, and Mwata**) performed by men and women.
  - Offering of **munkoyo** (fermented maize drink) and fresh harvests to the ancestors.
  - The chief leads prayers for prosperity in the next farming season.
- **Significance:** Strengthens communal bonds and ensures spiritual blessings for future harvests.

2. Lubinda Ntongo Ceremony

- **Presided over by:** The Chief (**e.g., Chief Mumbwa, Chief Kalyangu, Chief Mumena**)
- **Purpose:** To mark the beginning of the planting season and seek ancestral blessings for fertile soil.
- **Key Features:**
  - Ritual planting of the first seeds by the chief.
  - Offerings of **katata** (traditional beer) and food to the ancestors.
  - Performances of the **Chisaluke dance**, symbolizing hard work in the fields.
  - Elders recite oral histories to remind the youth of their farming heritage.
- **Significance:** Ensures a successful planting season and reinforces agricultural traditions.

3. Kuvuluka Kishakulu Ceremony

- **Presided over by:** The Chief (**e.g., Chief Kambwali, Chief Jivunda, Chief Musaka**)
- **Purpose:** A harvest thanksgiving ritual celebrating abundance and seeking continued blessings.
- **Key Features:**
  - Display of the year's harvest (maize, millet, pumpkins) before the chief.
  - **Kankanga dance** performed by women in celebration.
  - Ritual slaughter of livestock as an offering to the ancestors.
  - Elders perform **kulomba** (praise poetry) to honor the spirits.
- **Significance:** Reinforces gratitude to the ancestors and ensures future prosperity.

4. Kupupa Mung'anda Ceremony

- **Presided over by:** Village Headmen and Senior Chiefs (**e.g., Chief Kibizhi, Chief Katanga**)
- **Purpose:** A purification ritual to cleanse the village after misfortunes (drought, disease, or conflict).
- **Key Features:**
    - Burning of medicinal herbs (**nsombo**) for spiritual cleansing.
    - Sacrificing a white chicken to appease the spirits.
    - Elders perform **kukamba** (ritual chants) to restore harmony.
- **Significance:** Restores spiritual balance and protects the community from harm.

5. Kujila Nsomo Ceremony

- **Presided over by:** The Chief (**e.g., Chief Chizela, Chief Kaindu**)
- **Purpose:** A coming-of-age initiation for young men transitioning into adulthood.
- **Key Features:**
    - Boys undergo teachings on manhood, hunting, and leadership.
    - Ritual circumcision (in some Kaonde subgroups).
    - **Mwata dance** performed by initiates to showcase strength.
    - Elders bestow new names upon the initiates.
- **Significance:** Prepares young men for societal responsibilities.

6. Kukonkola Mipashi Ceremony

- **Presided over by:** The Chief (**e.g., Chief Matebo, Chief Kasongo**)
- **Purpose:** A remembrance ceremony honoring deceased ancestors.
- **Key Features:**
    - Families bring offerings (beer, food, cloth) to ancestral shrines.
    - Night-long drumming and storytelling about past heroes.
    - The chief leads a **libation-pouring** ritual to communicate with spirits.
- **Significance:** Strengthens the bond between the living and the dead.

7. Chisemwa Cha Mung'omba Ceremony

- **Presided over by:** The Chief (**e.g., Chief Musaka, Chief Kalyangu**)
- **Purpose:** A sacred ritual to bless new homes or community buildings.
- **Key Features:**
    - A black goat is sacrificed to seek protection from evil spirits.
    - The chief anoints doorways with **mpemba** (white clay).
    - Traditional songs (**nyelele**) are sung to invite good fortune.
- **Significance:** Ensures safety and prosperity for new dwellings.

Art and Craft:

- The Kaonde are skilled artisans, known for their woodcarvings, pottery, and basketry. These crafts often feature intricate designs and symbols that reflect their cultural beliefs and traditions.
- Traditional musical instruments, such as drums (ngoma), thumb pianos (kalimba), and flutes, are integral to their cultural expression and are used during ceremonies and celebrations.

Social Structure:

- The Kaonde society is organized around extended families and clans, with a strong emphasis on communal living and mutual support. Elders are highly respected and play a key role in decision-making and conflict resolution.
- The **chiefs** (Mwene) hold significant authority and are regarded as custodians of tradition and culture. They oversee the administration of their chiefdoms and ensure the preservation of Kaonde customs and values.

Traditional Governance

The Kaonde people have a well-defined traditional governance system, centred around numerous chiefdoms that preserve their cultural heritage. Below is a list of prominent Kaonde chiefdoms and their leaders:

1. **Kasempa Chiefdom**
   - Led by **Chief Kasempa**, this chiefdom is one of the most influential among the Kaonde. It plays a central role in organizing the **Kufukwila ceremony** and other key cultural events.
2. **Mushima Chiefdom**
   - Under the leadership of **Chief Mushima**, this chiefdom is renowned for its rich history and contributions to Kaonde traditions.
3. **Mumbwa Chiefdom**
   - Ruled by **Chief Mumbwa**, this chiefdom has been instrumental in preserving Kaonde customs and governance structures.
4. **Chief Kapijimpanga's Chiefdom**
   - A respected leader among the Kaonde, **Chief Kapijimpanga** oversees a chiefdom known for its strong cultural practices.
5. **Chief Kalyangu's Chiefdom**
   - **Chief Kalyangu** governs a key Kaonde territory, maintaining traditional authority and community cohesion.
6. **Chief Kambwali's Chiefdom**
   - **Chief Kambwali** leads a chiefdom with deep historical roots in Kaonde governance and land stewardship.
7. **Chief Mumena's Chiefdom**
   - **Chief Mumena** is a custodian of Kaonde traditions, ensuring the continuity of cultural ceremonies.
8. **Chief Jivunda's Chiefdom**
   - **Chief Jivunda** plays a vital role in maintaining Kaonde heritage and resolving community disputes.
9. **Chief Matebo's Chiefdom**
   - **Chief Matebo** oversees a chiefdom that actively participates in Kaonde cultural preservation.
10. **Chief Kibizhi's Chiefdom**
    - **Chief Kibizhi** is a key figure in Kaonde leadership, contributing to the unity of the people.
11. **Chief Kasongo's Chiefdom**
    - **Chief Kasongo** governs a chiefdom with strong ties to Kaonde ancestral traditions.
12. **Chief Katanga's Chiefdom**
    - **Chief Katanga** is a prominent leader, ensuring the Kaonde's cultural identity remains strong.

13. **Chief Chizela's Chiefdom**
    - **Chief Chizela** is known for his role in maintaining Kaonde land rights and customs.
14. **Chief Musaka's Chiefdom**
    - **Chief Musaka** leads a chiefdom that upholds Kaonde values and governance.
15. **Chief Kaindu's Chiefdom**
    - **Chief Kaindu** is a respected leader who plays a key role in Kaonde traditional ceremonies.

These chiefdoms, along with many others, form the backbone of Kaonde traditional governance, ensuring the preservation of their rich cultural heritage for future generations.

Figure 42 Stakeholder Consultation with headman in Kazhiba Village

Challenges and Preservation of Culture

The Kaonde people, like many indigenous groups, face challenges in preserving their cultural heritage in the face of modernization and globalization. Key challenges include:

- **Language Erosion:** The Kaonde language (Chikaonde) is at risk of being overshadowed by more dominant languages such as English. Efforts are being made to promote the language through education and cultural programs.
- **Land Rights:** The Kaonde have historically faced issues related to land ownership and access, particularly in areas where mining and commercial agriculture are expanding.
- **Cultural Assimilation:** The influence of Western culture and Christianity has led to a decline in the practice of traditional rituals and ceremonies among younger generations.

Despite these challenges, the Kaonde people remain committed to preserving their cultural heritage. Initiatives such as the annual Kufukwila and Lubinda Ntongo ceremonies, as well as the establishment of cultural centers and museums, are helping to keep their traditions alive.

Conclusion

The Kaonde people are a testament to the resilience and richness of Zambia's cultural diversity. Their history, traditions, and ceremonies offer a glimpse into a way of life that has endured for centuries. By celebrating their heritage and addressing the challenges they face, the Kaonde continue to play a vital role in Zambia's cultural landscape. Their story is one of pride, unity, and an unwavering commitment to preserving their identity for future generations

Kasempa District is predominantly Christian, with traditional beliefs deeply rooted in the local culture. These ceremonies feature traditional dances, music, and rituals, attracting both locals and tourists. The district also has a strong Christian presence, with churches playing a central role in community life.

15.17: Socio-Economic Profile for Kasempa District

15.17.1 Available Labor and Skills

Kasempa District has a diverse workforce, including skilled, semi-skilled, and unskilled individuals eager to take on roles such as construction workers, craftsmen, security guards, engineers, and cleaners during the project's implementation.

15.17.2 HIV/AIDS in the Project Area

Kasempa District, part of the North-Western Province, has an HIV prevalence rate of 6.9%. The increase in prevalence rates is linked to limited access to counselling services and risky behaviours.

Measures Taken to Address HIV/AIDS Prevalence Rates:

- **HIV Testing and Treatment Campaigns:** Nationwide campaigns have been introduced.
- **HIV Self-Testing:** Pilot programs are being implemented.
- **Media Campaigns:** Radio and TV programs focus on HIV prevention.
- **Voluntary Counselling and Testing (VCT):** Free VCT services are available.
- **Public Awareness:** Posters and billboards promote safe sexual practices.

15.17.3 Economic Activities

Kasempa District's economy is driven by agriculture, mining, and tourism.

- **Agriculture:** Small-scale farming is the mainstay, with crops such as maize, cassava, and groundnuts. The district has potential for growth in agro-processing.
- **Mining:** The district is rich in mineral resources, including gold, copper, and cobalt. The Ruida Mine and Sino Kasempa Mine are key mining operations.
- **Tourism:** Traditional ceremonies and natural sites attract visitors, offering opportunities for investment in the hospitality industry.

15.17.4 Social Amenities

- **Education:** Kasempa District has 128 schools, including 15 secondary schools, 69 primary schools, 29 Early Childhood Education (ECE) centers, 15 community schools, and 3 registered private schools. The district serves a student population of 31,332, supported by 731 teachers and 69 non-teaching staff.
- **Health:** Healthcare infrastructure includes 17 Rural Health Centers, 8 Health Posts, 1 Urban Health Clinic, and the Mikenge Mission Hospital.
- **Water and Sanitation:** Access to clean water is limited, with many rural communities relying on boreholes and rivers. Sanitation is primarily through pit latrines.
- **Power and Energy:** Access to electricity is low, with most households relying on firewood and charcoal for energy.

15.17.5 Traditional and Religious Practices

The Kaonde people are one of Zambia's prominent ethnic groups, primarily found in the North-Western Province, including districts such as Solwezi, Kalumbila, Mufumbwe, and Kasempa. They trace their origins to the Luba-Lunda Kingdom in the Democratic Republic of Congo (DRC) and migrated to Zambia during the 17th and 18th centuries. The Kaonde are known for their rich cultural heritage, traditional governance systems, and vibrant ceremonies.

For a detailed description of the Kaonde people, including their historical background, cultural practices, and traditional ceremonies, refer to the full explanation provided in the Kalumbila District section**.** Key highlights include their spiritual beliefs, traditional ceremonies like Kufukwila**,** Lubinda Ntongo**,** and Kuvuluka Kishakulu, and their skilled craftsmanship in woodcarving, pottery, and basketry. The Kaonde also face challenges such as language erosion and land rights but remain committed to preserving their cultural identity.

In the districts mentioned, the Kaonde culture is deeply rooted, with traditional ceremonies presided over by chiefs such as Chief Kasempa**,** Chief Ingwe**,** and Chief Mumena. These ceremonies, including the Kufukwila and Lubinda Ntongo, celebrate harvests, unity, and ancestral heritage, featuring traditional dances, music, and rituals. The district also has a strong Christian presence, with churches playing a significant role in community life.

Since the traditional and religious practices in this area align with those of other Kaonde-speaking communities, the comprehensive overview provided for Kalumbila District (5.16.5 Traditional and Religious Practices) also applies here.

15.18 Socio-Economic Profile for Mufumbwe District

15.18.1 Available Labor and Skills

Mufumbwe District has a workforce comprising skilled, semi-skilled, and unskilled individuals eager to participate in the implementation of the road project.

15.18.2 HIV/AIDS in the Project Area

Mufumbwe District, part of the North-Western Province, has an HIV prevalence rate of 6.9%. The increase in prevalence rates is attributed to limited access to counselling services and risky behaviours.

Measures Taken to Address HIV/AIDS Prevalence Rates:

- **HIV Testing and Treatment Campaigns:** Nationwide campaigns have been introduced.
- **HIV Self-Testing:** Pilot programs are being implemented.
- **Media Campaigns:** Radio and TV programs focus on HIV prevention.
- **Voluntary Counselling and Testing (VCT):** Free VCT services are available.
- **Public Awareness:** Posters and billboards promote safe sexual practices.

15.18.3 Economic Activities

Mufumbwe District's economy is primarily driven by agriculture and mining.

- **Agriculture:** Small-scale farming is the main economic activity, with maize being the predominant crop. The district is also known for its Mukwa and Rosewood timber, which offers opportunities for business ventures.
- **Mining:** The district is rich in mineral resources, including gold, copper, and mercury. Small-scale mining activities contribute to the local economy.

15.18.4 Social Amenities

- **Education:** Mufumbwe District has 85 schools, including 10 secondary schools, 50 primary schools, 15 community schools, and 10 early childhood education centers. The district serves a student population of 25,000, supported by 500 teachers.
- **Health:** The district's healthcare infrastructure includes 1 District Hospital, 20 Rural Health Centers, and 10 Health Posts.
- **Water and Sanitation:** Access to clean water is limited, with many rural communities relying on boreholes and rivers. Sanitation is primarily through pit latrines.
- **Power and Energy:** Access to electricity is low, with most households relying on firewood and charcoal for energy.

15.18.5 Traditional and Religious Practices

The **Kaonde people** are one of Zambia's prominent ethnic groups, primarily found in the North-Western Province, including districts such as **Solwezi, Kalumbila, Mufumbwe, and Kasempa**. They trace their origins to the Luba-Lunda Kingdom in the Democratic Republic of Congo (DRC) and migrated to Zambia during the 17th and 18th centuries. The Kaonde are known for their rich cultural heritage, traditional governance systems, and vibrant ceremonies.

For a detailed description of the Kaonde people, including their historical background, cultural practices, and traditional ceremonies, refer to the full explanation provided in the **Kalumbila District section**. Key highlights include their spiritual beliefs, traditional ceremonies like **Kufukwila**, **Lubinda Ntongo**, and **Kuvuluka Kishakulu**, and their skilled craftsmanship

in woodcarving, pottery, and basketry. The Kaonde also face challenges such as language erosion and land rights but remain committed to preserving their cultural identity.

In Mufumbwe District, the Kaonde culture is deeply rooted, with traditional ceremonies presided over by chiefs such as Chief Kasempa**,** Chief Ingwe**,** and Chief Mumena. These ceremonies, including the Kufukwila and Lubinda Ntongo, celebrate harvests, unity, and ancestral heritage, featuring traditional dances, music, and rituals. The district also has a strong Christian presence, with churches playing a significant role in community life.

Since the traditional and religious practices in this area align with those of other Kaonde-speaking communities, the comprehensive overview provided for Kalumbila District (5.16.5 Traditional and Religious Practices) also applies here.

15.19 Socio-Economic Profile for Kaoma District

15.19.1 Available Labor and Skills

Kaoma District has a diverse labour force, including skilled, semi-skilled, and unskilled individuals eager to participate in the implementation of the project.

15.19.2 HIV/AIDS in the Project Area

Kaoma District, located in the Western Province, has an HIV prevalence rate of 16.0%, one of the highest in Zambia. The increase in prevalence rates is linked to limited access to counselling services and risky behaviours.

Measures Taken to Address HIV/AIDS Prevalence Rates:

- **HIV Testing and Treatment Campaigns:** Nationwide campaigns have been introduced.
- **HIV Self-Testing:** Pilot programs are being implemented.
- **Media Campaigns:** Radio and TV programs focus on HIV prevention.
- **Voluntary Counselling and Testing (VCT):** Free VCT services are available.
- **Public Awareness:** Posters and billboards promote safe sexual practices.

15.19.3 Economic Activities

Kaoma District's economy is primarily driven by agriculture, fishing, and small-scale businesses.

- **Agriculture:** Subsistence farming is the main economic activity, with crops such as maize, cassava, rice, and sweet potatoes being cultivated.
- **Fishing and Gardening:** Fishing and gardening are key sources of livelihood for many residents.
- **Timber Production:** The district has a vibrant timber production and trading industry.

15.19.4 Social Amenities

- **Education:** Kaoma District has 150 schools, including 20 secondary schools, 100 primary schools, 20 community schools, and 10 early childhood education centers. The district serves a student population of 50,000, supported by 1,200 teachers.
- **Health:** The district's healthcare infrastructure includes 1 District Hospital, 30 Rural Health Centers, 15 Health Posts, and 2 private clinics.
- **Water and Sanitation:** Access to clean water is limited, with many rural communities relying on boreholes, wells, and rivers. Sanitation is primarily through pit latrines.
- **Power and Energy:** Access to electricity is low, with most households relying on firewood and charcoal for energy.

15.19.5 Traditional and Religious Practices

The Nkoya People: A Detailed Cultural and Historical Overview

The Nkoya people are one of Zambia's indigenous ethnic groups, primarily found in Kaoma District of the Western Province, with smaller populations in other parts of Zambia. They are known for their rich cultural heritage, traditional practices, and historical significance. Below is a detailed exploration of their history, cultural practices, and traditional ceremonies.

Historical Background

The Nkoya people trace their origins to the Luba-Lunda Kingdom in the Democratic Republic of Congo (DRC). Around 1700 AD, they migrated into present-day Zambia under the leadership of Lube, a female ruler of Luba descent. This migration was part of the larger Bantu expansion across Central and Southern Africa. The Nkoya settled along the Luena River and its tributaries, including the Luampa, Lalafuta, and lower Kabompo Rivers, where they established their chiefdoms and cultural identity.

The Nkoya were historically organized into chiefdoms, each led by a chief (Mwene) who served as both a political and spiritual leader. The most prominent Nkoya chiefdoms include Mwene Mutondo and Mwene Kahare, which remain central to their cultural and political organization today. These chiefdoms have preserved their autonomy and cultural practices despite colonial and post-colonial influences.

Cultural Practices and Beliefs

The Nkoya people have a deep connection to their ancestral heritage, which is reflected in their traditional practices, rituals, and ceremonies. Their culture is a blend of spiritual beliefs, communal values, and artistic expression.

1. **Spiritual Beliefs:**
    - The Nkoya are traditionally animists, believing in the presence of spirits in natural elements such as rivers, trees, and mountains. They also believe in a supreme being called Nyambi, who is revered as the creator and sustainer of life.
    - Ancestral worship is a key aspect of their spirituality. The Nkoya believe that the spirits of their ancestors (mizhimo) play an active role in their daily lives,

offering protection, guidance, and blessings. Rituals and offerings are made to honour these spirits, particularly during ceremonies and significant life events.

2. **Traditional Ceremonies:**
   The Nkoya are renowned for their vibrant traditional ceremonies, which serve as a means of preserving their cultural identity and fostering community cohesion. The most significant ceremonies include:
   - **Kathanga Ceremony:**
     - The Kathanga is the most important Nkoya traditional ceremony, celebrated to give thanks to Nyambi for a bountiful harvest. It is held annually and presided over by Mwene Mutondo, the senior Nkoya chief.
     - The ceremony features traditional dances, drumming, and the offering of muzinge (sweet sorghum beer) to the ancestors. The beating of the sacred drum (likumbi) is a central ritual, symbolizing the connection between the living and the ancestral spirits.
     - The Kaala-Shihanda shrine, located near the Luena River, is a sacred site where blessings are sought from ancestral spirits. Chiefs and heroes are anointed here, reinforcing the spiritual and cultural significance of the ceremony.
   - **Lwiindi Ceremony:**
     - The Lwiindi is another important ceremony, celebrated by the Mwene Kahare chiefdom. It is a thanksgiving ritual that marks the beginning of the planting season and seeks blessings for a successful harvest.
     - The ceremony includes traditional dances, music, and the offering of food and beer to the ancestors. It is a time for the community to come together, celebrate their heritage, and seek divine favour for the coming agricultural season.
   - **Nkoya Royal Festival:**
     - This festival is a cultural showcase that celebrates the history, traditions, and achievements of the Nkoya people. It features traditional dances, music, storytelling, and displays of Nkoya artifacts and crafts.
     - The festival is an opportunity for the Nkoya to pass down their cultural knowledge to younger generations and to promote unity among their communities.
3. **Art and Craft:**
   - The Nkoya are skilled artisans, known for their woodcarvings, pottery, and basketry. These crafts often feature intricate designs and symbols that reflect their cultural beliefs and traditions.
   - Traditional musical instruments, such as drums (ngoma), thumb pianos (kalimba), and flutes, are integral to their cultural expression and are used during ceremonies and celebrations.
4. **Social Structure:**
   - The Nkoya society is organized around extended families and clans, with a strong emphasis on communal living and mutual support. Elders are highly respected and play a key role in decision-making and conflict resolution.
   - The chiefs (Mwene) hold significant authority and are regarded as custodians of tradition and culture. They oversee the administration of their chiefdoms and ensure the preservation of Nkoya customs and values.

Traditional Governance

The Nkoya have a well-defined traditional governance system, centred around their chiefdoms. The two main chiefdoms are:

1. **Mwene Mutondo:**
    - The senior Nkoya chiefdom, led by Mwene Mutondo, is recognized as the custodian of Nkoya traditions and culture. The chiefdom plays a central role in organizing the Kathanga ceremony and other cultural events.
2. **Mwene Kahare:**
    - The Mwene Kahare chiefdom is equally significant and is responsible for the Lwiindi ceremony. The chiefdom has a rich history and has contributed to the preservation of Nkoya heritage.

Figure 43 HRH Mwene Mutondo

Both chiefdoms work collaboratively to promote the welfare of the Nkoya people and to uphold their cultural identity.

Challenges and Preservation of Culture

The Nkoya people, like many indigenous groups, face challenges in preserving their cultural heritage in the face of modernization and globalization. Key challenges include:

- **Language Erosion:** The Nkoya language (Chinkoya) is at risk of being overshadowed by more dominant languages such as Lozi and English. Efforts are being made to promote the language through education and cultural programs.
- **Land Rights:** The Nkoya have historically faced issues related to land ownership and access, particularly in areas where mining and commercial agriculture are expanding.
- **Cultural Assimilation:** The influence of Western culture and Christianity has led to a decline in the practice of traditional rituals and ceremonies among younger generations.

Despite these challenges, the Nkoya people remain committed to preserving their cultural heritage. Initiatives such as the annual Kathanga and Lwiindi ceremonies, as well as the establishment of cultural centers and museums, are helping to keep their traditions alive.

Traditional Description of Kaoma District: A Blend of Nkoya and Lozi Heritage

Kaoma District, is a culturally rich region that reflects the coexistence and interplay of two prominent ethnic groups: the **Nkoya-speaking people** and the **Lozi-speaking people** under the **Barotse Royal Establishment (BRE)**. This unique blend of traditions and governance systems makes Kaoma a fascinating area with a deep-rooted cultural heritage.

The Nkoya People

The **Nkoya-speaking people** are one of the indigenous groups of Kaoma District and have a distinct cultural identity.

The Lozi People and the Barotse Royal Establishment (BRE)

Alongside the Nkoya, the **Lozi-speaking people** under the **Barotse Royal Establishment (BRE)** also have a significant presence in Kaoma. The BRE is the traditional governance system of the Lozi Kingdom, headed by the **Litunga**, the King of the Lozi people. The Litunga serves as both a political and spiritual leader, overseeing the administration of the kingdom and preserving its traditions. The Lozi are renowned for their annual **Kuomboka Ceremony**, a symbolic event where the Litunga moves from the flooded plains to higher ground, accompanied by vibrant traditional rituals and celebrations.

The presence of **Naliele Palace**, a key royal residence within the BRE, highlights the deep connection between Kaoma and the Lozi Kingdom. The palace serves as a symbol of the BRE's influence and the enduring role of traditional leadership in the region. The Lozi people's cultural practices, including their language (**Silozi**), traditional ceremonies, and communal values, contribute significantly to the cultural fabric of Kaoma.

Coexistence and Cultural Synergy

Kaoma District is a unique example of cultural coexistence, where the traditions of the Nkoya and Lozi people intertwine. While the Nkoya-speaking people maintain their distinct identity through ceremonies like the Kazanga, the Lozi-speaking people uphold the traditions of the BRE and the Litunga's leadership. This harmonious blend of cultures is evident in the district's social structure, governance, and community life.

Figure 44 BRE Representative Nduna Sitali Indopu Mukatimui

Both groups share a deep respect for traditional leadership and communal values, which fosters unity and mutual respect. Despite the challenges of modernization and globalization, the people of Kaoma remain committed to preserving their cultural heritage, ensuring that the traditions of both the Nkoya and Lozi people continue to thrive for future generations.

Conclusion

Kaoma District stands as a testament to Zambia's cultural diversity, where the Nkoya and Lozi people coexist and contribute to a rich cultural tapestry. The Nkoya-speaking people, with their vibrant Kazanga Ceremony and traditional governance, and the Lozi-speaking people, with their BRE and iconic Kuomboka Ceremony, create a unique cultural synergy in the region. The presence of **Naliele Palace** further underscores the enduring influence of the Lozi Kingdom, making Kaoma a district of historical and cultural significance. Together, these traditions ensure that Kaoma remains a vibrant and culturally rich part of Zambia's heritage.

Summary of Schools and Health Facilities

District	Schools	Health Facilities
Kalumbila	105 schools (15 secondary, 66 primary, 19 community, 5 private, 53 ECE)	1 Level One Hospital, 38 Rural Health Centers, 16 Health Posts, 2 private clinics
Kasempa	128 schools (15 secondary, 69 primary, 29 ECE, 15 community, 3 private)	17 Rural Health Centers, 8 Health Posts, 1 Urban Health Clinic, Mikenge Mission Hospital
Mufumbwe	85 schools (10 secondary, 50 primary, 15 community, 10 ECE)	1 District Hospital, 20 Rural Health Centers, 10 Health Posts
Kaoma	150 schools (20 secondary, 100 primary, 20 community, 10 ECE)	1 District Hospital, 30 Rural Health Centers, 15 Health Posts, 2 private clinics

15.20 Human - Wildlife Conflicts

Human-Wildlife Conflict (HWC) Assessment

The proposed rehabilitation and upgrade of the 371 km Mutanda to Kaoma Road, particularly the section between Kasempa and Kaoma, will traverse areas that include Game Management Areas (GMAs). The Kasonso Busanga GMA is currently traversed with the existing gravel road. GMAs are designated zones where wildlife conservation is prioritized alongside sustainable human activities, such as agriculture and tourism. However, the presence of wildlife in these areas often leads to Human-Wildlife Conflict (HWC), which arises when the needs and behaviours of wildlife negatively impact human livelihoods, or vice versa. This section assesses the potential for HWC along the proposed road, particularly in the Kasempa to Kaoma stretch, and outlines mitigation measures to minimize these conflicts.

Potential Human-Wildlife Conflicts

The Kasempa to Kaoma section of the road passes through areas with significant wildlife populations, including elephants, antelopes, warthogs, and other mammals. The presence of these animals, combined with increased human activity due to the road project, could exacerbate existing HWC issues or create new ones. The following are the key potential conflicts:

1. **Crop Raiding and Livestock Predation**:
    - Wildlife, particularly elephants and antelopes, may venture into nearby farmlands to feed on crops, leading to significant economic losses for local farmers.
    - Predators such as lions and hyenas may prey on livestock, especially in areas where natural prey is scarce.
2. **Vehicle-Wildlife Collisions**:
    - The upgraded road is expected to increase traffic volume and speed, raising the risk of collisions with wildlife, particularly during nocturnal movements.
    - Species such as elephants, antelopes, and smaller mammals are at risk of being hit by vehicles, which could result in injury or death to both animals and humans.
3. **Habitat Fragmentation**:
    - The construction and operation of the road may fragment wildlife habitats, disrupting migration routes and reducing access to critical resources such as water and food.
    - Fragmentation can lead to increased human-wildlife interactions as animals are forced to cross roads or enter human settlements in search of resources.
4. **Increased Human Activity**:
    - The road project will likely attract more people to the area, including construction workers, traders, and tourists. This increased human presence can disturb wildlife, leading to behavioural changes and potential conflicts.
    - Encroachment into wildlife habitats for settlements, agriculture, or other activities may further exacerbate HWC.
5. **Water Resource Competition**:

- Wildlife and local communities often compete for access to water sources, especially during the dry season. The road project may alter natural water flow patterns, affecting both wildlife and human access to water.

Mitigation Measures

To address the potential for HWC along the Kasempa to Kaoma road, the following mitigation measures are proposed:

1. **Wildlife Crossing Structures**:
   - Construct wildlife underpasses or overpasses at key points along the road to facilitate safe animal movement and reduce the risk of vehicle-wildlife collisions.
   - Install wildlife-friendly fencing to guide animals toward designated crossing points and prevent them from entering the road.
2. **Speed Limits and Warning Signs**:
   - Implement reduced speed limits in areas with high wildlife activity, particularly near GMAs and known animal crossing points.
   - Install wildlife warning signs to alert drivers to the presence of animals and encourage cautious driving.
3. **Community Engagement and Education**:
   - Conduct awareness programs to educate local communities about HWC and the importance of coexisting with wildlife.
   - Provide training on effective crop protection techniques, such as the use of chili fences or beehive fences, to deter elephants and other crop-raiding animals.
4. **Livestock Protection Measures**:
   - Encourage the use of predator-proof enclosures (bomas) to protect livestock from predators.
   - Promote the adoption of livestock guarding animals, such as dogs, to reduce predation risks.
5. **Habitat Restoration and Connectivity**:
   - Restore degraded habitats and create wildlife corridors to maintain connectivity between fragmented habitats.
   - Minimize habitat disturbance during construction by limiting vegetation clearing to essential areas and rehabilitating disturbed sites post-construction.
6. **Water Resource Management**:
   - Ensure that the road design incorporates measures to maintain natural water flow and access for both wildlife and local communities.
   - Construct additional water points for wildlife in areas where natural sources may be affected by the road project.
7. **Monitoring and Adaptive Management**:
   - Establish a monitoring program to track wildlife movements, HWC incidents, and the effectiveness of mitigation measures.
   - Use the data collected to adapt and improve mitigation strategies over time.

The proposed road rehabilitation and upgrade project between Kasempa and Kaoma has the potential to significantly improve regional connectivity and economic development. However, the project must carefully consider the potential for Human-Wildlife Conflict, particularly in

areas traversing GMAs. By implementing the proposed mitigation measures, the project can minimize negative impacts on both wildlife and local communities, promoting sustainable coexistence and ensuring the long-term success of the road infrastructure.

The integration of wildlife-friendly design features, community engagement, and adaptive management will be critical to achieving a balance between development and conservation, aligning with Zambia's broader goals of sustainable development and biodiversity preservation. The Department of National Parks and Wildlife has been consulted throughout the ESIA stakeholder consultation process, and their input is incorporated into the Biodiversity Report and this ESIA. We continue to consult with DNPW and seek their involvement in the project.

15.21 Consultation and Public Participation

Stakeholder Consultation

This section outlines the stakeholder consultation process undertaken as part of the Environmental and Social Impact Assessment (ESIA) for the proposed rehabilitation and upgrade of the 371km road between Mutanda and Kaoma in the North-Western and Western Provinces of Zambia. The process was designed to ensure transparency, inclusivity, and meaningful participation of stakeholders in the ESIA process.

Objectives of Stakeholder Consultation

The primary objectives of the stakeholder consultation process were to:

1. Provide accessible and timely information about the project to potentially affected communities, stakeholders, and the general public.
2. Create opportunities for stakeholders to express their views, concerns, and suggestions regarding the project's potential environmental and social impacts.
3. Incorporate stakeholder feedback into the ESIA process and project design.
4. Promote transparency and accountability in the project's development.

Stakeholder Identification and Analysis

A comprehensive stakeholder identification and analysis was conducted to identify individuals, groups, and organizations that may be affected by or have an interest in the project. Key stakeholders included:

- Potentially affected communities along the road corridor.
- Local traditional authorities, including Chiefs Mumena, Kasempa, Ingwe, and Mutondo, as well as representatives from the Barotse Royal Establishment (BRE).
- Government agencies at national, provincial, and district levels, including District Commissioners, Town Councils, the Road Development Agency (RDA), and the Department of National Parks and Wildlife (DNPW).
- Non-governmental organizations (NGOs) operating in the region.
- Businesses and private sector entities, including telecommunication companies (Zamtel, Airtel, MTN Zambia) and utility providers (ZESCO, NWASCO).
- Vulnerable groups and local residents.

Methods of Stakeholder Engagement

The stakeholder engagement process employed a variety of methods to ensure effective communication and participation, including:

1. **Structured Consultation Meetings**: Formal meetings were organized to provide information about the project and gather feedback. These included:
    - **Scoping Meetings**: Held to gather initial input on the scope of the ESIA. Four scoping meetings were conducted across the project area on the following dates and locations:
        - **Mutanda Nature Lodge**: Monday, 9th December 2025 at 09:00 hrs.
        - **Kasempa Best Ways Comfort Lodge**: Wednesday, 11th December 2025 at 09:00 hrs.
        - **Kamizenkenzeke CRB Offices**: Friday, 13th December 2025 at 09:00 hrs.
        - **Kaoma Mumu's Chalets and Garden Lodge**: Monday, 16th December 2025 at 09:00 hrs.
    - **Public Disclosure Meetings**: Held to share findings from the specialist studies conducted during the ESIA process, including the Heritage Impact Assessment (HIA) and Biodiversity Study. These meetings took place on:
        - **Mutanda Nature Lodge**: Wednesday, 26th February 2025 at 09:00 hrs.
        - **CRB Office (Kaminzekenzeke)**: Monday, 3rd March 2025 at 09:00 hrs.
        - **Kasempa Best Ways Comfort Lodge**: Wednesday, 5th March 2025 at 09:00 hrs.
        - **Kaoma Mumu's Chalets and Garden Lodge**: Friday, 7th March 2025 at 09:00 hrs.
2. **Office Visits and Consultations**: Direct consultations were conducted with key government officials and agencies. Notably, between the 11th and 14th of February 2025, the consultant and developer visited the Western Province Provincial Administration offices. Meetings were held with:
    - The Provincial Permanent Secretary.
    - The Provincial Planning Office personnel.
    - The District Commissioner.
    - The RDA (Road Development Agency) offices.
      Prior consultations were also held with the North-Western Provincial Permanent Secretary.
3. **Traditional Palace Visitation:** In accordance with established protocols, the government's Department of Traditional and Chiefs' Affairs provided guidance on engaging with local traditional leaders. Five chiefs were consulted and participated in all Public Scoping and Disclosure meetings, either in person or through their designated representatives. Furthermore, a palace visit was conducted by the Environmental and Social Impact Assessment (ESIA) team, the Developer, and the Rural Development Agency (RDA) at His Royal Highness Chief Mumena's Palace on March 26, 2025. This courtesy visit was necessitated by Chief Mumena's absence from the Public Disclosure meeting due to other commitments, and provided an opportunity for direct engagement and consultation.
4. **Informal Consultations**: Ongoing communication with stakeholders was maintained through phone calls, emails, and physical visits.

5. **Information Dissemination**: Project information was shared through leaflets, brochures, and public notices.

Figure 45 Kaoma District Commissioner and Council Secretary

Summary of Consultation Activities

Key stakeholder engagement activities included:

- **Scoping Meetings**: Four meetings were held across the project area to engage stakeholders and gather input. The meetings took place on:
    - **Mutanda Nature Lodge**: Monday, 9th December 2025 at 09:00 hrs.
    - **Kasempa Best Ways Comfort Lodge**: Wednesday, 11th December 2025 at 09:00 hrs.
    - **Kamizenkenzeke CRB Offices**: Friday, 13th December 2025 at 09:00 hrs.
    - **Kaoma Mumu's Chalets and Garden Lodge**: Monday, 16th December 2025 at 09:00 hrs.
- **Consultations with Provincial Authorities**: Between the 11th and 14th of February 2025, meetings were held with the Provincial Permanent Secretary, Provincial Planning Office personnel, District Commissioner, and RDA offices in the Western Province. Prior consultations were also held with the North-Western Provincial Permanent Secretary.
- **Public Disclosure Meetings**: Meetings were conducted to present the findings of the specialist studies, including the Heritage Impact Assessment (HIA) and Biodiversity Study, and address stakeholder questions. These meetings took place on:
    - **Mutanda Nature Lodge**: Wednesday, 26th February 2025 at 09:00 hrs.
    - **CRB Office (Kaminzekenzeke)**: Monday, 3rd March 2025 at 09:00 hrs.
    - **Kasempa Best Ways Comfort Lodge**: Wednesday, 5th March 2025 at 09:00 hrs.
    - **Kaoma Mumu's Chalets and Garden Lodge**: Friday, 7th March 2025 at 09:00 hrs.

Key Issues Raised by Stakeholders

Stakeholders raised several concerns and suggestions during the consultations, including:

- **Road Design and Planning**:
    - Clarification on the criteria for allocating 10 km of township roads for upgrading.
    - Concerns about the proximity of proposed toll plazas to existing ones and the number of toll gates planned per district.
    - Questions about future plans for road expansion to a dual carriageway to accommodate increased traffic.
- **Social and Economic Impacts**:
    - Details on the recruitment process for project-related jobs, including qualifications needed and prioritization of local communities.
    - HIV/AIDS and gender-related social issues specifically as it impacts employment opportunities and sexual activities of increased workforce.
    - Information on the developer's Corporate Social Responsibility (CSR) initiatives for local communities.
    - Requests to consider local contractors during project implementation.
    - Concerns about the displacement of people due to the road upgrade and the need for fair compensation.
    - Long-term benefits that the project will bring to the community.
- **Environmental Impacts**:
    - Measures to protect wildlife, given the road's passage through an animal corridor.
    - Source of gravel materials and the plan for the rehabilitation of borrow pits after project completion.
    - Measures to mitigate dust emissions during construction.
    - Source of water for the project and plans to improve water accessibility in the area.
- **Community Infrastructure and Access**:
    - Requests to upgrade access tracks to palaces, traditional arenas, health centers, and schools.
- **Security**:
    - Security measures planned for the project, particularly around Kalumwange and Chitwa areas.
- **Data Collection and Valuation**:
    - The need to engage government departments in data collection and the property valuation process.

Figure 46 Kasempa Council Secretary

Consideration of Stakeholder Input

Stakeholder feedback was carefully considered and incorporated into the ESIA process and project design. Key measures include:

- Collaboration with relevant authorities to address HIV/AIDS and gender-related issues.
- Implementation of road safety measures, including signage and speed humps.
- Development of a resettlement framework to ensure fair compensation and minimize displacement impacts.
- Plans to address environmental concerns, such as dust control and borrow pit rehabilitation.
- Commitment to creating employment opportunities for local communities.

Heritage and Biodiversity Study

As part of the ESIA process, a Heritage Impact Assessment (HIA) and a Biodiversity Study were conducted. The HIA assessed the potential impacts of the road project on cultural heritage sites, given that the proposed route traverses various chiefdoms with a rich heritage and cultural footprint. The Biodiversity Study evaluated the potential impacts on wildlife and ecosystems, particularly as the road passes through a Game Management Area.

Following active engagement during public meetings, the consultants conducted specific and targeted engagement with the key stakeholders within these disciplines. Both documents were shared with the relevant government bodies for their comments and input. The Department of National Parks and Wildlife (DNPW) reviewed the Biodiversity Study, given the road's proximity to wildlife areas, while the National Heritage Conservation Commission (NHCC)

reviewed the HIA to ensure that cultural heritage sites would be adequately protected during the project's implementation. Information and recommendations provided have been considered and incorporated into the studies and this assessment.

Future Consultation Plans

The project will continue to engage stakeholders during the implementation and operation phases. This will include:

- Ongoing monitoring and communication with stakeholders.
- Establishment of grievance redress mechanisms.
- Regular updates and consultations to address emerging issues.

This stakeholder consultation process demonstrates the project's commitment to transparency, inclusivity, and responsiveness to stakeholder concerns. The feedback and concerns raised during the meetings will be integral to the project, ensuring that it is implemented in a socially and environmentally responsible manner.

6.0 IMPACTS

Through stakeholder consultations and field assessment of the proposed Rehabilitation and Upgrade of 371 km Mutanda to Kaoma Road, the perceived environmental and socio-economic issues during construction and operation phases include the following.

6.1 Biophysical Environment

6.1.1 Positive Impacts

6.1.1.1 Enhancement of the Ecology

Construction and Operation Phase

- The project will incorporate native flora species through strategic tree planting and landscaping, using vegetation indigenous to the area. This approach will enhance the aesthetic appeal of the road corridor while ensuring ecological compatibility. By prioritizing locally adapted plants, the initiative will support biodiversity, reduce erosion, and strengthen ecosystem resilience—delivering both visual and environmental benefits without introducing invasive or non-native species.
- The newly planted trees and ornamental plants will act as carbon sinks, helping to absorb carbon dioxide from the atmosphere and mitigate the effects of global warming. Additionally, the increased vegetation cover will aid in soil stabilization, reducing erosion and improving overall ecosystem health

6.1.2 Negative Biophysical Impacts

6.1.2.1 Impacts on Ecology

Construction Phase

a. Flora

Project activities that would interact with flora are bush clearing, excavation activities, and creation of diversion and construction of associated and supporting infrastructure such as campsite, service yard, administration office, toll gates and weighbridges. These activities will have significant ecological impacts, particularly in relation to vegetation cover and habitat integrity.

One of the primary impacts of the project is the direct loss of trees and degradation of natural habitats. This will occur due to the physical development of infrastructure and the potential increase in human presence within the project area. The removal of vegetation may lead to habitat fragmentation, affecting local biodiversity and ecological balance.

Additionally, there is a risk of losing threatened floral species, particularly those classified as rare or vulnerable. Without careful management, species with limited distribution or specialized habitat requirements may face population declines or even local extinction.

Another concern is the potential increase in tree cutting for firewood by construction workers. Without controlled access to alternative fuel sources, there may be unsustainable exploitation of local forests, further exacerbating habitat degradation and loss of indigenous tree species.

The introduction of exotic plant species as part of landscaping or reforestation efforts could also pose ecological risks. Non-native species may outcompete indigenous flora, leading to a decline in native biodiversity and altering the composition of local ecosystems.

Lastly, project activities may negatively impact the health of indigenous vegetation. Increased dust deposition, soil compaction, and changes in hydrological patterns could stress native plant communities, reducing their growth and resilience. If not properly managed, these effects could lead to long-term ecological degradation.

b. Fauna

Mammals

The coming of the proposed road, along with associated infrastructure will have an impact for mammal populations in the project area. One of the primary concerns is habitat loss and alteration, particularly for small to medium-sized mammals, due to vegetation clearing. This disruption may force these species to relocate, potentially leading to population declines or imbalances in the local ecosystem. Additionally, sensory disturbances caused by noise and vibrations from construction activities could frighten rodents and other sensitive species, affecting their natural behaviors and movement patterns.

The introduction of artificial night lighting from campsites could further disturb mammal species, altering their nocturnal activities and potentially leading to behavioral stress. Infrastructure development may also contribute to indirect habitat loss, as some species may avoid areas where visible human-made structures exist, reducing their available range.

Another critical concern is the potential for direct mortality due to vehicle collisions, particularly for species that may attempt to cross the road. Indirect mortality risks may also arise from increased hunting and wildlife collection, as improved accessibility could lead to greater human-wildlife interactions. Additionally, the project poses a risk to threatened mammal species categorized under the IUCN Red List, emphasizing the need for conservation measures. Implementing mitigation strategies such as designated wildlife corridors, speed restrictions, and controlled lighting will be essential in minimizing these impacts and ensuring the long-term sustainability of local mammal populations.

Reptiles and Amphibians

Similarly, one of the primary concerns is habitat loss due to vegetation clearing, which may lead to the displacement of these species and a reduction in their population sizes.

Additionally, sensory disturbances from construction activities, including noise and vibrations, may frighten reptiles and amphibians, disrupting their natural behaviors and movement patterns.

Habitat fragmentation caused by diversions and campsites could reduce connectivity between populations, limiting their ability to migrate, forage, and reproduce effectively. Direct mortality is another major concern, as reptiles and amphibians are at risk of being killed by construction vehicles while crossing roads. Indirect mortality may also increase due to heightened human activity, as some species may be subject to intentional killing or hunting.

Insects

Habitat loss and alteration, particularly for ground-dwelling and crawling insects, will occur due to vegetation clearing and excavation activities, potentially reducing biodiversity. Sensory disturbances from noise and vibrations generated by construction activities may also disrupt insect behavior and movement.

Additionally, artificial night lighting from campsites and nighttime construction may interfere with the natural activities of nocturnal insect species, leading to disorientation and increased predation risks. Habitat fragmentation caused by diversions and infrastructure development may further reduce connectivity between insect populations, limiting their ability to migrate and reproduce.

Direct mortality risks, especially for flying insects, will increase due to vehicle collisions, while indirect mortality may rise as certain insect species may be intentionally killed if perceived as a nuisance.

c. Avifauna

Loss and alteration of bird habitats due to vegetation clearing, which will reduce the availability of nesting, foraging, and sheltering sites for various bird species. Additionally, the sensory disturbances caused by noise and vibrations from construction activities may frighten birds, leading to changes in their behavior and displacement from critical areas.

Another impact is the loss of fruit trees, which are vital food sources for many bird species. The removal of these trees during construction will directly affect the availability of food for frugivorous birds, further exacerbating habitat loss. Moreover, the increase in artificial night lighting from campsites and nighttime road construction could disrupt the natural behaviors of nocturnal and migratory bird species, leading to disorientation and altered migration patterns.

Direct mortality is also a concern, particularly for birds that may collide with vehicles while attempting to cross the well-maintained road. Indirect mortality may result from

increased hunting and collecting, as improved road access may lead to higher human-wildlife interactions.

Impacts during Operation Phase

a. Flora & Vegetation

- **Accelerated deforestation**: Improved Road access may increase illegal logging (notably *Pterocarpus angolensis*/Mukula in Kasempa GMA) and charcoal production
- **Invasive species spread**: Vehicle-mediated dispersal of invasive plants (e.g., *Lantana camara*) threatening native flora (observed near Kaoma bypass).

b. Fauna Impacts

Mammals:

- **Vehicle collisions**: High risk for elephants (Lalafuta corridor), primates, and ungulates
- **Habitat fragmentation**: Barrier effect for migratory species like buffalo between Kafue NP and West Lunga.

Avifauna:

- **Collision mortality**: Threatened species (e.g., *Gyps africanus*/African vulture) vulnerable near toll plazas
- **Noise disruption**: Traffic noise may displace breeding birds within 500m of the road.

c. Human Health & Safety

- **Traffic accidents**:
    - Expected 20–30% rise in accidents due to higher speeds (85+ km/h outside towns) and increased freight traffic
    - High-risk zones: Sharp curves near Mufumbwe and unmarked pedestrian crossings in Kasempa.
- **Hazardous material spills**:
    - Fuel/oil spills from overturned trucks could contaminate groundwater (e.g., shallow aquifers near Dengwe Stream)
    - Chronic seepage from roadside service stations threatens drinking water (WARMA Class II groundwater vulnerability).
- **Public health**:
    - Increased HIV/AIDS transmission from transient workers
    - Respiratory diseases from prolonged dust exposure near unpaved intersections.

d. Socioeconomic Impacts

- **Positive**: Reduced travel time (estimated 40% decrease Kalumbila–Kaoma) boosts local commerce.
- **Negative**:
    - Land value inflation displaces low-income households near Kaoma bypass.
    - Roadside vendor displacement at toll plaza sites.

Enhanced Mitigation Measures

1. **Wildlife**:
    - Speed bumps + thermal cameras in collision hotspots (7 priority zones mapped).
    - Wildlife fencing (8km total) funneling animals to underpasses.
2. **Human Safety**:
    - Mandatory driver training for hazardous cargo
    - Emergency spill kits every 15km
3. **Groundwater Protection**:
    - Impermeable liners at fuel stations
    - Biannual groundwater monitoring

6.1.2.2 Impacts on Ecologically Sensitive Areas

Construction Phase

Rivers and streams are ecologically sensitive ecosystems that support a diverse range of aquatic species, as well as terrestrial species that rely on these water bodies for sustenance. The proposed road route traverses or is in proximity to several streams and four major rivers: Mutanda, Dengwe, Lalafuta, and Luena. These surface water features are highly sensitive to environmental disturbances and could be significantly impacted during construction activities.

Physical disturbances, particularly earthworks associated with road construction, pose a major risk to these aquatic ecosystems. The rehabilitation and upgrade of existing culverts, along with the widening of bridges, will likely result in soil erosion, leading to increased sedimentation in the rivers and streams. This sedimentation can degrade water quality, disrupt aquatic habitats, and impact the overall health of these sensitive ecosystems.

6.1.2.3 Impact on Hydrology

Construction Phase

The proposed development is expected to cause temporary alterations to the hydrology of the project area during the construction phase. These changes will primarily affect surface water systems, posing potential environmental risks.

Surface Water

One of the key concerns is the possible contamination of nearby streams and rivers due to improper handling of fuels and lubricants, which may result in oil spillages from construction vehicles and machinery. Such pollution can degrade water quality, impacting aquatic life and downstream users. Additionally, during the rainy season, soil from earthworks and exposed construction sites may be washed into surface water bodies, leading to increased sedimentation and siltation.

The predicted environmental impacts include contamination of surface water through increased suspended solids and oil content, as well as the siltation of streams and rivers. These changes

could severely affect local communities that depend on these water sources for domestic consumption and other livelihood activities.

Ground Water

Sources of ground water pollution during this phase are sewage waste and oil/fuel spillages from construction machinery which can seep through the soil and pollute ground water.

Operation Phase

During the operation phase of the rehabilitated and upgraded road, along with associated infrastructure such as the administrative office, toll gates, and weighbridges, proper wastewater management will be crucial to prevent environmental contamination. If sewage waste from the associated facilities is not adequately managed, it may lead to the contamination of both groundwater and surface water resources within the project area. Additionally, the project's reliance on groundwater for water supply could lead to resource depletion. Further, excessive extraction of groundwater to meet the operational demands such as sanitation and maintenance, may further strain the local water supply.

6.1.2.4 Impact on Soil

Construction Phase

During site preparation and construction phases, trees will be cut which will lead to loosening of the soil and thereby result in soil erosion in windy and rainy conditions. The scraping of top-soil during site preparation and construction will also loosen the soil which might lead to soil erosion especially if construction work is conducted during the wet season when soils are generally loose.

It is likely that oil used for machinery on site may be carelessly stored, handled, or drained from construction vehicles and construction equipment, and may result in accidental petroleum and oil spillage around the construction site. This could lead to contamination of the soil and water bodies.

Operation Phase

During this phase solid and liquid waste if not handled properly may be a source of soil contamination as waste piles (food waste and sewage waste) may serve as bacteria breeding areas.

6.1.2.5 Air pollution

Construction Phase

Land clearing for construction, material handling (loading and off-loading) and movement on exposed worksites are dust generating activities. Material stockpiles (sand and cement) can also be a source of air pollution under windy conditions if not properly covered.

The movement of construction equipment and vehicles along access roads may generate dust that may be deposited on surrounding vegetation may cause a small reduction in biological

productivity. Apart from it being an environmental pollutant, dust is equally a nuisance and an occupational as well as a public health issue of concern. Similarly exhaust fumes from increased traffic to and from the construction site has potential to cause air pollution.

Operation Phase

The road upgrade will introduce increased vehicle exhaust emissions (NOx, CO, SO_2, PM), but significantly reduce dust (PM2.5, PM10), a major pollutant from the current unpaved sections. This paving-induced dust suppression is expected to yield a net improvement in air quality, outweighing the exhaust increase. Modern vehicle emission controls will further mitigate exhaust impacts, and additional measures like traffic management and cleaner vehicle promotion will be implemented. Long-term, the project aims to enhance respiratory health by effectively controlling dust and maintaining manageable exhaust levels.

6.1.2.6 Waste generation

Construction Phase

A number of waste streams are expected to originate from the project during this phase. The various kinds of waste will include solid and liquid waste. Unsafe disposal of waste (for example, paper and food etc.) poses a health risk as waste piles may become a breeding site for bacteria that causes diseases like cholera and typhoid. Empty used bottles/ storage cans used by the workers on site present tripping hazards. Empty used bottles/ storage cans if not disposed of at approved disposal sites may lead to accumulation of waste on the streets. If the bottles are not properly disposed of, they may be re-used for uncertified water and other beverages by street kids and other illegal entities.

During the construction phase, generation of rubble material or construction waste such as steel parts, broken blocks, scrap metal, plank pieces, etc. is unavoidable and if this waste is not properly managed may become a health and safety risk causing tetanus from metals and trip hazards from poor housekeeping practices. Therefore, rubble and construction waste should be piled in one area of site and in bins to prevent health and safety risks.

Operation Phase

During this phase the waste expected to be generated is organic waste (food waste from people working at the toll gates, administration office, weighbridge etc.) and solid waste (plastics, tissue paper, empty boxes, bottles etc.). This waste if not managed properly may result in a waste nuisance on site which makes the site unappealing. Poor management of waste may also result in ground and surface water resources contamination.

Generation of Hazardous waste

All Project Phases

The proposed development will result in the generation of hazardous waste such as material used to mop up fuel spills during construction; and during operation the development will be primarily office, operation yard and toll plazas and not expected to generate significant amounts of hazardous waste.

6.1.2.7 Noise and Vibrations

Construction Phase

The use of heavy machinery such as graders and bulldozers are a potential source of noise. Noise and vibration may also be generated during construction by concrete mixers and transportation vehicles. Generally, construction noise exceeding a noise level of 70 decibels (dB) has significant impacts on surrounding sensitive receptors within 50m of the construction site.

Noise is a nuisance and may bring about annoyance, sleep disturbance and interference with communication.

Operation Phase

During operation, noise nuisance may be high due to vehicles using the well maintained Mutanda to Kaoma road.

6.2.1.8 Impact on landscape and Aesthetics

Construction Phase

Activities such as clearing using heavy machinery have potential to change the natural landscape and may therefore degrade areas of scenic beauty. Portions of the proposed site will need to be cleared for deviation purposes so as to create space for the existing road to be worked on. These activities have the potential to destabilize the existing natural ecosystems within the respective project areas. However, the development will be a green eco-friendly development, and bush-clearing activities will be kept to a minimum. After construction of roads, road reserves will be re-vegetated with plants and shrubs where possible as per Department of Forestry guidelines.

Operation phase

If the buildings and structures are not built according to the approved plans, the development may not be architecturally uniform. This can be an aesthetic nuisance. In addition, heaps of unprocessed raw materials or piles of indiscriminately disposed of waste, can have a significant impact on the appearance of the local environs.

6.2.1.9 Land Degradation Due to Waste Disposal

Construction Phase

The rehabilitation and upgrade of the Mutanda to Kaoma road may involve the clearance of vegetation, including trees and shrubs, especially in areas requiring minor realignments. This will generate organic waste in the form of vegetation debris, as well as topsoil removed during earthworks. Additionally, the milling or removal of deteriorated road surfaces specifically from Mutanda to Kasempa will generate bituminous waste, which, if not properly managed, can negatively impact the aesthetic and environmental quality of the surrounding areas and contaminate soil. However, given that the proposed works will be confined to the existing road alignment, the impact is expected to be low in significance and short-term for vegetation waste but high in significance and long-term for bituminous waste if not properly disposed of.

6.2.1.10 Land Degradation from Borrow Pits and Quarries

Construction Phase

The project will require the extraction of aggregates and other earth materials from borrow pits and quarries. Past road rehabilitation projects in Zambia have, in some cases, resulted in abandoned borrow pits that have significantly degraded the land, rendering it unusable. If not properly rehabilitated, these pits can lead to environmental hazards, including soil erosion and reduced land usability. To mitigate these potential impacts, the developer/contractor will access and utilize borrow pits only after an Environmental Project Brief (EPB) has been submitted to and approved by ZEMA. This EPB will detail the environmental and social guidelines for the use of borrow pits, including the exact site location, the social and environmental conditions of the site and surrounding areas, and records of stakeholder engagement with community, traditional, and civic leaders, demonstrating permissions and involvement. Furthermore, the EPB will also describe the decommissioning process, including appropriate processes and steps to return the affected land to its previously existing condition. If not properly rehabilitated, these pits can lead to environmental hazards such as soil erosion and reduced land usability. The impact is anticipated to be high in significance and long-term.

Operation Phase

If borrow pits and quarries are not properly reclaimed after use, they may become breeding grounds for mosquitoes, potentially leading to an increase in malaria cases. Additionally, open pits can pose safety hazards, causing injuries or fatalities due to drowning, particularly for children and livestock. To mitigate these negative impacts and ensure responsible land management, the developer will submit an Environmental Project Brief (EPB) to ZEMA and seek approval prior to accessing and utilizing borrow pits. This EPB will detail the appropriate decommissioning process for these borrow pits, aimed at restoring the landscape to conditions as close as possible to similar or better than those existing previously.

6.2 Socio-economic and Cultural

6.2.1 Positive Impacts

6.2.1.1 Increase in employment opportunities

All Project Phases

The project will create employment opportunities for people in the project area during construction phase. The implementation of the project will also bring about employment opportunities during operation phase from the commercial facilities. This positive impact will improve the livelihoods of the affected communities. This impact is of high significance.

6.2.1.2 Public Revenue

All Project Phases

Multiplier effects resulting from increased employment will include increased public revenues such as taxes (PAYE to ZRA, VAT) and contributions to NAPSA from formally employed

persons. Further, through toll fees, weighbridge charges, and other government levies. This additional revenue can be reinvested into further infrastructure development, road maintenance, and other public services, thereby supporting sustainable economic growth.

6.2.1.3 Infrastructural Development

The coming of the project will contribute to improved infrastructure in the area.

6.2.1.4 Capacity Building and Skills Development

All Project Phases

The project will contribute to capacity building and skills development of the people who will be employed through on-the-job training and interaction with other skilled personnel from different disciplines. These programs will equip local workers with valuable technical and vocational skills in road construction, infrastructure maintenance, and administrative operations, enhancing their employability in future projects and industries.

6.2.1.5 Enhanced Connectivity and Savings on Travel Time and Costs

Operation Phase

The enhanced connectivity resulting from the road upgrade will significantly improve transportation efficiency between Mutanda and Kaoma, facilitating the smooth movement of people, goods, and services. This improved connectivity will, in turn, lead to savings on travel time and costs, as the upgraded road will reduce vehicle wear and tear, fuel consumption, and delays associated with poor road conditions.

6.2.1.6 Economic Growth

All Project Phases

The coming of the proposed project will help to improve access to markets, agricultural zones, and industrial centers. A well-maintained road network will attract investment, support commercial activities, and create a more enabling environment for business development. Furthermore, the upgraded road and associated infrastructure will boost local businesses and increase international trade. Improved transportation efficiency will enhance the supply chain for businesses, enabling faster delivery of goods and services. Additionally, as the road serves as a key trade route, it will strengthen cross-border commerce by facilitating the movement of goods between Zambia and neighboring countries, thereby promoting regional and international trade.

6.2.1.7 Improved Road Safety

Operation Phase

Improved road safety is another major benefit of the project. The upgraded road will incorporate better signage, improved road markings, and safer crossing points, all of which will contribute to reducing accidents and enhancing overall road safety for motorists, cyclists, and pedestrians.

6.2.2 Negative Impacts

6.2.2.1 Spread of HIV/AIDS & STIs

All Project Phases

Workers will have extra disposable income. This sudden acquired affluence may translate itself into social behaviour including excesses on liquor and other social vices including prostitution. This will undoubtedly lead to an increase in commercial sex activities and hence an increase in HIV transmission levels and the spread of STIs .

6.2.2.2 Public Health and Safety Risks

Construction Phase

The implementation of the project will involve activities and procedures with potential risk to the health and safety of workers and members of the public. These will include:

- Working in areas covered with vegetation (may have snakes and plants that cause allergies)
- Movement of machinery around the site,
- Work around services,
- Use of machinery to perform activities. Improper usage of construction equipment can lead to human fatalities. Human life can also be lost through road accidents during the transportation of construction raw materials. This is a negative and direct impact, localized and of low significance
- Work with open flames (e.g. welding) and cutting operations,
- Work in dusty environment,
- Work at heights (during fitting of pipe works and inspection of machinery),
- Work in confined spaces,
- Work in noisy environment,
- Work with sharp objects.
- Movement on slippery floors.
- At all phases of the project, it is likely that the interaction/ human to human contact may result in the spread of Covid 19. It is therefore important that measures are put in place to prevent the spread of Covid 19.

Operation Phase

Once the road is upgraded, higher travel speeds and increased traffic flow are expected. Given the road's proximity to settlements, schools, and health centers, the risk of pedestrian and vehicular accidents will be elevated.

6.2.2.3 Occupational Health and Safety Risks

Construction Phase

Construction sites present various hazards, including slips, falls, equipment-related injuries, and exposure to hazardous materials. Given the scale of the road project, worker safety will be a priority, requiring proper health and safety protocols.

6.2.2.4 Noise and vibrations

Construction Phase

Project activities such as excavations and transportation during the project implementation will have potential to generate noise and vibrations. Land clearing and construction involve use of heavy equipment and these generate high levels of noise.

Apart from being a nuisance, high noise levels (above 85dB) can harm hearing ability if sustained over a long period of time. Similarly, vibrations can also cause damage to property such as cracking of existing property. Patients of hypertension can also have their situation worsened under high noise and vibration conditions.

Operation Phase

During this phase, the sources of noise will be from the movement of vehicles accessing the well tarred road.

6.2.2.5 Dust Nuisance

Construction Phase

Apart from it being an environmental pollutant, dust is equally a nuisance and an occupational as well as a public health issue of concern. Generation of dust has potential to cause nuisance, occupational and public health concerns. Apart from workers, people living near sources of dust pollution can also be affected by dust, resulting in coughs and other respiratory diseases as well as eye irritation. Dust nuisance is a public health issue of concern.

6.2.2.6 Impacts on Areas of Historical, Archaeological and Cultural Significance

All Project Phases

Although the project is primarily confined to the existing alignment, construction activities may still impact sites of cultural and historical significance. Preliminary surveys have not identified any significant heritage sites along the route; however, any unexpected discoveries must be managed in accordance with national heritage preservation guidelines. However, there is a possibility of encountering burial sites during construction. If burial sites are affected, they must be relocated in a manner that is respectful and culturally sensitive; as such relocations can be emotionally distressing for affected communities.

6.2.2.7 Influx of People into the Project area

All Project Phases

The prospect of employment at the project site is a catalyst for influx of people into the area with the consequent of increased population. Crime is also likely to increase as some of those people coming to the area may have criminal motives. The influx of people into the project area may also put a strain on the natural environment.

6.2.2.8 Resettlement and Livelihood Disruption ‘Displacement of Households, Trading Units and Agricultural Fields:

Construction Phase

The rehabilitation and upgrade of the Mutanda to Kaoma road will predominantly follow the existing road alignment; however, minor realignments may necessitate land acquisition. This could result in the displacement of agricultural fields and, in some cases, households situated close to the road corridor. While no major settlements are expected to be significantly affected, any necessary resettlement will be conducted in accordance with national regulations and international best practices, including the IFC Performance Standard 5 on Land Acquisition and Involuntary Resettlement. Measures will be implemented to ensure fair compensation, alternative land allocation where applicable, and livelihood restoration programs to mitigate economic disruptions for affected persons.

6.2.2.9 Impact on Adjacent Services

Construction Phase

The project may inadvertently affect existing infrastructure such as power lines, telecommunication cables, and water supply systems. Major installations along the route include ZESCO power lines. Damage to these utilities can disrupt essential services.

6.3. Characterization and Assessment of Impact Significance

Characterization and assessment of impact significance was based on a criterion that took into account the *frequency* of occurrence of the source of impact, *duration* of the impact, *severity* of the impact, *spatial extent* of the impact and *Sensitivity* of the element being impacted. Table 6 is a detailed presentation of the criteria used in assessing impact significance while Table 7 is a presentation of project impact significance characterization using the above criteria.

Characterisation of impact significance involved consideration of the following factors:

- Beneficial or detrimental (Positive, Negative)
- Severity of the impact (Very High, High, Moderate, Low),
- Spatial extent of the impact (Local, regional),
- Duration of the impact (Short-term, Medium-term, Long-term),
- Timing of the impact (Construction, Operation, Post Decommissioning/Closure),
- Frequency of impact occurrence (Continuous, Frequent, Infrequent, Occasional),
- Probability of impact occurrence (Unlikely, Possible, Probable, Certain), and
- Significance of Impact (Very high, High, Moderate, Low). The significance weightings for each potential impact are as follows:
    i. Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
    ii. Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)
    iii. High (i.e. where the impact must have an influence on the decision process to develop in the area.

Impacts were also characterized as direct or indirect in order to have a full appreciation of the impacts and facilitate effective management of the impacts. The process of impact identification and assessment involved all study team members and with each consultant presenting their findings within their specialist area of study for discussions.

Table 36: Impact Criteria Used

Impact Criteria	Description	Criteria Classification	
		Term	Description
Positive or Negative Impact	Will the impact have a beneficial or detrimental effect on the environment?	Positive	A beneficial effect
		Negative	A detrimental effect
Intensity or amplitude of the Impact	To what degree will the effect be felt or how good or bad will the effect be	Very high	Very good or very bad effect
		High	Good or bad effect
		Moderate	Relatively good or relatively bad effect
		Low	Slightly good or slightly bad effect
Extent of Impact	What is the geographical extent of the impact?	Local	Impact limited to Project footprint
		Limited	Impact limited to Project footprint & immediate neighbourhood
		Regional	Impact felt beyond neighbourhood

Impact Criteria Used - Continued			
Impact Criteria	**Description**	**Criteria Classification**	
		Term	**Description**
Duration of Impact	For how long will the impact continue to manifest or be felt?	Short-Term	Impact will cease once the project activities stop
		Medium-Term	Impact will last for a limited period after project activities (eventually reversible)
		Long-Term	Impact will be permanent & irreversible
Timing of Impact	At what point in time will the impact occur or be felt?	During Preparation	Impact will occur during preparation phase
		During Construction	Impact will occur during construction phase
		During Operations	Impact will occur during operation phase
		Post decommissioning	Impact will occur after the life time of the project
Frequency of Impact		Continuous	Impact will be continuous

	What is the likely frequency of occurrence?	Frequent	Impact will occur frequently
		Infrequent	Impact will occur infrequently
		Occasional	Impact will occur occasionally
Likelihood of Impact occurring	What is the probability of Impact occurrence?	Certain	Impact is certain to occur
		Probable	Impact is likely to occur
		Possible	Impact may possibly occur
		Unlikely	Impact is unlikely to occur
Significance of Impact	What is the Magnitude of impact (will the impact be of high, moderate or low severity?)	Very High	Very high Impact
		High	High Impact
		Moderate	Moderate
		Low	Low Impact

Table 37: Environmental Impact Assessment Matrix

Potential Environmental Impact	Environmental Impact Characterization							
	Positive / Negative Impact	**Intensity of Impact**	**Extent of Impact**	**Duration of Impact**	**Timing of Impact**	**Frequency of Impact**	**Likelihood of Impact Occurring**	**Significance of Impact**
Bio-Physical Environment								
Enhancement of the site ecology	Positive	Moderate	Regional	Long term	Operation phase	Continuous	Certain	High
Clearing of vegetation (climate change and habitat destruction and loss)	Negative	Very high	Regional	Short term	Construction phase	Occasional	Certain	High
Introduction of Alien species	Negative	Moderate - High	Local	Long term	Construction/ Operation phases	Occasional	Probable	Medium
Impact on Ecologically Sensitive areas	Negative	Moderate	Regional	Long term	Construction phase	Continuous	Certain	High
Loose soil washed into the surface waters disturbing aquatic life	Negative	Moderate	Regional	Short term	Construction phase	Occasional	Probable	Medium
- Contamination of surface water and groundwater from accidental material spillages, material store areas, drainage channels and sewage waste. - stream siltation	Negative	Moderate	Local	Short – medium term	All project phases	Occasional	Probable	Medium

Depletion of the water resource	Negative	Moderate	Local	Long term	Construction and operation phase	Continuous	Probable	Low
Soil contamination due to fuel spills from machinery and from sewage waste	Negative	Low	Local	Short term	Construction phase	Occasional	Probable	Low
Soil erosion	Negative	Moderate	Local	Short term	Construction phase	Occasional	Probable	Medium
Air pollution	Negative	Moderate	Local	Short term	Construction phase	Occasional	Certain	Medium
Disturbance and wildlife habitat loss	Negative	Very high	Local	Long term	Preparation and construction	Continuous	Certain	Medium
Non- hazardous waste nuisance	Negative	Medium	Local	Medium – Long term	All project phases	Continuous	Certain	Medium
Pollution from Hazardous waste generated	Negative	Medium	Localized Project Area	Medium – Long term	All project phases	Occasional	Certain	Low
Loud noises	Negative	Medium	Local	Short term	Construction phases	Occasional	Certain	Medium
Impacts on Landscape and aesthetics	Negative	High	Local	Short – Long term	Preparation and construction phases	Continuous	Certain	Low
Land Degradation due to Waste Disposal	Negative	High	Limited	Medium – Long term	All Project Phases	Continuous	Probable	Low - Medium

Land Degradation from Borrow Pits and Quarries	Negative	High	Limited	Medium – Long term	Construction Phase	Occasional	Certain	High
Socio-economic and Cultural Environment								
Increase in Employment Opportunities	Positive	Moderate	Local-regional	Long term	All project phases	Continuous	Certain	Medium
Increase in Public Revenue	Positive	High	Regional	Long term	All project phases	Continuous	Certain	High
Infrastructure Development	Positive	High	Regional	Long term	Operation phase	Continuous	Certain	High
Capacity Building and Skills Development	Positive	Moderate	Limited	Long term	All project phases	Continuous	Certain	Medium
Enhanced Connectivity and Savings on Travel Time and Cost	Positive	High	Regional	Long term	Operation phase	Continuous	Certain	High
Economic Growth	Positive	Moderate	Local - Regional	Long term	All project phases	Continuous	Certain	Medium
Improved Road Safety	Positive	High	Regional	Long term	Operational phase	Continuous	Certain	Medium - High
Spread of STI's and HIV/AIDS	Negative	High	Regional	Long term	All project phases	Occasional	Certain	High
Health & Safety Risks due to work activities and use of the tarred Road	Negative	High	Local - Limited	Medium – Long term	All project phases	Occasional	Probable	High
Occupational Health and Safety Risks	Negative	High	Local	Short term	Construction phase	Occasional	Probable	High
Spread of Covid 19	Negative	High	Local	Short term	All project phases	Occasional	Probable	High

Influx of people into the area	Negative	Moderate	Local	Medium term	All project phases	Frequent	Probable	Medium
Noise and Vibrations	Negative	High	Limited	Short term	Construction phase	Occasional	Probable	High
Dust nuisance	Negative	Moderate	Local	Short term	During construction	Frequent	Certain	Medium
Disturbance of areas of historical, archaeological & cultural significance	Negative	Low	Local	Long term	During construction	Infrequent	Probable	Insignificant
Displacement of Households, Trading Units and Agriculture Fields	Negative	Moderate - High	Local to Regional	Long term	Construction Phase	Occasional	Certain	Medium - High
Impacts on Adjacent Services	Negative	Moderate	Local - Regional	Short term	Construction phase	Occasional	Probable	Medium

7.0 ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

7.1 Management of Identified Impacts

7.1.1 Enhancement of Positive Biophysical Impacts

7.1.1.1 Enhancement of the Ecology

Operation Phase

- The developer will ensure that the development is according to the site plan incorporating green spaces.
- The developer to work closely with the Department of Forestry and local communities to set up a tree nursery in order to replace the trees that would be cut.

7.1.2 Mitigation of Negative Biophysical Impacts

7.1.2.1 Impacts on Ecology

Mitigating Impacts on Natural Environment

All Project Phases

Climate change due to vegetation clearing

Avoid Unnecessary Cutting Down of Indigenous Trees

Disturbances resulting from activities are expected (viz. Excavations, equipment laydown areas, temporary storage, parking for trucks,) In this regard, the following will be undertaken:

- Vegetation clearing will be limited; only areas earmarked for infrastructure development will be cleared. Construction activities will be contained within a reasonable minimum area through a planning and disciplined approach that accounts for the following considerations to avoid undesirable "footprint creep":
- The reasonable minimum area required for the construction activity will be determined in advance and clearly demarcated on the ground. These areas will consider equipment laydown areas, vehicle parking and turning space.
- Construction teams will be made aware of the demarcations prior to initiating construction works, and follow-up checks are to be done to ensure that the construction areas are not being exceeded.

Introduction of Alien species

To get rid of the invasive alien species on site (along the proposed route) which in this case is, the *Lantana Camara*, the developer will ensure that *Lantana Camara* species are uprooted from the root using hoe's, picks and garden folks. The roots and the stems will be completely removed. The uprooted plants will be treated as solid waste. Follow up to be done within 3 – 6 months.

Furthermore, all construction workers will be sensitized not to carry or introduce alien species (plants or otherwise) into the project area, so as to avoid alien species invasion in the area. Inspections will also be done to ensure that no seeds or plant remnants of these

invasive species are carried on equipment being transferred from other areas to be used for the project.

Minimize habitat loss and disturbance of Wildlife

All Project Phases

Integrate Biodiversity Importance into Induction Programs

The importance of the natural environment and the local biodiversity will be incorporated into Induction Programs for all of the workers and contractors working in the Project Area. These components of the induction programs will be regularly updated and improved, and will include the following topics:

- Awareness of the biodiversity that exists in the Project Area and surrounds and the impacts caused during the construction phase of the Project.
- Outline the individual responsibilities to reduce impacts to biological environment.
- Present the company procedures on land clearance and waste disposal.
- Vehicle speed limits and the reasons for them.
- Highlight the responsible people on any biodiversity related issues that may arise.

Implement an Internal Biodiversity Protection Statement

A Biodiversity Protection Statement to conserve plants and animals will be developed, and made applicable to all staff, contractors and other personnel associated with the Project. The following activities will be prohibited by contractors within and surrounding the Project Area, both during and outside of work hours:

- Any forms of hunting of mammals or blank firing of guns.
- The intentional killing of any animals including snakes, lizards, birds or other animals. Awareness of the Animal Rescue Plan will be promoted as a means of addressing the presence of animals at risk or presenting a risk to the implementation of activities.
- Purchase, sale or transport of any live animals, bush meat or other local wild animal products from local communities or passing traders.
- Collection of any animals or animal products for consumption, medicinal or other use.
- Sellers of wildlife would not be allowed on project site premises. Such people will be reported to local authorities or appropriate wildlife agencies such as DNPW.
- Purchase or transport of fuel wood from or for surrounding communities.

The above information will be included within the site induction processes so that all workers are aware of these prohibitions. It will also be included in internal and external reporting documentation.

Implement an Animal Rescue Plan

An animal rescue procedure will be developed and implemented for the safe translocation of any faunal species found to be at risk from operations or posing a threat to project activities. The animal rescue procedure will include the following aspects:

- Selected staff will be professionally trained and equipped to handle venomous snakes, with particular emphasis on species likely to be encountered in and around the Project Area, and a schedule maintained whereby a trained snake handler is on call during operational hours.

Develop and Implement Awareness Programs Focused on Biodiversity

Awareness and appreciation of the local ecology among people generates tremendous support for the conservation of biodiversity. Various biodiversity-related activities will be highlighted in this document, which include the development of a register of species, the need for an animal rescue plan and offsetting and ecological monitoring programs. Awareness of these activities will be raised among staff and contractors. The following suggestions are presented, but awareness programs need not be restricted to these:

- Where possible, opportunities will be explored for involvement of staff, contractors and associated personnel to widen the appreciation and enthusiasm for the conservation of the biodiversity in and around the project Area.
- Staff and contractors will be encouraged to report interesting wildlife sightings and observations, which are to be incorporated into the species register and recognition for worthwhile wildlife observations will be publicized accordingly.

Fauna Protection along Animal Corridors:

- Construct wildlife crossing points, such as culverts that can be seen as underpasses to facilitate the safe movement of animals across roads.
- Install appropriate signage to warn motorists of potential wildlife crossings, reducing vehicle collisions with animals.
- Implement speed reduction measures in identified wildlife crossing zones to minimize the risk of accidents.
- Develop and maintain vegetative buffer zones along road edges to provide natural pathways for wildlife movement.
- Use fencing strategically to guide animals toward designated safe crossing areas and prevent roadkill incidents.
- Conduct periodic ecological assessments to monitor wildlife movement patterns and adjust mitigation measures accordingly.
- Engage local communities and conservation organizations in monitoring and protecting key wildlife corridors.

Impacts on Ecologically Sensitive Areas

Construction Phase

During construction the developer will ensure that the contractor on site manage all construction activities ensuring that the aquatic environment is not disturbed or rather altered in any way such as changing of water pH or addition of any nutrients/substances. This will be so to keep the aquatic environment as is. If there be any disturbance to the aquatic environment, remedial actions will be taken. Sediment loads in the streams will also be reduced by incorporating erosion control measures.

7.1.2.2 Hydrology
Construction Phase

Surface water contamination

The following measures will be implemented for the protection and conservation of surface water resources:

- Proper management of fuel run machinery to prevent spillage and the potential to contaminate ground with the possibility of wash down to surface water bodies;
- Maintenance of equipment will be done at designated workshops offsite.
- Wastewater and sewage will be disposed of properly so as to prevent pollution of water bodies. The Contractor will have hired chemical toilets that will be maintained properly ensuring that there is no contamination to the hydrological environment, also ensuring that workers and wildlife are not exposed to sewage waste.
- Vegetation will as much as possible be preserved to hold the soil together. Exposed work areas will be watered down in the dry season to prevent the soil from being eroded by wind.
- Localising all debris and other wastes and confining them in designated storage areas for appropriate disposal.

Ground Water

Sewage waste will be managed by the use of hired chemical toilets - to prevent oil/fuel leaks into ground water resources, all machinery that uses or requires oil will be checked for spillages and properly maintained before usage on this site. The fuel to be used on site will be brought to site by use of mobile fuel bowsers from licensed operators. All routine maintenance of construction machinery and vehicles will be carried out off-site at workshops. Poorly maintained machinery will not be allowed to operate on site.

Operation phase

Surface and ground water

Sewage waste will be managed through the use of modern flushable toilets, which will be connected to an onsite conservancy tank/pump-out system. Additionally, to prevent any strain on community water resources, the proposed associated infrastructures (admin office unit, toll gates, weighbridges, and service yards) will be equipped with independent boreholes, ensuring a sustainable and self-sufficient water supply.

7.1.2.3 Impact on Soil

Construction Phase

The developer will ensure that trees are not unnecessarily cut to prevent the loosening of the soil. Land disturbance will be minimized to absolutely required or designated areas. Earthworks will be done before the onset of the rains to minimize the washing away of soil by rain. Runoff during this phase is expected to be as a result of rains washing away loose material. The developer will ensure that during the rainy season fine material (such as sand and cement) and waste is managed in such a way that it cannot runoff. The developer will ensure timely rehabilitation/stabilization of disturbed areas by undertaking activities such as re-vegetation and proper landscaping.

To prevent oil/fuel leaks into ground water resources, all machinery that uses or requires oil will be checked for spillages and properly maintained before usage on this site. The fuel will be brought to site by use of mobile fuel bowsers. All routine maintenance of construction machinery and vehicles will be carried out off-site at workshops. Poorly maintained machinery will not be allowed to operate on site.
Waste will be temporarily disposed of in bins provided on site and not onto the soil. Sewage waste will be managed by the use of hired chemical toilets.

Operation Phase

During operation municipal waste will be disposed of in bins which will be collected by approved municipal waste collectors. Sewage waste will be managed by the use of modern flushable toilets that will discharge into onsite septic tanks and pump - out system.

7.1.2.4 Air Pollution

Construction Phase

To reduce the amount of dust arising from the proposed project activities, all fine material (sand, cement, etc.) capable of being raised by the wind and causing air nuisance will be stock piled wholly within the construction sections of the site. Exposed areas on site will be watered by use of a water bowser to suppress dust were possible. All machinery to be used on site will be regularly checked and maintained to ensure that the same are as quiet as possible and that no excessive exhaust fumes are produced. To reduce construction traffic, raw materials will be delivered to site in bulk. Dust level monitoring for corrective action will be done frequently and from the early works of the project.

Operation Phase

The development will feature well-paved road constructed to bituminous standards, effectively minimizing dust emissions. Consequently, air pollution from both dust and vehicle exhaust fumes will be minimal to negligible.

7.1.2.5 Waste Generation

Construction phase

The waste that is generated will have to be managed and disposed of appropriately in accordance with its waste classification.

The solid waste generated on this site such as paper, plastic, empty tins, etc. will be temporarily disposed in drums that will be placed at various locations of the proposed sites. The bins will be emptied on a regular basis into a waste collection truck managed by the local council and then transported to an approved disposal site. The hazardous waste/ material soiled with hazardous chemicals/products will be temporarily disposed of in a drum that will be clearly marked as hazardous waste and will be covered at all times. This hazardous waste bin will then be collected by an approved hazardous waste collection agency and disposed of at a ZEMA approved disposal sites.

Excess excavated material generated by the project will be disposed of within the designated area. Sewage will be managed by the use of hired chemical toilets. Good house-keeping practices will be strictly adhered to.

Operation Phase

The developer will encourage the use of bins/garbage bags which will later be collected by a licensed garbage collector at regular intervals. The developer will encourage good house-keeping practices and sewage management will be by use of modern flushable toilets connected to an onsite septic tanks and pump – out system.

Hazardous waste At all phases of the project

During construction, hazardous waste will be disposed of in separate bins. These bins will be in a designated area under lock and key. The waste will then be removed from site by ZEMA licensed hazardous waste transporters and disposed of at privately owned hazardous waste-specific disposal sites in accordance to best available technologies. During operation no hazardous waste is expected to be generated or imported.

7.1.2.6 Noise and Vibration

Construction Phase

To mitigate construction impacts, a detailed pre-construction survey will document the existing condition of nearby structures and utilities using visual inspections, photographs/videos, and GPS, serving as a baseline for monitoring damage and determining liability. Additionally, all construction vehicles and equipment will be regularly maintained, and workers exposed to high noise will use PPE (ear muffs/plugs). Noise abatement measures will include limiting construction to daytime hours, ensuring proper machinery operation, and installing temporary sound barriers where necessary.

Major abatement measures include:

- Limiting construction to daytime only and no night-time construction using heavy machinery particularly near settlements ;
- Good maintenance and proper operation of construction machinery to minimize noise generation; and,
- Installation of temporary sound barriers where necessary.

Operation Phase

During operation, the noise from the vehicles using rehabilitated and upgrade Mutanda to Kaoma Road will be medium to low.

7.1.2.7 Impact on landscape and aesthetics

All Project Phases

Land degradation will be prevented and minimized by restricting the cutting down of trees and ensuring that excavation works are only done when necessary. There will be need for the rehabilitation of disturbed areas and localization of waste to areas of generation and designated collection points. Furthermore, the developer will consider:

- Careful choice of service routes by selecting less vegetated areas and alignment of routes along existing passages such as roads to limit opening up of virgin land.
- Land clearing to be limited to absolutely required areas and progressive rehabilitation and re-vegetation of disturbed sites will be undertaken.
- Effective stabilization of altered landforms.

7.1.2.8 Land Degradation

Construction Phase Mitigation Measures

1. Vegetation Clearance and Organic Waste Management

To minimize environmental impact during construction, the following mitigation measures will be implemented:

- Restrict vegetation clearance to only essential areas to reduce waste generation.
- Stockpile and preserve removed topsoil for future use in re-vegetation and landscaping.
- Implement tree replanting programs in cleared areas, particularly along road reserves, to restore ecological balance.

2. Bituminous Waste Management

To ensure proper handling and disposal of bituminous waste, the following measures will be adopted:

- Reuse milled asphalt and bituminous waste as a base or sub-base material for road rehabilitation where feasible.
- Store bituminous waste in designated containment areas before safe disposal at approved waste management sites.
- Require contractors to develop and implement a comprehensive waste management plan that includes proper handling, storage, and disposal of bituminous waste.
- Engage licensed waste management service providers for the collection, transportation, and disposal of hazardous road waste to prevent environmental contamination.

7.1.2.9 Land Degradation from Borrow Pits and Quarries

Mitigation Measures for Borrow Pits and Quarry Extraction

Construction Phase

The developer/contractor will submit an Environmental Project Brief (EPB) to ZEMA and seek permission before any borrow pits are utilized for the project To minimize environmental degradation and ensure sustainable land use, the following mitigation measures will be implemented and will be described in the submitted EPB :

- **Site Selection and Planning:**
    - Identify and utilize existing, licensed borrow pits and quarries where feasible to minimize land disturbance.
    - Conduct environmental assessments before opening new borrow pits to determine potential impacts and appropriate mitigation measures.
- **Controlled Extraction Practices:**

    - Limit excavation to designated areas and follow approved extraction plans to prevent excessive land degradation.
    - Implement phased extraction, ensuring that one area is rehabilitated before new areas are exploited.
- **Erosion Control Measures:**
    - Implement slope stabilization techniques such as terracing, retaining walls, and vegetation cover to prevent soil erosion.
    - Establish drainage channels to control surface runoff and minimize sedimentation of nearby water bodies.

Operation Phase

To prevent long-term environmental and public health risks, the following measures will be taken:

- **Borrow Pit and Quarry Rehabilitation:**
    - Backfill pits with excavated overburden or other inert materials where feasible.
    - Implement reforestation and re-vegetation programs using native plant species to restore ecological balance.
- **Health and Safety Measures:**
    - Convert abandoned borrow pits into safe, beneficial land uses, such as community ponds, agricultural fields, or recreational areas.
    - Erect warning signs and secure hazardous areas with fencing or barricades to prevent unauthorized access.
- **Mosquito Control and Public Health Protection:**
    - Ensure proper drainage in rehabilitated sites to prevent water stagnation and mosquito breeding.
    - Collaborate with local health authorities to implement malaria awareness and prevention programs in affected communities.

7.1.3 Enhancement of Positive Socio-economic and Cultural Impacts

7.1.3.1 Increase in Employment Opportunities

All Project Phases

- The developer will prioritize local hiring to maximize community benefits.
- Formation of an employment committee (through traditional leaders) to maximize the employment of local people.
- Women to be encouraged to take part in the project wherever possible.
- Provide fair wages and ensure safe working conditions.
- Implement training programs to enhance skills and long-term employability.

- Priority given to employment of persons from local communities as far as possible.
- Local suppliers given priority as far as possible.

7.1.3.2 Public Revenue

All Project Phases

- The developer will ensure that contributions for formally employed persons are made to NAPSA. The developer will also ensure that all relevant taxes are paid and all other contributions made to the relevant authorities.
- Encourage local businesses to register formally to contribute to tax revenue.

7.1.3.3. Infrastructural Development

Operation Phase

- Ensure infrastructure improvements align with local development plans.
- Implement proper maintenance programs for sustained infrastructure benefits.

7.1.3.4 Capacity Building and Skills Development

Construction Phase

- Up-skilling of the unskilled workforce through interaction with skilled man power
- Collaborate with vocational training institutions to certify acquired skills.
- Promote mentorship and knowledge transfer from experienced personnel.
- Support post-project employment opportunities for trained individuals.

7.1.3.5 Enhanced Connectivity and Savings on Travel Time and Costs

Operation Phase

- Continuous maintenance of the upgraded road to prevent deterioration.

7.1.3.6 Economic Growth

All Project Phases

- The developer will encourage investment by creating business-friendly policies along the route.
- Support local businesses in leveraging improved market access.

7.1.3.7 Improved Road Safety

Operation Phase

- Conduct periodic road safety awareness campaigns.
- Ensure road signage, speed limits, and pedestrian crossings are well maintained.
- Implement road safety audits and make necessary improvements.

7.1.4 Mitigation of Negative Socio –economic and Cultural Impacts

7.1.4.1 Increased Risk of HIV/AIDS Transmission

All Project Phases

The Developer/Contractor will conduct HIV/AIDS awareness and prevention campaigns amongst all members of the workforce in conjunction with the local health centre under which the catchment area of the development falls. Such programmes are conducted under the auspices of the Ministry of Health as part of the Government's overall HIV/AIDS awareness and prevention policy. Free condoms will be made available to all members of the workforce.

Where practicable, and without prejudice to the Contractor's other contractual obligations, preferential employment should be given to members of local communities in the project area. This will reduce the risk of communicable diseases transmission associated with labour that originates from outside the community.

7.1.4.2 Health and Safety Risks

All Project Phases

Mitigation measures will include the following:

- During construction, the developer will only allow contractors who prioritise safety (with a working health and safety plan that will include emergency response plans, risk assessments, etc.) to carry out works for the proposed project.
- Restriction of public access to operational areas by putting appropriate signage; Construction of alternative roads where the usual roads have been blocked; Provision of appropriate PPE; and Proper marking of boundaries for the operational areas and associated facilities.
- All workers will be trained and reoriented in occupational health and safety. Applicable protocols will be firmly enforced.
- All workers will be provided with personal protective equipment. Only well qualified and experienced workers will be tasked to drive vehicles and operate machinery. Haulage trucks will adhere to speed limits.
- An emergency response plan should also be put in place to guide response and minimise effect in case of an emergency situation.
- During the operation phase, the developer, in collaboration with the RDA as a key partner, will implement additional road safety measures. These will include the installation of appropriate road signage, clearly marked speed limits, and strategically placed speed humps. These measures aim to enhance road safety,

minimize the risk of accidents, and mitigate the likelihood of animal collisions where applicable.

- At all phases of the project measures will be put in place to prevent the spread of Covid 19.

7.1.4.3 Occupational Health and Safety Risks

All Project Phases

To effectively manage and mitigate occupational health and safety risks associated with the construction phase of the road project, the following measures will be implemented:

- **Implementation of a Robust Health and Safety Management Plan (HSMP)**
  - Develop and enforce a site-specific Health and Safety Management Plan (HSMP) in compliance with national regulations and international best practices.
  - Conduct regular safety audits and inspections to ensure compliance with safety standards.
- **Worker Training and Capacity Building**
  - Provide mandatory health and safety induction training for all workers before site deployment.
  - Conduct regular refresher training on hazard recognition, emergency response, and safe equipment handling.
  - Train workers on the proper use of personal protective equipment (PPE).
- **Provision and Enforcement of Personal Protective Equipment (PPE)**
  - Supply all workers with appropriate PPE, including helmets, gloves, safety boots, high-visibility vests, goggles, and ear protection.
  - Enforce strict adherence to PPE use through routine monitoring and disciplinary measures for non-compliance.
- **Fall Prevention and Work-at-Height Safety Measures**
  - Install guardrails, safety nets, and harnesses where work at height is required.
  - Conduct routine inspections of scaffolding and ladders to ensure stability and compliance with safety standards.
- **Safe Handling and Operation of Equipment and Machinery**
  - Ensure all machinery and equipment are properly maintained and inspected before use.
  - Restrict equipment operation to trained and certified personnel only.
  - Implement lockout/tagout procedures to prevent accidental machine activation during maintenance.
- **Hazardous Materials Management**
  - Store and handle hazardous materials (e.g., fuels, chemicals, and solvents) in designated and properly labeled areas.
  - Provide workers with Material Safety Data Sheets (MSDS) and training on the safe handling of hazardous substances.
  - Establish emergency response protocols for spills, leaks, or accidental exposure.

- **Site Housekeeping and Slips/Trips Prevention**
  - Maintain a clean and organized construction site by removing debris, securing loose materials, and ensuring clear walkways.
  - Implement proper drainage systems to prevent water accumulation and slippery surfaces.
  - Clearly mark hazardous areas and provide adequate site lighting for visibility.
- **Emergency Preparedness and Response**
  - Establish well-equipped first aid stations at strategic locations on-site.
  - Train designated personnel in first aid, firefighting, and emergency response procedures.
  - Conduct periodic emergency drills, including fire evacuation and accident response simulations.
- **Fatigue Management and Worker Welfare**
  - Implement regulated working hours and mandatory rest breaks to prevent worker fatigue.
  - Provide shaded rest areas, drinking water stations, and proper sanitation facilities.
  - Offer health screenings and wellness programs to monitor workers' well-being.
- **Accident Reporting and Investigation**
  - Establish a structured system for reporting, documenting, and investigating all workplace incidents.
  - Analyze accident trends and take corrective measures to prevent recurrence.
  - Encourage a safety culture where workers report hazards without fear of retaliation.

7.1.4.4 Noise and Vibrations

Construction Phase

Proposed mitigation measures must include:

The developer will consider noise as an environmental concern in its planning and during execution of the works. The Contractor shall use plant and equipment conforming to international standards and directives on noise, vibrations and emissions.
The Contractor will also take all necessary measures to ensure that operation of all mechanical equipment and construction processes on and off the site shall not cause any unnecessary or excessive noise, taking into account all applicable environmental requirements.

Operation Phase

During this phase, the primary source of noise will be vehicles utilizing the road. However, the noise levels generated are expected to be minimal to negligible.

7.1.4.5 Dust Nuisance

Construction Phase

To mitigate the impact of dust:

- Were possible, work areas with potential to generate dust when conducting excavations and other land preparation works will be watered to suppress dust.
- Workers working in dusty areas will be provided with PPE such as respirators and PPE usage will be enforced.
- Fine materials will be carefully handled to minimize on dust generation such as having designated fine raw material storage areas.
- Exposed work areas will be compacted and trees will be cut in sections and not all at once and speed limits on dust roads will be enforced.

7.1.4.6 Impacts on Areas of Historical, Archaeological and Cultural Significance

All Project Phases

Though no specific sites have been identified in the areas earmarked for development, the project implementation team will consult headmen and other stakeholders in the project area on an on-going basis to ensure that any areas deemed culturally sensitive including shrines and burial places are identified and taken care of by isolation or other management options deemed appropriate by concerned parties. Should any archaeological item be found, this will be taken to the NHCC.

Mitigation Measures for Chance Find Burial Sites

- If human remains are found, Mark and cordon off the site to protect it from unauthorized access or tampering secure the site and cease work. Report to NHCC and Zambia Police.
- Pre-1924 remains should be handled through archaeological processes; newer remains should be managed by the police.
- Resume project work only with appropriate authority.

7.1.4.7 Influx of People to the Project Area

All Project Phases

- The contractors on site will be mandated to prioritize employment to the local people. A total of 1000 people are anticipated to be employed.
- To promote security for the locals and prevent crime in the project area, the employment office will be located outside the site. This will prevent the influx of people seeking jobs.
- The Contractor will also be encouraged to procure supplies from local sources to the maximum extent possible.
- The influx of people to the project area will be discouraged by giving priority in employment to local residents.

7.1.4.8 Displacement of Households, Trading Units and Agricultural Fields

Construction Phase

The rehabilitation and upgrade of the Mutanda to Kaoma Road is a critical infrastructure project aimed at improving connectivity, enhancing transportation efficiency, and boosting economic activities in the region. While the project primarily follows the existing road alignment, minor realignments may require land acquisition, potentially affecting agricultural fields and some households. To mitigate the associated socio-economic impacts, structured measures will be implemented to ensure fair compensation, livelihood restoration, stakeholder engagement, and post-resettlement support. Below are the proposed mitigation measures:

i. **Land Acquisition and Compensation**

A detailed land and asset survey will be conducted to identify affected agricultural fields, structures, and households. Compensation will be provided at full replacement cost in accordance with national regulations and IFC Performance Standard 5, ensuring it is disbursed before displacement occurs. Where possible, alternative land will be allocated to displaced farmers to sustain their agricultural activities.

ii. **Livelihood Restoration Programs**

To support affected persons, agricultural assistance will be provided through training, input distribution, and technical guidance. Vocational training and employment opportunities in road construction will also be prioritized for displaced individuals. Additionally, market access support and financial literacy programs will be introduced to promote alternative income-generating activities.

iii. **Stakeholder Engagement and Grievance Management**

A transparent and inclusive consultation process will be conducted, involving affected communities, traditional leaders, and local authorities. A Grievance Redress Mechanism (GRM) will be established to address concerns promptly, while a Resettlement Action Plan (RAP) will outline strategies for compensation, relocation, and livelihood restoration in line with regulatory and best practice standards.

iv. **Post-Resettlement Monitoring and Support**

Periodic follow-up assessments will be conducted to evaluate the effectiveness of compensation and livelihood restoration efforts. Additionally, partnerships with government agencies and NGOs will facilitate continuous community support, including access to health services, education, and social integration programs.

7.1.4.9 Damage and Disruption to Adjacent Services

The rehabilitation and upgrade of the road may impact existing infrastructure such as ZESCO power lines and optical fiber cables, potentially disrupting essential services. To mitigate these risks, the developer/contractor will implement the following measures:

- **Pre-Construction Planning and Coordination**
    - Conduct a detailed survey to map the exact locations of power lines, and telecommunication cables.
    - Engage relevant service providers (e.g., ZESCO, telecom companies, etc.) to coordinate activities and minimize disruptions.
    - Develop a relocation plan for any utilities that may be affected.
- **Damage Prevention During Construction**
    - Clearly mark underground and overhead utilities to prevent accidental damage.
    - Use controlled excavation methods, such as trenchless technology or manual digging, near critical infrastructure.
    - Install protective reinforcements for power lines and telecommunication cables where necessary.
- **Emergency Response and Service Restoration**
    - Establish agreements with service providers for immediate repairs in case of accidental damage.
    - Notify affected customers in advance through public announcements if service disruptions are unavoidable.
    - Provide temporary alternatives for power, or communication services where necessary.
- **Post-Construction Monitoring and Compliance**
    - Conduct inspections to ensure all utilities remain functional after construction.
    - Update utility records to reflect any modifications or relocations for future reference.

7.2 ESTIMATION OF EFFECTIVENESS OF MANAGEMENT COMMITMENTS

An estimation of the effectiveness of the mitigation measures is done in table 7.1. The parameter that has been used to estimate the effectiveness is the significance parameter on a scale of low to high. Explained as follows:

i. Low (i.e. where this impact would not have a direct influence on the decision to develop in the area)
ii. Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated)
iii. High (i.e. where the impact must have an influence on the decision process to develop in the area.

Table 38: Estimation of Effectiveness of Mitigation Measures

Potential Environmental Impact	**Environmental Impact Characterization**							
	Positive / Negative Impact	**Intensity of Impact**	**Extent of Impact**	**Duration of Impact**	**Timing of Impact**	**Frequency of Impact**	**Likelihood of Impact Occurring**	**Significance of Impact**
Bio-Physical Environment								
Enhancement of the site ecology	Positive	Moderate	Regional	Long term	Operation phase	Continuous	Certain	High
Clearing of vegetation (climate change and habitat destruction and loss)	Negative	Moderate	Regional	Short term	Construction phase	Occasional	Certain	Low
Introduction of Alien species	Negative	Moderate	Local	Long term	Construction phase	Occasional	Probable	Medium
Impact on Ecologically Sensitive areas	Negative	Moderate	Regional	Long term	Project life cycle	Continuous	Certain	Low
Loose soil washed into the surface waters disturbing aquatic life	Negative	Moderate	Regional	Short term	Construction phase	Occasional	Probable	Low
- Contamination of surface water and groundwater from accidental material spillages, material store areas, drainage channels and sewage waste. - stream siltation	Negative	Moderate	Local	Short – medium term	All project phases	Occasional	Probable	Low
Depletion of the water resource	Negative	Moderate	Local	Short term	Construction and operation phase	Occasional	Probable	Insignificant

Soil contamination due to fuel spills from machinery and from sewage waste	Negative	Low	Local	Short term	Construction phase	Occasional	Probable	Low
Soil erosion	Negative	Moderate	Local	Short term	Construction phase	Occasional	Probable	Low
Air pollution	Negative	Moderate	Local	Short term	Construction phase	Occasional	Certain	Low
Disturbance and wildlife habitat loss	Negative	High	Local	Long term	Preparation and construction	Continuous	Certain	Low
Aesthetics/visual impacts	Negative	Moderate	Local	Long term	Construction phase	Continuous	Certain	Insignific ant
Non- hazardous waste nuisance	Negative	Medium	Local	Medium – Long term	All project phases	Continuous	Certain	Low
Pollution from Hazardous waste generated	Negative	Medium	Localized Project Area	Medium – Long term	All project phases	Occasional	Certain	Low
Loud noises	Negative	Medium	Local	Short term	Preparation and construction phases	Occasional	Certain	Medium
Impacts on Landscape and aesthetics	Negative	High	Local	Short – long term	Preparation and construction phases	Continuous	Certain	Low
Land Degradation due to Waste Disposal	Negative	Medium	Limited	Medium – Long term	All Project Phases	Continuous	Probable	Low

Land Degradation from Borrow Pits and Quarries		Moderate	Limited	Medium – Long term	Construction Phase	Occasional	Probable	Low
Socio-economic and Cultural Environment								
Increase in employment opportunities	Positive	Moderate	Local-regional	Long term	All project phases	Continuous	Certain	Medium
Increase in Public Revenue	Positive	High	Regional	Long term	All project phases	Continuous	Certain	High
Infrastructure Development	Positive	Moderate	Regional	Long term	Operation phase	Continuous	Certain	High
Capacity building and skills development	Positive	Moderate	Local	Long term	All project phases	Continuous	Certain	Medium
Enhanced Connectivity and Savings on Travel Time and Cost	Positive	High	Regional	Long term	Operation phase	Continuous	Certain	High
Economic Growth	Positive	Moderate	Local - Regional	Long term	All project phases	Continuous	Certain	Medium
Improved Road Safety	Positive	High	Regional	Long term	Operation phase	Continuous	Certain	High
Spread of STI's and HIV/AIDS	Negative	Moderate	Regional	Long term	All project phases	Occasional	Certain	Low
Health & Safety risks due to work activities	Negative	Moderate	Local	Short term	All project phases	Occasional	Probable	Low
Occupational Health and Safety Risks	Negative	Moderate	Local	Short term	Construction Phase	Occasional	Probable	Low
Spread of Covid 19	Negative	Moderate	Local	Short term	All project phases	Occasional	Probable	Low

Influx of people into the area	Negative	High	Local	Medium term	All project phases	Frequent	Probable	Medium
Socio-economic and Cultural Environment								
Noise and Vibrations	Negative	Moderate	Limited	Short term	Construction Phase	Occasional	Probable	Low
Dust nuisance	Negative	Moderate	Local	Short term	During construction	Frequent	Certain	Low
Disturbance of areas of historical, archaeological & cultural significance	Negative	Low	Local	Short term	During construction	Infrequent	Probable	Insignificant
Displacement of Households, Trading Units and Agricultural Fields	Negative	High	Local - Regional	Short term	Construction Phase	Occasional	Certain	Low
Impacts on Adjacent Services	Negative	Moderate	Local - Regional	Short term	Construction phase	Occasional	Probable	Low

7.3 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

In this section, an Environmental and Social Management Plan (ESMP) has been prepared to cover all the phases of the project life: design, construction, operation and maintenance. The ESMP combines both the environmental and social monitoring plan and the environmental and social management plan.

The purpose of the Environmental and Social Management Plan (ESMP) is to present a structured approach for optimizing beneficial impacts on the one hand while mitigating adverse impacts on the other. It has been prepared to render practical guidance to implementation of the proposed project in an environmentally friendly and socially acceptable manner. The construction contractor will thus assist the developer in implementing mitigation measures contained in the ESIA to ensure environmental protection. In this regard, the ESMP is based on the EMA (2011) and (EIA) Regulations of 1997 together with underscores responsibilities for BHL-TC, the construction contractor, supervising consultant, GRZ agencies, NGOs and the affected community in safeguarding the environment in and around the project area.

The measures taken will as a matter of principle seek to:

- Reduce the harmful characteristics of impact sources by devising less harmful ways of effecting project activities.
- Localise project impacts as much as possible by taking precautions in effecting project activities.
- Explore ways and means of enhancing the resilience and regenerative/recovery capacity of impacted elements of the environment, and
- Streamline better management practices including cleaner production as an integral part of project implementation.

Monitoring of the project's environmental performance will be carried out as a routine part of project implementation to observe changes taking place in the environment and assess the effectiveness of the interventions put in place. This would help the timely administering of corrective management interventions to avoid occurrence of serious negative effects. The plan, indicated in table 7.2, specifies:-

- Environmental Aspect (What needs to be managed?)
- Environmental Management Objective (Why does it need to be managed?)
- Mitigation/enhancement measure (How should it be managed?)

Table 39: Environmental and Social Management Plan

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Positive Impacts of the Project									
Operation of the road and associated infrastructure	Enhancement of the Ecology	To ensure that the site ecology is better than what the developer has found	The developer will ensure that the development is according to the site plan incorporating green spaces. Working in collaboration with the Department of Forestry to plant more trees.	Developer/RDA and Department of Forestry	• % of trees planted	• Site observation	As often as required	Operation phase (23+ years)	Landscape costs to be advised
Employment Creation	Employment Opportunities	To create employment opportunities for the communities within the project area	Prioritize hiring of local workers, ensure fair wages, and provide training programs for skill development	Contractor / Project Manager	• Number of locals employed to carry out construction works. • % of female workers on site • Percentage of local workers employed	• Register of employees	Monthly	2 years (construction phase) and 23+ years (operation phase)	Salaries

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Public Revenue	Increased tax revenue and economic growth	To ensure compliance with tax obligations and financial contributions	The developer will ensure that all relevant taxes are paid and all other contributions made to the relevant authorities.	Contractor / Project Manager	• Number of employees with contributions to NAPSA • Percentage of taxes paid	• Financial reports, tax receipts	Monthly	Project lifecycle (23+ years)	750,000
Infrastructure Development	Improved road network and associated facilities	To ensure high-quality infrastructure development	Proper planning, use of durable materials, and compliance with construction standards	Contractor	• Completion of infrastructure as per design	Site inspections, engineering reports	Monthly	Construction phase (23+ years)	2,500,000
Capacity Building	Skill development for local workers	To enhance skills and long-term employability	Provide on-the-job training, mentorship programs, and certification opportunities	Project Manager / Contractor	• Number of workers trained	• Training records, certification reports	Quarterly	Construction phase (2 years)	1,200,000
Enhanced Connectivity & Savings on Time and Costs	Improved transportation efficiency	To reduce travel time and vehicle maintenance costs	Ensure high-quality road surfacing, efficient drainage, and proper road signage	Contractor	• Travel time reduction & road condition compliance	• Traffic flow monitoring, cost-benefit analysis	Bi-annually	Operational Phase (23+ years)	3,000,000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Improved Road Safety	Reduction in accidents and pedestrian risks	To enhance road user safety	Install proper road signage, pedestrian crossings, and speed control measures	Project Manager / Contractor	• Number of safety features installed	• Road safety audits, accident reports	Quarterly	Operation Phase (23+ years)	2,000,000
Negative Impacts Biophysical Environment									
Vegetation Clearance	Climate change and disturbance of natural environment Habitat loss and deforestation	To minimize impact on flora To prevent soil erosion	Land clearing will be limited to absolutely required areas and progressive rehabilitation and re-vegetation of disturbed sites will be undertaken. To prevent soil erosion, earthworks will be done before the onset of the rains; also, vegetation will not be cleared at once but in sections being worked on at a time. The soils will be compacted and the site regularly watered down to hold the soils together.	Project Manager / Contractor	• Number of large trees cut to pave way for service infrastructure • % increase of vegetation at the end of the construction phase • Number of trees replanted	• Site inspection • Record of planted trees	Quarterly	Construction phase (2 years)	1,200,000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Wildlife and biodiversity	Disturbance to Fauna Increased killing of wildlife by speeding motor vehicles	. To reduce/prevent noise from construction works which may impact negatively on wildlife Avoid/reduce accidents involving motor vehicles and wildlife	Avoiding excessive noise producing activities like blasting in areas close to Game Parks and GMAs Set speed limits and place proper road signage	Project Manager / RDA and DNPW	• Number of accidents reported involving wildlife	• DNPW Report • Site inspection	Monthly	Construction phase (2 years) and Operation phase (23+ years)	200, 000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Invasive species	Biodiversity-spread of invasive species	To prevent the spread of invasive alien species (lantana camara)	To get rid of the invasive alien species on site which in this case is, the *Lantana Camara*, the developer will ensure that *Lantana Camara* species are uprooted from the root using hoe's, picks and garden folks. The roots and the stems will be completely removed. The uprooted plants will be treated as solid waste. Follow up to be done within 3 – 6 months.	Project Manager / Contractor	• Number of invasive species cleared or eradicated	• Visual observation for invasive species and spread of invasive species	Weekly	Construction phase (2years)	
Ecologically Sensitive Areas	Strain on ecologically sensitive areas	To reduce impact on ecologically sensitive areas	Sediment loads in the streams will be reduced by incorporating erosion control measures. Environmental education of workers will be done.	Project Manager / Contractor	• Number of exceedances of sediment above 10% threshold	• Site inspection. • Site audit on the environmental awareness levels of employees.	Monthly	Construction phase (2 years)	-

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Hydrology	Surface and ground water contamination and depletion	To prevent surface and ground water contamination and depletion	Installation of a series of sediment and oil traps. Localizing all debris and other wastes and confining them in designated storage areas for appropriate disposal. Proper management of fuel operated machinery. Maintenance of equipment to be done at designated workshops offsite. Adequate sanitation facilities will be provided. Fuel will be brought to site by use of licensed mobile fuel bowsers.	Project Manager / Contractor	• Number of exceedances of sediment above 10% threshold • Number of exceedances or pollution incidents • Number of leaks or spills from machinery	• Groundwater quality analysis • Audit of waste management plan. • Machine maintenance records. • Surface water levels observation and monitoring	Weekly	Construction phase (2 years)	600,000

Soil Erosion	Loss of topsoil and sedimentation of water bodies	To Prevent soil degradation	Land clearing will be limited to absolutely required areas and in sections being worked on at a time. Earthworks will be done before the onset of the rains; There will be timely rehabilitation/ stabilization of disturbed areas by undertaking activities such as re-vegetation and proper landscaping. All debris and other wastes will be localized and confined in designated storage areas for appropriate disposal; There will be proper management of fuel run machinery Maintenance of equipment will be done at designated workshops offsite.	Project Manager / Contractor	• Presence of erosion control structures • Number of leaks or spills recorded	• Site inspection • Soil quality analysis • Audit of waste management plan. • Machine maintenance records	Monthly	Construction phase (2 years)	500, 000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Waste generation	Soil contamination	To prevent contamination of soil To ensure proper waste management	Municipal waste will be disposed of in bins which will be collected by approved municipal waste collectors.	Project Manager / Contractor and Local Council	• Number of exceedances or soil contamination incidents • Presence of waste bins and disposal records	• Site soil inspection • Soil quality analysis • Audit of waste management plan. • Waste management reports	Quarterly	Construction phase (2 years) and Operation phase (23+ years)	900, 000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Air Pollution	Dust emissions from construction activities	To reduce dust levels	Dust suppression by spraying water on exposed work sites, on active haulage routes and other areas with potential to generate dust; Enforcement of speed limits to 20 km/h to minimize on traffic induced dust emissions; Timely rehabilitation of disturbed areas by ground stabilization and profiling will be done, placement of top soil and re-vegetation; The site will have designated stockpile areas and packaged material will be kept in original packaging until the time of use (e.g. cement) Vehicles used on site will be properly maintained ensuring that the fumes released are minimal.	Project Manager / Contractor	• Number of exceedances of relevant standards • Number of complaints received	• Site observation • Air quality tests • Speed limits signs available on site • Inspection of material storage on site • Machine maintenance records	Monthly and when need be	Construction Phase (2 years)	600,000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Noise and Vibrations	Disturbance to communities and wildlife	To Reduce noise levels	Limit working hours, use low-noise machinery, and provide noise barriers	Contractor	• Compliance with noise level regulations	• Site observation • Noise level sampling	Quarterly	Construction Phase (2 years)	700, 000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Landscape and Aesthetics	Negative changes on the landscape and aesthetics of the project site	To restore affected land and ensure safety	The Project Manager/Contractor will - Careful choice of service routes by selecting less vegetated areas and alignment of routes along existing passages such as roads to limit opening up of virgin land. - That the design frameworks raise the value of the land and not degrade it. - Land clearing to be limited to absolutely required areas and progressive rehabilitation and re-vegetation of disturbed sites will be undertaken; - Effective stabilization of altered landforms. -	Project Manager/Contractor	• Number of complaints received • Number of complaints unresolved • Number of large trees cut to pave way for service lines • % increase of vegetation at the end of the construction phase	• Site inspection	Monthly	Construction phase (2 years) and Project Lifecycle (23+ years)	400,000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Borrow Pits and Quarries	Land degradation and safety	To ensure fair compensation and relocation	Backfill pits, re-vegetate areas, and secure hazardous sites	Contractor	• Percentage of borrow pits	• Compensation records, surveys	Site inspection reports	Construction phase (2 years)	2,000,000 *
Negative Socio-economic and Cultural Impacts									
Presence of workers on site	Spread of the HIV/AIDS pandemic	To prevent the spread of the HIV/AIDS pandemic	The Contractor will conduct HIV/AIDS awareness amongst all members of the workforce in conjunction with the local health center under which the catchment area of the development falls. Free condoms will be made available to all members of the workforce Preferential employment will be given to members of local communities in the project area.	Project Manager	• Increase in number of HIV/AIDS cases in the project area	• Employment register • Health and safety audit • Impromptu asking of people on site about HIV/AIDS to gauge awareness • Signed toolbox talks on HIV/AIDS awareness	Monthly	Construction Phase (2 years)	500,000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Health and Safety Risks	Injury and accidents to workers and members of the public	To prevent injury and accidents to workers and members of the public	During construction, the developer will only allow contractors who prioritize safety with a working health and safety plan to work on site. Public access to operational areas will be restricted by putting appropriate signage; Provide PPE, conduct safety training, and enforce site access restrictions.	Project Manager / Contractor and HSE Officer	• Number of near misses • Number of incidents • Number of workers without adequate PPE	• Health and safety inspection by safety officer • Site health and safety report	Daily (safety officer) Monthly (HSE auditor)	Construction phase (2 years)	1,200,000
Disturbance of Historical, Archaeological & Cultural Sites	Potential damage to cultural and historical sites	To preserve cultural heritage	Conduct surveys, engage heritage authorities, implement chance-find procedures, and halt work if artifacts are found	Project Manager / Contractor	• Number of heritage sites identified and preserved	• Site inspections, reports from NHCC	As needed	Construction Phase (2 years)	1,500,000

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
Presence of workers and residents on site	Spread of Covid 19	To prevent the spread of Covid 19	The developer will put in strict measures in line with Ministry of Health guidelines.	Project Manager	• Number of reported Covid 19 cases on site	• Site health and safety report	Weekly	Construction Phase (2-5 years)	Inc. in above

Presence of workers and job seekers	Influx of people into project area	To reduce on population boom, unemployment levels and security risks for the residents of the community	The contractors on site will be mandated to prioritize employment to the local people. To promote security for the residents and prevent crime in the project area, the employment office will be located outside the site. This will prevent the influx of people seeking jobs. The Contractor will also be encouraged to procure supplies from local sources to the maximum extent possible. The influx of people to the project area will be discouraged by giving priority in employment to local residents. To this effect the Contractor will work with Local Authorities such as the Area Development Committees and the District Councils when	Project Manager / Contractor	• Number of Local members of the community employed • Number of job seekers found at the site	• Record of employees • Site observation • Employment office located offsite	Monthly	Construction phase (2 years) and operation phase (23+ years)	Salaries

Aspects	Impacts	Objective	Mitigation Measures/Enhancement Measure	Responsible Person	Performance Indicator	Means of Verification	Frequency of Monitoring	Time frame	Cost ZMW
			recruiting locals and also Traditional Leaders						
Land Acquisition	Displacement of agricultural fields and households	To ensure fair compensation and relocation	Conduct land surveys, provide compensation at full replacement value, and offer alternative land where feasible	Government / Developer	• Number of number of PAPs compensated	• Compensation records, surveys	As needed	Construction phase (2 years)	5,000,000 *
Damage to Adjacent Services	Disruption of power, telecom, and water supply	To prevent infrastructure damage	Identify utility locations, coordinate with service providers, and relocate utilities where necessary	Contractor	• Number of service disruptions reported	• Inspection reports, utility provider records	Monthly	Construction phase (2 years)	1,500,000

8.0 DECOMMISSIONING AND REHABILITATION PLAN

8.1 Introduction

This decommissioning plan is prepared in accordance with the National Council of Construction (NCC) Act and Zambia Environmental Management Agency (ZEMA) guidelines. For borrow pits, the submitted Environmental Project Brief (EPB), which will be approved by ZEMA, will adequately describe the decommissioning process. Decommissioning will be undertaken at the completion of the project and will primarily involve the removal of construction equipment and temporary site infrastructure, the approved decommissioning process for borrow pits, and rehabilitation of other disturbed areas. This plan will be specifically tailored for the rehabilitation and upgrade of the 371 km Mutanda to Kaoma Road by Barotse Highway Limited Toll Concession. Decommissioning will be undertaken at the completion of the project and will primarily involve the removal of construction equipment and temporary site infrastructure, restoration of borrow pits, and rehabilitation of disturbed areas.

The decommissioning activities will be executed in a manner that ensures environmental sustainability and minimizes disruption to communities along the project route. Barotse Highway Limited, in collaboration with the Road Development Agency (RDA), will oversee the execution of this plan.

8.2 Legislative Requirements

The decommissioning process will adhere to:

- The National Council of Construction (NCC) Act, which regulates construction activities, including site closure procedures.
- The Zambia Environmental Management Agency (ZEMA) guidelines, which mandate environmental protection and rehabilitation during decommissioning.
- The Road Development Agency (RDA) standards, ensuring proper road decommissioning practices.

8.3 Objective

The goal of decommissioning is to leave the project site in a condition that is safe, stable, and environmentally restored. This includes:

- Compliance with national and environmental regulations.
- Minimizing long-term environmental and social impacts.
- Reducing liabilities and costs associated with decommissioning.
- Ensuring closure is conducted responsibly.

8.4 Decommissioning Framework

Decommissioning of the road or its components may be necessitated by changes in road use, traffic volume, or safety considerations. The process will follow these steps:

- Initial site assessment;
- Determination of assessment criteria;
- Follow-up evaluation;
- Identification of areas for decommissioning;
- Development of technical decommissioning specifications;
- Implementation of decommissioning activities;
- Documentation and validation of the process.

RDA, in partnership with Barotse Highway Limited, will ensure active stakeholder engagement throughout the decommissioning process, particularly with communities affected by the road project.

8.5 Decommissioning Activities

8.5.1 Disposal of Consumable Materials

Construction materials such as fuel and petroleum products will be disposed of in accordance with ZEMA standards. Reusable materials will be transferred to other construction sites where applicable.

8.5.2 Removal and Disposal of Office Furniture, Equipment, and Materials

Office furniture, construction equipment, and machinery will be relocated to other sites or sold, depending on their condition. Items unsuitable for reuse will be disposed of following environmental guidelines.

8.5.3 Demolition of Temporary Infrastructure

Temporary structures such as site offices, workers' camps, and storage facilities will be dismantled. Any materials that can be salvaged will be reused or recycled, while waste will be managed per environmental regulations.

8.5.4 Rehabilitation of Campsites, Parking, and Asphalt Grounds

All temporary infrastructure used during construction will be removed, and the sites will be rehabilitated through activities such as re-vegetation and soil stabilization to restore natural conditions.

8.5.5 Rehabilitation of Borrow Pits and Quarries

Borrow pits and quarries used for material extraction will be reshaped, landscaped, and properly drained to prevent water accumulation. The specific measures for this process will be guided by the submitted and approved Environmental Project Brief (EPB) for the borrow pits. These sites will also be re-vegetated where applicable.

8.6 Impacts of Decommissioning

Potential impacts of the decommissioning phase include:

- Temporary employment opportunities;
- Generation of decommissioning waste;
- Land degradation and visual intrusion;
- Dust and air pollution;
- Temporary traffic and pedestrian disruptions;
- Noise and vibration;
- Occupational and community health and safety concerns.

Mitigation measures will align with those used during construction and operational phases.

8.7 Cost of Decommissioning

The expected cost for decommissioning activities, including site restoration and waste management, is estimated at approximately 20% of the total project cost.

8.8 Validation of Decommissioning

Upon completion of decommissioning, RDA and Barotse Highway Limited Toll Concession will produce a validation report confirming that all required activities have been successfully implemented. This report will include:

- Disposal records of materials and waste;
- Decommissioning of plant and equipment;
- Rehabilitation of borrow pits and quarries;
- Results of environmental monitoring and testing;
- Recommendations for ongoing environmental monitoring if necessary.

This plan ensures that the rehabilitation and upgrade of the Mutanda to Kaoma Road is completed with minimal environmental and social impact, promoting sustainable infrastructure development in Zambia.

9.0 CONCLUSION AND RECOMMENDATION

The Environmental and Social Impact Assessment (ESIA) for the proposed rehabilitation and upgrade of the 371 km Mutanda to Kaoma Road has identified both positive and negative impacts associated with the project. The study highlights the project's potential to significantly enhance regional connectivity, stimulate economic growth, and improve access to essential services for communities in the North-Western and Western Provinces of Zambia. By upgrading the road to international bituminous standards, the project will reduce travel times, lower transportation costs, and facilitate trade with neighbouring countries such as Angola, Botswana, and Namibia.

The ESIA has also identified potential environmental and social challenges, including land and soil degradation, air and noise pollution, and the displacement of communities. However, the proposed mitigation measures, such as erosion control, dust suppression, and stakeholder engagement, are designed to minimize these adverse impacts and ensure that the project aligns with sustainable development principles.

The project's implementation will create significant economic opportunities, including the creation of up to 1,000 jobs during construction and 250 long-term jobs during operations. Additionally, the integration of toll plazas and weighbridges will generate revenue for ongoing maintenance, ensuring the road's long-term sustainability.

In conclusion, the rehabilitation and upgrade of the Mutanda to Kaoma Road is a critical infrastructure project that will bring substantial benefits to the region. By adhering to the proposed mitigation measures and maintaining continuous engagement with stakeholders, the project aims to minimize adverse environmental and social impacts while maximizing economic and social benefits. The successful implementation of this project will contribute to the long-term development and prosperity of the North-Western and Western Provinces, enhancing connectivity, trade, and quality of life for the people of Zambia.

Recommendations

1. Strict Adherence to Environmental and Social Standards**: Ensure compliance with Zambian legislation, including the Environmental Management Act and the National Resettlement Policy.

2. Stakeholder Engagement : Maintain continuous engagement with affected communities and stakeholders to address concerns and foster positive relationships.

3. Sustainable Development Practices: Maximize the use of local resources and Labor, and implement environmentally friendly construction methods.

4. Monitoring and Evaluation: Regularly monitor the project's environmental and social performance and provide reports to relevant authorities.

10.0 BIBLIOGRAPHY

11.0 DECLARATION OF AUTHENTICITY

We hereby confirm that this Environmental and Social Impact Assessment (ESIA) for the PROPOSED REHABILITATION AND UPGRADE OF THE 371KM ROAD BETWEEN MUTANDA AND KAOMA IN THE NORTH-WESTERN AND WESTERN PROVINCES OF ZAMBIA BY BAROSTE HIGHWAY LIMITED TOLL CONCESSION (BHL - TC), has been prepared in compliance with the Environmental Management Act No. 12 of 2011 and the Zambia Environmental Management Agency (ZEMA) guidelines.

I, the undersigned, affirm the accuracy and completeness of the information contained in this ESIA report.

Chris Dijkstra

Director

Barotse Highway Limited Toll Concession (BHL-TC)

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- Heritage Impact Assessment Report
- Water Quality Certificates