ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION IN LAKE NATRON AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT IN ARUSHA REGION-TANZANIA

VOLUME 1: ENVIRONMENTAL IMPACT STATEMENT (EIS)

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EXECUTIVE SUMMARY

Introduction

Woswosi Soda Limited (WWSL) formally known as Ngaresero Valley Company Limited (NVCL) is a limited liability company incorporated on 22 September 2022 and registered under Certificate No. 157942433. WWSL are in possession of two prospecting licenses, PL-12236/2023 and PL-13190/2025, covering approximately 290.891 km² and 259.797 km², respectively.

The company proposes to undertake trona extraction and soda ash production at Lake Natron, specifically at Wosiwosi Village, Gelai Lumbwa Ward, Longido District in Arusha Region. The project involves the extraction of trona from the lake and the establishment of a processing plant along the lake shore for soda ash production using the conventional monohydrate process. The project is expected to operate over a long-term period based on the availability and natural regeneration of trona resources within the lake.

The project is located at Wosiwosi Village, within Gelai Lumbwa Ward in Longido District, Arusha Region, Tanzania. It is strategically positioned in Lake Natron, which will serve as the primary source of trona for soda ash production. The project area falls within Lake Natron Game Controlled Area (GCA), covering an area of 3,000 square kilometres was designated by a government notice of 1974. According to the First Schedule of the Environmental Impact Assessment (EIA) and Audit Regulations, 2005 and its last amendment of 2024, this Project falls under category A Projects for which EIA is mandatory. The Environmental and Social Impact Assessment (ESIA) has been compiled to meet the legal requirements of Tanzania legislation and International Environmental and Social (E&S) standards.

Project Objective and Scope

The ESIA for the Project is aimed at ensuring that all possible environmental and social impacts related to the project are identified and assessed with appropriate mitigation, management, and monitoring measures. Both physical, biological, and socio-economic data from the study area and its surrounding communities were taken to create a better understanding of the baseline information and ascertain the extent and magnitude of potential impacts. In addition, the findings of the ESIA study were used to prepare the Environmental Management Plans.

Methodologies and Approaches

Data collection: Various data collection methods that were used during the ESIA study are as follows:

- Document review: A review of existing data and studies conducted in the Project area was undertaken to collect information/data about the proposed Project area and its surroundings.
- Fieldwork activities were conducted to collect baseline data and information. The collection of baseline data involved the assessment of biodiversity (flora, fauna and aquatic), hydrology, hydrogeology, air quality, noise and vibration, soil, archaeology, and cultural heritage. A detailed disruption of the methods for these baseline studies has been provided in this ESIA report.

Project Description

Project Phases and Activities

i) **Site Preparation and Construction Phase**

Feasibility Studies, Geoscience and Engineering Studies will be conducted to ensure that the proposed project is technically and economically viable. When these studies provide favourable results and all approvals are met, the project will advance to the Construction Phase. The construction stage is anticipated to las for two years, during which that time efforts will be focused on establishing the core processing facility and the key essential supporting infrastructures needed for the project to function. The key essential infrastructure are not limited to but will include:

- Water supply system utilizing Lake Natron (processing) and Ewaso Ngiro River (domestic use), Site access (internal roads for transport of materials and personnel), and;
- Reliable power supply (national grid electricity sub-station supported by solar energy for auxiliary uses).
- Accommodation for approximately 300 construction personnel
- Management offices
- Specialized electrical and mechanical workshops, and;
- Dedicated lay-down areas for construction materials and long-term equipment spares. (This includes managing logistical requirements, such as transporting fine and coarse aggregates from local quarries and shipping critical supplies like cement (from Longido), steel (from Arusha), and timber, with the strategy to move materials in large quantities to minimize trips across the Longido game reserve.)

This phase will employ heavy construction machinery, including excavators, bulldozers, graders, dozers and front-end loaders. Construction materials, resources and other equipment needed for construction will be sourced locally, (Longido, Arusha, etc)

ii) **Operation Phase**

Operation phase will encompass the extraction of Trona from Lake Natron, the processing of the Trona through Conventional Monohydrate Process and the delivery of Soda Ash as a final product to local and international markets. The operation is expected to last 150 years based on the current Trona resource available at Lake Natron. It is expected to exceed these years due to the natural ability of Lake Natron to develop the Trona ore needed for processing. Key activities will include but not limited to:

- Mining Activity (Extraction of trona from Lake Natron using Dredgers).
- Sucking and pumping of trona extracted trona 1km.
- Wastes generation and management
- Power & Fuel Supply Management
- Water supply and management
- Handling of vehicles, machines and heavy equipment
- Occupational health and safety management.
- Maintenance works
- CSR and stakeholder engagement

- Progressive rehabilitation works

It is anticipated that 98% of the final product is intended to be exported to countries with large industrial markets (China, India, United States and Europe), while 2% will serve the local market.

iii) **Decommissioning Phase**

Decommissioning will mark the formal closure of the project. Based on preliminary exploration data, the estimated mine life is projected to exceed 150 years, though this period may be extended depending on the outcomes of ongoing exploration activities. It will involve safely shutting down operations, dismantling infrastructure, restoring the site, and monitoring post-closure.

Waste Management Measures

Proper waste management practices will be implemented to handle different types of waste generated during construction, operation, and decommissioning. The waste will be separated, with recyclable waste sent to recycling centres and non-recyclable waste disposed of in compliance with environmental regulations.

Project Supporting Infrastructure

a) Offices and Accommodation

The Project will include an office and accommodation camp for staff to support project activities.

b) Power Supply

Power for operations will be drawn primarily from the national grid (TANESCO), with backup provided by Solar Panels:

- Main Plant Power Requirement Ranges: 11 to 15 MW
- Solar Panel Farm to provide 10 MW of power to Township
- Voltage System: 11 kV stepped down to 415 V for internal distribution

c) Water Supply

Process water will be sourced from Lake Natron and utility water will be sourced from Ewaso Ng'iro River, regulated under water rights permits.

- Process water demand: 2.0 m^3/hr
- Domestic water demand: 0.5 m^3/hr
- Storage Capacity: 3,500 m^3 stainless steel tank with float-controlled inlet

Water is treated and recycled through the clarifier and thickener circuits to minimize consumption.

Stakeholder Engagement

The stakeholder engagement focused on the identification and participation of stakeholders in the proposed Trona Extraction and Soda Ash Production Project. The main objectives of stakeholder consultations were to provide information about the project, obtain views from stakeholders, and understand their expectations of the proposed project.

The specific issues raised, and their response are attached in Appendix 6 of Volume 2. Further information on stakeholders such as consultation forms are in Appendix 2 of Volume 2 and photos with stakeholders are in Appendix 5 of Volume 2.

Impact Assessment

The Impact Assessment aimed to identify and assess potential effects on identified receptors and resources using defined criteria. The goal was to develop mitigation measures to minimize adverse effects and enhance potential benefits. Impacts for the Project were determined through stakeholder consultation, existing baseline conditions, proposed Project activities, and the consultants' professional expertise.

One method for pinpointing environmental effects with substantial implications is to recognize the environmental elements that may be influenced by or exert an influence on the proposed project. A commonly acknowledged strategy involves identifying Valued Ecosystem Components (VECs), as defined by the Canadian Environmental Assessment Agency in 1999, as detailed in Chapter 7 of this Project report. The identified VECs in the Project area were soil, surface water, groundwater, flora, fauna, aquatic biodiversity, cultural heritage site, air quality, access to natural resources, community health, safety, security and human rights, noise and vibration, public infrastructure, visual amenities, local economy, and employment, greenhouse gases (GHGs) and waste and effluent waste.

Potential Impacts and Mitigation Measures

The identified potential impacts fall within acceptable limits and standards, meaning that while some impacts are moderate or low in significance, others are highly positive even before applying mitigation measures. With effective and efficient implementation of the recommended mitigation and management strategies, the significance of impacts can be reduced to low-negative or very low-negative levels, and some impacts may remain highly positive or become even more positive. This positive outcome is largely due to:

- Location of the Project: The project is located in a modified habitat influenced by human activities mainly farming and settlement.
- Localized impacts: Most Impacts are confined to a specific and limited local area.
- Mitigation measures: Effective mitigation measures are in place to address potential adverse impacts.
- Mitigatable Impacts: Some impacts are moderate but can be adequately mitigated through planned measures.
- Community Benefits: The project brings significant social and economic benefits to the local community, hence considered highly positive. This could include employment opportunities increased business opportunities or other positive contributions to the community's well-being.

The detailed assessment of the Environmental and Social impacts in all project phases has been detailed in Chapter 7 of this ESIA report.

Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) for the proposed project is designed to mitigate potential environmental and social risks and impacts by ensuring that the project is performed in an environmentally and socially responsible manner. The plan considers all the proposed project's activities, mitigation measures, impacts, and costs to minimize potential or

actual significant environmental and social impacts. The ESMP is developed based on potential significant environmental and social risks and impacts caused by the project, with committed responsibilities and monitoring activities.

The Environmental and Social Management Plan for the proposed Trona Extraction and Soda Ash Production Project has been compiled in line with the requirements of the Environmental Management Act, CAP 191 R.E 2023, and the Environmental Impact Assessments and Audit Regulations, 2005, as last amended in 2024.

The ESMP has been divided into the following management plans:

- Land and Soil Management Plan;
- Water Resource Management Plan;
- Flora, Fauna and Aquatic Management Plan;
- General Environment and Waste Management Plan;
- Air Quality Management Plan;
- Noise and Vibration Management Plan;
- GHG Management Plan;
- Aesthetic and Visual Amenities Impact Management Plan;
- Community Health and Safety Management Plan;
- Community Management Plan, and;
- Labour and Working Condition Management Plan

Overall, the ESMP aims to ensure that the proposed project is implemented in a manner that minimizes potential negative impacts on the environment and local communities and promotes positive impacts. More details on the ESMP are discussed in Chapter 8 of this report.

Environmental And Social Monitoring Plan

The Environmental Monitoring Plan is intended to provide continuous feedback on the effectiveness of the planned mitigation measures identified. The parameters identified for monitoring and for which the plan has been prepared relate to the following main aspects: Soils, Land and Soil Management, Biodiversity (Flora, fauna, and aquatic species), Air Quality, Noise and Vibration, Water Resource, Groundwater levels, Surface Water Levels, Water Quality, Waste Management, Emergencies, General Health, Workers Health, and Employment opportunities. Further details are discussed in Chapter 9 of this ESIA report.

The monitoring plans will be reviewed constantly to ensure they are in line with the planned Project development and any changes that may occur.

Conclusion and Recommendation

The ESIA concludes that the proposed Trona Extraction and Soda Ash Production Project has the potential to contribute significantly to the local and national economy while ensuring environmental sustainability and social well-being. The successful implementation of the recommended mitigation measures, management plans, and continuous stakeholder engagement will be crucial to achieving these goals. By adhering to the recommendations outlined in this report, WWSL can ensure that the project is conducted in an environmentally responsible and socially inclusive manner, fostering sustainable development in the region

The proposed recommendations are structured to address key areas of concern, including environmental management, stakeholder engagement, monitoring and reporting, capacity building, emergency preparedness, and regulatory compliance. They are designed to mitigate negative impacts, enhance positive outcomes, and ensure the project's sustainable development. By implementing these measures, WWSL can promote responsible resource extraction, protect the environment, and contribute positively to the nation and the local community.

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ACKNOWLEDGEMENT

Woswosi Soda Limited (WWSL) would like to extend sincere gratitude to all individuals, organizations, and agencies who contributed to the preparation of the Environmental and Social Impact Assessment (ESIA) of the proposed Trona Extraction and Soda Ash Production Project in Lake Natron at Wosiwosi Village, Gelai Lumbwa Ward and Longido District in Arusha Region-Tanzania. Their valuable input, expertise, and collaboration have been instrumental in shaping the scope and direction of this assessment.

WWSL would like to express appreciation to:

- Government Ministries & Regulatory authorities including the Vice President's Office (Division of Environment) (VPO – DoE), Ministry of Minerals, Residents Mine Officer (RMO) Arusha, Ministry of Water, Internal Drainage Water Board, Ministry of Natural Resource and Tourism, Ministry of Land, Housing and Human Settlements Development and National Environment Management Council
- Regional Administration authorities including Arusha Region, Regional Commissioner (RC), Regional Administrative Secretary (RAS)
- District Administration including Longido District Council, Ngorongoro District Council. District Management Team including District Commissioner (DC), District Administrative Secretary (DAS), District Executive Director (DED) and Heads of Departments.
- Ward Administration including Gelai Lumbwa Ward, Pinyinyi Ward, and Mirrugoi Ward.
- Village Administration including Wosiwosi Village, Magadini Village, Pinyinyi Village, Engaresero Village, Matale Village, Alaililai Village, and Ilchang'it Sapukin Village.
- Institution and other International Organisations including United Nations Educational, Scientific and Cultural Organization (UNESCO), Ramsar Site Department, Worldwide Fund for Nature (WWF), International Union for Conservation of Nature and Natural Resources (IUCN), Ngorongoro Conservation Area Authority (NCAA), and Tanzania Association of Tour Operators (TATO).
- Members of the local community and other stakeholders who participated in public consultations and shared their perspectives, concerns, and aspirations regarding the project.
- Yesaya Kaoneka (WWSL Representative) for providing information in compiling this EIS as well as Scoping and Terms of Reference (TOR)
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- WWSL management staff for providing material and moral support to the consultant in undertaking and completing the ESIA study as planned. The team dedicated most of the time and effort tirelessly to ensure that the consultants conducted this assignment successfully.

LIST OF ACRONYMS AND ABBREVIATIONS

CAP	Chapter / Clause
CSR	Corporate Social Responsibility
DC	District Commissioner
DED	District Executive Director
E&S	Environmental and Social
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
GCA	Game Controlled Area
GHGs	Greenhouse Gases
GRM	Grievance Redress Mechanism
IDBWB	Internal Drainage Basin Water Board
IFC PS	International Finance Corporation Performance Standards
ILO	International Labor Organization
IUCN	International Union for Conservation of Nature and Natural Resources
NCAA	Ngorongoro Conservation Area Authority
NEMC	National Environment Management Council
ML	Mining Licence
LOM	Life of Mining
WWSL	Woswosi Soda Limited
OHS	Occupational Health and Safety
OSHA	Occupational Safety and Health Authority
PAP	Project Affected Persons
PL	Prospecting License
RC	Regional Commissioner
RE	Revised Edition
RMO	Residents Mining Officer
TANESCO	Tanzania Electric Supply Company Limited
TANROADS	Tanzania National Roads Agency
TAWIRI	Tanzania Wildlife Research Institute
TFS	Tanzania Forest Services
UNESCO	United Nations Educational, Scientific and Cultural Organization
VECs	Valued Ecosystem Components
VPO – DoE	Vice President's Office – Division of Environment

WWF	Worldwide Fund for Nature
WHO	World Health Organization

1 INTRODUCTION

1.1 General Background

Interest in the potential of Soda Ash extraction has been present in Tanzania since the 1950's with prominent entities such as Toyo Soda Manufacturing, now known as Tosoh Corporation conducting studies from 1972 to 1976. Interest in the potential of Soda Ash extraction grew further, when in 1996, an Engineering and Consulting Company by the name of SWECO conducted an Environmental Impact Assessment for a proposed Soda Ash extraction site near the village of Engare Sero. In 2006, Lake Natron Resources Limited - jointly owned by the Government of Tanzania through the National Development Corporation (NDC) and TATA Chemicals Limited of India - proposed a similar development comprising a soda ash extraction plant, coal-fired power station, and associated transport infrastructure. The proposed project generated major concerns due to the environmental purpose of the proposed project location, which lead to TATA Chemicals Limited to withdraw from the project.

Currently, the project is now managed by Woswosi Soda Limited (WWSL) formerly known as NVCL who are in possession of two prospecting licenses, PL-12236/2023 and PL-13190/2025, covering approximately 290.891 km² and 259.797 km², respectively. These licenses were issued to Woswosi Soda Limited (WWSL) in accordance with Section 31 of the Mining Act, Cap. 123 (refer to Appendix 8. The licensed area includes Lake Natron, a saline-alkaline lake known to host extensive deposits of carbonate evaporites, primarily sodium carbonates occurring in the form of anhydrites. Lake Natron's geochemical and climatic characteristics its endorheic (closed) hydrological system, arid to semi-arid climate, high ambient temperatures averaging around 40°C, and low mean annual precipitation below 500 mm create optimal conditions for the concentration and precipitation of sodium carbonate minerals. These factors make the lake a highly favourable geological setting for natural soda ash formation. The primary objective of the proposed soda ash mining project is to generate income from the investments made by the proponent

The project involves the extraction of trona from Lake Natron and the establishment of a soda ash production plant along the lake shore at Wosiwosi Village, Gelai Lumbwa Ward, Longido District, in the Arusha Region of Tanzania. Unlike the previous proposed project, this current project differs as it uses the Conventional Monohydrate Process instead of the Conventional Crystal Growth Method. The monohydrate process utilizes electricity as a power source instead of coal powered fire stations resulting in a much more technically and economically superior processing as compared to Crystal Growth Method.

Furthermore, the earlier ESIAs assessed a fuel-based operational scenario involving diesel-powered dredgers, which presented inherent risks related to air pollution, fuel storage, and accidental spills. In contrast, the present ESIA evaluates an updated project configuration based on electrically powered dredgers. This transition to electric equipment substantially reduces emissions, minimizes contamination risks to water and soils, and improves overall environmental performance.

In addition to this, the Project further incorporates a water storage silo, absent in earlier designs, to regulate seasonal water availability. By enabling controlled releases during dry periods, the tank is intended to support the ecological functioning of Lake Natron while enhancing water security for adjacent communities. This measure reflects an integrated and environmentally responsible approach to water resource management. The Project's water

management design will align with the Ramsar Convention's wise use principle by maintaining the ecological character of Lake Natron through regulated seasonal flows, thereby supporting wetland biodiversity while enhancing water security for surrounding.

1.2 Project Ownership

Woswosi Soda Limited (WWSL) is a limited liability company incorporated on 22 September 2022 under Section 15 of The Companies Act CAP 212 R.E. 2023 and registered under Certificate No. Woswosi Soda Limited (WWSL) is a limited liability company incorporated on 22 September 2022 under Section 15 of The Companies Act, CAP 212 R.E 2023 and registered under Certificate No. 157942433 (refer to Appendix 1). The company was specifically established to undertake soda ash mining and processing operations within Tanzania

1.3 Soda Ash Context

Soda Ash, chemically known as sodium carbonate (Na_2CO_3), is a white, odorless, water-soluble alkaline compound that is one of the most important inorganic industrial chemicals. It occurs naturally in trona and natron deposits or can be produced synthetically via processes such as the Solvay method. Naturally occurring soda ash is found in saline and alkaline lakes, such as Lake Natron in Tanzania, Lake Magadi in Kenya, and the Green River Basin in the USA, where arid climatic conditions and closed hydrological systems favour the precipitation of sodium carbonate minerals. Sodium carbonates exist in various crystalline forms, including anhydrous (Na_2CO_3), monohydrate ($Na_2CO_3 \cdot H_2O$), and decahydrate ($Na_2CO_3 \cdot 10H_2O$), with anhydrous and monohydrate forms primarily used in industrial applications.

Soda ash is a highly versatile chemical, playing a key role in the manufacture of glass, detergents and soaps, chemical products, metallurgical applications, pulp and paper processing, water treatment, and environmental control measures such as flue gas desulfurization. Globally, over 60 million tonnes of soda ash are consumed annually, with natural deposits providing a cost-effective and environmentally sustainable source of the mineral. Industrial extraction from trona-rich lakes typically involves dredging or pumping brine, followed by crushing, dissolving, clarification, evaporation, and crystallization to produce high-purity soda ash.

1.3.1 Demand for Soda Ash

The global soda ash market, valued at USD 22.4 billion in 2025, is forecasted to reach USD 32.8 billion by 2035 (a 3.9% CAGR). This upward trend is primarily due to increased consumption of detergents and container glass in growing economies. With the Asia Pacific region dominating a large segment of the market, it is expected to exhibit strong CAGRs. Over the last decade (since 2010), the soda ash trade growth (4.3% annually) has outpaced overall demand growth (3.5% annually). With its importance in industrial processing and versatile application in different sectors (Glass Manufacturing, Detergent Manufacturing, Water Treatment, pH Regulation, etc), its growth is expected to continue to rise in the coming years (Figure 1.1).

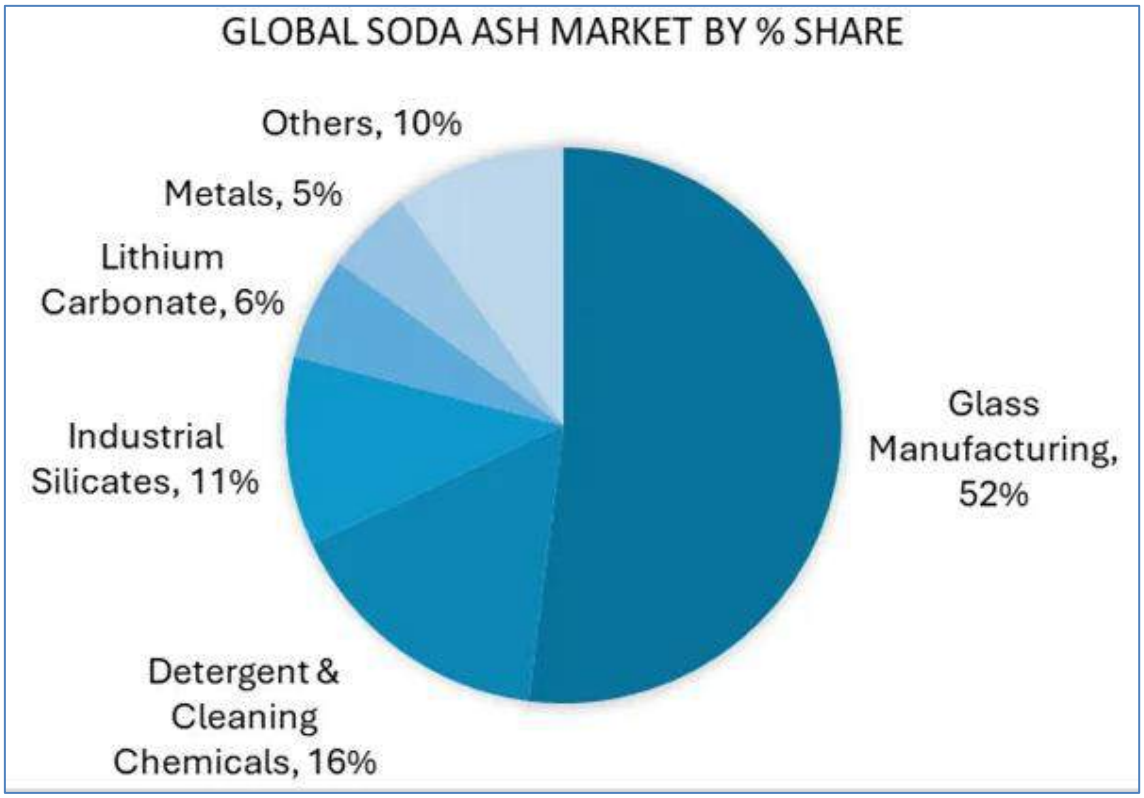

Figure 1.1: Soda Ash Global Market Share

(Source: www.Alchempro.com, 2025)

1.3.2 Soda Ash in Lake Natron

Lake Natron is an extremely shallow, highly caustic Salt Lake located in northern Tanzania, near the border with Kenya. This unique body of water lies in the eastern branch of Africa's Great Rift Valley, northeast of the Ngorongoro Crater, settling at the lowest point of the valley (600 meters above sea level) among volcanic hills. The lake's dimensions are roughly 57 kilometers long and 22 kilometers wide, but its depth rarely exceeds three meters. The area is defined by a harsh climate, with temperatures often surpassing 40°C and receiving irregular seasonal rain from December to May.

Lake Natron has long been recognized for its potential as a source of soda ash due to the high concentration of sodium carbonate in its waters, primarily in the form of trona, a mineral from which soda ash is derived. The idea of exploiting these resources for soda ash production dates to the 1950s when early studies identified the lake's potential for commercial soda ash extraction. However, it wasn't until the 1970s that more serious attempts to develop the lake's soda ash reserves were made. The 1990s and 2000s saw further studies and efforts conducted with promising findings for commercial extraction of soda ash. Recent developments have seen Woswosi Soda Limited (WWSL) to employ modern techniques to minimize environmental impact while still capitalizing on the lake's resources.

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1.4 ESIA Methodology

1.4.1 Objectives of the ESIA

The objective of this study is to carry out a comprehensive Environmental and Social Impact Assessment (ESIA) for the Trona Extraction and Soda Ash production project. The study aims to identify, assess, and predict potential environmental and social impacts associated with the project, propose appropriate mitigation/enhancement measures, and ensure compliance with national environmental regulations. The ultimate goal is to support Woswosi Soda Limited (WWSL) in obtaining an Environmental Impact Assessment Certificate from the National Environment Management Council (NEMC).

1.5 Project Categorization

According to the First Schedule of the Environmental Impact Assessment and Audit Regulations, 2005 (as last amended in 2024), the proposed Trona Extraction and Soda Ash Production project falls under the mining projects, which fall under category A Projects for which full EIA is mandatory.

Section 81 (1) of the Environmental Management Act, CAP 191 R.E 2023 requires any person, being a proponent or developer of a Project or undertaking of a type specified in the Third Schedule of the Act, to undertake or undertake, at his own cost, an EIA study. It is further specified in Section 81 (2) that the EIA should be carried out before the commencement of the Project or undertaking. Also, Section 81(3) states that a “Permit or License for carrying out of any Project or undertaking by any written law shall not entitle the proponent or developer to undertake or to cause to be undertaken a project or activity without an EIA certificate issued under this Act”.

To meet these requirements, WWSL contracted MTL Consulting Company Limited to review and update the previous ESIA document uploaded in the NEMC system. Specifically, the tasks involved:

- Review and comprehensively address all NEMC comments on the submitted ESIA Report to ensure regulatory compliance.
- Undertake additional stakeholder consultations to respond to NEMC comments and integrate stakeholder inputs into the ESIA.
- Undertaking additional technical studies including:
    - Conducting air quality, noise, and vibration assessments to evaluate potential project impacts and define mitigation measures.
    - Carry out surface water and groundwater studies to assess potential impacts on water resources and recommend mitigation measures.
    - Undertake ecological and avifauna studies to assess biodiversity impacts and identify appropriate mitigation measures.
    - Update and finalize the ESIA Report by incorporating NEMC comments and findings from the additional studies.

These tasks were conducted to ensure the update ESIA document is in compliance with the relevant national legislative requirements, while also taking cognizance of the international best practice.

1.6 Technical Approach and Methodology

1.6.1 Hydrology and Hydrogeological Studies

Hydrological observations were undertaken across selected points within the Lake Natron Basin, including stream sub-catchments, wetlands, emergent springs, and near-lake surface water bodies. Flow conditions, water levels, and drainage dynamics were recorded to understand seasonal and spatial variability in surface water movement. Complementary hydrogeological assessments focused on aquifer characteristics, groundwater recharge behaviour, and the potential pathways through which project activities could influence subsurface water systems.

Water samples were collected from both surface sources using 250 ml, 500 ml, and 1000 ml laboratory-grade plastic sampling bottles. Each sample was handled with care (preserved immediately on site to maintain chemical and microbiological integrity) and then transported under controlled conditions to the laboratory (Ardhi University) for detailed analysis.

a) Air Quality Studies

Air Quality Assessment conducted for the proposed Soda Ash mining project was to establish and assess the potential Air Quality impacts that are associated with the project activities. The proposed project intends to add a processing plant, tailing storage ponds and other additional infrastructure. These inclusions will have potential environmental and health risks associated with this project. The methodology provided below was conducted while referring to applicable Air Quality Guidelines and Standards that are in line with the project. These are:

- Tanzania Bureau of Standards – TZS 845:2019, Air Quality – Specification;
- Tanzania Bureau of Standards – TZS 983:2019, Air Quality – Vehicular Exhaust Emission Limits;
- Tanzania Bureau of Standards – EMDC 2 (1758), Air Quality – Vehicular Exhaust Emission Limits; and
- Environmental Management (Air Quality Standards) Regulations, 2007.
- First Schedule, Permissible Weight Concentration of Emission Limits from the Atmosphere to a Receptor and Respective Test Methods.
- Second Schedule, Highest Permissible Quantity of Emission and Test Methods.
- Fourth Schedule, Emission Limits for Motor Vehicles.

- Sampling Locations

The monitoring points were selected based on the following considerations:

- Location of proposed Soda Ash Processing Plant and supporting infrastructures;
- Easily definable and with easy future access in case of need for comparison measurements during or after completion of the assessment.
- Near identified sensitive receptors affected by the source of pollution: and
- Identified sources of dust and emission pollution in the areas surrounding the proposed locations.

- Particulate Matter Measurements (PM2.5 & PM10)

Dust Levels (PM10 & PM2.5) were determined using a portable “Microdust pro” air sampler, famously known as Casella Cel that complies with EN50081-1:1992 and EN 50081-2:1993 or following the ISO 9096:2003 and the Tanzanian TZS 836-part 1:2004; TZS 837 parts 1, 2 & 3:2004. The sampling equipment was fixed at a breathing height of approximately 1.5 meters above the ground for PM10 & PM2.5 determination in all selected Monitoring stations. The portable dust sampler was set out in the field for 8 hours for each Monitoring station. After 8 hours of reading time, the sampler pump was noted in the logbook, and the instrument was switched off. To achieve quality assurance/ quality control all monitoring and sampling equipment were checked and calibrated before use and maintained following the equipment manual.

- Ambient Pollutant Gases Measurements

Ambient gases were measured following the EPA Provisional Reference Methods using a portable Bosean Mult-Gas Detector with detector sensors for the targeted gases following ISO 8760:1990; ISO 8761:1989; ISO 4219:1979; TZS 837-part 1 to 5:2004 and/or equipment manufacturer method. Parameters to be measured include Carbon Monoxide (CO), Nitrogen Dioxide (NO2), Nitric Oxides (NO), Sulfur Dioxide (SO2) and Hydrogen Sulphide (H2S). The instrument was set up at the same Monitoring location and left out in the field for 8 hours to simulate the average person’s working timeline.

b) Noise and Vibration assessment

The measurements and assessment of environmental noise levels were determined by ISO standards using a Quality Meter with Sound (CEL-633C1/K1 Logging Environmental 1/3 Octave Band Sound Level Meter (Class 1)). On taking measurements, the device-meter scale was set to the “A” weighed measurement scale which enables the device to respond in the same manner as the human ear. The device was held approximately 1.5 m above the surface and at least 3 m away from hard reflecting surfaces. A suitable windshield was used on the microphone for all measurements to minimize wind interference. The noise survey was performed by the recommended method for evaluating the environmental noise impact on surrounding communities, concerning annoyance: “The measurement and rating of environmental noise concerning land use, health, annoyance and speech communication”.

Each measurement was taken over a representative period to ensure that all possible variations in noise generation in the area, i.e. all possible noise sources are included in the measurement. Care was taken to take enough measurements, over long enough periods and in normal working conditions to evaluate noise levels as near as possible to representative potential exposure levels.

The general principles employed for measuring sound pressure levels at the site are briefly described below: All microphone measuring points were at least 1.5 m above ground level and 3.5 m away from reflecting surfaces. A suitable windshield was used on the microphone for all measurements to minimize wind interference. The sound level meter was set to A-weighting and I-time weighting for all measurements.

The measurements and assessments of vibration levels were determined following the Environmental Management (Standards for Control of Noise and Vibration Pollution) Regulations, 2015. The instrument used was an Extech 407860 Heavy Duty Vibration Meter.

The device was set to measure vibration in millimetres per second (mm/s) as stated in the 2015 regulation.

c) Visual Amenities and Landscape

Photographs at sampling points were taken at varying distances to establish a visual baseline. It is anticipated that the Visual amenities and Landscape will change or be reformed during the project's life cycle, as there will be infrastructure that will be presented in the area. Changes in the landscape will be based on the creation of three-dimensional images, satellite imagery, and topographic details

d) Climate Change Assessment

Assessing climate change impacts in the ESMPU focuses on identifying and quantifying greenhouse gas (GHG) emissions associated with project activities and evaluating their significance in the context of national and global climate objectives. The assessment considers both direct and indirect emissions, including fuel combustion from vehicles, and transport of personnel and equipment by road. It also includes minor contributions from waste management and land disturbance activities. The Climate Change assessment employed review of previous climate change assessments if available, collection of current and projected climate data, and utilization of a checklist which provides information on average fuel usage, type and specifications of equipment's, fuel types, and other information that provides carbon footprint release information

e) Flora Survey

The assessment employed standard ecological survey techniques, including stratified transects, systematic plot-based sampling, and species identification through field observation and herbarium reference, covering major vegetation types.

This involved:

- Cross-checking conservation status of recorded species using updated IUCN Red List (Version 2025-1), CITES Appendices, and the List of East African Plant Species (LEAP);
- Reviewing updated satellite imagery and regional land use data where applicable

f) Fauna Survey

The Fauna study covers the Project area and the surrounding environment. The results of surveys provide a fauna checklists by main habitat types, that facilitate impact assessment, development of mitigation measures, and an overall environmental management plan.

The study aims to provide the ecological state of terrestrial fauna (Birds, Reptiles, Large and Medium mammals) to assist in the assessment of environmental impacts and develop mitigation and management measures to minimize the impacts associated with the Project.

This involves:

- Assessing the fauna composition, classifying and mapping their occurrence in their habitats confined in the vegetation categories occurring within the Project area.
- Determining the abundances and diversities of fauna within the Project area;
- Identifying and mapping habitat characteristics within the Project area and assess critical habitats such as migratory routes, nesting sites, roosting sites, and home ranges for different fauna (small mammals, birds, reptiles, amphibians, and invertebrates);

- Identifying and mapping fauna species of special concern falling under the International Union for Conservation of Nature (IUCN) Red List and those of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) with concern to endemic/rare, critically endangered, and threatened species.
- Providing the baseline conditions in areas potentially affected by the Project to understand potential impacts and provide appropriate mitigation and management measures.
- Conducting a systematic review to identify priority ecosystem services in the project footprint and suggest mitigation measures for sustainable management.
- Identifying and assessing invasive alien species of fauna in the Project footprint and provide control/mitigation measures for their management.
- Providing a baseline fauna checklist with emphasis on rare/threatened species (based on the IUCN Red List, CITES category, and level of feeding on the food pyramid), migratory and mega-fauna species.

g) Aquatic Biology Survey

The field survey for the benthic and aquatic fauna assessment of the proposed Soda Ash Production Project aimed to evaluate potential impacts of project activities on the aquatic environment and to propose appropriate mitigation measures to minimize or avoid adverse effects.

The study was carried out along the shoreline and inflowing streams of Lake Natron, focusing on areas within and adjacent to the proposed dredging zones. These locations were identified as being most susceptible to direct or indirect impacts arising from project operations.

Sampling sites were selected opportunistically, based on habitat accessibility, representativeness, and the likelihood of aquatic fauna presence. The selected sites included inflowing freshwater streams, spring outlets, and vegetated littoral zones. At each sampling station, habitat characteristics such as substrate type, aquatic vegetation cover, flow conditions, and the presence of emergent or submerged plants were documented to provide ecological context for the observed fish and benthic macroinvertebrate assemblages.

- Benthic Invertebrates: Benthic macroinvertebrates were collected using two sampling devices, a modified D-net (500 µm mesh size, 0.1 m² metal frame) and a Surber sampler. The collected samples were preserved and later identified to the lowest practicable taxonomic level to determine community composition and diversity.
- Fish sampling and Identification: Fish were sampled using a combination of small-mesh gill nets and seine nets, enabling effective capture of species inhabiting both shallow shoreline zones and inflowing stream habitats associated with the proposed dredging points of Lake Natron.
- Conservation Status Assessment: Identified fish species were assessed for their conservation status using:
    - The International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2025-1);
    - The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendices; and
    - The Tanzania Fish Conservation Rankings (URT, 2009c).

h) Stakeholder Consultation

This process identified and engaged key stakeholders who will be affected by the Project, as well as those with interest or influence both directly and indirectly on the proposed Trona Extraction and Soda Ash Production Project. Methods included using questionnaires, verbal discussions, and physical meetings with community groups. The study included a diverse range of stakeholders, such as the Regional Administration Secretary, District Commissioner, District Executive Director and his technical team, government institutions like the Residents Mine Officer (RMO), Internal Drainage Basin Water Board, Occupational Safety and Health Authority (OSHA), NGOs, project surrounding villages, etc. There is a sense that the project will bring positive benefits to the surrounding communities and the nation. However, the investor is encouraged to implement strong controls to address potential negative impacts. The study also found that the public has high expectations for positive outcomes, particularly regarding employment opportunities, markets for animal products and improved social services. The investor (WWSL) is advised to manage the risks associated with these high community expectations.

i) Archaeology and Cultural Heritage

The assessment was conducted through:

- Desk-based review: Analysis of existing archaeological, ethnographic, and historical records, including previous studies in the Lake Natron and Olduvai Gorge region;
- Field surveys: Systematic pedestrian surveys across the proposed mining footprint (Lake Natron's shoreline and mudflats), processing plant site, and linear infrastructure (pipelines, roads). Key informant interviews were held with elders, village leaders, and the local communities (primarily Maasai) in Wosiwosi Village, Gelai Lumbwa Ward, and surrounding areas; and
- Community consultations: Public meetings and focused group discussions to identify sites of cultural significance.

1.7 Project Investment Cost

The proposed Trona Extraction and Soda Ash Production Project investment cost is estimated to be USD 172 million.

1.8 ESIA Study Team

This ESIA study was conducted by MTL Consulting, a registered consulting firm and the experts listed in Table 1.1 below after fulfilling the requirements stipulated in Environmental Management Act, CAP 191 R.E 2023 and the Environmental Management (Registration and Practice of Environmental Experts) Regulations, 2021.

Table 1.1: MTL Team Registered with NEMC

Name of Expert	Firm	Area of Expertise	EIA Expert Reg. No	Signature
John-Bosco Tindyebwa	MTL	Team Leader & Geologist	NEMC/EIA/0030	
Michael Batibo	MTL	Air, Noise & Vibration Expert & Project Coordinator	EC/EE-EIA/2022/0026	
Graham Maeda	MTL	Socio-economic Expert	EC/EE-EIA/2021/0003	
Emmanuel Masasila	MTL	Hydro Geology	EC/EE-EIA/2021/0065	
Eng. Samson Mwitalemi	MTL	Water Resources and Environmental Engineer	EC/EE-EIA/2023/7409	
Grace Ngowi	MTL	Social-economic and Stakeholders Engagement Expert	EC/EE-EIA/2022/0021	
Loveness Kabika	MTL	Biodiversity Expert	EC/EE-EIA/2019/0020	

(Source: MTL Consulting; 2026)

Table 1.2: EIA-NEMC Non-Registered Experts

S/N	Name	Area of Expertise	Signature
1	Simeo Robert	Biodiversity (Wetland and Terrestrial Flora) Expert	
2	Eng. Julieth Bundala	Mining Expert	
3	Onesmo Haule	Biodiversity (Fauna) Expert	
4	Farida Mayowela	Aquatic Biodiversity Expert	

(Source: MTL Consulting; 2026)

1.9 Report Structure

The ESIA for Soda Ash Project report has been structured to align with the minimum requirements of the Environmental Impact Assessment and Audit Regulations of 2005 and subsequent amendments of 2024. It is presented in twelve (12) chapters, supported by a comprehensive list of references, and should be read alongside Volume 2, which provides the appendices. The chapters are organized as follows:

- **Chapter One –** Introduction: Introduces the project, including general background, investment cost, ownership, nature of operations, extraction and processing methods, and processing workflow. It also covers the current project status, the rationale for ESIA, study objectives, methodologies, study area, the team of experts, and the overall report structure.
- **Chapter Two –** Project Description: Provides a technical overview of the project, associated activities, and detailed descriptions of project components, infrastructure, and utilities related to the proposed Soda Ash Extraction and Processing Project.
- **Chapter Three –** Policy, Legal and Administrative Framework: Outlines the relevant national policies, legal provisions, and administrative structures, as well as applicable international best practice standards.

- **Chapter Four –** Environmental and Social Baseline Conditions**:** Presents a comprehensive description of the prevailing biophysical and socio-economic conditions at the project site and its surroundings.
- **Chapter Five –** Stakeholder Participation and Consultation: Provides details on the project's approach to stakeholder participation, detailing the engagement strategies and activities that have been carried out to date.
- **Chapter Six –** Project Alternatives: This section focuses on the discussion of the various project alternatives that have been evaluated throughout the ESIA process.
- **Chapter Seven –** Environmental and Social Impact Assessment: This chapter provides description and assessment of the environmental and social impacts together with the proposed mitigation measures associated with the Project.
- **Chapter Eight –** Environmental and Social Management Plan: Provides the management programs to be implemented across all phases of the project.
- **Chapter Nine –** Environmental and Social Monitoring Plan: Describes the monitoring framework and programs to be applied throughout the project's life cycle.
- **Chapter Ten** – Cost–Benefit Analysis: Provides details on the resource evaluation and cost benefit analysis of the project.
- **Chapter Eleven –** Decommissioning and Closure Plan: This chapter describes both the conceptual closure and decommissioning plan for the Project.
- **Chapter Twelve –** Summary of Findings, Conclusion, and Recommendations: Summarizes the key findings and provides general conclusions and high-level recommendations.

Additionally, this report will read in conjuction with Volume 2, which contains the appendices.

- Appendix 1: Certificate of Incorporation.
- Appendix 2: Consultation Forms.
- Appendix 3: Meeting Minutes.
- Appendix 4: Baseline Summary of Project Area.
- Appendix 5: Consultation Pictures.
- Appendix 6: Views Raised by Stakeholders and Responses.
- Appendix 7: Stakeholders Engagement Letter,
- Appendix 8: Stakeholders Concerns from the previous ESIA study 2007
- Appendix 8A: Records from Tanzania
- Appendix 8B: Records from Kenya
- Appendix 9: Soda Ash Aquatic Biodiversity Report
- Appendix 10: Prospecting Licenses,
- Appendix 11: Soda Ash Fauna Biodiversity Report
- Appendix 12: TAWIRI Report
- Appendix 13: Water Quality Lab Result,
- Appendix 14: Site Layout Plan,
- Appendix 15: Emergency Response Plan,

2 PROJECT DESCRIPTION

2.1 Project Location and Accessibility

2.1.1 Project location

The proposed soda ash production project is located at Wosiwosi Village, within Gelai Lumbwa Ward in Longido District, Arusha Region, Tanzania. The project area is strategically positioned in Lake Natron, which will serve as the primary source of trona for soda ash production. Lake Natron is believed to be with a maximum of 57 kilometres long and 22 kilometres wide equivalent to an area of 1254km^2 (TAWA, 2025). Trona extraction activities will take place within Lake Natron, specifically on the Wosiwosi side.

The project area falls within Lake Natron Game Controlled Area (GCA) covering an area of 3,000 square kilometres designated by government notice of 1974. The GCA includes a wetland of international importance with 224,781ha (2,248km^2) squeezed between Monduli and Longido districts to the east and Ngorongoro to the west at (2°30' S, 36 °E) (TAWA, 2025).

2.1.2 Project Accessibility

The proposed soda ash production project site is accessible by road from Arusha City, via Mto wa Mbu, continuing along the road to Engaruka. Also, the main other access routes include:

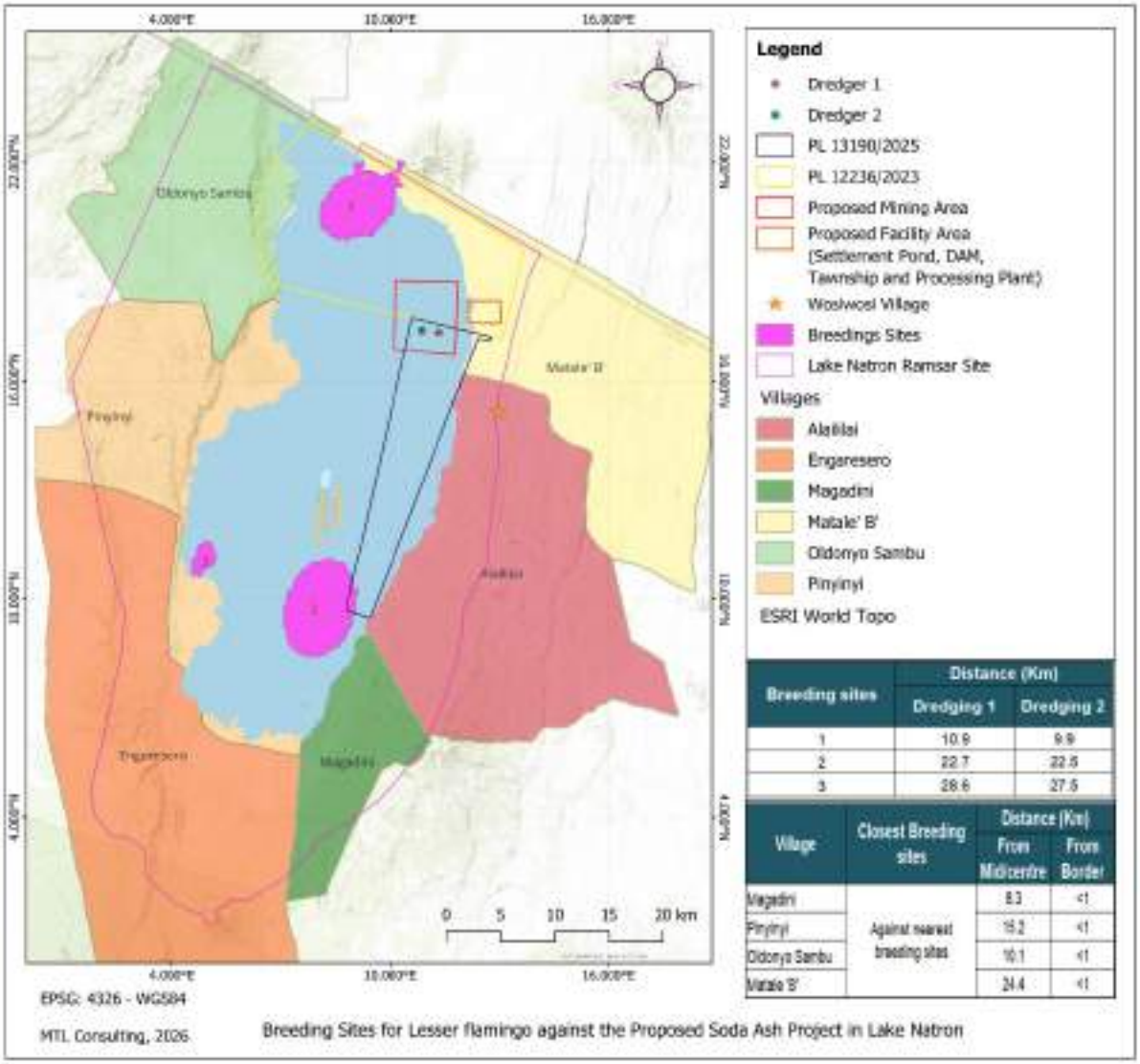
- From Longido Town: The project site is approximately 100 km from Longido Town Centre, accessible via an all-weather rough road passing through Ketumbeine Village.
- From Gelai Lumbwa: From Gelai Lumbwa, the site is located about 48 km east, towards Wosiwosi Village.
- From Arusha City: The distance from Arusha to the proposed project site is approximately 178 km by road.
- From Dar es Salaam Port: The project site lies approximately 800 km from the Port of Dar es Salaam, facilitating the transport of imported equipment and the export of finished products.

2.2 Licenses

WWSL holds two prospecting licenses: PL 12236/2023 (a large area of 291.41 sq. km) and PL 13190/2025 (covering 88.6496 sq. km).

- PL 12236/2023, covering approximately 291.41 km², which spans Pinyinyi Ward in Ngorongoro District and Gelai Lumbwa Ward in Longido District (NBS Shapefiles, 2022); and
- PL 13190/2025, covering approximately 88.65 km², primarily located within Gelai Lumbwa Ward.

The main project mining facilities will be in PL 12236/2023 and PL 13190/2025 (Figure 2.1). This includes the locations of dredgers deployed during exploration and the proposed site for the processing plant. Initially, the processing plant will be established approximately 1 km from the extraction point. However, as dredging operations advance, the distance between the extraction site and the processing plant is expected to increase progressively (Figure 2.2).



Breeding sites	Distance (Km)	
	Dredging 1	Dredging 2
1	10.9	9.9
2	22.7	22.5
3	28.6	27.5

Village	Closest Breeding sites	Distance (Km)	
		From Midcentre	From Border
Magadini	Against nearest breeding sites	8.3	<1
Pinyinyi		16.2	<1
Oldonyo Sambu		10.1	<1
Matale B'		24.4	<1

Figure 2.1: PL 13190/2025 and PL 12236/2023

(Source: MTL Consulting, 2026)

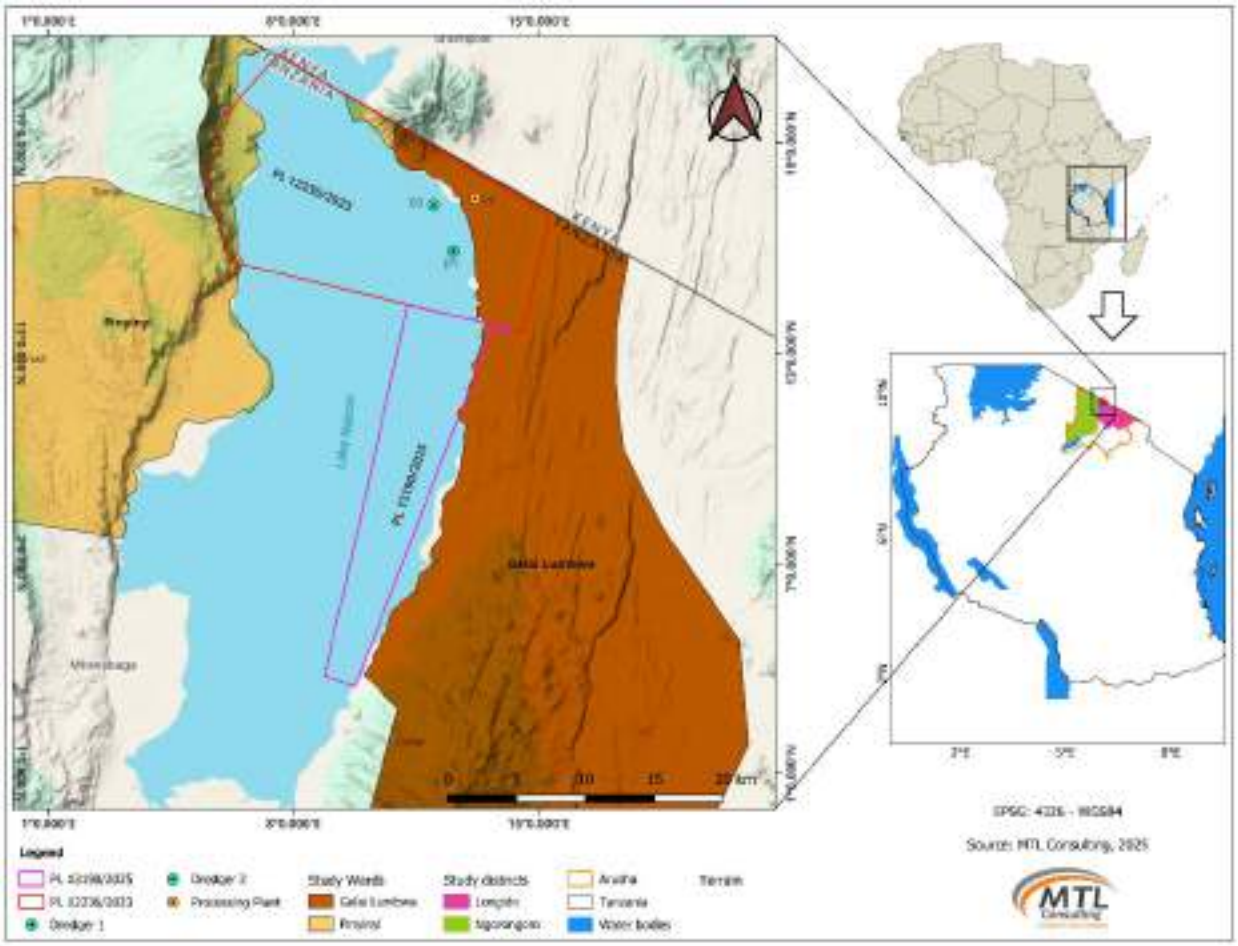


Figure 2.2: Project Location

(Source: MTL Consulting, 2025)

2.3 Project Boundary

2.3.1 Spatial Boundary

The proposed soda ash project covers an area within Wosiwosi Village, Gelai Lumbwa Ward in Longido District, extending partly into Pinyinyi Ward in Ngorongoro District. The project area encompasses approximately 380 km², defined by Prospecting License PL 12236/2023 (291.41 km²) and PL 13190/2025 (88.65 km²) (Figure 2.1).

The project boundary extends along the southeastern shore of Lake Natron, where trona extraction activities will occur, and includes the proposed processing plant site located approximately 2.5 km inland from the extraction point. The geographic coordinates defining the outer limits of the project were obtained from official NBS shapefiles (2022), and the prospecting license documents are provided in Appendix 8 of Volume 2.

The study area for this ESIA includes the immediate project footprint comprising the selected site within Lake Natron, associated infrastructure, and the access route connecting the operation site to supporting facilities.

Additionally, the spatial boundary incorporates zones of indirect and cumulative influence, accounting for potential impacts on surrounding terrestrial and aquatic ecosystems, including water quality, aquatic biodiversity, terrestrial biodiversity and shoreline communities. This integrated approach ensures that the assessment addresses both direct impacts within the

project site and indirect effects within the wider Lake Natron GCA, providing a comprehensive and spatially coherent framework for the ESIA.

2.3.2 Temporal Boundaries

The proposed Trona Extraction and Soda Ash Production Project is planned to have an estimated lifespan of approximately 257 years, encompassing distinct project phases: construction, operation, decommissioning, and post-closure monitoring.

The construction phase is anticipated to last approximately 3 years, during which site preparation, installation of processing facilities, and supporting infrastructure will be undertaken. The operational phase is expected to extend for approximately 257 years, involving continuous trona extraction, processing, and product transportation. Following the operational phase, decommissioning and closure activities will be implemented, likely over a period defined by the Life of Mine (LOM) and in accordance with the approved Mine Closure Plan. A post-closure monitoring period will follow to evaluate the success of rehabilitation and ensure environmental stability.

The temporal boundaries of this EIA extend from the initiation of baseline studies which establish pre-project environmental and socio-economic conditions through to the post-closure phase. The EIA therefore identifies, predicts, and evaluates impacts associated with the construction, operation, decommissioning, and post-closure stages of the project, ensuring that both short-term and long-term effects are comprehensively addressed.

2.3.3 Institutional Boundaries/Framework

The various institutions and their roles in environmental management of the Proposed Soda Ash construction project were identified to determine the institutional boundaries of the ESIA. Table 5.3 in Chapter 5 summarizes the identified institutions and their roles concerning the proposed Project.

2.4 Project Design

The proposed Lake Natron Soda Ash Project is to be implemented by Woswosi Soda Limited (WWSL), aims to extract and process naturally occurring Sodium sesquicarbonate (Na2CO3·NaHCO3·2H2O) also known as Trona from Lake Natron to produce soda ash (Sodium Carbonate – Na_2CO_3). The project has been designed to use the dredging mining process to extract solid trona from the lakebed and use the Conventional Monohydrate process to produced Soda Ash, supported by modern engineering systems and environmentally responsible infrastructure. While water from Lake Natron is used during the mining and processing stages to facilitate slurry transport and washing, the project does not involve abstraction of brine as a primary raw material.

The project design is optimized for low energy consumption, and minimal environmental disturbance,

2.4.1 Mining and Dredging System

a) Overview of the Mining Method

Mining of trona within Lake Natron will be undertaken using a Cutter Suction Dredger (CSD) specifically selected and configured to minimize environmental disturbance while ensuring efficient recovery of trona deposits from the lakebed. The method has been designed in

accordance with Ramsar “wise use” principles, emphasizing controlled extraction, protection of sensitive habitats, and maintenance of the lake’s hydrological and ecological integrity.

The soda ash recovery process begins with the extraction of trona from the lakebed using a Cutter Suction Dredger (CSD). The dredging system has been designed to efficiently extract solid trona, which is subsequently mixed with process water to form a slurry for hydraulic transport while maintaining the integrity of the lakebed. Table 2.1 provides specifications of the proposed dredger.

Table 2.1: Proposed Dredger Specifications

S/N	Parameter	Specification
1	Dredger Type	Cutter Suction Dredger (CSD)
2	Dredging Capacity	250–300 tons/hour (~1,000 m^3/hour slurry)
3	Power	254 kW total (Cutter: 40 kW)
4	Cutter Diameter	950 mm
5	Maximum Dredging Depth	6 m
6	Swing Width	19.1 m
7	Fuel Tank Capacity	8.4 m^3

After the trona is dredged (mined from the lake surface by a dredger), it is reduced in size by a mechanical crusher built in the dredger

A mixture of trona solids and lake water will pass through a screening mesh called a sieve bend at the dredge where excess process water and fine particles will be returned to the lake and a mixture of solids of the right particle size and water (Called slurry) will be transported from the lake to the factory by a series of centrifugal pumps.

b) Proposed Mining Method

The exploration was conducted in 60 km^2 of Lake Natron, representing approximately 5% of the lake’s total area. This was done for a bankable report in order attract foreign investors and stock listing for future of the project. Within the 60 km^2, the intended area to be mined throughout the life cycle of the project will be 10km^2, which represents approximately 0.8% of the lake’s total area. The area contains 400 million tons of trona bearing resource, with the minable area containing 243 million tons of soda ash-bearing sediment. To ensure controlled extraction and minimize environmental impact, the mining operation will employ a rotational dredge mining approach, the method will include dividing the 10km^2 mining area into small cells of 200 meters by 100 meters, considering the 15m as an average mineable depth. This method allows for efficient resource use, controlled sediment management, and minimal disturbance to the lake ecosystem.

At any given time, only a small portion of the mining area will be actively dredged. Each cell will be fully contained using alkali-resistant materials, such as high-density polyethylene (HDPE) geomembranes or polypropylene geotextiles, supported where necessary by corrosion-resistant frames. Floating silt curtains will be employed within the cells to trap suspended sediments (Figure 2.1), while water from dredging will be treated via settling ponds before being returned to the lake. This ensures that turbidity, pH, and salinity in surrounding waters remain within environmentally safe limits.

Figure 2.3: Proposed Curtains to be Employed During Dredging Activities

(Source: WWSL; 2026)

c) Description of the Cutter Suction Dredger

The proposed Cutter Suction Dredger is a floating, electrically powered dredging unit equipped with a rotating cutter head and suction pipeline (Figure 2.4 & 2.5). The cutter head gently loosens consolidated trona from the lakebed, after which the material is immediately entrained into a slurry and hydraulically conveyed through a closed pipeline system. This approach avoids open excavation, blasting, or mechanical scraping of the lakebed.

The dredger is designed to handle dredged trona material in slurry form (solid trona mixed with water for transport) efficiently while maintaining precise control over dredging depth and footprint. Dredging depth will be strictly limited to the trona-bearing horizon, thereby preventing unnecessary disturbance of underlying sediments. Attached in Volume 2 is the instruction manual for the propose dredgers for the project.

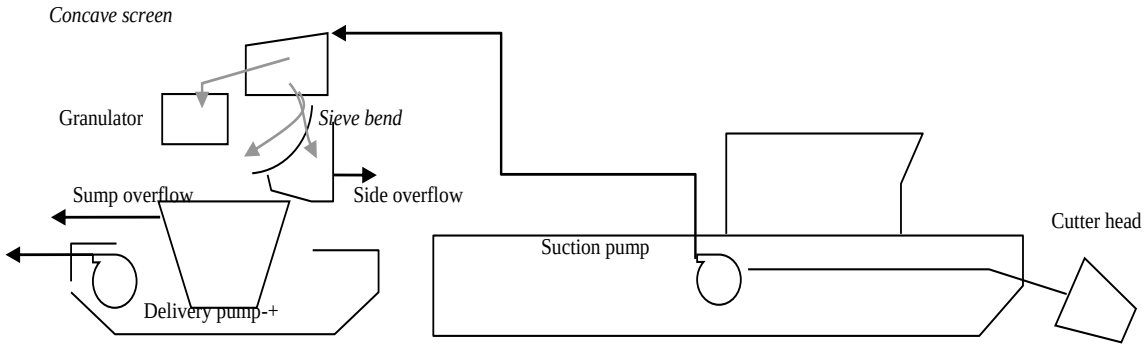


Figure 2.4: Layout for the Proposed Dredger

(Source: WWSL; 2026)

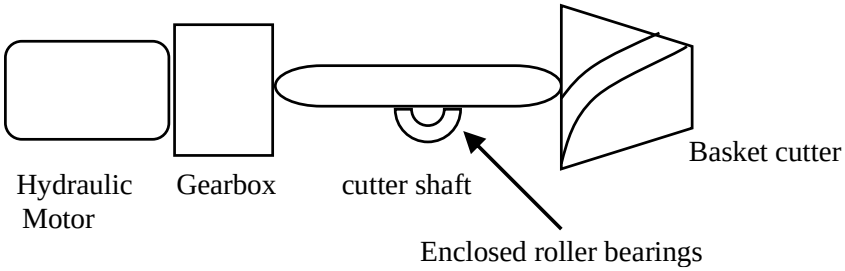


Figure 2.5: Layout of the Dredge Head Assembly

(Source: WWSL; 2026)

d) Mining Rate

The proponent plans to extract approximately 1,000,000 tons of raw sediment per year, producing 660,000 tons of soda ash annually (Table 2.2). Each cell contains an estimated 480,000 tons of raw sediment, meaning that 2–3 cells will be actively mined each year to meet production targets. At this rate, the total 243 million tons of resource in the mining area could be extracted over approximately 150+ years, without taking into account geological recovery cycles.

This long-term approach ensures that the project meets production needs sustainably while limiting the environmental footprint at any one time.

Table 2.2: Mining Containment Description

Parameter	Value
Cell size	200 m × 100 m (0.02 km²)
Mining depth per cell	15 m
Sediment volume per cell	300,000 m³
Mass of raw sediment per cell	480,000 t
Soda ash yield per cell (66%)	316,800 t
Number of cells mined per year	2–3
Cell Regenerative Rate	10 Years
Total Mining Area	10 km² (50 cells)
Total resource	243,000,000 t
Annual extraction	1,000,000 t/year
Estimated project duration (without regeneration)	150+ years

(Source: WWSL, 2026)

e) Cells Closure

After extraction, each mined cell will be closed by removing containment structures and allowing the lakebed to regenerate naturally. Sediment redistribution, recolonization by algae and microorganisms, and wildlife return, particularly flamingos, will be carefully monitored. The dredge will then move to the next scheduled cell in the rotation, creating a sustainable, long-term mining cycle.

f) Environmental Design Considerations

To ensure compatibility with the Ramsar status of Lake Natron, the dredging system incorporates the following environmental safeguards:

- Low-Impact Cutter Head: The cutter head operates at controlled rotational speeds to reduce sediment resuspension and turbidity within the water column.
- Electric Power Supply: The dredger is powered by electricity, eliminating on-site fuel combustion and reducing risks of hydrocarbon spills, air emissions, and noise pollution.
- Closed Slurry Transport: Tronae slurry is transported via sealed pipelines, preventing leakage and minimizing interaction with surrounding lake waters.
- Localized Dredging Footprint: Dredging is confined to clearly demarcated mining zones, with exclusion buffers maintained between mining and ecologically sensitive areas.
- Progressive Dredging: Mining advances in a phased and progressive manner, allowing for natural re-equilibration of sediments and reducing cumulative impacts.

Details for issues to be taken into consideration during design period are provided below:

i) Protection of Lakebed Integrity and Hydrology

The dredging methodology has been designed to preserve the structural and chemical integrity of the lakebed. Controlled dredging depths and low cutting forces prevent excessive sediment mixing and maintain the natural stratification of sediments. The dredging system is designed to avoid the formation of deep pits, trenches, or depressions in the lakebed that that could alter local hydrodynamics or natural lake water circulation patterns within the lake. Such features may act as collection points for saline water, increasing hydraulic head and enhancing vertical infiltration potential. By maintaining a relatively uniform lakebed profile, the system preserves natural lake water circulation patterns and reduces the likelihood of focused seepage into underlying formations.

ii) Compatibility with Ecological Sensitivity

Given the ecological importance of Lake Natron, particularly as a breeding and feeding habitat for waterbirds, dredging operations will be spatially and temporally managed to avoid sensitive ecological periods. Operational controls will include speed limits, noise management measures, and continuous environmental monitoring to detect and respond to any adverse changes in water quality or habitat conditions.

iii) Protection of Lakebed Integrity, Hydrology, and Groundwater Resources

The dredging methodology has been specifically designed to preserve the physical, chemical, and hydrogeological integrity of the lakebed and to prevent saline water migration from the lake into underlying non-saline or slightly saline groundwater systems. Given the hypersaline nature of lake water and the potential connectivity between surface water and shallow groundwater systems, protection of subsurface environments is a key design and operational priority.

iv) Preservation of Lakebed Stratigraphy and Sealing Function

The lakebed comprises stratified sediment layers that act as a natural hydraulic barrier between hypersaline lake water and underlying groundwater units. Controlled dredging depths are strictly limited to the trona-bearing horizon and will not penetrate deeper, low-permeability

clayey or evaporitic layers that provide natural confinement. By maintaining these strata intact, the dredging operation preserves the lakebed's sealing function and minimizes the risk of vertical saline seepage.

Low cutting forces and controlled cutter head rotational speeds are applied to avoid excessive sediment disturbance, fracturing, or remoulding that could increase permeability. This approach limits the creation of preferential flow paths that could facilitate downward migration of saline water into less saline groundwater zones. Control of Hydraulic Gradients and Seepage Risk. Uncontrolled dredging can alter local hydraulic gradients, potentially inducing downward seepage of saline water. To mitigate this risk, dredging is undertaken in shallow, incremental passes rather than deep, continuous cuts. This ensures that pressure differentials between the lake water and subsurface groundwater remain within natural ranges. The methodology avoids prolonged exposure of freshly dredged surfaces and prevents the formation of open excavations that could act as recharge points for saline water. Progressive dredging and immediate slurry removal reduce the residence time of disturbed sediments, allowing natural consolidation processes to re-establish low-permeability conditions. Salinity Isolation and Chemical Stability. Chemical integrity of the lakebed is preserved by minimizing mixing between saline lake water and deeper sediment layers with different geochemical characteristics. Excessive mixing could mobilize salts or alter porewater chemistry, increasing the risk of saline contamination of adjacent groundwater systems. Controlled dredging ensures that saline porewater remains largely confined within the lake system. In addition, the closed slurry transport system prevents redistribution of saline material outside the designated mining zone, further limiting the risk of secondary contamination pathways.

v) *Groundwater Protection and Monitoring Measures*

To verify the effectiveness of these controls, groundwater protection measures include the establishment of baseline hydrogeological conditions and continuous monitoring of groundwater levels and salinity in surrounding areas. Monitoring wells will be used to detect any changes in electrical conductivity or salinity that may indicate saline intrusion. Adaptive management measures will be implemented should monitoring results indicate deviations from baseline conditions.

2.4.2 Monitoring at the Mining Site

Environmental monitoring will be conducted continuously. Water turbidity, pH, and salinity will be measured to ensure compliance with environmental standards, while algal density and wildlife activity will be monitored to detect potential impacts. The mining approach is adaptive, allowing adjustments to cell size, rotation schedule, or dredging intensity based on monitoring outcomes.

Through this rotational dredge mining methodology, the project aims to achieve sustainable soda ash production while maintaining the long-term ecological integrity of Lake Natron, protecting its unique biodiversity and sensitive habitats over the life of the project.

2.4.3 Slurry Transport and Conveyance System

The dredged trona, in the form of slurry (solid trona mixed with water), is transferred through a closed pipeline network to the processing plant. The pumping system will consist of:

- Six main slurry pumps: 332.6 m^3/hr, 74.5 kW each
- Two effluent pumps: 580 m^3/hr capacity

- Corrosion-resistant booster pumps (PVC-lined and stainless-steel heads)
- Pipeline material: HDPE-lined ducts to prevent leakage and chemical attack

The pipeline alignment has been designed as a buried underground system to minimize surface disturbance, maintain natural drainage patterns, and avoid fragmentation of wildlife movement corridors

2.4.4 Processing Plant

a) Processing Plant Context

The soda ash processing facility will use the Monohydrate Method, consisting of sequential stages that convert processed trona ore into refined soda ash. The process comprises crushing and screening of trona ore, which contains sodium carbonate (Na_2CO_3), sodium bicarbonate ($NaHCO_3$), and minor impurities such as silicates and organic matter. Following screening, the trona is subjected to calcination at temperatures ranging between 150 °C and 600 °C using rotary calciners powered by electricity, gas, or coal-fired systems, during which sodium bicarbonate is thermally converted to sodium carbonate.

b) Production Capacity and Design Life

Table 2.3 summarizes the key production and design parameters of the proposed project, indicating a large-scale, long-life operation. The facility is designed to process approximately 1,000,000 metric tonnes of trona per year, yielding an estimated 660,000 metric tonnes of soda ash annually at an overall recovery efficiency of about 70%, reflecting a technically efficient beneficiation and processing system. Operations are planned to run on a continuous 24-hour basis, which underscores the industrial intensity of the project and has implications for energy demand, noise, emissions, and occupational health and safety. Based on the currently delineated trona reserves, the project lifespan is estimated at approximately 150 years, indicating a long-term footprint with cumulative environmental and social considerations. The potential environmental impacts associated with these design and operational characteristics are assessed in detail in Chapter 7, while Chapter 11 addresses decommissioning and closure considerations to ensure long-term environmental sustainability and regulatory compliance.

Table 2.3: Project production capacity and design life

S/N	Parameter	Design Specification
1	Trona Feed	1,000,000 MT/year
2	Soda Ash Output	660,000 MT/year
3	Recovery Efficiency	70%
4	Operational Hours	24 hrs/day continuous
5	Project Lifespan	150 years (estimated based on reserves)

(Source: Woswosi Soda Limited, 2025)

2.4.1 Processing Plant Associated Units

) Washing (Washery)

At the washery, process water is separated from the trona solids using a de-watering wheel, at the de-watering tower. Process water with a density greater than 1.2 is introduced to remove sodium fluoride (NaF) and other insoluble solids from the Trona. The displaced water and fine solids (collectively referred to as the effluent) are pumped to settlement ponds, where the fines

settle out of the process water. Routine laboratory tests will be performed on the clarified process water to ensure it meets required specifications such as pH before it is discharged back into the lake in compliance with environmental standards.

The wet Trona discharged from the de-watering wheel undergoes further washing to remove unwanted components including NaF, NaCl, and insoluble particles. It is then fed to hydrocyclones for additional particulate separation. Centrifuges are subsequently used to separate process water from the product, reducing the moisture content to below 11%.

The by-products generated during washing are pumped to the settlement ponds, while the final product, known as crushed refined soda (CRS), is conveyed to the kilns for calcination.

a) Calcination

The Crushed Refined Soda (CRS) is fed into electric calciners (kilns), where it is heated to temperatures exceeding 600 °C, producing sodium carbonate (soda ash) as the primary chemical product. Upon exiting the kilns, the hot product is transferred to the grinding and screening section, where it is cooled, screened, and reduced to the required particle size.

Fine dust and other by-products generated during calcination are directed to an electrostatic precipitator, which removes dust from the exhaust gases. The cleaned hot gases are then released to the atmosphere. The collected fine dust is dissolved in saline process water and pumped to the settlement ponds.

b) Grinding and Screening (G&S)

In the grinding and screening plant, the hot soda ash first passes through a fluid bed cooler for temperature reduction. From the cooler, the product moves to the screening section, where material of the correct particle size is conveyed to the storage silos. Coarse material is sent to the mills for further grinding to achieve the desired particle size distribution (PSD), after which it is also transferred to the silos. Dust generated during grinding and screening is captured by extraction fans and removed through a wet scrubber system installed at the G&S facility.

c) Storage Silos

The final soda ash product is stored in dedicated silos. A bulk loading station is available for packing the product into rail wagons for transportation to Mombasa. Additionally, two packing units are used to fill gunny bags for regional and local markets. Dust emissions from the silos, bulk loading area, and packing stations are controlled using extraction fans connected to bag filters.

2.4.2 Power Supply

The proposed project will require electrical power for both industrial processing operations and domestic and auxiliary services. To meet these requirements in a reliable and environmentally sustainable manner, the project will adopt a hybrid power supply system, comprising an on-site solar power installation and the national electricity grid.

The power demand for processing operations is estimated to range between 11 MW and 15 MW, reflecting the requirements of trona extraction, slurry pumping, and soda ash processing. Due to the continuous and high-load nature of these operations, they will be supplied by the national grid, which provides the necessary capacity and reliability for industrial-scale energy demand.

For domestic and auxiliary uses, including administration buildings, staff accommodation, lighting, and other low-load services, the project will primarily utilize solar power. The proposed solar installation will occupy an area of approximately 2 hectares and will be designed to meet the energy requirements of these non-process facilities.

To ensure reliability and continuity of power supply, particularly during periods of low solar generation (e.g., night-time or cloudy conditions), the national grid will serve as a backup source for the solar system. This configuration ensures that essential services remain operational at all times.

The integration of solar power as the primary source for auxiliary loads significantly reduces dependence on grid electricity for non-critical operations and contributes to lowering the project's overall environmental footprint. At the same time, the availability of grid backup ensures that reliability is not compromised.

Overall, the proposed power supply system provides a balanced approach that combines renewable energy utilization with dependable backup infrastructure, ensuring that both processing and supporting operations are adequately powered while minimizing environmental impacts.

2.4.3 Water Supply and Storage

The proposed project will require water for both industrial processing and domestic and auxiliary uses. To ensure efficient and sustainable utilization of water sources, a dual source water supply system will be adopted, utilizing Lake Natron and Ewaso Ngiro River for different purposes.

The water demand, abstraction rates and storage capacities have been estimated based on the anticipated production scale and workforce requirements.

Water Demand

a) Processing Water Demand

Water will be required fro trona slurry preparation, mineral processing and associated plant operations.

- Process water demand: 10.0 m^3/hr an approximate of 240 m^3/dayWater Source: Lake Natron

The saline characteristics of Lake Natron water make it suitable for processing, reducing the need for chemical adjustment.

b) Domestic and Auxiliary Water Demand

Freshwater will be required for domestic use, sanitation, cleaning and other auxiliary activities.

- Domestic Water Demand: 1.0 m^3/hr an approximate of 24 m^3/day
- Water Source: Ewaso Ngiro River

All water intended for portable use will be treated to meet relevant drinking water quality standards prior to consumption.

Water Supply Sources

a) Lake Natron – Processing Water

Lake Natron will serve as the primary source of water for industrial processing activities.

- Abstraction Rate: ~ 10.0 m³/hr
- Abstraction will be undertaken in a controlled manner to avoid significant alteration of lake hydrology and salinity balance.
- Intake structures will be designed to minimize disturbance to the lake ecosystem.

Ewaso Ngiro River – Domestic and Auxiliary Water

The Ewaso Ngiro River will supply freshwater for domestic and auxiliary uses.

- Abstraction Rate: ~ 1.0 m³/hr
- Abstraction will consider seasonal variability in river flows and maintain environmental flow requirements.
- All necessary water use permits will be obtained from relevant authorities.

Water Storage Systems

To ensure continuous water availability and operational reliability, the project will include dedicated water storage infrastructure with storage capacity of 3,500 m³ (Stainless Steel Tank). The storage system will accommodate both processing and domestic water requirements and will be equipped with a float-controlled inlet system to regulate inflows and maintain optimal storage levels.

The storage system will:

- Ensure continuous water supply during short-term abstraction interruptions
- Provide operational buffer for both processing and domestic use
- Support water recycling and system balancing
- Enhance resilience during dry periods or maintenance shutdowns

Design considerations for the storage system are:

- Corrosion-resistant stainless steel construction
- Leak prevention and containment measures
- Integration with water treatment and recycling systems
- Controlled inflow and outflow mechanisms

Water Management and Efficiency

The project will implement water management measures to enhance efficiency and minimize environmental impacts, including:

i. Recycling of process water
ii. Separation of industrial and domestic water uses
iii. Monitoring of abstraction rates and storage levels
iv. Implementation of water conservation practices
v. Compliance with water use permits and environmental regulations

The proposed dual-source water supply system, supported by a 3,500 m³ storage facility, ensures that the project meets its water requirements in a reliable, efficient, and environmentally sustainable manner.

By utilizing Lake Natron for processing and the Ewaso Ngiro River for domestic use, the project optimizes water use efficiency while reducing pressure on individual water resources. The storage system further enhances operational reliability by providing sufficient buffering capacity to accommodate fluctuations in supply.

2.4.4 Soda Ash Storage and Packaging Facilities

Refined soda ash will be stored in five steel silos, each with:

- Capacity: 15,000 tons
- Material: Mild steel with corrosion-resistant coating
- Dust suppression system: Pneumatic filters

Soda ash will be packed in 50kg, 100kg and 1000kg polypropylene bags (sourced from Dar Es Salaam) for domestic and export transport. Intermediate products such as bicarbonate and will be stored in separate tanks for reuse or safe disposal.

2.4.5 Waste Rock and Solid Waste Management

- Industrial Waste: Residual salts and scales from processing units will be collected and disposed of in settlement ponds or reused as secondary industrial inputs.
- Hazardous Waste: The hazardous wastes such as used oils, filters, and reagents will be stored in sealed drums and transferred to licensed disposal facilities.
- Domestic Wastes will be managed through segregation and composting.

A comprehensive Waste Management Plan will be implemented and approved by NEMC prior to operations.

Waste streams expected during the construction phase are remnant timber, scrap metals, food remains, plastics, oil and grease. Table 2.4 indicates the waste types, estimation amount of waste and proposed treatment for the waste.

Table 2.4: Types, Amount and Treatment/Disposal of Waste During Construction Phase

Waste	Types	Estimated Amount	Treatment/Disposal
Solid Waste (Degradable)	Remnants of Timber	1300 pieces	Shall be sold to the people for repurpose.
	Food Remains, Cardboards and Papers	8kg/day (based on generation rate 0.4kg/day/personal and 20 workers)	To be collected in the large skip bucket at site ready to be disposed at the onsite landfill.
	Scrap Metal, Drums	1tons	To be reused
	Tins, Glasses, and Plastics	20kg	To be solid to Recyclers
Liquid Waste	Sewage	1600 liters/day (Based on 100 people, water consumption rate of 20L/capital/day and wastewater discharge factor of 80%)	To be managed using onsite management system.
	Oils and Greases	10 liters per phase	Service and maintenance of vehicles will be done at designated garages.
E-Waste	Batteries, printed wiring boards, television sets, PC monitors, light bulbs, lamps.	2 ton for the planned 2 years of the project construction.	Collected in a designated section and contract e-waste authorized company for handling and disposal.

(Source: WWSL, 2025)

2.4.6 Ancillary Facilities

These facilities are designed with fire control systems, stormwater management, and safe sanitation.

- Workshops and Warehouses: For maintenance and storage of equipment and spare parts.
- Administrative Buildings and Control Room: Housing plant operations management systems.
- Staff Camp: Accommodation for up to 300 employees with water, power, and sanitation facilities.
- Weighbridge and Security Gatehouse: For logistics and transport control.
- Radio Communication and Monitoring Tower: For plant coordination and emergency response.
- Parking area: A designated Parking area will be developed to accommodate up to 100 vehicles, ensuring organized and secured parking for employees and visitors.
- Changing rooms: To support hygiene, safety and comfort pf workers, they will be constructed and strategically located near operational zones and staff quarters.
- Sanitation facilities: To ensure proper hygiene and sanitation for workers over 300 personnel, will include a total number of 35 washrooms whereby 20 will be for females and 15 for gents. The facilities will ensure inclusivity by including disabled-accessible units.
- Recreational Facilities: To promote well-being, morale and productivity of workers, the project will include development of several recreational facilities within the accommodation and community area, including sports fields and courts, recreation halls, fitness and gym center, cultural and social gathering space and walking paths and shaded areas for relaxation.

2.4.7 Environmental and Safety Design Features

- All ponds lined with HDPE and secondary clay barriers to prevent seepage.
- Stormwater diversion channels constructed around the site to minimize inflow to ponds.
- Dust control systems at conveyors, crushers, and packaging areas.
- Effluent recycling and closed-loop process water systems.
- Emergency spill containment, fire suppression systems, and safety buffer zones established around critical infrastructure.

2.4.8 Railway Infrastructure and Transportation Network

Efficient and sustainable transportation is critical to the Lake Natron Soda Ash Project due to the scale of production and the remote nature of the site. The proposed project will produce approximately 660,000 metric tonnes of soda ash per annum, necessitating a reliable, high-capacity logistics system for both domestic and export markets. The project design incorporates a dedicated railway connection as the primary transport mode, supplemented by road access during construction and for auxiliary materials.

a) Proposed Railway Connection

The proposed railway system will form part of the project's Phase II infrastructure development, focusing on linking the processing plant at Wosiwosi Village, Gelai Lumbwa

Ward, with regional and international export corridors. Two alternative routes have been identified:

- **Route A**: Direct connection from the project site to Magadi, Kenya, where an existing soda ash railway line links to the Kenya–Uganda Railway System and further to the Port of Mombasa for export. Figure 2.2 shows the proposed railway route.
- **Route B**: A shorter, domestic connection to the planned Mto wa Mbu railway corridor, which will interface with Tanzania's Central Line Standard Gauge Railway (SGR) network, facilitating transport to Dar es Salaam Port.

Both options aim to minimize environmental disturbance by utilizing existing corridors and rights-of-way where possible. Preliminary feasibility studies indicate that Route A, connecting to the Magadi line, is the most cost-effective and logistically viable for early-stage export operations.

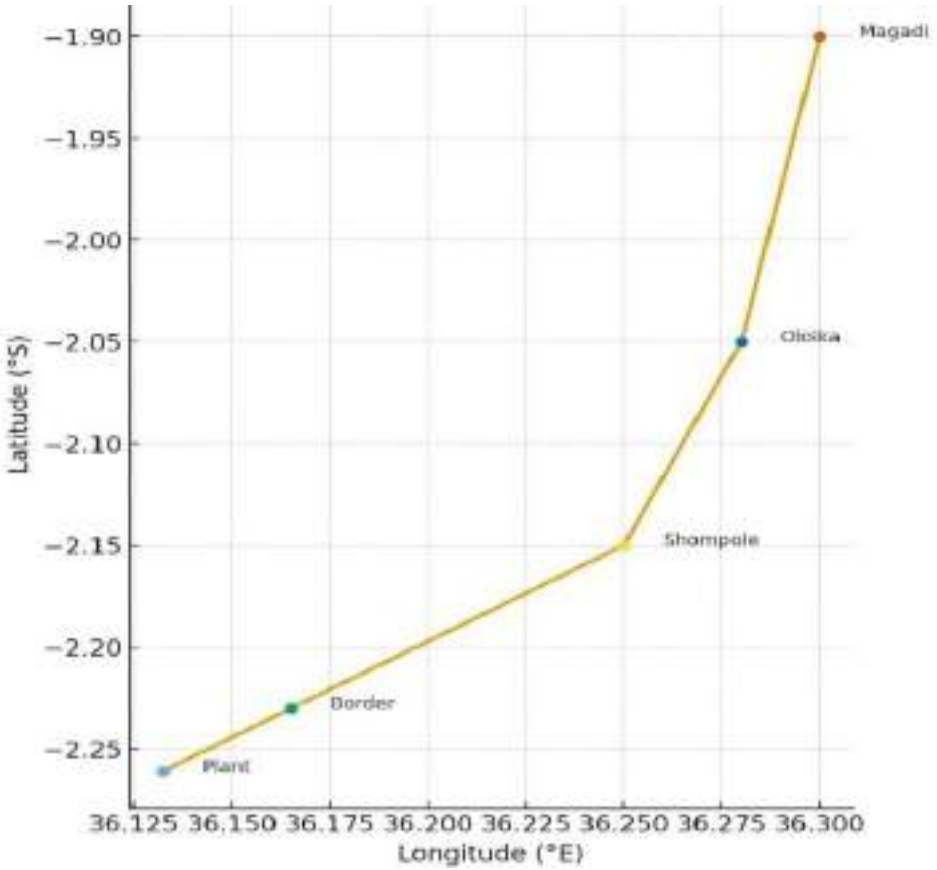


Figure 2.6: Proposed railway connection (50km)

(Source: WWSL, 2025)

b) Technical Description

The proposed rail line section within Tanzania will span approximately 5 km, extending from the processing plant to the Tanzania–Kenya border, with an additional 50 km section within Kenya connecting to Magadi. The total estimated cost for the railway infrastructure is USD 67 million, which includes:

- A single-track, heavy-duty Meter-gauge railway compatible with both Tanzanian and Kenyan rail systems;
- Ballasted track design for durability and reduced maintenance;

- Loading terminal and storage yard located adjacent to the soda ash silos for efficient bulk transfer;
- Conveyor-fed loading systems to minimize handling losses and dust emissions;
- Weighbridge and control systems for export compliance and quality assurance.

The railway infrastructure will integrate with the plant's internal logistics network, including access roads and container loading facilities. During operations, it will handle bulk soda ash, packaging materials, spare parts, and other supplies.

c) Construction and Operations

Rail construction will occur in parallel with plant commissioning activities. The project will prioritize local sourcing of aggregates, sleepers, and labour in compliance with Tanzania's Local Content Regulations. Environmental controls such as silt traps, dust suppression, and controlled vegetation clearance will be implemented throughout construction.

Once operational, the rail system will support an estimated 19 to 21 freight movements per week, reducing reliance on heavy trucks and minimizing greenhouse gas emissions and road congestion in the Longido–Mto wa Mbu corridor.

d) Environmental and Socio-Economic Considerations

The proposed railway route has been designed to avoid sensitive ecological zones, including the Lake Natron Ramsar area and flamingo breeding sites. Construction and operation will follow NEMC guidelines and incorporate wildlife crossings and noise-dampening technologies where necessary.

Economically, the railway will:

- Enhance regional trade connectivity between Tanzania and Kenya;
- Support employment creation during construction and maintenance phases;
- Facilitate cost-efficient export of soda ash, improving project viability.

e) Integration with Project Infrastructure

The railway complements other planned infrastructure systems such as:

- The processing plant at Wosiwosi;
- Evaporation and tailings ponds network;
- Power and water supply facilities;
- Storage silos and packaging units.

Together, these facilities will form a fully integrated supply chain, enabling large-scale industrial operations with minimal environmental impact and optimized logistics efficiency.

2.4.9 Ngorongoro Lengai UNESCO Global Geopark and Project Overlap

The Ngorongoro Lengai UNESCO Global Geopark is designated under the UNESCO Global Geoparks Programme to promote conservation of geological heritage, education, and sustainable development. While the UNESCO framework emphasizes protection of geoheritage and discourages activities that may degrade such resources, it does not constitute a direct permitting authority, and project approvals remain governed by national legislation.

Spatial analysis undertaken for this study confirms that the geopark boundary, as obtained and georeferenced from official sources[1], does not overlap with the project area. The proposed mining licence areas, infrastructure, and associated facilities are all located outside the geopark boundary, as presented in Figure 2.7. Therefore, no direct impacts on the geopark area or its geoheritage values are anticipated.

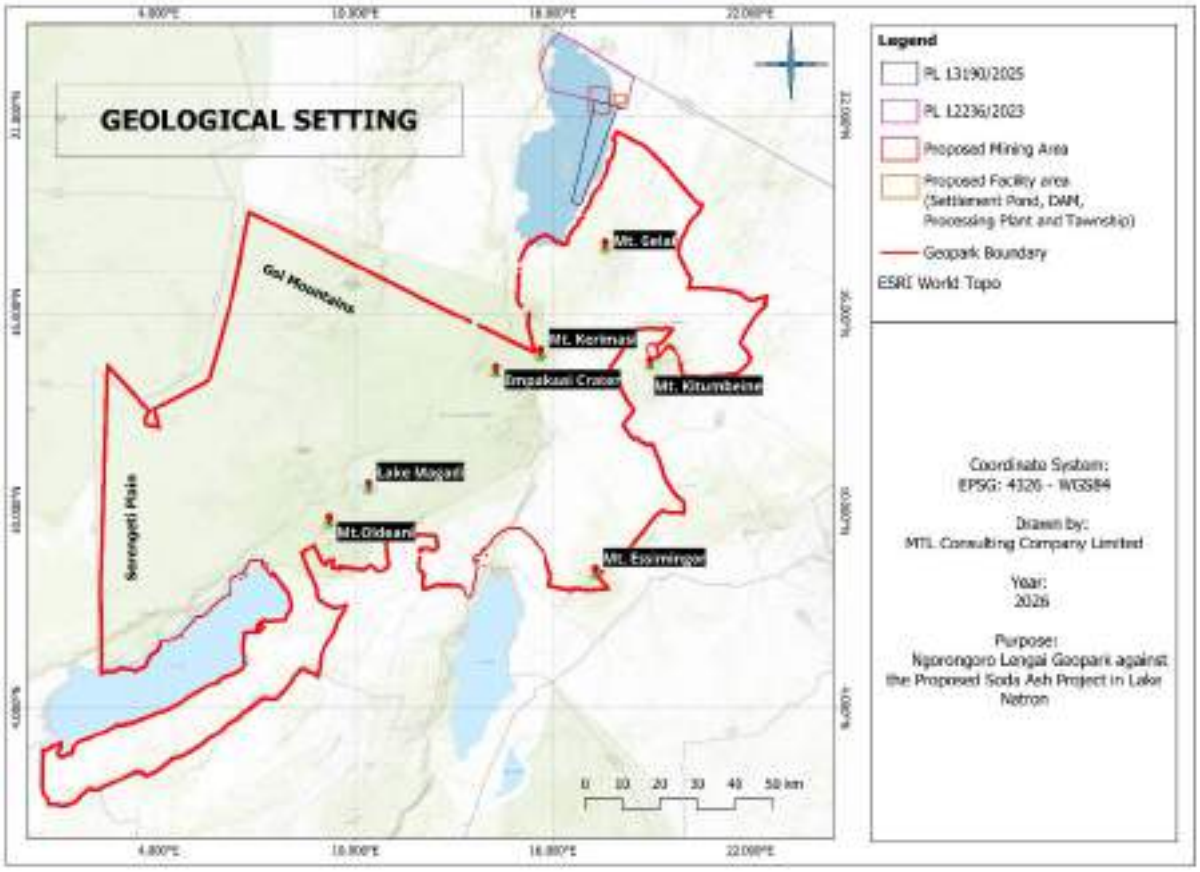


Figure 2.7: Ngorongoro Lengai UNESCO Geopark and Project Overlap

(Source: MTL Consulting, 2026)

2.5 Project Phases

2.5.1 Site Preparation and Construction

During this phase of the project, it is anticipated that a number of crucial Feasibility, Geoscience, and Engineering Studies to ensure that the proposed project is technically and economically viability. Should these studies yield favourable results and all necessary regulatory approvals be secured, the project will advance to the Construction Phase, which is the most expensive and capital-intensive stage of the plant cycle.

This phase is projected to span one to two years and requires substantial capital raising. The construction effort is extensive, focusing on both the core processing facility and essential supporting infrastructure. Key infrastructure elements include;

[1] https://www.ncaa.go.tz/geopark/

a) Water management systems (reservoirs for process/wastewater and a dedicated water supply scheme from the Ewaso Ng'iro River);

b) Site access (internal roads for transport of materials and personnel); and

c) Reliable power supply (an electricity sub-station supplemented by a diesel-powered generation plant with bunded fuel storage).

Auxiliary services are also integral to site operation such as;

a) Accommodation for approximately 300 construction personnel

b) Management offices

c) Specialized electrical and mechanical workshops, and

d) Dedicated lay-down areas for construction materials and long-term equipment spares.

This includes managing logistical requirements, such as transporting fine and coarse aggregates from local quarries and shipping critical supplies like cement (from Longido), steel (from Arusha), and timber, with the strategy to move materials in large quantities to minimize trips across the Longido game reserve.

The construction phase will utilize several materials, resources and equipment's which will be needed for the construction of the proposed processing plant and its supporting infrastructure (Table 2.5).

Table 2.5: Materials, Resources and Equipment's to be used during the Construction Phase

Materials	Approximate Quantity to be used	Unit	Potential Sources
Cement	672,000	Bags	Locally Sourced
Sand	98,400	T	Locally Sourced
3/4" Aggregate	78,400	T	Locally Sourced
Hard stones	134,200	T	Locally Sourced
Reinforcement steel (rebar)	13,440	T	Locally Sourced
Structural steel (extra)	8,000	T	Locally Sourced
A142 BRC mesh panels	13,900	EA	Locally Sourced
1000G DPM (membrane)	120,000	M^2	Locally Sourced
Marine boards (ply)	33,600	Sheets	Locally Sourced
Timber (4-m lengths)	39,200	PCS	Locally Sourced
Hessian curing cloth	2,000	Rolls (50 m^2/roll)	Locally Sourced
Water for construction	28,000,000	LIT	Ewaso Ng'iro River
Diesel (construction)	1,000,000	LIT	Locally Sourced

(Source: WWSL, 2025)

The actual construction work will employ heavy machinery, including excavators, bulldozers, graders, dozers, and front-end loaders, alongside specialized welding and hauling trucks, essential for site preparation, earthmoving, foundation work, and structural construction of the plant.

2.5.2 Operation Phase

During the operation phase, certain activities will be undertaken for the extraction of the trona and processing of the trona into Soda Ash. The expected activities include:

- Mining Activity (Extraction of trona from Lake Natron using Dredges).
- Sucking and pumping of trona extracted trona 1km.
- Wastes generation and management
- Power & Fuel Supply Management
- Water supply and management
- Handling of vehicles, machines and heavy equipment
- Occupational health and safety management.
- Maintenance works
- CSR and stakeholder engagement
- Progressive rehabilitation works.

Based on the current resource estimations, the project is expected to be in operation for over 257 years. This is due to the natural regeneration of the trona materials in Lake Natron and as such, the project is capable to operate many years over the expected years. Figure 2.8 illustrates a simple flow chart of the stages of the mining operation.

During this phase, trona will be extracted from Lake Natron using floating cutter suction dredgers with a capacity of 250–300 tons per hour. The extracted Trona is crashed and transported to the dewatering tower, where process water is separated from Trona using a de-watering wheel, and then taken to the washery where dense process water is used to removes impurities such as NaF and insoluble solids. Effluent containing fine solids is pumped to settlement ponds, while cleaned process water is tested before being returned to the lake. The wet Trona undergoes further washing, hydrocyclones separation, and centrifuging to reduce moisture to below 11%, producing CRS, which is then sent to calciners. In the calciners, CRS is heated above 600 °C to produce soda ash, and dust from this stage is captured by an electrostatic precipitator and directed to settlement ponds. The hot soda ash is then cooled in a fluid bed cooler, screened, and ground to achieve the required particle size, with dust controlled by a wet scrubber system. Finally, the refined product is stored in silos, where it is either loaded into rail wagons for transport or packed into bags for local and regional markets, with dust managed through extraction fans and bag filters. Most of the soda ash (98%) is intended for export to countries with large industrial markets, while the remaining 2% will serve the local market. Chemicals like polyacrylamide are used in purification, and careful storage is maintained to preserve quality.

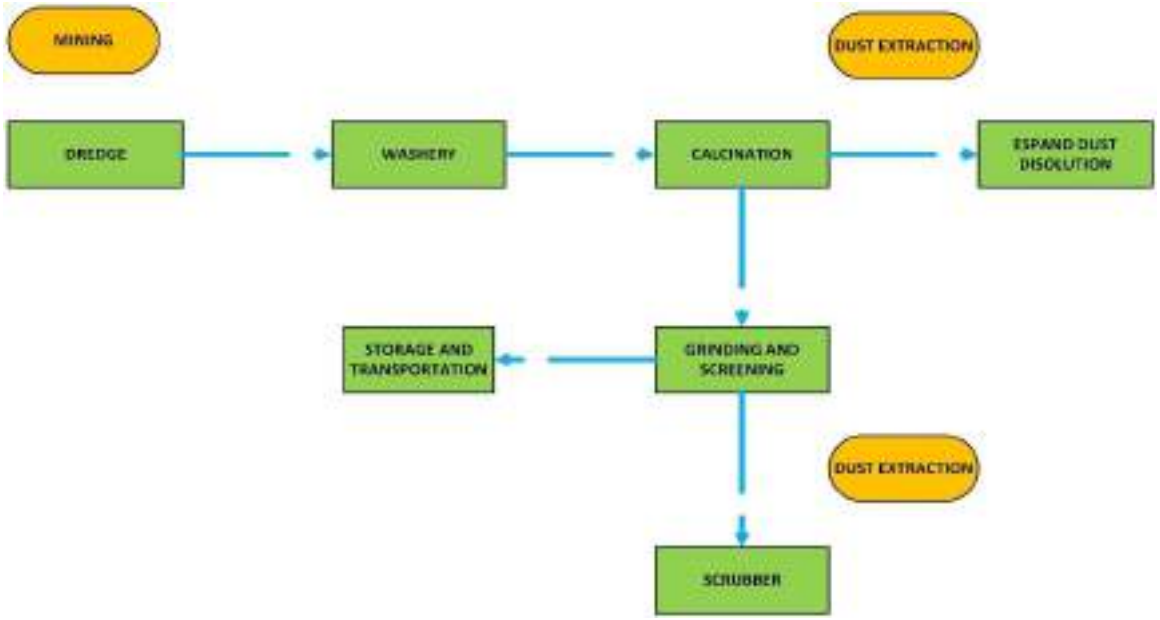


Figure 2.8: Flowchart of Extraction Stages

(Source: WWSL, 2025)

2.5.3 Decommissioning Phase

Decommissioning will mark the formal closure of the project. Based on preliminary exploration data, the estimated mine life is projected to exceed 150 years, though this period may be extended depending on the outcomes of ongoing exploration activities. The Project Proponent will develop a comprehensive Mine Closure Plan in compliance with the Mining (Safety, Occupational Health and Environmental Protection) Regulations, 2010, to guide all decommissioning, closure, and post-closure activities. The Mine Closure Plan will outline the technical, environmental, and social measures necessary to ensure that the site is safely and sustainably rehabilitated. Key activities anticipated during the closure phase include:

- Dismantling of the project structures
- Environmental Remediation including Rehabilitation, Reclamation and Monitoring
- Community Engagement

2.5.4 Post Closure

The post-closure phase of a mining project encompasses the long-term monitoring, maintenance, and management of the site following the completion of all mining and decommissioning activities. This phase ensures that the site remains environmentally stable, safe, and suitable for its designated post-mining land use. Comprehensive post-closure monitoring programs are implemented to assess the effectiveness of rehabilitation measures, detect any residual or emerging environmental impacts, and guide any necessary corrective actions. Regular progress and compliance reports are prepared and submitted to relevant regulatory authorities and key stakeholders to demonstrate ongoing environmental performance and adherence to the approved Mine Closure Plan. The post-closure phase will typically include the following key activities:

- Environmental Monitoring
- Maintenance and Repair
- Stakeholder Engagement

- Handing over closed facilities to the agreed new owner

2.6 Employment Opportunities

The project is expected to create significant employment opportunities for both skilled and unskilled workers. During the construction phase, approximately 100 people will be employed, while around 300 people are anticipated to be engaged during the operation phase. These opportunities will benefit both local and external workers, with priority given to qualified individuals from the surrounding communities.

Casual labour opportunities will also be provided and fairly distributed among the neighbouring villages to ensure inclusive participation and local economic benefits. In addition, the project will promote gender equality in employment by encouraging the recruitment of both men and women, ensuring that women are given equal access to available job opportunities. During the operation phase, employees will work an average of 8 hours per day to ensure continuous plant performance and efficiency.

2.7 Land Use, Acquisition and Compensation by the Project

The proposed Lake Natron Soda Ash Project will require land acquisition to establish the soda ash extraction, evaporation, and processing facilities within the defined project footprint. The Project area is located at Woswosi Village, within Gelai Lumbwa Ward in Longido District, Arusha Region, adjacent to the eastern and southeastern margins of Lake Natron. Residents in these village occupy land under customary ownership, as provided for under the Village Land Act, CAP 114 R.E 2023.

Land in this area is traditionally held by the Maasai pastoral communities, and rights to land are primarily acquired through inheritance, allocation by village councils, or temporary leasing for grazing or salt harvesting activities. The Village Government Councils are responsible for allocating unutilized land within their administrative boundaries in accordance with established land use plans.

a) Existing Land Use

At present, the dominant land uses within and around the proposed project footprint include:

- Pastoral livestock grazing, which is the main economic activity in the area;
- Small-scale salt collection and trading, particularly near the lake's shoreline;
- Livestock watering points; and
- Wildlife movement and natural vegetation zones, as part of the wider Lake Natron–Engaruka ecosystem (Game Controlled Area which is leased to hunting company Adam Clements Safari Limited).

Livelihoods are therefore largely dependent on pastoralism and small-scale trade, while a smaller portion of the population is employed in local government institutions, education, and community services.

The area surrounding Lake Natron is located within the broader Lake Natron Game Controlled Area (GCA), gazetted in 1974 under Government Notice No. 269 and currently managed under the Tanzania Wildlife Management Authority (TAWA). The GCA covers approximately 3,000 km² across parts of Ngorongoro, Longido, and Monduli Districts in northern Tanzania. The Gazetted land use in the lake Natron includes conservation area, game-controlled area and national park (Figure 2.9).

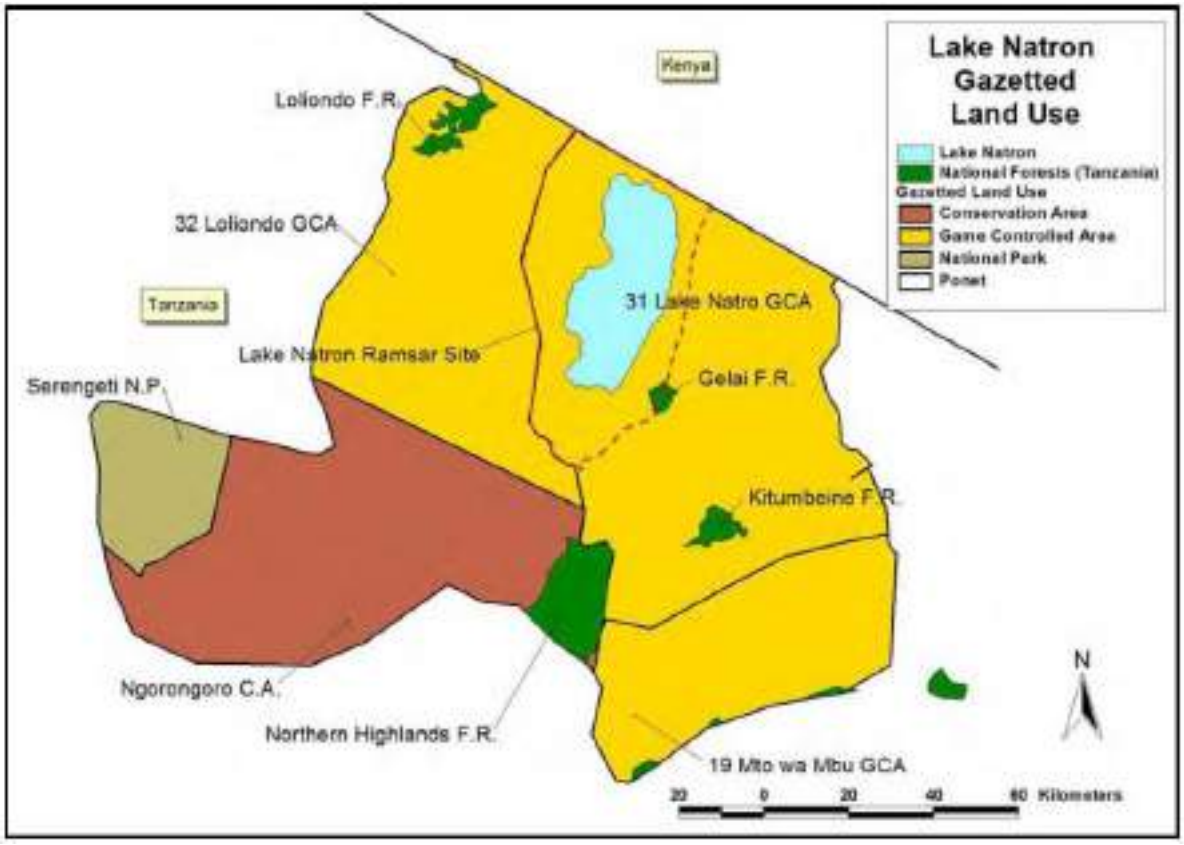


Figure 2.9: Gazetted land use of Lake Natron and adjacent catchments

(Ramsar Advisory Mission Report No. 59: Tanzania ,2008)

b) Co-existence between different Land uses

The proposed project area is located within a multiple-use landscape comprising conservation areas, tourism zones, hunting blocks, pastoral grazing land, settlements, and ecologically sensitive areas associated with Lake Natron. Key surrounding land uses include the Ngorongoro Conservation Area, Serengeti National Park, Lake Natron Game Controlled Areas (North and South), tourism activities, traditional pastoralism, seasonal salt collection activities, and limited agricultural activities. The EIS has therefore undertaken an assessment to evaluate how the proposed soda ash project can coexist with existing conservation and socio-economic land uses within the broader Lake Natron landscape.

The assessment established that the mining operation within the lake itself will occupy a relatively small portion of the overall lake ecosystem. Exploration activities were conducted within approximately 60 km², representing about 5% of the total lake area, primarily for preparation of a bankable feasibility report and resource confirmation. However, the actual mining footprint throughout the life of the Project will be limited to approximately 10 km², equivalent to only about 0.8% of the total lake area. This limited operational footprint substantially reduces the likelihood of significant interference with wider conservation, tourism, hunting, and grazing activities within the Ramsar ecosystem. To minimize environmental disturbance and support coexistence with surrounding land uses, the Project proposes a controlled rotational dredge mining approach. The mining area will be divided into smaller operational cells measuring approximately 200 m × 100 m, with mining undertaken sequentially rather than simultaneously across the entire footprint. This phased approach

minimizes the active disturbance area at any one time, supports sediment stabilization and natural regeneration processes, and reduces cumulative impacts on the lake ecosystem. In addition to the lake mining area, the Project will require approximately 150 hectares of land for associated surface infrastructure, including abstraction points and pipelines, camp facilities, settlement ponds, processing plant and utilities, water storage silos, access roads, buffer zones, and ancillary facilities. The majority of this land falls within village land held under customary tenure arrangements. Although the area has limited permanent occupation, it is seasonally utilized by local communities for livestock grazing and traditional salt collection activities.

Preliminary socio-economic surveys and stakeholder consultations indicate that no permanent residential houses or physical settlements are expected to be displaced by the Project. However, the assessment recognizes that some households and user groups may experience economic impacts, particularly pastoralists utilizing the area for seasonal grazing during dry periods. The Project therefore acknowledges the need to carefully manage potential land use conflicts between mining infrastructure development and traditional livelihood activities.rTo address these potential impacts and support coexistence between different land uses, the Project will implement the following measures which have been included in the Project Management Plans to Minimize the infrastructure footprint to the extent practicable and avoid ecologically or socially sensitive areas;

- Maintain traditional livestock access routes wherever feasible;
- Avoid unnecessary restriction of community access to grazing areas and salt collection zones;
- Develop and implement a Livelihood Restoration Plan for economically affected households and user groups;
- Undertake compensation in accordance with applicable Tanzanian laws and international standards where economic losses occur;
- Establish continuous stakeholder engagement mechanisms with affected villages, pastoral communities, conservation authorities, and other land users;
- Implement biodiversity protection and environmental monitoring measures to safeguard sensitive habitats and ecological functions; and
- Apply adaptive management measures to address any emerging land use conflicts during project implementation and operation.

The assessment further determined that the proposed mining and infrastructure areas do not overlap with key tourism facilities, core wildlife tourism zones, or major hunting operation areas. Tourism and hunting activities are largely concentrated within terrestrial conservation areas and wildlife movement corridors surrounding the lake, while the proposed project activities will remain spatially localized and operationally controlled.

Furthermore, due consideration has been given to the ecological importance of Lake Natron as a globally significant breeding habitat for Lesser Flamingos and other waterbirds. Accordingly, the Project will implement strict operational controls, water quality monitoring, controlled dredging schedules, sediment management measures, and biodiversity monitoring programs to minimize ecological disturbance and maintain ecosystem functionality. Based on the limited mining footprint, phased mining methodology, relatively small land requirement for associated infrastructure, absence of physical displacement, and implementation of mitigation and livelihood restoration measures, the assessment concludes that mining, conservation, tourism, hunting, grazing, and traditional community activities can coexist within the wider

Lake Natron landscape without causing significant adverse impacts on one another, provided that the proposed environmental and social management measures are effectively implemented throughout the Project lifecycle Compensation and Engagement

To facilitate land acquisition, the Project Proponent, in collaboration with the District Land Office and Village Governments, will engage a registered valuation firm to manage the compensation process. The compensation will follow the Land Act CAP 114 R.E 2023, the Land (Assessment of the Value of Land for Compensation) Regulations, 2001, and the Village Land Regulations, 2002.

The compensation approach will be based on private treaty negotiations between the project and affected persons, ensuring that valuation is conducted transparently and compensation reflects full replacement cost. Socio-economic surveys will be conducted to identify Project Affected Persons (PAPs) and assess both physical and economic impacts.

If any cases of compensation occur, the program will be done under consultation and valuation review, with affected communities to be notified through village assemblies and individual household consultations. The process will aim to ensure that:

- No physical displacement occurs where avoidable.
- All economic losses (e.g., temporary grazing restriction or salt access limitation) are fairly compensated; and
- Community members are fully informed and involved throughout all stages of the land acquisition process.

The Project Proponent will continue close engagement with the Longido District Council, the Ministry of Lands, and NEMC to ensure all land tenure and compensation procedures comply with both national legal requirements and international safeguard principles.

3 POLICY, LEGAL, AND REGULATORY FRAMEWORK

3.1 Overview

This section outlines the regulatory frameworks governing the development of the Proposed Trona Extraction and Soda Ash Production Project, emphasizing the importance of environmental and social protection. Compliance with these regulations is crucial to ensure that the project adheres to both national and international standards while safeguarding the environment and promoting the well-being of surrounding communities. The legal framework encompasses various acts, regulations, policies, and guidelines that guide the management of environmental and social aspects throughout the project's lifecycle.

3.2 Constitution of the United Republic of Tanzania

As the Proposed Trona Extraction and Soda Ash Production will be implemented and operated in Tanzania and must comply with the provisions of the Constitution of the United Republic of Tanzania (1977), which mandates all citizens to protect and preserve the nation's natural resources and environment. Table 3.1 presents the specific constitutional articles relevant to the Project that WWSL is required to observe.

Table 3.1: Specific Requirement as per the Constitution

Article	Specific Requirement	Relevant to the Project
14	Ensure that "Every person has the right to live and to the protection of his life by the society in accordance with the law".	WWSL commits to developing the Proposed Trona Extraction and Soda Ash Production Project and its associated activities are carried out in a way that safeguards community and worker health and safety through effective implementation of mitigation and monitoring programs that prevent accidents, control pollution, and manage environmental risks outlined in Sections 8 and 9.
18	Ensure freedom of expression as per conditions stipulated in sub-sections (a) to (d) of this article.	WWSL will ensure that stakeholders and affected communities can freely share their views during consultations, community meetings, and ESIA disclosures. This approach promotes transparency, inclusivity, and social acceptance of the project.
27	Ensure protection of the natural resources of the United Republic, the property of the state authority, all property collectively owned by the people, and respect for another person's property.	In alignment with constitutional principles, WWSL is committed to the protection of natural resources, public and private assets, and community property. The ESIA process will guide the company in ensuring sustainable land and soil utilization, reducing waste, preventing environmental degradation, and promoting the efficient management of materials and infrastructure. Furthermore, WWSL will obtain all necessary approvals, permits, and licenses from the appropriate authorities to ensure full legal
	Ensure safeguarding of the property of the state authority and all property collectively owned by the people, to combat all forms of waste and squandering, and to manage the national economy assiduously with the attitude of people who are masters of the destiny of their nation.	

Article	Specific Requirement	Relevant to the Project
	Ensure ownership of property and protect the property under the law.	compliance and foster sustainable project development.

(Source: Constitution of the URT; 1977)

3.3 Relevant Policies Related to the Project

National policy frameworks emphasize the integration of environmental considerations into development planning to prevent and mitigate potential adverse impacts on the environment and the surrounding communities. These frameworks outline specific requirements for the sustainable management of projects to ensure the conservation of natural resources and the protection of sensitive ecosystems. In line with these provisions, the proposed Trona Extraction and Soda Ash Production at Wosiwosi Village, Gelai Lumbwa Ward, Longido District, Arusha Region, will be implemented in compliance with relevant policies to promote environmental and social protection and sustainability.

3.3.1 National Environmental Policy (2021):

The overall objective of the NEP is to provide a national framework for guiding harmonized and coordinated environmental management for the improvement of the welfare of present and future generations. For the Proposed Project, this ensures that water quality, fisheries, and shoreline ecosystems are safeguarded during all stages of the project, which include construction, operation, and decommissioning.

Table 3.2: Key Issues as per NEP

Challenge	Government Commitment	Relevance to Project
Land Degradation	• Promote integration of environmental issues in land use planning and management across sectors; • Promote security in the land tenure system; • Enhance involvement and empowerment of communities and other stakeholders in land utilization and management; and • Promote restoration of degraded lands (URT, 2021).	The development of the Trona Extraction and Soda Ash Production Project may result in land disturbances, including site clearance, soil excavation, and erosion, during various project phases. To mitigate these potential impacts, WWSL is committed to upholding government commitments through ensuring alignment with land use planning, protecting the land, and effective implementation of the mitigation measures outlined in Section 8.5.3 of this ESIA report to safely restoration of degraded land. Additional measures will be applied as necessary to ensure adequate environmental protection and sustainable land management.
Deterioration of Water Sources	• Promote conservation of water sources. • Strengthen cross-sectoral coordination in the sustainable management of water sources. • Promote public participation and awareness in the	The Trona Extraction and Soda Ash Production Project may pose risks to water resources through the release of contaminated water and soil seepage, potentially impacting both groundwater and surface water during the construction, operational, and decommissioning phases. To manage these risks, WWSL is committed to safeguarding water resources by implementing the management

Challenge	Government Commitment	Relevance to Project
	management of water sources. • Enhance collaboration in the management of transboundary water sources.	programs detailed in Section 8.5.2, with supplementary measures to be developed and applied as necessary throughout the project lifecycle.
Loss of Wildlife Habitats and Biodiversity	• Promote ecosystem-based approaches to conservation of wildlife habitats and biological diversity. • Enhance capacity building for the management of wildlife habitats and biodiversity. • Enhance regional and international cooperation in addressing the loss of wildlife habitats and biodiversity. • Promote sustainable access and equitable benefit sharing of genetic resources. • Promote engagement of the private sector in the conservation of wildlife habitat and biological diversity. • Promote transboundary ecosystem conservation initiatives. • Promote preventive and management measures against Invasive Species.	The Trona Extraction and Soda Ash Production Project may affect biodiversity and disrupt ecosystems through activities such as site clearance, soil excavation, and vegetation removal during construction, as well as throughout operational and decommissioning phases. To mitigate these potential impacts, WWSL will comply with all applicable laws, regulations, and government programs aimed at conserving biodiversity and protecting ecosystems.
Deterioration of Aquatic Ecosystem	• Strengthen cross-sectoral coordination and collaboration in the management of marine, freshwater bodies, and wetlands. • Collaborate with the private sector in the management of aquatic resources. • Strengthen transboundary coordination in the management of shared aquatic ecosystems.	
Deforestation	• Promote the development of alternative sources of energy which are readily accessible and affordable to the public. • Promote integrated practices in addressing deforestation.	The construction, operation, and decommissioning activities of the Trona Extraction and Soda Ash Production Project could cause deforestation through site clearance and soil excavation, which involves the removal

Challenge	Government Commitment	Relevance to Project
	• Encourage the private sector to invest in forest management. • Enhance collaboration with the private sector in forest management.	of vegetation cover. To address and control deforestation, this ESIA report details biodiversity management and monitoring plans in Sections 8.7.2 and 9.2.3, which will be effectively implemented by WWSL to ensure adherence to government commitments. However, additional measures will be developed when
Environmental Pollution	• Promote green technologies and integrated management of municipal waste, chemical waste, e-waste, and waste emanating from oil and gas operations. • Strengthen national capacity in waste management, urban planning, and control of noise pollution. • Enhance collaboration with the Private Sector to address environmental pollution. • Enhance public awareness and participation in pollution control. • Enhance regional and international cooperation on pollution control.	Handling of waste during the construction, operation, and decommissioning of the Trona Extraction and Soda Ash Production Project could pose a risk of environmental pollution. To address and control this risk, the proponent (WWSL) will enforce the waste management and monitoring plan detailed in sections 8.5.4 of this ESIA report. This approach will help protect the environment and adhere to government commitments. Additionally, the site-specific waste management plan will be developed when deemed necessary.
Climate Change	• Strengthen institutional and human resources capacity on climate change issues. • Promote public awareness of climate change impacts. • Promote collaboration with the private sector on climate change initiatives. • Promote regional and international cooperation to address climate change. • Promote the development and transfer of green affordable technologies	Transportation activities, machinery, and operation of the project during construction, operation, and decommission may involve the use of fossil fuels (Hydrocarbons), which potentially emit greenhouse gases such as NOX, SOX, and COX, which are contributors to air quality deterioration and may result in climate change. To ensure the prevention/control of the emission of greenhouse gases, the brief air quality management and monitoring plan discussed in sections 8.5.6, and 8.5.7 of this ESIA report will be applied by WWSL to ensure alignment with this commitment.
Good Governance	• Strengthen accountability, transparency, participation, and the rule of law in environmental management. • Promote awareness of good governance in environmental management.	As the development of the Trona Extraction and Soda Ash Production Project contacts the environment during construction, operation, and decommissioning may potentially affect environmental aspects either positively or negatively. Therefore, WWSL (Proponent) will continue collaborating with the government to ensure awareness in environmental

Challenge	Government Commitment	Relevance to Project
		management is well enhanced among employees and the surrounding local communities as well.
Resource Mobilization	• In collaboration with stakeholders, facilitates the availability of adequate resources for environmental protection and management. • Create an enabling environment that attracts the private sector to finance and invest in environmental management interventions.	As a key stakeholder in environmental management, WWSL (Proponent) is committed to allocating the necessary resources to safeguard the environment during its operations. The company will also support and implement environmental protection initiatives wherever possible.
Gender	• Strengthening gender mainstreaming in environmental management. • Promote public awareness of the role of gender in environmental conservation.	Construction, operation, and decommissioning of the proposed Project may involve the use of human resources, which include both male and female genders. However, the local communities surrounding the project have both genders as well. To align with this commitment, the proponent (WWSL) will ensure all genders are involved and will participate in the issues concerning environmental protection/conservation equally and promote the importance of each gender.

(Source: MTL Consulting, 2025)

3.3.2 Mineral Policy of Tanzania, 2009

The policy underscores the importance of integrating environmental and social considerations into extractive resource projects to ensure long-term sustainability. The policy emphasizes the need to balance the protection of flora, fauna, and natural surroundings with the promotion of social and economic development. Also, outlines strategies to minimize or eliminate adverse environmental impacts, enhance health and safety conditions in mining areas, and address social issues affecting women, children, and local communities.

However, it provides a framework for maintaining environmental and social sustainability in mining operations and includes specific strategies for safeguarding the environment and ensuring human health and safety. Table 3.3 describes the detailed strategies for environmental protection, health, and safety to be achieved by WWSL.

Table 3.3: Mineral Policy Statement

S/N	Government Statement/Strategies	Relevance to Project
1	Strengthen the institutional capacity in monitoring and enforcement of laws and regulations on safety and occupational health, environmental protection, and management in mining areas.	Given that the Trona Extraction and Soda Ash Production Project interacts with the environment, whether positively or negatively, WWSL will comply with all laws and regulations related to safety, occupational health, and environmental protection in all phases of the project.

S/N	Government Statement/Strategies	Relevance to Project
2	Continuing to harmonize laws and regulations governing safety, occupational health, and environmental issues in the mineral sector.	As a stakeholder in the mining sector, WWSL is committed to adhering to government regulations on safety, occupational health, and environmental issues. The company continues to ensure that these regulations are always followed and aligned with relevant policy statements (URT, 2019).
3	Continue to provide education on health and safety, HIV/AIDS, and environmental management to small, medium, and large-scale miners and their surrounding communities.	As the development of the Project requires human resources in all phases and may potentially influence population influx to the local communities, which may result in the interaction between people at the site and those at the local communities, and cause potential eruption of communicable diseases like HIV/AIDS, resulting in health and safety hazards and other environmental degradations. Therefore, to ensure adherence to this statement, WWSL commits to collaborating with the government to provide education on health and safety, HIV/AIDS, as well as environmental protection.

(Source: Mineral Policy, 2019)

3.3.3 Other policies

In addition to the main policies described above, it is important to apply extra measures that respond to the specific challenges of the Trona Extraction and Soda Ash Production Project. These additional policies are intended to strengthen environmental protection, encourage sustainable practices, and reduce possible environmental and social impacts linked to the project. Table 3.4, therefore, presents other policies that WWSL will comply with to support the sustainable development of the project.

Table 3.4: Other Policies Relevant to the Project

S/N	Policy	Requirement/Statement	Relevance to Project
1	National Investment Promotion Policy (1996)	Promotion of exports emanating from domestically produced goods and services to enhance the development of a dynamic and competitive export sector.	Since WWSL is regarded as an investor in the Country will develop and implement strategies that aim to increase export production to ensure that its operations contribute to the growth of the export sector in Tanzania and therefore, enhance the requirement of the policy.
2	National Land Policy, 1995	**Land Tenure** • All land in Tanzania is public land and vested in the President as trustee on behalf of all citizens; • The rights and interests in land of citizens shall not be taken without due process of law; • Full, fair, and prompt compensation shall be paid when land is acquired; • Village Councils will administer village land, and their powers will be subject to limitations embedded in laws and procedures; and • Consultation and consent of the Village Council will be required whenever alienation of village land is necessary. **Land Utilization** • Special areas for various investments will be identified and set aside for allocation to investors by the government. • Land will be allocated to investors according to their ability to develop and that interests of citizens over their land shall be safeguarded. • Land ceilings will be determined by the government based on use, location, feasibility study and proven ability of the applicant to develop the said parcels of land. • Land hoarding will be discouraged by strict enforcement of development conditions and by the use of local by-laws, planning and land use regulations.	As the proposed Trona Extraction and Soda Ash Production Project will acquire land from local communities for its development. Therefore, WWSL will ensure all legal procedures and processes for land acquisition are followed to comply with all requirements of this statement.
3	National Forest Policy, 1998	**Section 4.3.4 (PS-23)-EIA Requirement:** Environmental impact assessment will be required for the investments that convert forest	Although the proposed Trona Extraction and Soda Ash Production Project will not be developed and executed in a forest reserve area but will observe the requirements of the

S/N	Policy	Requirement/Statement	Relevance to Project
		land to other land use or may cause potential damage to the forest environment.	policy statement by undertaking this ESIA study, which will provide the appropriate mitigation measures to maintain available natural trees and vegetation for supporting wildlife.
4	Wildlife Policy, 1998	**Section 3.3.3 (x)-EIA Mandatory;** Undertake EIA for the proposed developments in PAs and preparation of environmental planning for developments to be carried out in wildlife areas outside PAs in order to minimize negative impacts.	The Trona Extraction and Soda Ash Production Project is located within the Lake Natron Game Controlled Areas, which require to be protected. WWSL commits to ensuring that the project protects the surrounding wildlife areas through undertaking this ESIA study to conform with section 3.3.3 of the policy, which comprises the biodiversity management and monitoring plan in sections 8.7.2 and 9.2.3 to be applied to safeguard wildlife. Moreover, additional measures will be taken onsite when deemed necessary.
5	HIV/AIDS Policy, 2001	• Ensure prevention of transmission of HIV/AIDS; • Promote HIV testing; • Ensure care for people who are living with HIV/AIDS; and • To participate in HIV/AIDS research nationally and internationally.	The development of the Trona Extraction and Soda Ash Production Project potentially results in a population increase in the nearby local communities due to job seeking, business opportunities, etc. This condition may result in a high risk of the spread of HIV/AIDS and other communicable diseases. To comply with the highlighted policy objective, WWSL committed to developing and implementing a comprehensive disease management plan.
6	National Gender Policy, 2002	• Promote gender equality and equal participation of men and women in economic, cultural and political matters; and • Ensure equitable opportunities for women and men	The construction and operation activities of the Trona Extraction and Soda Ash Production Project require human resources for its implementation. To ensure alignment with the policy objective, WWSL has established and implemented a transparent employment system that provides equal chances and opportunities for both males and females to be employed without considering their gender differences.
7	National Water Policy (NAWAPO) (R.E: 2025)	• All water resources in the country are vested in the United Republic of Tanzania and every citizen has an equal right to access and use of the nation's water resource; • Water use for basic human needs has the highest priority. Water to sustain the environment and other uses are subject to social and economic criteria, which shall be reviewed from time to time;	Thus, the Trona Extraction and Soda Ash Production Project is surrounded by various water resources both surface and groundwater also requires water for utilization during its construction and operation of which permit will be secured. To ensure alignment with the policy statements, water resource management programs developed in section 8.7.3 have to be implemented by WWSL to safeguard water

S/N	Policy	Requirement/Statement	Relevance to Project
		• Developments in water basins and water abstraction shall be subjected to permits and mandatory legal requirements for an EIA; • The “Polluter Pays Principle” shall apply in conjunction with other legal and administrative actions; • Standards for in-stream flows, industrial effluents and other waste discharges to be developed will be enforced; • Water-related activities should aim to enhance or to cause least detrimental effects on the natural environment; • The allocation and consumption of water for environmental purposes is to be given appropriate considerations; • Water for environmental purposes shall be determined on the best scientific information available, considering both the temporal and spatial water requirements, to maintain the health and viability of riverine and estuary ecosystems; • A sound information and knowledge base, including data on surface and groundwater (quantity and quality), socio and economic data shall be established; and • Status of surface and groundwater resources, in terms of quantity, quality and its use shall regularly be determined, and information made easily accessible to stakeholders and decision makers.	Resources. Moreover, additional measures will be taken onsite when deemed necessary.
8	National Health Policy, 2003	• Reduction of the burden of disease, maternal and infant mortality, and increased life expectancy through the provisions of adequate and equitable services. Furthermore, the policy aims to facilitate the promotion of environmental health and sanitation, adequate nutrition, control of communicable diseases and treatment of common conditions. • Promote environmental cleanliness, monitoring of food and water quality, and safety achieved through collaboration with other stakeholders.	As the Trona Extraction and Soda Ash Production Projectinvolves the use of human resources (people). Protection of the health of all people working on the project is required. Moreover, the health of the local community members must also be considered. To ensure the achievement of good well-being of employee and the surrounding communities, WWSL commits to providing health-supportive material, PPE, facilities, training, and other services to their workers, and also collaborate with the local government authorities to provide community support, awareness, and training to the surrounding communities. Also, ensure environments are well protected.

S/N	Policy	Requirement/Statement	Relevance to Project
9	Sustainable Industrial Development Policy, 1996-2020.	**Section 3.5.3 (d):** Environmental Impact Assessment (EIA) and appropriate mitigation measures will be enforced on all projects at the implementation stage. • Promote the continuous application of an integrated preventative environmental strategy, including propagation of efficient use of raw materials and energy, elimination of toxic or dangerous materials, as well as reduction of emissions and waste at source.	Development of Trona Extraction and Soda Ash Production Project potential to impact various environmental aspects i.e. water, land, soil, air, and biodiversity (flora and fauna) due to the interaction of its activities and such aspects. To ensure alignment with the policy objective, Chapter 8 highlights environmental and social management programs which to be applied by WWSL in safeguarding the environment. Additional site-specific measures will be established and implemented when deemed necessary.
10	National Construction Industry Policy, 2003.	• Increased value for money to industry clients as well as environmental responsibility in the delivery process; • The viability and competitiveness of domestic construction enterprises; and • Optimization of the role of all participants and stakeholders through process, technological, and institutional enhancement, and appropriate human resource development.	Construction activities of the Trona Extraction and Soda Ash Production Project may potentially result in various environmental impacts on water, air, soil, and biodiversity. To comply with this policy objective, WWSL commits to ensure a safeguarding environment by applying the management programs in Chapter 8 and provide priority to local contractors in order to increase money circulation and industry development. Also, ensure all contractors align with the environmental management plans and tender documents of each contractor to be made available.
11	National Energy Policy, 2015	• Promote renewable energy sources and sustainable use of biomass for power generation; and • Facilitate integration of renewable energy technologies in buildings and industrial designs.	The source of power for the Trona Extraction and Soda Ash Production Project will be supplied by TANESCO. To ensure compliance with this policy, WWSL will collaborate with the government (TANESCO) to promote and encourage the use of renewable energy for its operation.
12	Cultural policy, 1997	• Emphasizes the protection of national heritage and traditional values and encourages the integration of culture in development.	The Gelai area is rich in Maasai cultural heritage. WWSL will implement a Chance Find Procedure during excavation. If any archaeological or sacred sites (e.g., burial grounds or ritual trees) are discovered, work will stop immediately, and the Ministry of Natural Resources and Tourism (Antiquities Division) will be notified

(Source: Compiled by MTL Consulting; 2025)

3.4 Applicable National Legislation

3.4.1 Environmental Management Act CAP 191 R.E 2023

The Environmental Management Act's guiding principle is that "every person has the right to live and to the protection of his life by society in compliance with the law". Section 81 of the Act makes it a mandatory requirement for an EIA to be carried out by proponents intending to develop and implement projects specified in the third schedule of the Act. Such Projects have the potential to cause medium to High impacts on the environment. As per First Schedule (16)(iv) of the Environmental Impact Assessment and Audit Regulation of 2005 and its amendments, 2024, the proposed Trona Extraction and Soda Ash Production Project falls within category A projects, specifically under the Extractive Industry-(Mining), of which EIA is mandatory. To ensure compliance with this Act and its Regulation, WWSL has undertaken a full EIA study and will submit it to NEMC for approval in order to obtain the Environmental Certificate as required by this Act.

3.4.2 Mining Act CAP 123 R.E 2023

The Mining Act is the guiding act for the management of all mining activities in the country. The Act generally, define Mineral as "any substance, whether in solid, liquid or gaseous form, occurring naturally in or on the earth, or in or under the seabed formed by or subject to a geological process, but does not include petroleum or surface water". Therefore, Trona Extraction and Soda Ash Production is considered as a mining project and will be guided by all requirements of this Act.

In seeking Mining Licenses for the confirmed Trona Extraction and Soda Ash Production Potentials, WWSL will adhere to the environmental and social management requirements detailed in Table 3.5 of the Act.

Table 3.5: Environmental and Social Management Requirements as per Mining Act

S/N	Section	Requirement	Relevance
Environmental Management Related Requirements			
1	Section 49 (2): Application for Mining License.	Every applicant for the Mining License shall include a feasibility study which should set out the proposed program of mining operations, including measures to taken in relation to any adverse impacts on the environment.	As WWSL prepares to apply for the Mining License, the company will develop a feasibility study that incorporates this EIA study. This study will address all potential environmental impacts and outline the mitigation measures, as discussed in section 8. The feasibility study to together with this ESIA study, after approval, will be submitted to the Mining Commission during the application for the license as required by the Act.
2	Section 52 (c): Obligations of holder of Mining Licences.	The holder of a Mining Licence shall take all appropriate measures for the protection of the environment in	After obtaining a Mining License and start the operation of the Trona Extraction and Soda Ash

S/N	Section	Requirement	Relevance
		accordance with The Environmental Management Act, Cap. 191 R.E 2023.	Production Project. The licensee (WWSL) will ensure effective implementation of the appropriate environmental and social management and monitoring commitment discussed in sections 8 and 9 upon approval of this EIS report.
Social Management Related Requirement			
3	Section 52 (d): Obligations of holder of Mining Licenses.	The holder of a Mining License shall implement the proposed plan for relocation, resettlement of, and payment of compensation to local communities within the mining areas in accordance with the Land Act;	Once the Mining License is obtained, WWSL will acquire land for project development. The company will prepare and submit a Resettlement Action Plan and adhere to all procedures for land acquisition, considering the current ownership by local communities in the area.

(Source: Mining Act, 2023)

3.4.3 Other Relevant Legislation

In addition to the above-mentioned acts, other supporting legislation of which WWSL will be required to comply for the sustainable development of the proposed Trona Extraction and Soda Ash Production Project are outlined in Table 3.6.

Table 3.6: Other Legislation Relevant to Project

S/N	Legislation/Act	Requirements	Relevance to Project
Land Management			
1	Land Act CAP 113, R.E 2023	**Section 20 (1) to (5):** Occupation of land by non-citizens restricted. (1) For avoidance of doubt, a non-citizen shall not be allocated or granted land unless it is for investment purposes under the Tanzania Investment Act Cap. 38. (2) Land to be designated for investment purposes under subsection (1) of this section shall be identified, gazetted, and allocated to the Tanzania Investment Center, which shall create derivative rights to investors. (3) All lands acquired prior to the enactment of this Act shall be deemed to have no value, save for unexhausted improvements for which compensation may be paid under this Act or any other law. (4) For the purposes of this Act, anybody corporation whose majority shareholders or owners are non-citizens shall be deemed to be a non-citizen or foreign company's. (5) At the expiry, termination, or extinction of the right of occupancy or derivative right granted to a non-citizen or a foreign company, reversion of interests or rights in and over the land shall vest in the Tanzania Investment Center or any other authority as the Minister may prescribe in the "Gazette".	The proposed Trona Extraction and Soda Ash Production Project will require land for it to be development. To ensure compliance with this Act, WWSL will need to acquire land purposeful for the investment of the project, as the company owner is a non-citizen of Tanzania. Also, it will be required to adhere to all listed subsections.
2	Village Land Act CAP 114 R.E 2023	**Section 22 (2):** A person or group of persons not ordinarily resident in a village may apply for a customary right of occupancy.	WWSL is considered an investor who intends to develop the proposed Trona Extraction and Soda Ash Production Project on Village Lands (Wosowosi Village) and will need to acquire land for its activities. To comply with this act, the company will process for acquiring land by engaging the valuation company to manage

S/N	Legislation/Act	Requirements	Relevance to Project
			the compensation program. Also, a survey will be conducted to determine land size, and the market research and valuation to set the negotiation basis. Further stages will also be done in line with the requirements of the Act.
3	Urban Planning and Act, CAP 355 2023	**Section 29 (1):** Notwithstanding the provisions of any other written law to the contrary, no person shall develop any land within a planning area without planning consent granted by the planning authority or otherwise than in accordance with planning consent and any conditions specified therein.	Before the commencement of the Trona Extraction and Soda Ash Production activities, WWSL commits to engaging the land use planning authority on its development intention in the area to allow the proposed development to be done and to obtain consent. Upon obtaining the planning consent, the company will adhere to the terms and conditions throughout all stages of the project.
4	The Land Use Planning Act (Cap. 116 R.E 2023)	**Section 28:** Requires any development to be in integrated with the relevant land use plan. **Section 32:** Prohibits any development that is inconsistent with a sanctioned plan.	Lake Natron is a sensitive Village Land and Conservation Area. WWSL must ensure the extraction site is formally surveyed and zoned for industrial/mining use. Adherence involves maintaining buffer zones between the plant and the Ewaso Ngiro River to prevent encroachment on grazing land or flamingo breeding mudflats.
5	The Local Government (District Authorities) Act, Cap. 287	Empowers District Councils to provide for the health, order, and good government of their area. It mandates the payment of Service Levies to the District Authority.	The project is located in Longido District. WWSL must align its operations with the District Development Plan, pay all local levies, and obtain building permits for the processing plant. Failure to coordinate with the Gelai Lumbwa Ward leadership could lead to social unrest or "stop orders" from the District Executive Director (DED).

S/N	Legislation/Act	Requirements	Relevance to Project
Water Resource Management			
1	Water Resources Management Act, CAP 331 R.E 2023	• **Section 7:** Requires every person residing in Mainland Tanzania shall have a take and a duty to safeguard and protect water resources and to inform the relevant authority of any activity and phenomenon that may affect the quantity and quality other water resources significantly; • **Section 9:** Requires carrying out an ESIA for any development in water resource areas or watershed; • **Section 43:** Stipulates the application for a water use permit in accordance with the Act to divert, dam, store, abstract and use water from surface and/or ground water sources. The holder of a water use permit shall not cause or allow any water to be polluted, prevent damage to the source, ensure sustainable use of water and submit any data on request from the Basin Water Board; • **Section 63 (1):** Requires "a person who wishes to discharge effluents from any commercial, industrial, or agricultural source or from any sewage works or trade waste systems or from any other source into the surface water or to underground strata shall apply to the Basin Water Board for a Discharge Permit in accordance with this Act; • **Section 63 (2):** Require the application for a Discharge Permit shall be made in accordance with Section 75 of this Act"; and • **Section 87(1):** Stipulates that no person shall engage in any construction activity that blocks or otherwise impedes the flow of water in a watercourse unless a permit authorizing the activity has been obtained in accordance with the provisions of Part VII of the Act.	The construction and operation activities, like soil excavation, use of hydrocarbons, and chemicals, sanitary systems associated with the proposed Trona Extraction and Soda Ash Production Project, may potentially result in water source contamination (Lake Natron) through the occurrence of runoff, if appropriate mitigation measures are not well implemented. Through this ESIA report the water resource management and monitoring plans have been proposed in section 8.7.3 and 9.2.1 of which WWSL will apply to safeguard water resources and to ensure complying with highlighted requirement of this Acts. Further measures will be established and implemented on site when deemed necessary.
2	Water Supply and Sanitation Act, CAP 272 R.E 2023	• **Section 67 (1):** Any person who deposits or allows or causes to be deposited any earth material or liquid in such manner or place that it may be washed, fall or be carried into the waterworks commits an offence and shall be liable on conviction to a fine of not less than one million shillings but not exceeding five million shillings or to imprisonment for a term of	

S/N	Legislation/Act	Requirements	Relevance to Project
		not less than twelve months but not exceeding three years or to both; and • **Section 68 (1):** A person shall not dump, discharge or cause to be dumped or discharged any unauthorized waste into the sanitation works.	
3	The Energy and Water Utilities Regulatory Authority Act, Cap. 414	**Section 7 (a)** Requires EWURA to perform the functions conferred on the Authority by sector legislation; **Section 7(b)** subject to sector legislation– (i) to issue, renew and cancel licences; (ii) to establish standards for goods and services; (iii) to establish standards for the terms and conditions of supply of goods and services; (iv) to regulate rates and charges; (v) to make rules; Section 7(c) to monitor the performance of the regulated sectors in relation to– (i) levels of investment; (ii) availability, quantity and standard of services; (iii) the cost of services; (iv) the efficiency of production and distribution of services; and (v) other matters relevant to the Authority;	During construction, operation and decommissioning of the project, there will be significant withdraw amount of water from Lake Natron and it will install solar panels for energy supply. WWSL will acquire secondary licence from EWURA as required by the Act.
Occupational, Health and Safety Management			
1	The Occupational Health and Safety Act, CAP 297 R.E 2023	**Section 16 (1)**: Requires any person being the owner or occupier of the factory or workplace, shall, before operation be required to register such factory or workplace under this Act.	Under this Act, the proposed Trona Extraction and Soda Ash Production Project will be considered as a workplace that will involve human resources during construction and its operation. To comply with this act, WWSL will register the project and seek compliance to ensure a safe working environment for employees.
		Section 60: Every or workplace where activities carried out, involve hazardous processes or hazardous equipment or use of hazardous chemicals substance like to results adverse effect to people or serious damage to property or environment in case of accident, the employer shall ensure that; (a) Undertake risk assessment annually or any other time when the need for the risk assessment deems necessary is done by approved inspection authority; and (b)	During the construction, operation, and decommissioning of the proposed project, WWSL will undertake risk assessment to identify potential hazards to which employees will be exposed and propose appropriate control measures to prevent/reduce such risks. The risk assessment will be reviewed

S/N	Legislation/Act	Requirements	Relevance to Project
		Evidence of risk assessment to be furnished to the Chief Inspector or any inspector when requested.	and updated annually, and where necessary at any time, and to be submitted to the Chief Inspector for approval.
2	Public Health Act, CAP 99, R.E. 2023	• **Section 30:** Any Occupier or owner of any premises shall keep his premises free from breeding sites, other disease vectors, vermin, and other disease-causative agents; and • **Section 54:** A person shall not cause or suffer from a nuisance likely to be injurious or dangerous to health existing on any land, premises, air, or water.	To comply with the Act, WWSL will ensure that the worker accommodation facilities are free from breeding sites, disease vectors, vermin, and other health hazards. This will be achieved by implementing the mitigation and monitoring measures outlined in Sections 8.7.10 and 9.2.7 of the ESIA study. Furthermore, the project will actively prevent environmental pollution of land, air, and water by adhering to the measures specified in Sections 8.7.4, 8.7.6, and 8.7.3. Additional measures will be established and implemented on-site when deemed necessary.
3	Prevention and Control of HIV/AIDS Act, 2008;	• **Section 6 (1):** Every ministry, department, agency, local government authority, parastatal organization, or institution whether public or private, shall design and implement gender and disability-responsive HIV and AIDS plans in its respective area and such plans shall be mainstreamed and implemented within the activities of such sector; and • **Section 8 (1):** The Ministry, health practitioners, workers in the public and private sectors, and NGOs, shall, for the purpose of providing HIV and AIDS education to the public, disseminate information regarding HIV and AIDS to the public.	The development of the Trona Extraction and Soda Ash Production Project could lead to an increase in the local population, potentially facilitating the transmission of communicable and sexually transmitted infections (STIs) such as HIV and gonorrhea. To mitigate this risk and prevent the spread of such diseases to nearby communities, WWSL will work closely with the government to establish and implement relevant programs, in accordance with the management measures outlined in Section 8.7.10 of the ESIA, aimed at addressing the impact of communicable diseases. More measures will be established and implemented on-site when deemed necessary.

S/N	Legislation/Act	Requirements	Relevance to Project
4	The Factories Act, Cap 297	• **Part III (sect 13-20)** requires general health environment in the factory to protect workers. It governs the registration of factory premises, ventilation and working conditions, machine safety, provision of personal protective equipment, and first aid requirements • **Section 56(1)** Mandates regular inspection of plants and machinery for safety and health of workers. Inspection may include sample collection from the factory	The WWSL will register the processing facility, ensure safe working conditions, provide adequate ventilation, control dust and heat, safeguard machinery, supply personal protective equipment, and provide welfare and first aid facilities to workers. These requirements are essential to protect occupational health and safety during project implementation.
Chemical Management			
1	Industrial and Consumer Chemicals (Management and Control) Act (CAP. 182 R.E. 2023).	**Section 16:** Requires the application for producing, warehousing, exporting, importing, transporting or dealing in chemicals shall contain (a) the description of premises on which the chemicals will be stored, produced and marketed; dealers in chemicals (b) the equipment and facilities which are available for distributing, handling, producing, processing, and transporting chemicals from those premises; (c) the qualifications of the personnel under whose direct Supervision those operations will be carried out; (d) the arrangements made or to be made for the safety, health and the environment within and outside the premises; (c) contingency plans and procedures for dealing with emergency; and (f) the arrangements made or to be made for securing the safety keeping of and maintenance of adequate records in respect of chemicals stored in or distributed from those premises.	Processing activities associated with Trona Extraction and Soda Ash Production will involve the use of various chemicals. As WWSL commits to apply for a permit to import, transport, and deal with chemicals, following all the required procedures to ensure adherence with all requirements stipulated under this Act.
	The Government Chemists Laboratory authority Act,2016	**Sect 22(1) requires safe management of chemical waste and related waste.** **Section 24 (1)** A laboratory shall not offer chemical, forensic science or DNA laboratory services regulated under this Act unless the laboratory is registered under this Act. **Section 24 (2)** A laboratory shall not be registered unless it has staff who possess relevant qualifications and the laboratory premises containing facilities that meet standards prescribed in the regulations.	Soda Ash is a chemical product. WWSL must be registered as a Chemical Producer/Dealer. Adherence involves training staff on the Global Harmonized System (GHS) of labelling and ensuring all chemical waste from the extraction process is handled per GCLA's toxic waste guidelines.

S/N	Legislation/Act	Requirements	Relevance to Project
		Sect 25 (1)) A certificate shall be issued by the Chief Government Chemist in respect of- (a) registered chemical; (b) chemical dealers; (c) training laboratory; (d) chemical	
Labour and Employment Management			
1	Employment and Labour Relations Act, CAP 366 R.E. 2023	• **Section 5 (1):** No person shall employ a child under the age of fourteen of years; • **Section 6 (1):** Any person who procures, demands or imposes forced labour commits an offence; • **Section 7 (1)**: Every employer shall ensure that he promotes an equal opportunity in employment and strives to eliminate discrimination in any employment policy or practice; and • **Section 13 (2):** An employment standard constitutes a term of a contract with an employee unless - (a) a term of the contract contains a term that is more favourable to the employee; (b) a provision of an agreement alters the employment standard to the extent permitted by the provisions of this Part; (c) a provision of any collective agreement, a written law regulating employment, wage determination or exemption granted under section 100 alters the employment standard.	The development of the Trona Extraction and Soda Ash Production Project will involve the use of manpower both skilled and unskilled labor, WWSL will implement the standardized human resource manual, which addresses all issues related to employment, contracts, non-discrimination, etc., to align with the requirement of this Act.
2	Workers Compensation Act, CAP 263 R.E. 2023	• **Section 71 (1):** An employer carrying on business in Tanzania shall, within the prescribed period and in the prescribed form, register himself with the Director-General and furnish the Director-General with- (a) the prescribed particulars of the employer's business; and (b) any additional particulars he may require. (2) The particulars referred to in subsection (1) shall be furnished separately in respect of each business carried on by the employer. (3) An employer shall, within seven days of any change in the particulars so furnished, notify the Director General of the change. (4) Any person who fails to comply with the provisions of this section commits an offense and shall, on conviction, be liable to a fine not exceeding fifty million shillings or imprisonment for a term not exceeding five years or to both; and	The proposed Trona Extraction and Soda Ash Production Project is privately owned by WWSL, which will also serve as the employer. The project will require a workforce and become mandatory of this act to be applicable. To comply with the Act, the company will register the workplace and maintain all necessary records, including earnings and other documentation, as mandated by the laws.

S/N	Legislation/Act	Requirements	Relevance to Project
		• **Section 72 (1):** An employer shall keep a register or other record of the earnings and other prescribed particulars of all employees employed by the employer and shall, at all reasonable times, produce the register or record or a satisfactory reproduction on demand to an authorized person inspection. (2) An employer shall retain the register, record or reproduction for a period of at least three years after the date of the last entry on that register or record. (3) An employer who fails to comply with a provision of this section commits an offense and shall, on conviction, be liable to a fine not exceeding twenty million shillings or imprisonment for a term not exceeding five years or to both.	
3	Social Security Regulatory Authority Act (CAP 135 RE: 2018)	**Section 30 (1)** Subject to the provisions of the respective schemes laws, every employer in the public sector and private sector shall register their employees with the mandatory scheme in the public and private sectors, respectively.	The proposed Trona Extraction and Soda Ash Production Project is privately owned by WWSL, which will also act as the employer. The project will require a workforce, and it will be mandatory for the provisions of this act to apply. The company will register its employees with the mandatory scheme with the respective authority in order to comply with the Act.
4	The Person with Disability Act , Cap 183, 2010	**Section 31:** Requires Every employer, public or private, shall, where there is a vacant post fit for a person with disability and the person applies for the vacancy, give the employment to the persons with disabilities who meet the minimum qualification for such an employment. **Section 32:** For purposes of maintenance and safeguarding employment of persons with disabilities, every employer shall endeavour to maintain employment of the persons with disabilities on his working place. **Section 34 (1)** It shall be a duty of every employer to- (a) take all necessary measures to improve work Environment to prevent	WWSL's recruitment policy for the Wosiwosi project must be inclusive. The proponent will ensure that the factory and administrative offices have accessible infrastructure (ramps, specialized toilets) and that no person is discriminated against during the hiring process due to physical disability.Also WWSL will ensure there is no upcoming injuries and impairment at workplace as per act.

S/N	Legislation/Act	Requirements	Relevance to Project
		injuries and impairment; (b) provide job accommodation and provision of working tools; (c) ensure safe and healthy working conditions for all employees with disabilities; (d) protect employees with disabilities from harrasment; (e) permit employees with disabilities to exercise their labour and trade union rights in accordance with any relevant laws; and (f) enable employed persons with disabilities to have effective access to general. technical and vocational guidance and continuing training for their carrier and advancement	
5	The National Social Security Fund (NSSF) Act, 1997	**Section** 6.(1) Every person who is a member of the existing Fund shall be an insured person under this Act. (2) Every person who is self employed or who is employed in the private sector, other than in a body which is a parastatal organisation under the Parastatal Pension Fund Act, 1978, shall be registered as an insured person, (3) Every non-pensionable employee in the Government service and parastatal organisation shall be registered as an insured person. **Section 11.**-(1) Subject to the provisions of this Act, every contributing employer shall, unless such employer has been registered under the existing Fund, within one month, register under this section in the prescribed manner. (2) The period of one month mentioned in subsection (1) shall, in every case, begin upon the commencement of this Act or the date when person concerned becomes a contributing employer. (3) Upon the first day of the month following the month in which the mentioned in subsection (1) expires, the employer to whose registration that period relates shall be a contributing employer for the purposes of this Act,	The proposed Trona Extraction project will provide employment opportunities for both indigenous people and neighborhood people during construction, operations and decommissioning who might be skilled or unskilled. To comply with this act, the WWSL project proponent will register as employer and adhere to all requirements of the acts. This will ensure future safe social status of local people.

S/N	Legislation/Act	Requirements	Relevance to Project
6	The Income tax Act (Cap. 332 R.E 2019)	Section 8(1): requires calculate and report all gains or profits made from running a business during a specific year, and that amount will be taxed. Section 9: requires payment of income from any investment, declare and include all gains or benefits earned from an investment during the year when calculating income for tax purposes. Subdivision 65A-65I regulates how income from natural resource extraction is taxed, including royalties, transfers, and foreign participation**.**	The project will generate revenue through the extraction and processing of Trona and production of soda ash, and therefore must compute and declare its taxable income in accordance with the Act. This provision is important for financial planning, legal compliance, and ensuring proper accounting of project revenues and expenses. WWSL must register for a TIN and VRN, remit Corporate Tax (30%), and ensure all staff in Wosiwosi have their PAYE and Withholding Tax deducted and remitted to TRA to avoid penalties or site closure
Forest and Wildlife Management			
1	The Forest Act, CAP 323 R.E. 2023	**Section 18 (1):** In any proposed development in a forest reserve, private forest or sensitive forest area including watersheds to which this section applies, whether that development is proposed by, or is to be implemented by, a person or organization in the public or private sector, the proposer of the development shall prepare and submit to the Director an Environmental Impact Assessment of the proposed development from independent consultants selected from a list approved by the Government of the United Republic and, notwithstanding any other law to the contrary, no development to which this section applies shall be commenced unless and until an Environmental Impact Assessment has been completed to the satisfaction of the Director.	The proposed Trona Extraction and Soda Ash Production Project is located within the Lake Natron Controlled Area, which is designated as a sensitive area under these Acts. To ensure compliance with the requirements of the Acts, WWSL has developed this ESIA report, which includes appropriate management programs against on Flora and Fauna Biodiversity (Section 8.7.2). The report will finally be submitted to NEMC for approval. After the approval, the company will ensure the effective implementation of the management programs to align with commitments to safeguard biodiversity.
2	Wildlife Conservation Act CAP 283 RE: 2023	**Section 35 (1):** Every significant physical development in a wildlife protected area, the Wildlife Management Area, the buffer zone, migratory route or dispersal area to which this section applies, whether that development is prepared by, or is being implemented by a person or organization in the public or private sector, the prospective developer shall prepare and submit to the satisfaction of the Minister responsible for the environment a report on Environmental Impact Assessment of the proposed development.	

S/N	Legislation/Act	Requirements	Relevance to Project
Road and Standard Management			
1	Road Act, CAP 167 R.E 2023	**Section 31 (1)** Any person who damages, removes, or obscures the road furniture commits an offense and shall be liable on conviction to a fine not less than two hundred thousand shillings or to imprisonment for a term not exceeding one year or to both.	To fulfill the requirement for transporting material required for the project from Dar es Salaam to the Project site via Arusha Road, WWSL will prepare an extensive traffic management plan. This plan will include specific actions to prevent any damage to the road reserves during transit.
2	Standards Act, CAP 130 R.E. 2023.	**Section 18 (5):** Any person who (a) applies a standards mark to any receptacle or cover of any commodity or to any label attached to any commodity or any receptacle or its cover; or (b) places or encloses any commodity in a receptacle or cover to which a standards mark has been applied or in a receptacle or cover to which is attached a label to which that mark has been applied, shall, for subsection (4), be deemed to have applied that standard mark to that commodity.	Given that the project involves Trona Extraction and Soda Ash Production, which will be stored in a container for transportation, adherence to this Act is required. WWSL will ensure full compliance with all necessary standards for the proper storage of the Soda Ash in respective containers for proper transportation.
Contractors Registration and Electricity Management			
1	Contractors Registration Act, CAP 235. R.E. 2023	**Section 20 (4):** An employer or developer who engages an unregistered firm or persons commits an offense and on conviction is liable to a fine of not exceeding ten percent of the contract sum or project value but not less than one percent of such contract sum or project value or five million shillings whichever amount is greater or to imprisonment for a term of not less than three years or to both.	The development of the Trona Extraction and Soda Ash Production Project includes the construction of various supporting structures, such as accommodation camps, offices, mess halls, kitchens, and more operational facilities. WWSL is committed to employing or contracting registered and approved contractors as well as engineers to carry out all construction activities, ensuring full compliance with these provisions under the Acts.
2	Engineers Registration Act (CAP. 63 R.E 2023)	Section (3) requires “Any person who practices engineering activities without a valid practicing certificate commits an offence and on conviction shall be liable to-(a) in case of an individual, a fine of not less than five hundred thousand shillings or to imprisonment for one year or to both; or (b) in case of a firm, a fine	

S/N	Legislation/Act	Requirements	Relevance to Project
		of not less than five million shillings. (4) The Board may consider provisions of a practicing certificate for a period less than a year as it may deem fit.	
3	The Business Activities Registration Act, Cap. 213	**Section 3:** Requires all business undertakings in Mainland Tanzania to be registered and issued a Business License	Before commencement of Soda Ash Business, the WWSL will obtain business licence from Ministry of Industry and trade for the compliance purpose. This will serve as primary permit alongside with Mineral License. WWSL must remain a legally compliant entity with BRELA. Adherence ensures transparency in ownership, which is a prerequisite for the Mining Commission when reviewing the Mineral Rights application for the Lake Natron site
4	The Companies Act, Cap. 212	**Section 3(1)** Any seven or more persons, or, where the company to be formed will be a private company, any two or more persons associated for any lawful purpose may, by subscribing their names to a memorandum of association and otherwise complying with the requirements of this Act in respect of registration, form an incorporated company, with or without limited liability. **Section (2)** Such a company may be either— (a) a company having the liability of its members limited by the memorandum to the amount, if any, unpaid on the shares respectively held by them (in this Act termed "a company limited by shares"); or (b) a company having the liability of its members limited by the memorandum to such amount as the members may respectively thereby undertake to contribute to the assets of the event of its being wound up (in this Act termed "a company limited by guarantee"); or (c) a company not having any limit on the liability of its members (in this Act termed "an unlimited company.")	
5	The Investment and economic special zone Act ,2025	**Section 11** requires investors to be registered by Tanzania Investment and special economic zones authority and provide all needed information to the authority.	As a large-scale project, WWSL will register with the TIC to benefit from tax exemptions on imported machinery. To adhere, the

S/N	Legislation/Act	Requirements	Relevance to Project
			proponent will submit a Technology Transfer Plan to show how local Tanzanians will be trained to manage the Soda Ash production technology
6	The Electricity Act, CAP 131 R.E 2023	**Section 8 (2):** Any person who intends to conduct any of the activities stipulated in subsection (1)(a) "generation" shall be required to apply to the authority for a license unless(a) that person has been exempted to the authority or (b) the activity is exempted under subsection 4 or 5 of section 18.	Electricity will be supplied by TANESCO, and in case of deficiency standby solar power panels will be applied. To ensure compliance with this Act, WWSL commits to consult TANESCO for the supply of electricity and a license to generate electricity.

(Source: Compiled by MTL Consulting; 2025)

3.5 Principal Regulation Related to the Project

3.5.1 Environmental Impact Assessment and Audit Regulations, 2005, as last amended 2024

These regulations were established to reinforce the Environmental Management Act by promoting sustainable development, ensuring the efficient use and management of resources, and addressing potential adverse impacts, whether biophysical, social, or otherwise, through anticipation, avoidance, minimization, or mitigation measures.

Regulation 4(b) stipulates that no project requiring an EIA under the Act, these regulations, or any other applicable law may proceed without first completing and securing approval of the EIS in accordance with these provisions. To comply with the regulation, WWSL has conducted this ESIA study to assess the potential impacts associated with the Trona Extraction and Soda Ash Production Project and outlines the appropriate management strategies to mitigate or enhance such impacts. The report will be submitted to NEMC for approval and the company will align with all commitments upon implementation of the project.

3.5.2 Other Regulations Relevant to the Project

Other regulations related to mining operations are recognized (Table 3.7) and will continue to be adhered to by WWSL regarding the operation of the Trona Extraction and Soda Ash Production Project, not limited to the following.

Table 3.7: Other Relevant Regulations

S/N	Regulations	Requirements	Relevance to Project
Environmental Management			
1	Environmental Management (Soil Quality Standards) Regulations, 2007	**Regulation 5 (1):** A person undertaking any activity that impacts upon soil shall comply with soil quality standards that may be prescribed by the National Environmental Standards Committee.	The construction, operation, and decommissioning activities like excavation of soil, soil erosion, chemical handling, and spillage associated with the proposed Trona Extraction and Soda Ash Production Project will directly interact with soil, this interaction may potentially cause a negative impact on soil through deterioration of its quality, structure, chemistry, profile, facility etc. to ensure alignment with the regulation WWSL will employ effectively the suggested management programs in Section 8.7.4 and where necessary will also undertake various assessment soil studies, sampling, practices to safeguard and prevent soil contamination.
2	Environmental Management (Air Quality Standards) Regulations, 2007	• **Regulation 7 (1):** Every person shall be required to comply with the minimum air quality standards approved and published pursuant to these Regulations. • **Regulation 8 (1):** No person shall emit or release any hazardous substance, chemical, gas, or mixture containing gaseous and hazardous substances into the environment unless such emission or release is permitted under these Regulations or any other written law. • **Regulation 8 (2):** A person who releases any hazardous substance, chemical, gas or mixture containing gaseous and hazardous substances into	The construction, operation, and decommissioning activities, such as soil excavation, landscaping, site clearance, and the use of fossil fuels in vehicles and machinery, along with the operation of the central processing facility, could potentially increase the emission of greenhouse gases like SOX, NOX, and COX. This could lead to air quality degradation and contribute to climate change. To ensure compliance with the relevant regulations, WWSL commits to implement the management and monitoring programs outlined in Sections 8.7.6, 8.7.8, and 9.2.4. Additionally, where necessary, the company will conduct air quality assessments, sampling, and other practices to safeguard air quality deterioration.

S/N	Regulations	Requirements	Relevance to Project
		the environment or into any other segment of the environment contrary to these Regulations commits an offence; • **Regulation 9:** A person undertaking any activity shall be required to comply with the highest permissible emission limits from the atmosphere to a receptor and respective test methods for sulphur oxides, carbon monoxide, black smoke and suspended particulate matters, nitrogen dioxide, nitrogen dioxide, ozone as prescribed in the First Schedule to these Regulations; and • **Regulation 10:** A person who undertakes an activity shall be required to comply with the highest permissible quantity of emission of sulphur oxides, carbon monoxide, hydrocarbon as total organic carbon, dust, nitrogen oxides or lead released into the air from a pollution source and respective test methods prescribed under the Second Schedule to these Regulations.	
3	Environmental Management (Water Quality Standards) Regulations, 2007.	• **Regulation 5 (1):** Any person who -(a) knowingly puts or permits to be put or to fall to be carried into any stream, so as either singly or in combination with other similar acts of the same nature or interfere with its due flow or pollute its waters; (b) puts solid refuse of any manufactory or manufacturing process, or puts any rubbish or puts any other waste or puts any putrid solid matter into such stream; (c) causes to fall or flow or knowingly permits to fall or flow or to be carried into any stream any poisonous, noxious or polluting liquid discharged from any factory or manufacturing process; (d) pollutes water sources or interferes with soils and vegetation that protects water sources; (e) pollutes any ground water potential, commits an offence; and	Waste management is crucial for protection of water resources (Lake Natron, Ewaso Ng'iro River and Boreholes etc) and the general environment surrounding the proposed Trona Extraction and Soda Ash Production Project. As required by this regulation, WWSL will never "puts solid refuse of any manufactory or manufacturing process, or puts any rubbish or puts any other waste or puts any putrid solid matter into such stream. Also, pollutes water sources or interferes with soils and vegetation that protects water sources and pollutes any groundwater potential. This will be achieved through effective implementation of the proposed management and monitoring programs listed in sections 8.7.3, and 9.2.1. Furthermore, the company will conduct a comprehensive water

S/N	Regulations	Requirements	Relevance to Project
		• **Regulation 6 (1):** No person shall discharge any hazardous substance, chemical, oil, or mixture containing oil in any waters except in accordance with what is prescribed under these Regulations or any other written law.	resource assessment study, sampling, and other practices to safeguard water resources where deemed necessary.
		• **Regulation 7 (1):** Every applicant for a water right or permit under relevant laws governing the management of water resources, abstraction and use of water shall, within twenty-one days of lodging their application, file through the Basin Water Officer a statement to the Council indicating the likely impact on the environment if the water right or permit is granted; and • **Regulation 8 (1):** A holder of a water right or permit shall be required to comply with effluent or receiving water standards prescribed by any other written law, provided that they are not below the standards prescribed under these Regulations.	Water demand for the proposed project for supporting various activities is estimated to be 30 to 50 cubic meters per day and 70 to 80 cubic meters per day during the construction and operation phase, respectively. This amount of water will be sourced from surface water (Ewaso Ng'iro River) and groundwater for which a deep borehole and its storage tank will be constructed on the project site. Before water abstraction, the proponent, WWSL, will apply for water use rights from the Internal Drainage Basin Water Board (IDBWB), and along with that application, will submit this ESIA study to the Authority as required. Moreover, the company will comply with effluent or receiving water standards as well as terms and conditions stipulated under the right or permit granted.
4	Environmental Management (Solid Waste Management) Regulations, 2009 as Amended, 2018	• **Regulation 6:** Every person living in Tanzania shall have a stake and a duty to safeguard the environment from the adverse effects of solid wastes and to inform the relevant authority on any activity and phenomenon resulting from solid waste that is likely to adversely affect the public health and environment; • **Regulation 9 (1):** Any person wishes to deal in solid waste as collector, transporter, depositor or manager of transfer station shall apply to local government authority for a permit; • **Regulation 11 (1):** No one shall dispose of any solid waste without a permit issued by the local	Effective solid waste management is essential for preventing environmental pollution. The development of the Trona Extraction and Soda Ash Production Project is expected to produce various types of solid waste, including excavated soil and rocks, food waste, cardboard, plastic wraps, and other packaging materials, resulting from construction, operation, and decommissioning activities. To comply with regulations, WWSL will submit the ESIA report to the relevant authorities, outlining the potential impacts of solid waste on public health and the environment, and detailing the measures to manage it as described in Chapters 8.7.5. Additionally, the company will apply for the

S/N	Regulations	Requirements	Relevance to Project
		government authority for that purpose; (2)-All wastes shall be finally disposed of at areas designated for that purpose by the local government authority; • **Regulation 15 (1):** Every occupier of any premises shall be obliged to use approved receptacles by the Council or local government authority.	necessary permits for the collection, transportation, and disposal of solid waste when required.
5	Environmental Management (Standards for Control of Noise and Vibrations) Regulations, 2015.	• **Regulation 7 (1):** Except as otherwise provided in these Regulations, no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise that annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and that of the environment; • **Regulation 8:** Except as otherwise provided in these Regulations, no person shall-(a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations which exceed 0.5 centimetres per second beyond any source property boundary or 30 meters from any moving source; • **Regulation 9 (2):** The maximum noise levels of continuous or intermittent noise from a factory or a workshop, to which a person may be exposed, shall not exceed the level specified in Column 1 of Part II of the First Schedule, for the time specified in Column 2 and 3 of that Part; • **Regulation 10 (1):** Tolerance limits for environmental vibrations, including occupational environment and air overpressure shall be as prescribed in the Second Schedule to these Regulations.	Management of Noise and Vibration is crucial for minimizing environmental and public health impacts. The Trona Extraction and Soda Ash Production Project is expected to generate noise and vibrations from various sources, including machinery and equipment operation, as well as vehicle transportation. To ensure compliance with noise and vibration regulations, WWSL commits to effectively implement the management and monitoring programs outlined in sections 8.7.7 and 9.2.5, respectively, to mitigate and control noise and vibration levels in line with prescribed standards. The company will further establish programs for monitoring, controlling, and managing noise and vibration levels at the site when deemed necessary.
6	Environmental Management (Prohibition of Plastic Carrier Bags) Regulations, 2022.	• **Regulation 5:** All plastic carrier bags, regardless of their thickness, are prohibited from being imported,	The project will require various materials, including construction supplies (such as cement, gypsum, paints, and chemicals), as well as operational and

S/N	Regulations	Requirements	Relevance to Project
		exported, manufactured, sold, stored, supplied, and used in Mainland Tanzania; and • **Regulation 7:** A person shall not sell or offer for sale beverages or commodities wrapped in plastic unless the nature of such commodities requires wrapping by plastics.	administrative, as well as domestic materials (processing chemicals, stationery materials, food). In order to comply with regulatory requirements, the use of biodegradable carrier bags will be promoted for delivering such materials to the site.
7	Environmental Management (Hazardous Waste Control and Management) Regulations, 2021.	• **Regulation4 (1):** Any person generating, collecting, storing, transporting, treating, recycling, reusing, recovering, and disposing of hazardous waste or any person exercising jurisdiction under these Regulations shall, in relation to any decision, order, exercise of any power or performance of any function, be guided by the following principles of environment and sustainable development relevant to hazardous waste management- (a) the precautionary principle; (b) polluter pays principle; and (c) the producer extended responsibility. (2) For the purpose of this regulation, "producer extended responsibility" means a policy approach that requires that any person producing or importing a product should internalize environmental costs in the production of the product and in the whole life cycle of such product; • **Regulation 5:** A person who owns or operates a facility or premises which generate hazardous and toxic waste shall minimize the waste generated by adopting the following cleaner production principles- (a) improvement of the production process through conserving raw materials and energy by-(i) Eliminating the use of hazardous and toxic raw materials within such times as may be prescribed by the Minister; and (ii) reducing toxic emissions and hazardous wastes to a level prescribed in the applicable national environmental quality standards.	The proposed Trona Extraction and Soda Ash Production Project would potentially result to hazardous wastes generation as it will involve the use of hazardous materials like chemicals, paints, electronics, machinery, hydrocarbons etc., during the construction, operation and decommissioning phase. To comply with this regulation, WWSL will apply the precautionary principle together with the management programs discussed in Chapter 8 to mitigate the impacts of hazardous waste on the environment. Furthermore, will also improve the production process through conserving raw materials and energy by eliminating the use of hazardous and toxic raw materials, reducing toxic emissions and hazardous wastes to a level prescribed in the applicable national environmental quality standards, monitoring the product cycle from beginning to end by identifying and eliminating potential negative impacts of the product; enabling the recovery and re-use of the product where possible; and reclamation and recycling.

S/N	Regulations	Requirements	Relevance to Project
		(b) monitoring the product cycle from beginning to end by- (i) identifying and eliminating potential negative impacts of the product; (ii) enabling the recovery and re-use of the product where possible; and (iii) reclamation and recycling; and • **Regulation 6 (1)** Every person living in Tanzania shall-(a) have a right to clean, safe and healthy environment; and (b) have a stake and a duty to safeguard the environment from adverse effects of hazardous wastes and to inform the relevant authority on any activity or phenomenon resulting from hazardous waste that is likely to adversely affect the environment and human health. (2) A generator of hazardous waste shall be responsible for the sound management and disposal of such waste and shall be liable for damage to the environment and injury to human health arising thereby.	
8	Environmental Management (Control and Management of Electrical and Electronic Equipment Waste) Regulations, 2021	**Regulation (2)**: requires a person who intends to collect or store or transport e-waste shall apply for a permit to the Minister by filling Form No. 1 prescribed in the Second Schedule to these Regulations and submit it to the Council for consideration.	The engineering services at Trona Extraction and Soda Ash Production Project may result in the generation of e-wastes such as scrap metals, unused spares, unused batteries, as well as unused electronic devices (tube lights, wires and cables, printers and laptops). To ensure the safe management of these wastes and align with the regulation, WWSL commits to applying for the required permits and observing all terms and conditions under the permit. The company will also contract a licensed dealer for the safe disposal of these waste streams.
9	Environmental Management (Control of Ozone Depleting Substances Standards) Regulations, 2023	**Regulation 5 (1)**: requires that any person shall not manufacture, import, export, sell, or offer for sale chemicals or a controlled substance listed in the Second and Third Schedules without a permit issued by the	Recognizing the protection of the ozone layer is a critical component in safeguarding human health and the environment from harmful ultraviolet radiation, WWSL is fully committed to supporting national and global efforts to control substances that

S/N	Regulations	Requirements	Relevance to Project
		Registrar of Chemicals under the Industrial and Consumer Chemicals (Management and Control) Act.	deplete the ozone layer. To align with this regulation, the company will obtain all necessary permits before engaging in any activity involving such substances during the development and operation of the Trona Extraction and Soda Ash Production Project, as part of its commitment to environmental responsibility and regulatory adherence.
Water Resource Management			
1	Water Resources Management (Water Abstraction, Use and Discharge) Regulations, 2010	**Regulation (4):** requires any person who intends to use water not for domestic purposes and who exceeds the limits provided in this regulation to notify the Board and apply for a water use permit in accordance with these regulations.	Given that the Trona Extraction and Soda Ash Production Project requires substantial volumes of water for construction and operational support, this regulation is directly applicable to the Project. To ensure compliance with the regulation, WWSL commits to apply for Water Use and Discharge Permits and will ensure strict adherence to the conditions outlined in the issued permits.
Chemical Management			
1	Industrial and Consumer Chemicals (Management and Control) Regulations, 2020.	• **Regulation 9 (1):** requires any person who transports a chemical shall (a) be registered by the Registrar and be issued with a certificate; and b) register the company and premises; • **Regulation 24 (1):** requires any person who uses or produces a chemical shall- (a) be registered by the Registrar and be issued with a certificate; (b) register the company, premises and chemicals; (c) create awareness to the public on the inherent risks of indiscriminate use and misuse of chemicals; and (d) set and adhere to the code of practice and guidelines on the safe use and handling of;	The Trona Extraction and Soda Ash Production Project will involve the use of chemicals for the ore processing of Soda Ash. Through that, the permit for importation, transportation, use, and storage of chemicals will be required. However, such use of chemicals may potentially result in chemical waste. To ensure alignment with the requirements of these regulations, WWSL commits to applying all the permits required for proper management of chemical and chemical wastes to ensure environmental protection.

S/N	Regulations	Requirements	Relevance to Project
		• **Regulation 27 (1):** requires any person who intends to store or warehouse a chemical shall- (a) be registered by the Registrar and be issued a certificate; (b) register the premises; (c) ensure the public is aware of the inherent risks of indiscriminate use and misuse of a chemical; and (d) set and adhere to the code of practice and guidelines on the safe use and handling of a chemical; and • **Regulation 34:** requires any person or company in possession of a chemical waste shall- (a) notify the Registrar in annual basis in the form set out in the Thirteenth Schedule to these Regulations; (b) ensure that the employees are made aware on the inherent nature and risks of mismanagement of the chemical waste; and (c) set and adhere to the code of practice and guidelines on the safe handling of chemical.	
Mining Related Regulations			
1	Mining (Safety, Occupational Health and Environment Protection) Regulation, 2010	• **Regulation 195:** It is the duty of every licensee, manager or agent of the licensee to institute and during the life of the mine to carry out a program of environmental protection and reclamation, in accordance with the standards described in this part.	Currently, WWSL is the owner of the two prospecting licenses (PL 12236/2023 and PL 13190/2025). The company plans to apply for a Mining License after the completion of exploration activities. This ESIA study has been prepared and will be submitted to the Mining Commission along with the required documents during the application for the Mining License. Furthermore, after being granted the Mining License, the company will ensure that environmental protection and reclamation are attained by effectively implementing the proposed management and monitoring programs in Sections 8 and 9.

S/N	Regulations	Requirements	Relevance to Project
2	Mining (Local Content) Regulations, 2025.	**Regulation (7):** requires any contractor, subcontractor, licensee, the corporation, or other allied entity carrying out a mining activity shall ensure that local content is a component of the mining activities engaged in by that contractor, subcontractor, and licensee, the Corporation, or other allied entity.	As WWSL seeks to obtain a Mining License for Trona Extraction and Soda Ash Production, it will be subject to the requirements of the applicable regulations once the license is granted. In compliance with these requirements, the company will prepare and submit a Local Content Plan to the Mining Commission for approval and will uphold all terms and conditions set forth in the approval throughout the duration of the project.
3	Mining (Integrity Pledge) Regulations, 2018;	**Regulation (5):** requires any Contractor, Sub-contractor, Licensee, or any other person conducting mining activities shall adhere to the following underlying integrity requirements: (a) Promoting integrity values, transparency and good governance; (b) Strengthening internal systems that support prevention of corruption; (c) Complying with laws, policies and procedures relating to anti-corruption; (d) Supporting prevention of corruption initiatives by the Government; (e) maintaining appropriate financial reports; (f) implementing a whistle blowing system; (g) refraining from dealing with unethical companies; and (h) ensuring proper operations in the course of carrying out Mining activities to avoid losses, injuries or damage to environmental, communities, individual and properties	WWSL commits to comply with the requirement of this regulation through ensuring the operation of Trona Extraction and Soda Ash Production Project, considering the promotion of integrity values, transparency and good governance, strengthening internal systems that support prevention of corruption, supporting prevention of corruption initiatives by the Government, maintaining appropriate financial reports, implementing a whistle blowing system, and ensuring proper operations in the course of carrying out Mining activities to avoid losses, injuries or damage to environmental, communities, individual and properties.
4	Corporate Social Responsibility Regulations, 2023	• **Regulation 4 (1):** The holder of the mining license shall be responsible for preparing a comprehensive plan for their social responsibility by involving the relevant village or street council in the area where mining activities are taking place, through the respective local authority; and • **Regulation 4 (2):** The holder of the mining license shall be obligated to involve the relevant village or street council in the area where mining activities are	Since WWSL is in the process of applying for a Mining License for Trona Extraction and Soda Ash Production and may become the license holder once granted, the company will engage with the surrounding communities (villages) and local government to gather suggestions on projects or priorities that align with their interests for Corporate Social Responsibility (CSR) initiatives. After collecting their input, the company will prepare a

S/N	Regulations	Requirements	Relevance to Project
		taking place in identifying the priorities of the communities within or surrounding the area during the preparation of the social responsibility plan.	detailed/comprehensive social responsibility plan and implement CSR to align with this regulation.
Safety Management			
Fire and Rescue Force (Safety, Inspections and Certificates) Regulations, 2008		**Regulation 5 (1):** Any person who is an owner or operator of the premises, vehicle, vessels, or any other conveyance facility that has not been issued with a Fire Safety Certificate by the Fire Authority shall apply in writing to the Fire Authority for the conduct of an inspection of their premises, vehicle, vessels, or any other conveyance facility.	The proposed Trona Extraction and Soda Ash Production Project will include the construction of buildings, processing plans, as well as the use of vehicles and machinery. WWSL will ensure that all its infrastructure is registered and will consult with the relevant Fire Authority to inspect the premises and associated facilities. This will ensure the implementation of an appropriate fire management system and the acquisition of a Fire Safety Certificate as mandated by this regulation.

(Source: Compiled by MTL, 2025)

3.6 Guidelines, Standards, Strategies, and Procedures

3.6.1 National Guidelines, Standards, and Procedures

The Tanzania Bureau of Standards (TBS), through the National Environmental Standards Committee (NESC), is mandated under Section 141 of the Environmental Management Act, Cap. 191 R.E 2023, to formulate environmental standards. The applicable national environmental standards relevant to the Trona Extraction and Ash Production Project, which WWSL will continue to comply with, are presented in Table 3.8.

Table 3.8: TBS Standards

S/N	Standards	Standard Requirement Description
1	TZS 860: 2019 Municipal and Industrial Wastewaters	This standard provides permissible limits of important environmental parameters such as biological oxygen demand (BOD), chemical oxygen demand (COD), pH, color, temperature range, total suspended solids, and turbidity as well as chemical and biological parameters. It also gives permissible limits to a range of inorganic and organic components. WWSL commits to ensuring that all effluents discharged from the Trona Extraction and Ash Production Project will be monitored and treated to comply with these specifications[2].
2	TZS 845: 2019 and Environmental Management (Air Quality Standards) Regulations, 2007	These standards provide permissible emission limits of sulfur oxides, carbon monoxide, hydrocarbons (as total organic carbon), dust, nitrogen oxides, and lead and the emissions from earth-moving equipment, power generation facilities, and others will include SO2, CO, dust, and NOx. To ensure adherence to the standard, WWSL commits to establishing monitoring programs designed to ensure those parameters are within the acceptable limits. Furthermore, the company will, where necessary, carry out air quality assessments, sampling, and other relevant measures to prevent and control any potential deterioration of air quality.
3	TZS 983:2019: Air Quality – Vehicular Exhaust Emissions Limits:	This standard is mainly derived from EU Directives 96/69/EC, 91/542/EEC, and 97/24/EC. It gives permissible limits for some common substances found in exhaust emissions of motor vehicles, namely CO, suspended particulate matter (PM), NOx, and hydrocarbons. The standard covers all types of vehicles, namely, passenger cars, light commercial vehicles, heavy-duty vehicles, and two and four-stroke motorcycles and scooters[3].

[2] https://tbs.go.tz/catalogues

[3] https://tbs.go.tz/catalogues

S/N	Standards	Standard Requirement Description
4	TZS 932:2017 Acoustic – General Tolerance Limits for Environmental Noise:	This focuses on urban environmental noise[4].
5	The Environmental Management (Standards for Control of Noise and Vibrations) Regulations, 2015	The standard provides permissible limits of environmental noise and vibration[5].
6	TZS 789: 2018: Drinking Water (Potable) Water - Specifications:	This standard prescribes the quality requirements for drinking water other than packaged drinking water. It applies to bacteriological, biological, virological, physical, chemical, and radiological quality criteria. It also applies to community piped water supplies, i.e., those water systems serving cities, municipalities, and townships, community standpipes, and wells, and drinking water distributed by tankers[6].
7	TZS 931:2006 Protection against Ionizing Radiation Limits.	for Occupational Exposure: which aims at protecting workers, whose practices expose them to ionizing radiation, namely, gamma and X-rays, alpha, beta, and other particles that can induce ionization[7].

3.6.2 National Climate Change Response Strategy (NCCRS) 2021-2026

The National Climate Change Strategy (NCCRS) 2021–2026 integrates adaptation, mitigation, and crosscutting approaches to enable the United Republic of Tanzania to benefit from global opportunities available to developing countries in tackling climate change. Its main objective is to enhance national capacity and resilience to climate-related challenges while advancing low-carbon and sustainable development pathways. The specific objectives of the strategy are outlined in Table 3.9.

Table 3.9: NCCRS Specific Objectives

Category	Specific Objective
Compliance Requirement	Align climate change interventions with the national development agenda of an industrialized economy.
	Devise and implement strategic adaptation and mitigation measures in line with the national circumstances, and requirements of climate change-related multilateral environmental agreements, Sustainable Development Goals (SDGs), and related bilateral and regional agreements.
Capacity Building Requirement	Enhance research, public awareness, education, and capacity building on climate change issues.

[4] https://tbs.go.tz/catalogues

[5] https://www.nemc.or.tz/uploads/publications/sw-1645447070-NOISE%20POLLUTION%20REGULATIONS_2015.pdf

[6] http://www.puntofocal.gov.ar/notific_otros_miembros/tza277_t.pdf

[7] https://www.tbs.go.tz/uploads/publications/en-1620119694-EMDC6(189)%20Protection%20against%20ionizing%20radiation%20Specification%20for%20industrial%20radiographic%20installations.pdf

Category	Specific Objective
Technological Requirement	Promote and facilitate the transfer of climate-smart technologies to support climate change adaptation and mitigation.
Social Responsibility	Promote gender-responsive climate change adaptation and mitigation interventions.
	Promote inclusive engagement of stakeholders, including community, media, civil society organizations, and the private sector in designing, implementing, and monitoring sustainable climate change adaptation and mitigation interventions.

(Source: Compiled by MTL Consulting, 2025)

WWSL Commitment: To align with the specific objectives of the strategy, Section 8.7.8 of this ESIA report includes climate change mitigation measures that will be implemented during development of the Trona Extraction and Soda Ash Production Project.

3.6.3 International Guidelines, Standards and Procedures

a) WBG EHS Guidelines – 1.2: Air Emissions and Ambient Air Quality

The WBG recommends using the air quality guidelines established by the World Health Organization (WHO) for managing air quality. WHO standards are categorized into interim targets and a final guideline target. The interim guidelines are notably conservative, as they do not account for the economic costs of meeting these standards. The final guideline target set by WHO is aspirational, and efforts should be made to progressively achieve it. For the proposed Trona Extraction and Soda Ash Production Project, progress toward meeting the final guideline target may be supported by regulatory adjustments, such as using low-sulfur fuels for construction and project-owned vehicles and implementing regular maintenance and possible mandatory emission testing of these vehicles.

Based on the above, Section 3.6.1, TBS Standards set out the Air Quality Standards that will be considered during execution of the project.

b) WBG EHS Guidelines – 1.3: Wastewater and Ambient Water Quality

IFC EHS Guideline 1.3 specifies that any discharges should not result in contaminant concentrations more than local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality. Receiving water use and assimilative capacity, taking other sources of discharges to the receiving water into consideration, should also influence the acceptable pollution loadings and effluent discharge quality.

Tanzania has water quality standards for effluent discharge into the environment (Section 3.6.1, which will be used and taken into consideration during the execution of the project.

c) WBG EHS Guidelines – 1.4 Water Conservation

The main mechanisms for water conservation suggested by guidelines are listed below.

- The setting of targets for water use, and monitoring of water flows against these targets;
- Water reuse where possible; and
- Reducing leaks and making more efficient use of water within the water reticulation system.

To align with the mechanisms outlined in these guidelines, mitigation measures have been proposed in section 8.8.2 of the report. WWSL will implement these measures to ensure water conservation throughout all phases of the Trona Extraction and Soda Ash Project.

d) WBG EHS Guidelines – 1.7 Noise

This is an internationally recognized guideline document containing information for the assessment and management of noise.

Table 3.10 presents the WBG noise guidelines that shall not be exceeded at the nearest noise-sensitive receptor (NSR) locations off-site.

Table 3.10: Noise Limit Level as per WBG EHS Guidelines

Receptor	One Hour L_{Aeq} (dB(A))	
	Daytime (07:00 – 22:00)	Night (22:00 – 07:00)
Residential; institutional; educational	55	45
Industrial; Commercial	75	70

LAeq = A-weighted equivalent sound levels over a measurement period, dB(A) = A-weighted decibel

(Source: IFC, 2012)

These Guidelines are designed to apply to noise emissions from facilities and stationary noise sources such as factories. The WBG and Tanzanian standards all share similar noise limit level guidelines with some exceptions. For example, the residential, institutional, and educational receptors for the standards all have a day-time limit of 55dB(A) and the industrial receptors have a day-time limit of 75dB(A). The only difference is for the night-time noise limit for industrial receptors, for which Tanzania Noise Standards are more stringent than the WBG with 70 dB(A).

The IFC, WBG, and Local Tanzania Noise standards apply to this project in their respective areas since this project is assessed in both local and international regulations. The receiving receptors (Residential, Institutional, Educational, Industrial, and Commercial) all share similar noise limit levels as mentioned above, although in the case of the difference during the night noise limit, both local and international guidelines are to be referred to provide the best limit level not to be exceeded.

3.7 Local Government By-laws

To protect the natural resources, environment, and the local communities surrounding the Trona Extraction and Soda Ash Production Project, WWSL will continue to align with local bylaws related to environmental and social protection. These bylaws, established by authorities in Arusha Region and Longido District Council, will work in conjunction with applicable regulations to ensure robust environmental and social safeguards throughout the project's development.

3.8 International Agreements, Conventions, Protocols, and Treaties

Tanzania has ratified several international conventions and agreements that address environmental protection and social sustainability. Some of these instruments have shaped

the formulation of national policies, guidelines, and regulations. Although not all have been fully domesticated into national law, adherence to their principles remains a good practice during the planning, construction, and operational phases of the Project. These conventions serve as key frameworks for promoting sustainable development, conserving natural resources, and fostering social equity (Table 3.11).

Table 3.11: International Agreements, Conventions, Protocols, and Treaties

International Convention	Objective	Relevance to Project
Montreal Protocol on substances that deplete the ozone layer, 1987, ratified by Tanzania in 2019	Control of manufacture and use of ozone-depleting substances.	The use of fossil fuels and hydrocarbons in machinery and vehicles associated with the Trona Extraction and Soda Ash Project can result in greenhouse gas emissions that contribute to the depletion of the ozone layer. To address this, WWSL commits to effectively implementing the management programs detailed in Section 8.7.8 of this report. These measures are designed to reduce emissions, maintain air quality, and mitigate climate change, ensuring compliance with relevant conventions. Nevertheless, further measures will be identified and introduced at the project site during implementation, whenever required.
Kyoto Protocol (1997)	Combat climate change by reducing greenhouse gas (GHG) emissions.	
United Nations Convention on Biological Diversity (CBD)	The three goals of the CBD are to promote the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources.	The proposed Trona Extraction and Soda Ash Production Project is located within the Lake Natron Game Controlled Area, a region of high ecological sensitivity and biodiversity importance. The area supports globally significant populations of Lesser and Greater Flamingos, as well as endemic fish species such as Alcolapia spp. Therefore, project planning and implementation must prioritize biodiversity conservation and the prevention of invasive species introduction. Additionally, since the area is also used as grazing land by the Maasai community, integrated land-use management is essential. WWSL Compliance with the CBD can be achieved through the effective implementation of biodiversity management programs outlined in Section 8.7.2 of this report. Also, site-specific measures will be established when deemed necessary.

International Convention	Objective	Relevance to Project
United Nations Framework Convention on Climate Change (UNFCCC), 1992	Its main objective is to achieve the stabilization of greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with climate systems and within a specific timeframe which will allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner	The greenhouse gas emissions from the construction and operation of the proposed Trona Extraction and Soda Ash Production Project will be managed by effectively implementing the mitigation measures and monitoring programs outlined in sections 8.7.6 and 8.7.8 of this ESIA report. This will protect air quality and ensure that the objectives of this convention are not compromised. Further measures will be designed and implemented during the project execution when required.
Millennium Sustainable Development Goals (SDG) 2030 Agenda	The purpose of the Sustainable Development Goals is to achieve a better and more sustainable future for all generations by ensuring prosperity, peace, the well-being of people, partnerships and collaborations, and the conservation of the planet's resources. The SDG has also set seventeen goals which makes the sustainable development to be achieved by protecting the environmental and social aspects.	The proposed Trona Extraction and Soda Ash Project's construction and operation could potentially affect water, air, biodiversity, and social conditions. To mitigate these impacts, WWSL commits to adhering to the goals and targets set by this SDG, ensuring the protection of environmental and social aspects to promote sustainable development.
ILO Conventions	This convention aims to promote good/ safe health and safety working conditions/environment to workers, ensure equal and fair treatment, and non-discrimination. The conversion also focuses on the protection of any form of child and forced labor situation.	Throughout all phases of the Trona Extraction and Soda Ash Production Project, workers must be provided with fair labor practices and working conditions. Additionally, to comply with the requirements of this convention, child labor and forced labor will be strictly prohibited.
Lusaka Agreement, 1994	The Lusaka Agreement promotes regional cooperation in combating the illegal trade of wild fauna and flora. It established the Lusaka Agreement Task Force (LATF) to coordinate joint enforcement operations, facilitate information sharing, and strengthen law enforcement capacity across member states. By promoting collaboration in investigations and prosecutions, the Agreement supports biodiversity conservation and the protection of Africa's wildlife resources from transboundary trafficking and related environmental crimes.	As project activities may potentially affect local ecosystems and wildlife habitats around Lake Natron. To mitigate such impact and conform to this convention, WWSL commits to implementing strict measures to prevent any form of illegal wildlife trade or disturbance to protected species during all project phases. The company will collaborate with local and national authorities, including the Tanzania Wildlife Management Authority (TAWA) and other relevant institutions, to ensure that all activities comply with national wildlife protection

International Convention	Objective	Relevance to Project
		laws and international conservation standards.
Convention on Wetlands of International Importance (RAMSAR Convention), 1971	This convention focuses on the conservation and sustainable use of wetlands. It recognizes wetlands as ecosystems of critical importance for biodiversity, water resource management, climate regulation, and livelihoods. Signatory states commit to the designation of wetlands of international importance and the implementation of sustainable practices to conserve these ecosystems.	The proposed Trona Extraction and Soda Ash Production Project will be developed at Lake Natron, which is internationally recognized as a Ramsar site due to its ecological significance. It serves as a critical habitat for various species, including the Lesser Flamingo (Phoeniconaias minor), which relies on the lake for breeding. The project's operations must align with the principles of the Ramsar Convention to ensure sustainable management and preservation of Lake Natron's ecological integrity. To ensure conformance with the convention, WWSL commits to preserving the ecological and cultural significance of Lake Natron. Incorporating sustainable practices and engaging stakeholders, which will help balance economic development with environmental conservation, ensuring the project aligns with both national and international obligations for wetland protection.
United Nations Convention to Combat Desertification (UNCCD) was Adopted in 1994 and ratified by Tanzania in April 1997.	The convention aimed at addressing desertification, land degradation, and drought, particularly in arid, semi-arid, and dry sub-humid areas. The Convention promotes sustainable land management, restoration of degraded lands, and conservation of soil and water resources to enhance ecosystem resilience and support livelihoods. It emphasizes community participation, capacity building, and integration of environmental and socio-economic strategies to prevent and reverse land degradation while contributing to sustainable development and poverty reduction.	Project activities like land clearing, excavation, and construction may contribute to land degradation if not properly managed. Therefore, adherence to the Convention is essential to maintain soil productivity, prevent erosion, and protect vegetation cover. WWSL commits to implementing sustainable land management practices in line with the UNCCD principles. The company will minimize land disturbance, apply soil stabilization and erosion control measures, and promote vegetation restoration in disturbed areas. Additionally, the company will monitor land conditions throughout the project cycle and collaborate with relevant authorities to prevent and manage any risks of land degradation or desertification resulting from project activities.

International Convention	Objective	Relevance to Project
Geneva Convention, 1977, rectified by Tanzania in 1983	The protocol set out rules for safeguarding civilians, the environment, and civilian infrastructure during both international and non-international armed conflicts. They prohibit attacks on non-combatants and the destruction of objects essential for civilian survival, including those related to water, food, and the natural environment. By promoting humanitarian principles, the Convention aims to minimize suffering and environmental damage during times of conflict while ensuring respect for human rights and dignity.	The development of the Trona Extraction and Soda Ash Production Project may require a workforce and interaction with the local community. Through such interaction, violation of human rights, social conflict, and environmental impact may occur. To mitigate the impacts and comply with this convention, WWSL commits to upholding respect for human rights, promoting a safe and fair working environment, and fostering peaceful coexistence with local communities. The company will also maintain strict compliance with national and international laws governing labor rights, security operations, and environmental protection throughout the project's lifecycle.

(Source: Compiled by MTL Consulting; 2025)

3.9 International Industry Good Practices Standards relevant to the Project

Complying with international standards ensures that environmental and social sustainability practices meet global benchmarks. This alignment not only enhances the Trona Extraction and Soda Ash Production Project's credibility but also minimizes risks, ensures legal compliance, and strengthens stakeholder trust. It demonstrates a commitment to sustainable development and supports global efforts to address environmental and social challenges, contributing to the project's long-term success. Table 3.12 outlines the international standards that WWSL will adhere to for the development of the Project.

Table 3.12: International Standards

Section/PS.	Title	Key Requirement
IFC PS on E&S Sustainability, 2012		
PS 1	Assessment and Management of Social and Environmental Risks and Impacts.	This Performance Standard (PS) focuses on integrating and managing environmental and social performance throughout the entire project lifecycle, in accordance with national regulations and international standards. It mandates the creation of an Environmental and Social Management System (ESMS), which involves a systematic approach to managing environmental and social risks and impacts. To ensure conformance with the standard, WWSL undertakes this ESIA study detailing environmental impacts associated with the proposed Trona Extraction and Soda Ash Production activities and provides the appropriate mitigation and monitoring measures to manage all impacts.
PS 2	Labor and Working Conditions	This standard is designed to ensure that the client establishes and maintains a positive worker-management relationship that

Section/PS.	Title	Key Requirement
		promotes fair treatment, non-discrimination, and equal opportunities for all workers, while adhering to national labor laws and international standards set by the International Labor Organization (ILO). PS2 specifically tackles child and forced labor, advocates for safe and healthy working conditions, and emphasizes the importance of safeguarding and advancing worker health by recognizing the crucial role of employees. The development of the Trona Extraction and Soda Ash Production Project will require both skilled and unskilled labor. WWSL commits to apply a standardized human resource manual, which covers all aspects of employment, including contracts, non-discrimination, and related matters, ensuring conformance with standards.
PS 3	Resource Efficiency and Pollution Prevention	This PS aims to abate pollution to air, water, and land that may threaten people and the environment at the local, regional, and global levels. This PS3 promotes the ability of private sector companies to adopt such technologies and practices where feasible.
PS 4	Community, Health, Safety and Security	The objective of this PS is to anticipate and avoid adverse impacts on the health and safety of the affected communities throughout the life of the Project because of routine and non-routine events. The PS also requires an assessment of how the use of security by the Project to safeguard personnel and property could impact on community security considering human rights.
PS 5	Land Acquisition and Involuntary Resettlement	This focuses on anticipating and preventing physical and economic displacement. When avoidance is not feasible, the standard seeks to minimize the negative social and economic impacts associated with such displacement.
PS 6	Biodiversity Conservation and Sustainable Management of Living Resource	This PS focuses on protecting and conserving biodiversity based on the Convention on Biological Diversity. It divides habitat into three categories; modified, natural, and critical, and guides on the required level of assessment for Projects in each type of habitat. For modified habitats, impacts on biodiversity should be minimized and mitigation measures implemented appropriately. For Project (s) in natural habitat, mitigation measures should be designed to achieve no net loss of biodiversity where feasible. For Projects in critical habitats, the Project's mitigation strategy should be described in a Biodiversity Action Plan and be designed to achieve net gains of those biodiversity values for which the critical habitat was designated.
PS 7	Indigenous Peoples	This addresses the protection of Indigenous Peoples' rights. Its goal is to safeguard their interests throughout the project's implementation. More broadly, it requires that the project avoids negative impacts on Indigenous Peoples and ensures their involvement and consent.
PS 8	Cultural Heritage	Cultural heritage, according to this PS, refers to tangible forms of cultural heritage, such as tangible movable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values; unique natural features or tangible objects that embody cultural values, such as sacred graves, rocks, lakes, and waterfalls; and certain instances of intangible forms of

Section/PS.	Title	Key Requirement
		culture that are proposed to be used for commercial purposes, such as cultural knowledge, innovations, and practices of communities embodying traditional lifestyles.
WBG General EHS Guidelines, 2007		
1	Environment	1.1 Air Emissions and Ambient Air Quality Requirements 1.2 Energy Conservation Requirements 1.3 Wastewater and Ambient Water Quality Requirements 1.4 Water Conservation Requirements 1.5 Hazardous Materials Management Requirements 1.6 Waste Management Requirements 1.7 Noise Requirements 1.8 Contaminated Land Requirements
2	Occupational Health and Safety	2.1 General Facility Design and Operation Requirements 2.2 Communication and Training Requirements 2.3 Physical Hazards Requirements 2.4 Chemical Hazards Requirements 2.5 Biological Hazards Requirements 2.6 Radiological Hazards Requirements 2.7 Personal Protective Equipment (PPE) Requirements 2.8 Special Hazard Environments Requirements 2.9 Monitoring Requirements
3	Community Health and Safety	3.1 Water Quality and Availability Requirements 3.2 Structural Safety of Project Infrastructure Requirements 3.3 Life and Fire Safety (L&FS) Requirements 3.4 Traffic Safety Requirements 3.5 Transport of Hazardous Materials Requirements 3.6 Disease Prevention Requirements 3.7 Emergency Preparedness and Response Requirements
4	Construction and Decommissioning	4.1 Environment Requirements 4.2 Occupational Health and Safety Requirements 4.3 Community Health and Safety Requirements
AfDB ISS, 2023		
1	Environmental and Social Assessment	This overarching safeguard governs the process of determining a Project 's environmental and social category and the resulting environmental and social assessment requirements. This EIA has been developed to ensure compliance with this operational safeguard.
2	Involuntary Resettlement, Land Acquisition, Population Displacement and Compensation.	This safeguard consolidates the policy commitments and requirements set out in the AfDB's policy on involuntary resettlement and incorporates several refinements designed to improve the operational effectiveness of those requirements.
3	Biodiversity and Ecosystem Services.	This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the AfDB's policy on integrated water resources management into operational requirements.

Section/PS.	Title	Key Requirement
4	Pollution Prevention and Control, Hazardous Materials and Resource Efficiency.	This safeguard covers the range of key impacts of pollution, waste, and hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.
5	Labour Conditions, Health and Safety.	This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonization with most other multilateral development banks. This will be applied by the proposed Project to protect health, safety and security of employee and the surrounding nearby communities.
European Investment Bank Environmental and Social Standards, 2022		
ESS 1	Assessment and Management of Environmental and Socials Risks and Impacts	ESS 1 underscores the importance of managing environmental and social impacts and risks throughout the life of the project through the application of the precautionary principle. The objectives are: • The development of an effective environmental and social management and reporting system that is objective and encourages continual improvements and developments. • Requirements for stakeholder engagement and disclosure throughout the life of the project.
ESS 2	Stakeholder Engagement	ESS 10 promotes the right to access information, as well as public consultation and participation. The objectives are: • Promoters to uphold an open, transparent, and accountable dialogue with all Projects affected communities and relevant stakeholders in an effective and appropriate manner. • The value of public participation in the decision-making process is stressed throughout the preparation, implementation, and monitoring phases of a project. • The right to access to remedies, including through grievance resolution, is actively required. ESS is applicable to this Project, throughout the study all stakeholders were identified and engaged, the Project will continue to engage all identified stakeholders and disclose relevant Project information throughout the life of the Project. The grievance redress mechanism for the Project will be developed also to be used in addressing grievances related to the Project.
ESS 3:	Resource Efficiency Pollution Prevention	ESS 2 recognizes the importance of avoiding and minimizing pollution from EIB-supported operations. The objective is: • A Project-level approach to resource efficiency and pollution prevention and control in line with best available techniques and internationally disseminated practices. Through this study, potential pollution as part of the Project activities have been identified and management and monitoring plans developed also to ensure that pollution from Project related activities are controlled.

Section/PS.	Title	Key Requirement
ESS 4	Biodiversity and Ecosystems	ESS 3 recognizes the intrinsic value of biodiversity and that its operations may have a potential impact on biodiversity and ecosystems. The objectives are: • The promoter has to take an approach and measures to protect and conserve all levels of biodiversity. • The standard applies to all habitats (marine and terrestrial) whether previously disturbed or legally protected. • Focus on major threats and supports the sustainable use of renewable natural resources and the equitable sharing of benefits from the project's use of natural resources. The Project will ensure adherence to this requirement. Baseline assessment for biodiversity has been conducted, potential impacts identified and proposed mitigation and monitoring plans have been developed to ensure that the biodiversity is protected.
ESS 5	Climate-Related Standards	ESS 4 is aligned with EU climate policies, which should be considered at all stages of the project cycle, regarding the assessment of the economic cost of GHG emissions and the climate vulnerability context. The objective is: The promoter specifically must ensure that all Projects comply with appropriate national and, where applicable, EU legal requirements, including multilateral agreements, related to climate change policy.
ESS 6:	Involuntary Resettlement	ESS 6 recognizes that projects sometimes necessitate land acquisition, expropriation, and/or restrictions on land use, resulting in the temporary or permanent resettlement of people from their original places of residence or their economic activities or subsistence practices. The objectives are: • Respect and protection of the rights to property and to adequate housing, and of the standard of living of all affected people and communities. • Mitigation of any adverse impacts arising from their loss of assets or restrictions on land use. • Assisting all affected persons to improve or at least restore their former livelihoods and living standards and adequately compensate for incurred losses. ESS 6 is applicable to the proposed Project since land will need to be acquired and therefore, WWSL will align with all requirements stipulated in Land Act (No. 4), 1999, The Village Land Act (No. 5), 1999, Village Planning and Regulation Act (No. *58), 2007 and* The National Land Use Planning Commission Act (No. 6), 2007.
ESS 7	Vulnerable Groups, Indigenous People and Gender	ESS 8 seeks to protect all vulnerable project-affected individuals and groups, whilst seeking to ensure that these populations duly benefit from EIB operations. The objectives are: • Full respect for the dignity, human rights, aspiration, cultures, and customary livelihoods of vulnerable groups including indigenous peoples. The free, prior, and informed consent of affected Indigenous groups.

Section/PS.	Title	Key Requirement
ESS 8	Labour Right	ESS 8 recognizes the non-discrimination labour practices and the use of appropriate codes of conduct to ensure fair treatment, non-discrimination, and equality of opportunity of workers. The objectives are: • Ensuring that promoters of EIB projects comply with the core labour standards of the International Labour Organisation (ILO) and with national labour and employment laws. • The establishment, maintenance, and improvement of worker-management relationships ESS 8 is applicable to the Project and WWSL will ensure adherence to these requirements. All categories of workers will be equally treated and comply with the requirements of the national labour laws and those ILO requirements.
ESS 9	Occupational and Public Health, Safety and Security	ESS 9 recognizes the importance of protecting and securing public and occupational health, safety and security and promotes the dignity of the affected community in relation to project-related activities. The objectives are: • Particular attention to vulnerable groups. • Promoters adhere to the international norms and relevant human rights principles when using security services. ESS 9 is applicable to the proposed Project to protect health, safety and security of employees and the surrounding nearby communities.
ESS 10	Cultural Heritage	ESS 5 recognizes the central role of cultural heritage within individual and collective identity, in supporting sustainable development and in promoting cultural diversity. The objectives are: • Identification, management, and protection of tangible and intangible cultural heritage that may be affected by project activities consistent with the applicable international conventions and declarations. • Emphasize the need for the implementation of a “chance-find procedure”, which outlines the actions to be taken if previously unknown cultural heritage is encountered.

(Source: Compiled by MTL Consulting; 2025)

3.10 Institutional Arrangements

The successful implementation of the Trona Extraction and Soda Ash Production Project requires effective coordination among various institutions at the national, regional, district, and community levels. Each institution has a defined mandate to ensure compliance with environmental, social, health, and safety requirements, as well as technical and operational standards. A summary of institutional organizations that are relevant to the proposed Project from an Environmental and Social perspective is provided in Table 3.13.

Table 3.13: Relevant Key Institutions in E&S Management

Level	Institution	Role and Responsibility	Remarks
National	Vice President's Office (Division of Environment)	i) Issuance of EIA and EA certificates ii) Issuance of scrap metal permits iii) Overall responsibility for planning and implementation of all environmental matters. iv) Responsible for the articulation of policy guidelines necessary for promotion and protection. v) Issue general guidelines to sector Ministries and coordinate all agencies and public/private institutions related to environmental management. vi) Advise the Government on legislative measures related to the management of the environment and on international agreements in the field of the environment. vii) Monitor and assess activities being carried out by relevant agencies to ensure that the environment is not degraded.	Environmental Management Act, CAP 191 (R.E: 2023)
	National Environment Management Council (NEMC)	In collaboration with other Ministries, the Council has jurisdiction to: viii) Carry on environmental audit as provided under the EMA. ix) Carry out surveys which will assist in the proper management and conservation of the environment. x) Undertake and co-ordinate research, investigation, and surveys in the field of environment and collect, and disseminate information about the findings of such research, investigation, or survey. xi) Review and recommend for approval of environmental impact statements. xii) Identify Projects and programs or types of Projects and programs, for which environmental audit or environmental monitoring must be conducted under EMA. xiii) Enforce and ensure compliance with the national environmental quality standards. xiv) Initiate and evolve procedures and safeguards for the prevention of accidents that may cause environmental degradation and evolve remedial measures where accidents occur. xv) Undertake, in co-operation with relevant sector Ministries, programs intended to enhance environmental education and public awareness about the need for sound environmental management as well as for enlisting public support and encouraging the effort made by other entities in that regard.	Environmental Management Act, CAP 191 (R.E: 2023)

Level	Institution	Role and Responsibility	Remarks
		xvi) Publish and disseminate manuals, codes, or guidelines relating to environmental management and prevention or abatement of environmental degradation. xvii) Render advice and technical support, where possible, to entities engaged in natural resources and environmental management to enable them to carry out their responsibilities. xviii) Perform such other function as the Minister may assign to it or as are incidental or conducive to the exercise by it of any or all the functions provided under this Act.	
	National Environmental Advisory Committee	xix) Examine any matter, which may be referred to by the Minister or any sector Ministry relating to the protection and management of the environment. xx) Advise the minister on any matter in connection with restocking and the limitation of stock numbers. xxi) Advise the Minister on matters relating to watering, grazing, and moving stock. xxii) Make recommendations to the Minister where there is degradation of the environment. xxiii) Receive and deliberate on reports from sector ministries on the protection and management of the environment. xxiv) Review and advise on any environmental standards, guidelines, and regulations that are to be made according to the provisions of the Act.	Environmental Management Act, CAP 191 (R.E: 2023)
	Ministry of Minerals	xxv) Enforce laws and regulations concerning Mineral Resources; xxvi) Issuance and regulation of mineral rights; xxvii) Oversee implementation of the Mining Policy; xxviii) Environmental monitoring and auditing; xxix) EIS and EMP approvals (through a multi-sectoral committee); and xxx) Conflict resolutions.	Mining Act, CAP 123 (RE: 2019)
	Ministry of Water	xxxi) Enforce laws and regulations for water quality and utilisation; xxxii) Issuance and regulation of water rights; and xxxiii) Enforce water and effluent discharge laws (standards, monitoring, and regulation).	Water Resources Management Act, 2009
	Ministry of Lands, Housing and Human Settlements Development	xxxiv) Issuing of Right of Occupancy; xxxv) Land use; xxxvi) Planning; and xxxvii) Valuation and compensation.	Land Act, 1999
	Ministry of Livestock and Fisheries (MLF)	xxxviii) Ensures that fishing activities and aquatic ecosystems in Lake Victoria are not adversely impacted.	Fisheries Act, 2003

Level	Institution	Role and Responsibility	Remarks
		xxxix) Provides guidance and permits where construction intersects with fisheries resources.	
	Occupational Safety and Health Authority (OSHA)	xl) Enforces workplace health and safety regulations during proposed soda ash construction and operation. xli) Conducts inspections, audits, and capacity building to safeguard workers' well-being.	OSHA Act, 2003
Regional-Arusha Region	Regional Secretariat	xlii) Responsible for coordination of all advice on environmental management in their respective regions and liaison. xliii) Regional Environmental Management Expert. xliv) Responsible for advising the local authorities on matters relating to implementation and enforcement of the Act. xlv) Link between the Region and Director of Environment from VPO as well as Director General of NEMC.	Environmental Management Act, CAP 191 (R.E: 2023)
District, Township, Ward, Mtaa/Village, and Hamlet,	Environmental Management Committees	xlvi) Initiate inquiries and investigations about any allegation related to the environment and the implementation or violation of the provisions of this Act. xlvii) Require any person to provide information or explanation about any matter related to the environment. xlviii) Resolve conflict among individual persons, companies, agencies, non-governmental organisations, government departments, or institutions about their respective functions, duties mandates, obligations, or activities under this Act. xlix) Inspect and examine any premises, street, vehicle, aircraft, or any other place or article which it believes or has reasonable cause to believe that pollutants or other articles or substances believed to be pollutants are kept or transported. l) Require any person to remove at their own cost any article or substance from any place which it believes such article or substance may be safely kept or destroyed without causing harm to health. li) Initiate proceedings of a civil or criminal nature against any person, company, agency, department, or institution that fails or refuses to comply with any directive issued by any of such Committees.	Environmental Management Act, CAP 191 (R.E: 2023)
District / Local	Land Allocation Committee	Land allocation and approvals	Village Land Act, 1999

Level	Institution	Role and Responsibility	Remarks
	District/Ward Functional Departments – Planning, Water, Health, Community Development, Natural Resources, etc.	lii) Extension Services. liii) Advise committees and departments on environmental matters. liv) Promote environmental awareness. lv) Gather and manage information on the environment and the utilization of resources. lvi) Prepare periodic reports on the state of the environment. lvii) Monitor the preparation, review, and approval of ESIA of local investments. lviii) Review bylaws on environmental management and sector-specific activities related to the environment.	Environmental Management Act, CAP 191 (R.E: 2023)
	Environmental Committees (District, Ward and Village/Street)	lix) Coordinating and advising on environmental policies and implementation obstacles. lx) Promoting environmental awareness. lxi) Information generation, assembly, and dissemination from any person. lxii) Initiate inquiries and investigations on any environmental disputes or violations of the Act. lxiii) Resolve conflicts among individual persons, companies, agencies, NGOs, and Government Departments. lxiv) Inspect any source of pollution in the area. lxv) Initiate proceedings of a civil nature against any person, company, or agency for failing or refusing action under the Act.	Environmental Management Act, CAP 191 (R.E: 2023)
	Councils (District, Ward, and Village)	lxvi) To oversee the performance of the Environmental Committees (within their jurisdictions).	

(Source: Compiled by MTL Consulting, 2025)

4 ENVIRONMENTAL AND SOCIAL BASELINE CONDITION

4.1 Project Area of Influence

4.1.1 Core Area

The core area of the proposed Soda Ash Project is located at Wosiwosi village, in Gelai Lumbwa Ward, in Longido District. Specifically, the project area will be located by the bank of Lake Natron. The core contains two Prospecting Licenses (PL 12236/2023 covering approximately 291.41km2 & 13190/2025 covering approximately 88.65km2). These two PL's spans the Pinyinyi Ward and Gelai Lumbwa Ward. The Wosiwosi village centre is approximately 16km from the proposed project location. There is currently no activity that is ongoing, and the land is used as a grazing area and a game-controlled area.

4.1.2 Area of Indirect Influence

The two PL's span the Pinyinyi and Gelai Lumbwa ward respectively but the project has the potential to influence areas outside these two wards. It is expected that during the construction and operation stage, residents from neighbouring wards such as Magadini and Engaresero Ward will be seeking employment for this project.

4.2 Environmental Baseline Conditions

4.2.1 Physiography

The physiography of the area is largely defined by rift related tectonic and volcanic processes, resulting in a landscape characterized by contrasting low lying saline flats and rugged volcanic uplands. Lake Natron itself occupies the central part of this endorheic basin and is a shallow, highly alkaline lake that receives water mainly from the Southern Ewaso Ng'iro River, seasonal streams, and groundwater seepage.

The lakebed consists of soda-rich evaporitic deposits, saline crusts, mudflats, and trona (sodium carbonate) formations that expand and contract seasonally depending on rainfall and evaporation. Surrounding the basin are the imposing volcanic features of Ol Doinyo Lengai to the south and Gelai Mountain to the east, with the Ngorongoro highlands forming the western escarpment. These highlands give rise to several ephemeral streams and alluvial fans that descend onto the rift floor, depositing sediments that create gently sloping plains merging into the lake flats. The overall topography ranges from flat to gently undulating plains around the lake margin to steep escarpments and volcanic cones rising above 2,900 metres. Geomorphological processes shaping the landscape include ongoing tectonic subsidence, fluvial and colluvial deposition, evaporitic mineral formation, and aeolian reworking of fine sediments during dry periods. The region's drainage is largely inward and seasonal, with most streams flowing only during the rains

4.2.2 Climate

a) Regional and Local Climate

The climate of the Lake Natron area is classified as semi-arid to arid, characterized by high temperatures, low and erratic rainfall, and intense evaporation throughout most of the year. The basin lies within the rain shadow of the Ngorongoro Highlands and the volcanic massifs of Gelai and Ketumbeine, resulting in a hot and dry environment with strong seasonal variability. Average annual rainfall in the area ranges between 400 and 800 millimetres, though this varies considerably depending on elevation and proximity to the escarpments. Rainfall

typically occurs in two distinct seasons, the long rains from March to May and the short rains from November to December, while the intervening months are predominantly dry. The low-lying lake basin receives significantly less rainfall than the surrounding highlands, leading to prolonged dry periods and high rates of surface evaporation, estimated at over 2,000 millimetres per year. Ambient temperatures are generally high, with mean daily values ranging from 25°C to 35°C, and extreme daytime temperatures exceeding 40°C are common during the dry season. Night-time temperatures, however, can drop markedly, particularly in the cooler months of June to August. Relative humidity is moderate to low, averaging between 40% and 65%, with the highest levels observed during the rainy seasons.

i) Rainfall

Meteorological data for rainfall was collected from TMA for a period of 10 years (2015 – 2024). Rainfall data for the project area indicates that the rainy seasons begins during late October and continues till mid-May, in which we see rainfall levels begin to decline. During this period, rainfall levels range from 1mm to 501mm. The dry season on the other hand, begins in June and ends in early days of October. During this period, the highest recorded rainfall level was 29mm.

The year 2023 indicated the highest level of rainfall recorded compared to the other years of recording. This level reach 501mm of rain, which is considered heavy to extreme rainfall in some parts of world. Figure 4.1 indicates the monthly rainfall from 2019 to 2024.

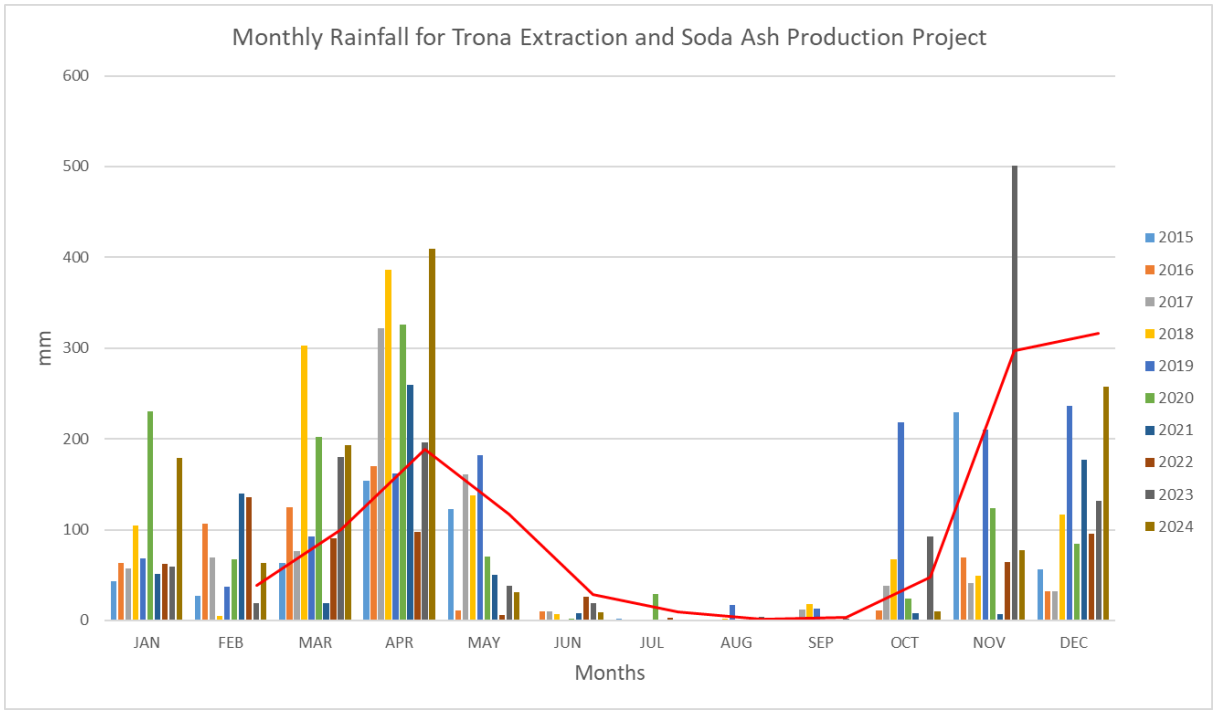


Figure 4.1: Total Monthly Rainfall

(Source: TMA, 2025)

ii) Temperature

- Maximum Average Temperature

Generally, regions that have semi - arid conditions have temperature levels that range between 25°C – 30°C, with often slight variations annually between the warm and cool months of the year. This is evident from the data as the project area experiences variations in

temperature, with majority of monthly averages ranging between 25°C and 31°C. Overall, the months of February and March indicate the highest levels of temperature hovering between 27. and 31°C respectively (Figure 4.2).

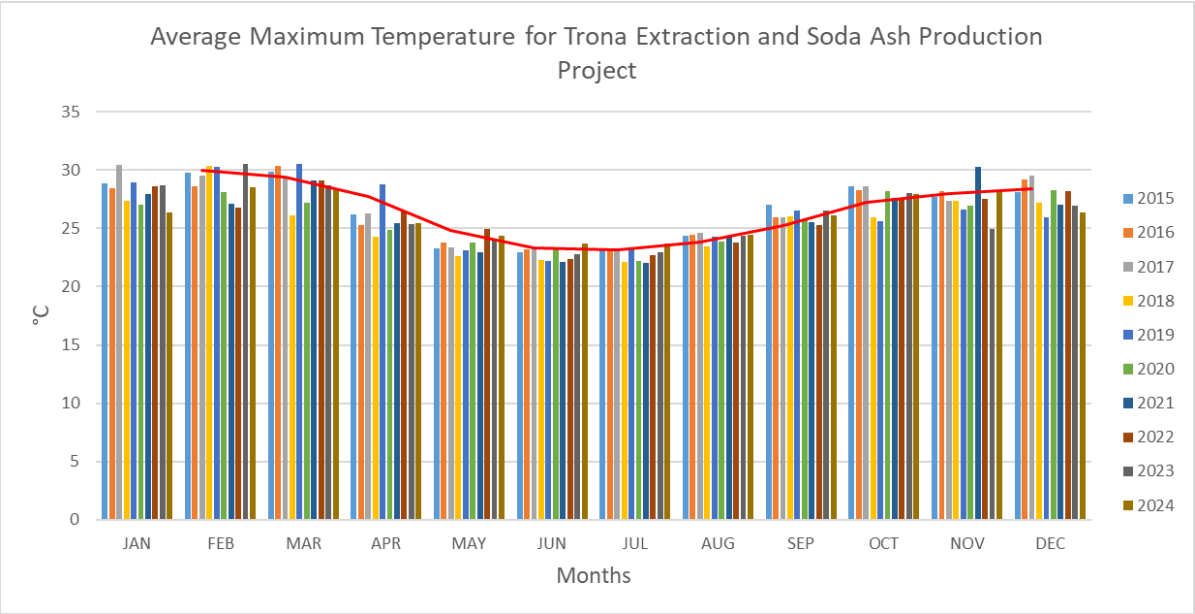


Figure 4.2: Average Monthly Temperatures

(Source: TMA, 2025)

- Average Minimum Temperature

With the proposed project being in an area considered as a semi -arid conditions, it also experiences very low temperatures. Temperatures can reach as low as 13°C, which generally for Tanzania is considered chilly. Overall, the months of June till September show the lowest average temperatures (Figure 4.3).

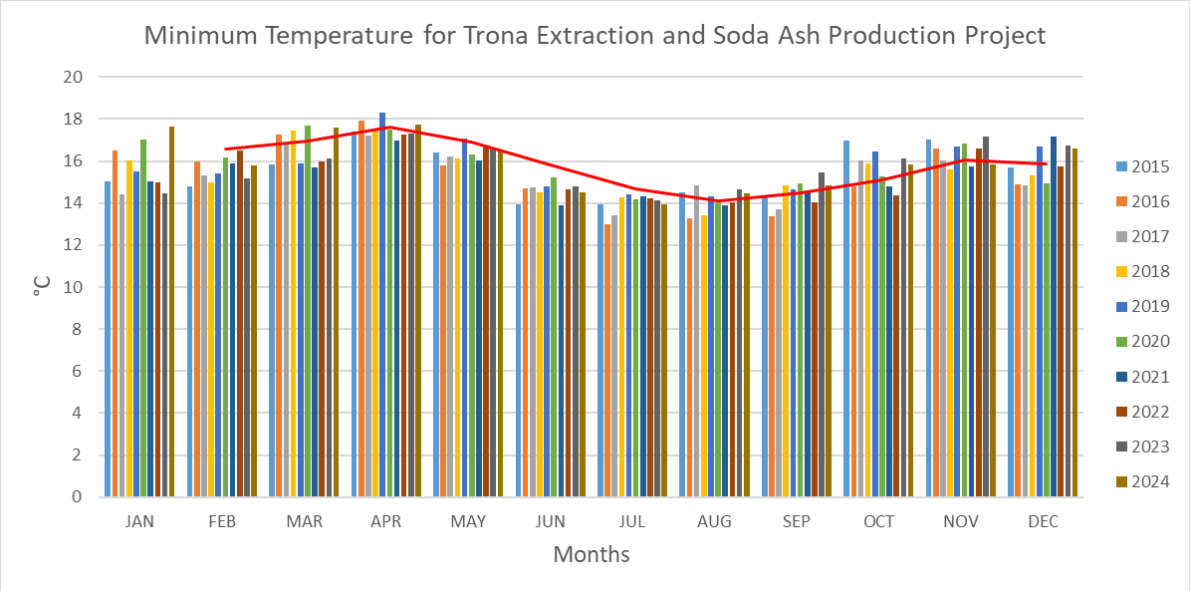


Figure 4.3: Minimum Average Temperature

(Source: TMA, 2025)

iii) Relative Humidity

The relative humidity recorded is often higher during the period from April to May and comparatively lower in the months of July to October. There is also significant variation in humidity levels, which range from around 61% to 90%. Figure 4.4 indicates the relative humidity trends over the four-year period between 2021 and 2025

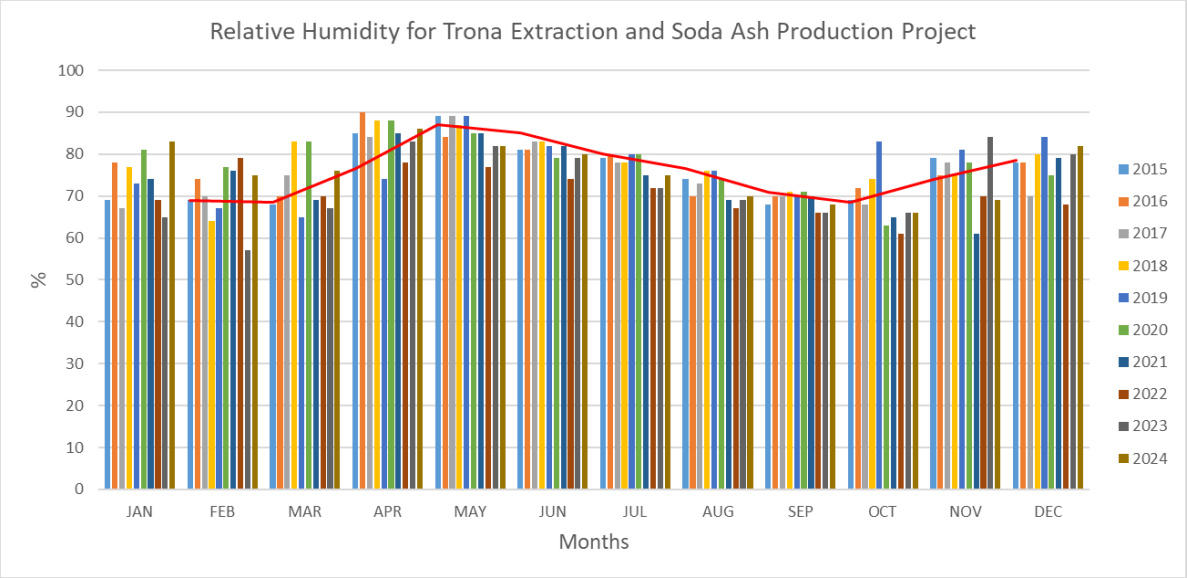
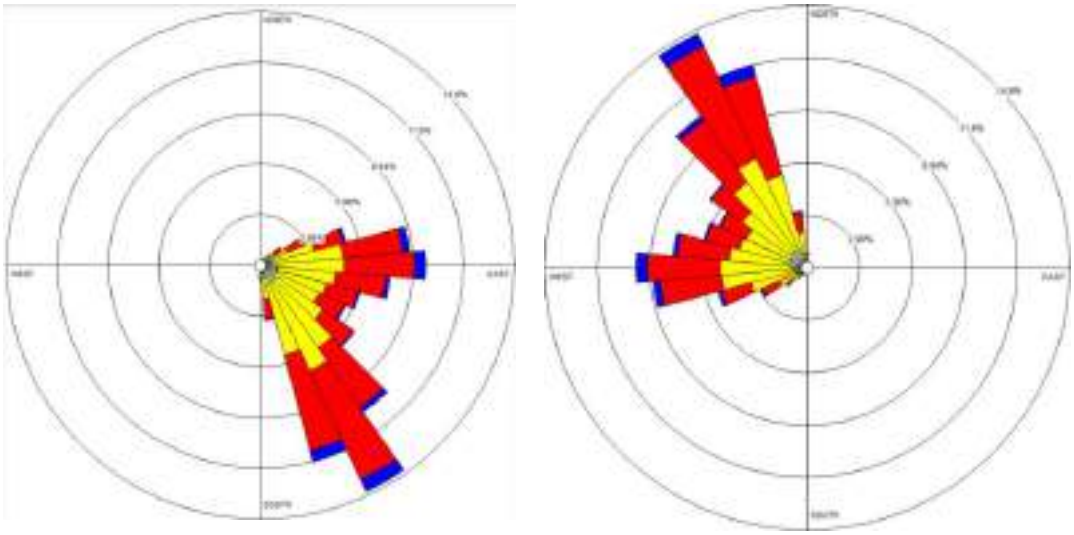


Figure 4.4: Relative Humidity for Soda Ash Project

(Source: TMA, 2025)

iv) Wind Speed and Direction

The prevailing wind direction during the reporting period was predominantly blowing from the Southeast and flowing towards the West northwest (WNW) direction. The average monthly wind velocity is 3.00 m/s. The wind rose diagram in Figure 4.5 indicates the wind speed and wind direction.



Blowing From *Blowing To*

Figure 4.5: Wind Speed and Direction

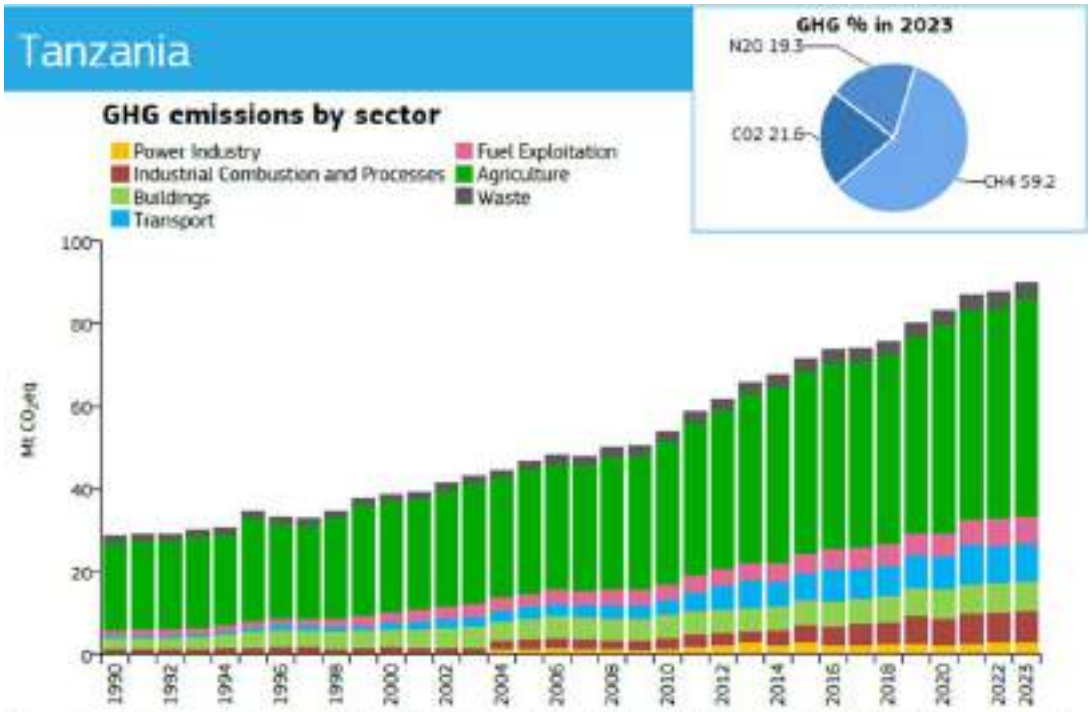
(Source: TMA, 2025)

4.2.3 Climate Change

a) Climate Change Status in Tanzania

Global greenhouse gas (GHG) emissions continue to rise despite international efforts such as the Kyoto Protocol, largely because many countries have not implemented emission reductions at the scale recommended by climate science. In 2023, global GHG emissions reached 53.0 Gt CO_2-equivalent (Gt CO_2e), representing a 1.9% increase compared to 2022 levels. The Kyoto Protocol, adopted in 1997, was the first legally binding international treaty aimed at reducing greenhouse gas emissions. While it had certain limitations, it set an important precedent and laid the groundwork for subsequent agreements, including the Paris Agreement.

Tanzania has actively engaged in international climate initiatives, joining the United Nations Framework Convention on Climate Change (UNFCCC) in 1996 and ratifying the Kyoto Protocol in 2002. These engagements have informed the development of national strategies to mitigate climate change. Tanzania's current framework, the National Climate Change Response Strategy (2021–2026), outlines the country's approach to addressing the impacts of climate change. Although Tanzania's per capita GHG emissions remain relatively low estimated at 0.2 tons per person in 2019 (World Bank) emissions are gradually increasing over time. According to a 2024 report by the European Commission's Joint Research Centre (JRC), Tanzania's total GHG emissions stand at 89,815 Mt CO_2e. Figure 4.6 presents the country's total GHG emissions over time.



Year	GHG emissions Mt CO_2eq/yr	GHG emissions per capita t CO_2eq/cap/yr	GHG emissions per unit of GDP PPP t CO_2eq/kUSD/yr	Population
2023	89.815	1.309	0.384	68.591M
2015	71.381	1.325	0.454	53.880M
2005	46.514	1.180	0.542	39.410M
1990	28.655	1.126	0.629	25.460M

Figure 4.6:Total GHG Emissions for Tanzania (kt of CO2e)

(Source: JRC/EIA Report, 2024)

The Intergovernmental Panel on Climate Change (IPCC) considers five sectors to be the major contributors of GHG emissions i.e. Land Use Land Use Change and Forest (LULUCF); Agriculture; Waste; Energy; and Industrial processes. Table 4.1 highlights the potential emissions of these sectors in Tanzania economy.

Table 4.1: Major Sources of Emissions in Tanzania

Sector	CO_2	CH_4	N_2O	NO_X	NMVOC	SO_2
LULUCF	√	√	√	√	x	√
Agriculture		√	√	√		
Waste		√	√			
Energy	√	√	√			
Industrial processes	√	√	√			√

(Source: National Climate Change Statistical Report, 2019)

b) Climate Change Projections

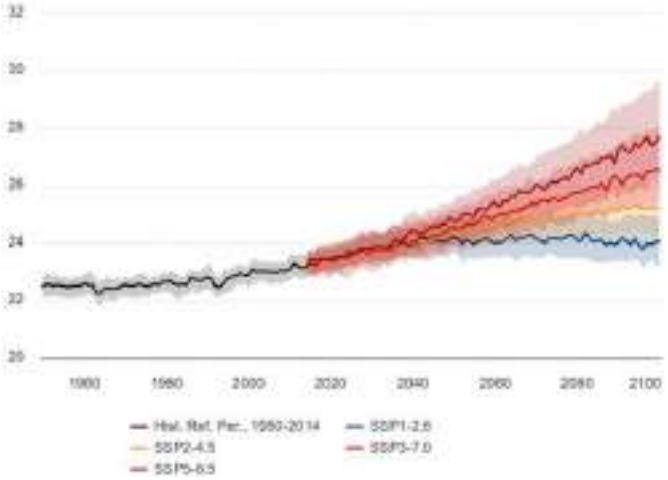
The Proposed Trona Extraction and Soda Ash Production project is not expected to trigger significant or irreversible changes to the global climate system. However, like most operations of its nature and processes needed to create soda ash, it will contribute marginally to Greenhouse Gas (GHG) emissions through fuel combustion, electricity uses and other associated activities. These emissions, while relatively small in scale compared to national or global totals, will add incrementally to the broader challenge of climate change. According to the CCKP (World Bank Climate Change Knowledge Portal), by 2050, the average annual temperature is projected to increase by 1.4 - 2.3°C compared to the last recorded reference average temperature in 1960 with dry spells increasing by more than 7 days (Figure. 4.7). Average annual rainfall is expected to increase by 9% compared to the last historical reference year of 1960, with higher chances of declining rainfall during July – September (Figure 4.8).

Project Average Mean Surface Temperature for 2020 - 2039

Projected Mean Surface Air Temperature for 2040 – 2059

Projected Average Mean Surface Temperature for 2060 - 2079

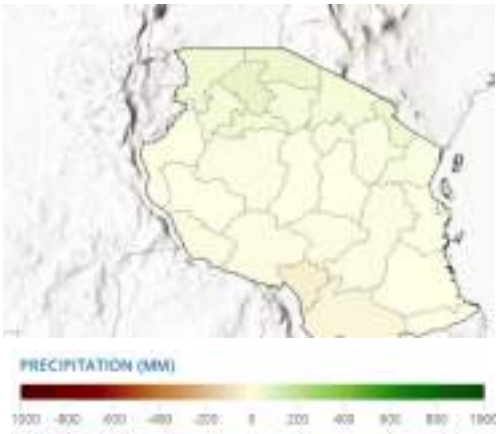
Projected Average Mean Surface Temperature for 2080 - 2099



Projected Increase Annual Temperature by 2100

Figure 4.7: Projected Climate Change Temperature Change

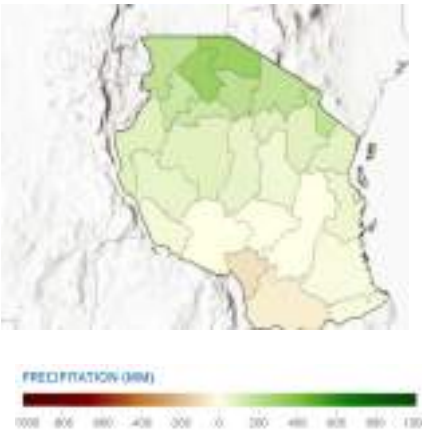
(Source: CCKP, 2025)



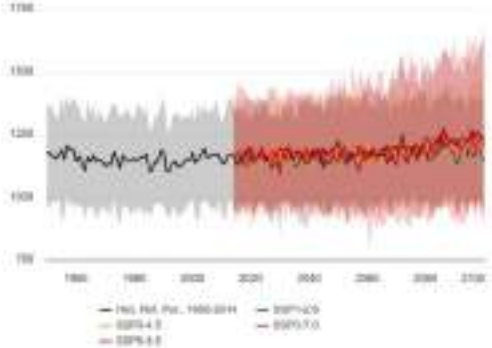
Project Precipitation (Rainfall) for 2020 - 2039

Projected Precipitation (Rainfall) for 2040 – 2059

Projected Precipitation (Rainfall) for 2060 - 2079



Projected Precipitation (Rainfall) for 2080 - 2099



Projected Precipitation by 2100

Figure 4.8: Project Precipitation

(Source: CCKP, 2025)

The proposed project will utilize a variety of heavy and light equipment's and vehicles throughout the Life of Mine of the project. These equipment and vehicles will play a vital role in the development and operation of the project. This equipment include Excavators, Bulldozers, Graders, Road Construction Equipment, Dozers, Front End Loaders, Trucks, etc. Operation of these equipment and vehicles will necessitate substantial consumption of fossil fuels, predominantly diesel, which will act as the primary energy source for both stationary and mobile equipment. Combustion of these fuels in internal combustion engines and power generation units will lead to the release of greenhouse gases (GHGs), primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases are recognized under the Intergovernmental Panel on Climate Change (IPCC) as key contributors to global warming and climate change due to their high Global Warming Potentials (GWPs). In addition to GHG emissions, fuel combustion will also produce trace amounts of air pollutants such as carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter (PM), which may have local air quality implications.

The magnitude of GHG emissions will depend on factors such as fuel type, equipment efficiency, engine condition, operating hours, and load factors. During high-intensity operational phases, particularly during trona hauling, waste removal, and processing activities, fuel consumption and associated GHG emissions are expected to be at their peak. Cumulatively, these emissions will contribute to the project's overall carbon footprint. Table 4.2 indicates the projected Annual GHG Emissions of the project

Table 4.2: Projected Annual GHG Emissions of the proposed Project

Source	Unit of Measurement	Value	Emission Factor	T CO_{2e} p.a.
Grid Supplied Energy	MWh	11.5	317g CO_{2e}/MWh[1]	3,645.5
Front End Loader	Litres	112,500	5.2563 x 10^{11} kg CO2e/L	301
Haulage Lorries	Litres	105,000	5.2563 x 10^{11} kg CO2e/L	280
Light Delivery Vehicles	Litres	102,000	5.2563 x 10^{11} kg CO2e/L	180
Low Ground Pressure Dozer	Litres	114,000	5.2563 x 1011 kg CO2e/L	250
Floating Dredges x2	Litres	3,600,000	5.2563 x 1011 kg CO2e/L	9,889.2
Total				**14,545.7**

(Source: MTL Consulting, 2025)

c) Potential Climate Change Risks to the Project

According to the CCKP (World Bank Climate Change Knowledge Portal) it is expected by 2050, the average annual temperature is projected to increase by 1.4 - 2.3°C compared to the last recorded reference average temperature in 1960 with dry spells increasing by more than 7 days. The projected changes in temperature will result in erratic changes in the amount of rainfall received on the sample point and nationwide as a whole. Lake Natron itself lies in a semi-arid environment characterized by high temperatures, with low and sporadic rainfalls and high evaporation rates. This will mean the highest risk faced by the project is Drought which is expected to extend the season by 7 days. With increased drought, comes erratic rainfall

behaviours. These behaviours will see a decline in rainfall patterns but also has potential to see an increase in flooding periods to compensate for the change in weather. These floodings can affect the processing plant, storage ponds and other infrastructure of the project. The Project's financial performance may also be affected by changes in water availability, disruption to energy supplies and transport infrastructure, and extreme temperature changes affecting operations and employee safety. Table 4.3 illustrates

Table 4.3: Potential Climate Change Risk to the Project.

Sector	Climate Change Impacts to the Sector	Climate Change Impact to the Sector in Relation to Project	Financial Impact to the Project
Water Resource	• Increased Drought from prolonged dry season	Increased droughts have the potential to harm the production process of the soda ash. Water is crucial in the production of Soda Ash as it is used in many of the production stages. (Crystallization, Steam Generation, etc.). Increased drought can result in delayed production or even low-quality Soda Ash.	• Increased cost for Water Supply • Delays in Production due to lack of Water • Less Sales with low Quality Soda Ash product • Increased Operational Cost due to Lack of Water.
	• Increased flooding from heavy rainfall	Increased projected rainfall and/or flooding have the potential to cause flooding on the facilities (Processing Plant, Storage Ponds). These Infrastructure can also be damaged or destroyed which can lead to delays in production.	• Increased costs to repair damaged facilities • Increased cost of reversing any environmental damage or spillage. • Increased operational costs from flooding that may damage project infrastructures
Human Health	• Increased risk of vector-borne diseases (Malaria) and waterborne diseases.	Diarrheal diseases and malaria, both leading causes of death in Tanzania, are likely to escalate due to increasing temperatures and heavy rainfall events. Projected increased flooding threatens further outbreaks of waterborne diseases such as cholera and typhoid.	• Reduced revenue from decreased productivity from increased vector-borne diseases • Increased operational costs as staff workers might be affected by the outbreak of waterborne diseases such as cholera and typhoid
Energy	• Reduced hydropower production • Damage to electrical infrastructure from	Approximately 70% of Tanzania's limited electricity supply comes from hydropower vulnerable to increasing evaporation, siltation from heavy rainfall events, and	• Increased operational cost of energy from unreliable power supply

Sector	Climate Change Impacts to the Sector	Climate Change Impact to the Sector in Relation to Project	Financial Impact to the Project
	floods and landslides	longer dry spells. A prolonged dry spell in October 2015 led to a near cessation of hydropower production.	

(Source: MTL Consulting, 2025)

4.2.4 Geology

a) Regional Geology

Lake Natron is situated within the northern Tanzanian sector of the East African Rift System (EARS), along the Eastern (Gregory) Rift Branch, a major active continental rift extending from Ethiopia through Kenya into northern Tanzania (Figure 4.9). This rift branch is characterized by crustal extension, normal faulting, and associated volcanism, which collectively control regional basin development and landscape evolution (Chorowicz, 2005; Dawson, 2008).

The Lake Natron basin occupies a tectonically controlled graben to half-graben structure, bounded by prominent NNE–SSW to N–S trending normal faults. These faults define steep rift escarpments and exert strong control on basin morphology, sediment thickness, groundwater inflow, and surface drainage (Macdonald & Dawson, 1978). Structurally, Lake Natron forms part of a series of aligned rift basins, linking Lake Magadi to the north with Lake Manyara and Lake Eyasi to the south and southwest, reflecting regional rift continuity (Tiercelin & Lezzar, 2002).

Regionally, the geology is dominated by Neogene to Quaternary volcanic rocks, including basalts, trachytes, and phonolites, interbedded with lacustrine and evaporitic sediments deposited within closed rift basins. Volcanic centres associated with rift activity, notably Mount Meru, Mount Kilimanjaro, and the natrocarbonatite volcano Ol Doinyo Lengai, have played a key role in supplying alkaline, sodium-rich material to the Lake Natron basin (Dawson, 2008). This geological and tectonic setting underpins the development of soda-rich lake waters and associated evaporite minerals, including trona.

Overall, Lake Natron represents a geologically young and tectonically active rift-lake environment, where faulting and volcanism remain the dominant controls on basin structure, hydrology, and mineralization, a factor of direct relevance to impact assessment and long-term environmental management (Chorowicz, 2005; Tiercelin & Lezzar, 2002).

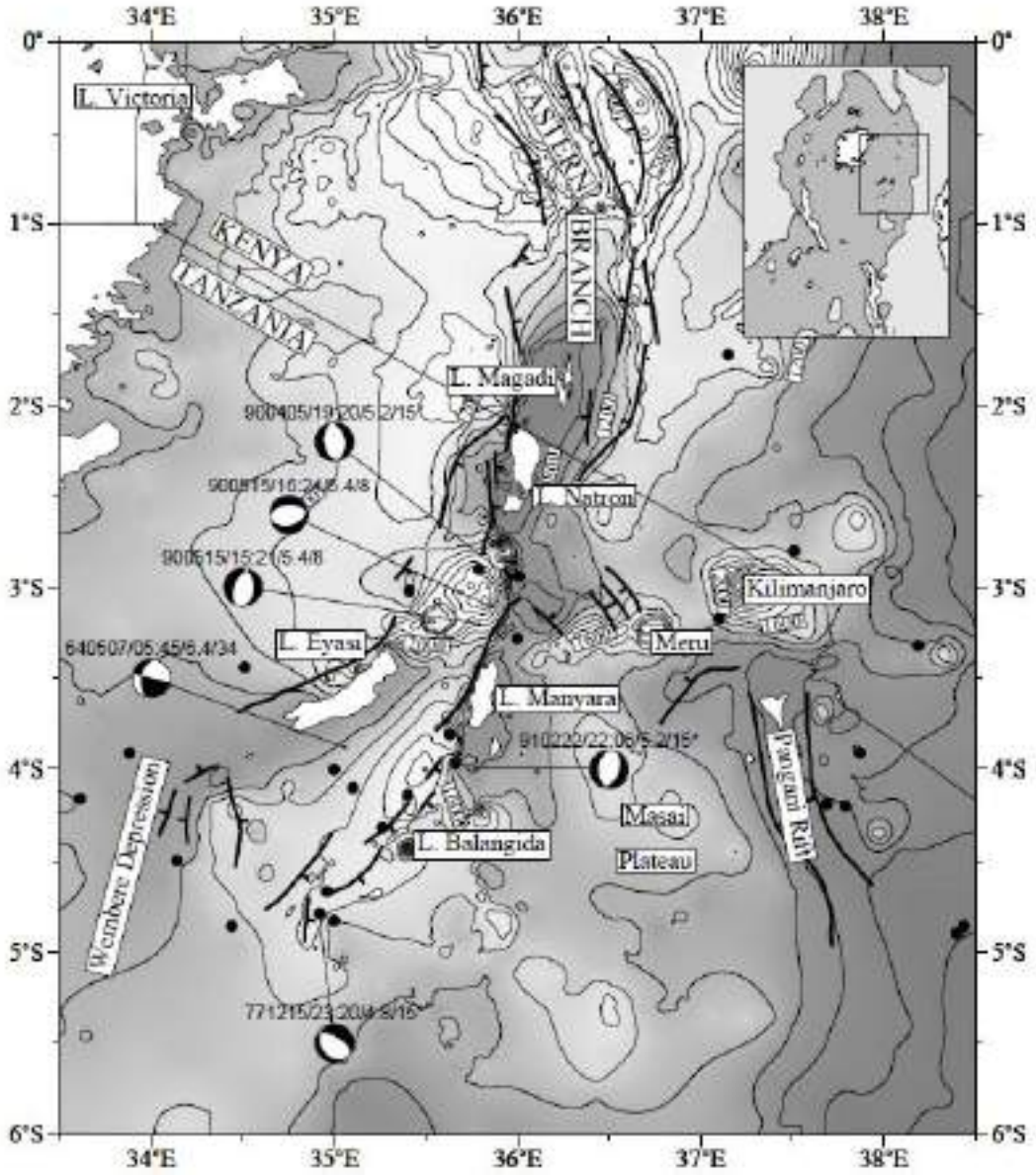


Figure 4.9: Morphology of the Eastern Branch of the East African Rift System in northern Tanzania and southern Kenya.

(Source: Foster A. et al., Journal of the Geological Society, London, Vol. 154, 1997)

b) Local Geology

The Project area is located within the Lake Natron basin in northern Tanzania and is geologically underlain by formations belonging to the Peninj Group, which forms part of the Neogene–Quaternary volcanic–sedimentary sequence of the eastern branch of the East African Rift System (Figure 4.10). The licensed areas (PL-12235 & PL-12236) occupy the eastern and northern flanks of Lake Natron, at about 610 m elevation. The lake basin is fault-controlled, bounded by escarpments and active volcanoes.

The Peninj Group unconformably overlies a volcanic basement composed predominantly of Sambhu basaltic lavas, with an estimated thickness of approximately 400 m and radiometric ages ranging between 3.5 and 2.0 million years (Ma) based on K–Ar dating (Isaac, 1967; Hay,

1976). These basalts represent the earliest volcanic activity within the basin and form the primary geological foundation of the Project area.

Overlying the Sambhu basalts are the Hajaro Beds, which consist of interbedded sandy, clayey, and basalt-derived sediments deposited prior to the establishment of the Peninj River drainage system at around 2 Ma. These deposits reflect early basin infilling under low-energy lacustrine and alluvial conditions associated with rift related subsidence (Hay, 1976; Deino et al., 2006). Above the Hajaro Beds, the Peninj Group reaches a cumulative thickness of approximately 80 m and contains stratigraphically important horizons with palaeontological and archaeological significance, reflecting favourable depositional environments during basin evolution.

The lower part of the Peninj Group is represented by the Humbu Formation, which is composed mainly of sandstone and alluvial deposits interbedded with complex tuffaceous and volcaniclastic sequences. A prominent main tuff horizon, locally intercalated with the Wa Mbugu basalt, serves as a key regional stratigraphic marker and allows subdivision of the Humbu Formation into three members: (i) basal sands and clays, (ii) an initial detrital basin infill, and (iii) the overlying main tuff unit (Isaac, 1967; Hay, 1976). The Peninj Group is capped by the Moinik Formation, comprising approximately 40 m of fine-grained lacustrine sediments, indicative of more stable lake conditions and reduced clastic input during the later stages of basin development.

Regionally, the licensed area and its surroundings are influenced by alkaline volcanism, characterised by older extrusive basaltic and andesitic rocks and younger soda-rich alkaline volcanic rocks, including nephelinite, phonolite, alkali basalts, and carbonatites associated with Mount Kerimasi (Dawson, 2008). Volcanic centres such as Ketumbaine and Gelai exhibit a progressive magmatic differentiation trend from basic-andesite to trachyte and phonolite, with nepheline-rich lithologies also recorded. The geological basement of the Project area is therefore interpreted to consist mainly of basaltic and andesitic rocks locally enriched with carbonatite material, which contributes to the development of carbonate-rich mineralised waters within the basin.

Structurally, the broader geological framework includes Neo-Archean syn-orogenic granitoids (2,800–2,500 Ma) and Paleo- to Neoproterozoic metamorphic units, including migmatites, granites, and marble–quartzite complexes associated with the East African Orogenic Belt (Shackleton, 1993). These older units are overlain by Neogene to Quaternary volcanic formations and unconsolidated sandy, gravelly, and silty sediments, which dominate the near-surface geology within the licensed area.

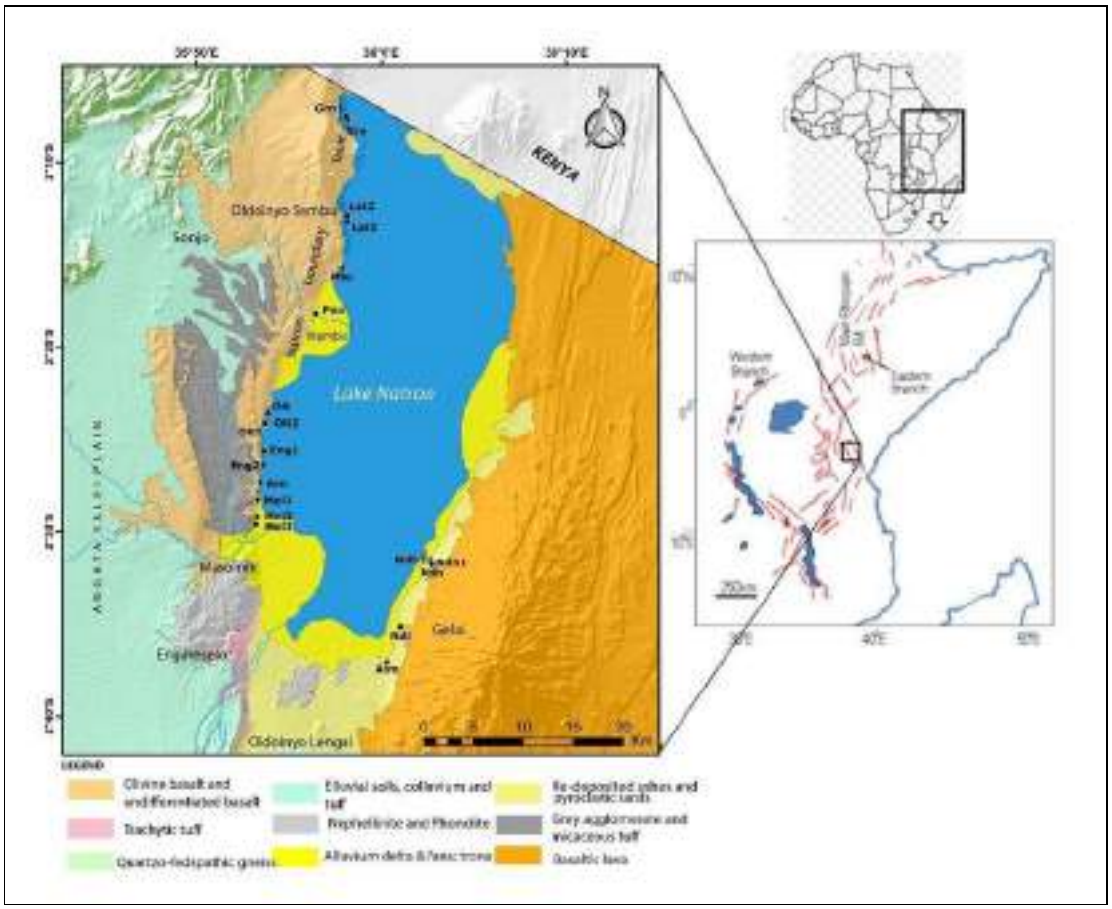


Figure 4.10: Summarized geology of Lake Natron Basin

(Source: https://dx.doi.org/10.4314/tjs.v49i3.11)

c) Site Lithology and Stratigraphy

Based on drilling program conducted in 2024 by Mining Today, the Project subsurface information is characterised by a layered evaporitic–lacustrine sequence typical of a closed, alkaline lake environment. The stratigraphy is dominated by trona-bearing horizons interbedded with clay and mixed trona–clay units, with localised occurrences of clay–gravel and clay–gravel–boulder layers. The overall sequence reflects alternating phases of evaporite precipitation and fine-grained sediment deposition under fluctuating hydrological and climatic conditions.

From the ground surface to depths of approximately 1–3 m, the profile commonly comprises trona and soil or trona–clay mixtures, representing recent evaporitic crusts and reworked surface deposits. Below this, a thick, laterally persistent trona unit is encountered across most boreholes, generally extending to depths of about 8–12 m, although local thickness variations are evident. This unit forms the principal economic horizon and is typically massive to weakly bedded, locally interrupted by thin clay or trona–clay interlayers.

Underlying and interbedded within the main trona sequence are clay-dominated horizons, locally grading into clay–gravel or clay–gravel–boulder units, particularly in deeper sections (generally below ~8–10 m). These coarser layers likely represent higher-energy depositional episodes or reworked alluvial inputs into the lake basin and may act as relatively more permeable horizons compared to the surrounding clays. Occasional core-loss intervals

recorded in some boreholes suggest zones of very weak, highly fractured, or disturbed material, possibly associated with solution features or soft, water-sensitive evaporites. Overall, the stratigraphy indicates a heterogeneous but predictable evaporite basin sequence, with competent trona layers separated by low-permeability clay units that locally transition to more transmissive gravelly lenses. Figure 4.11 presents the stratigraphic condition of the Project area.

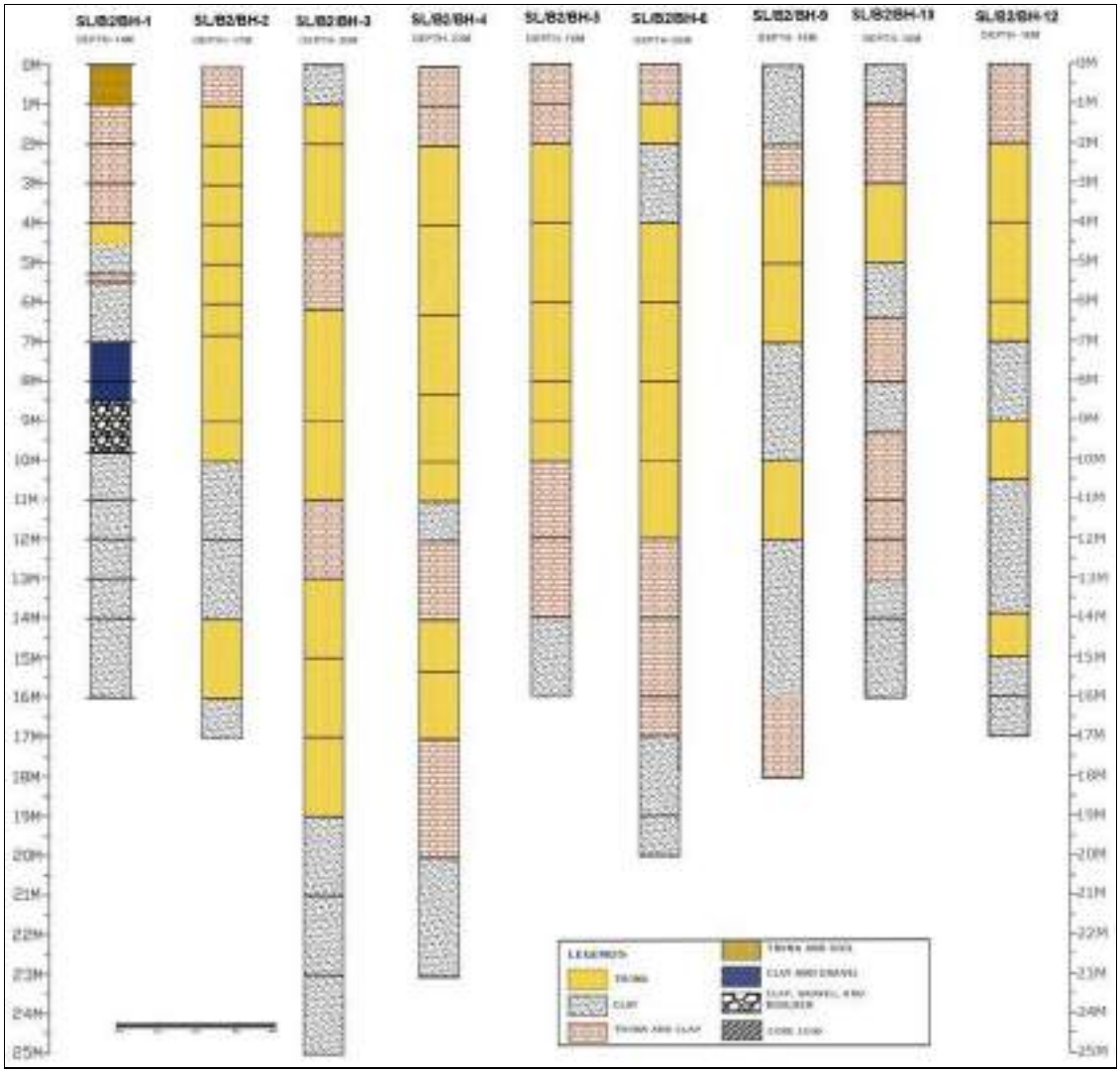


Figure 4.11: Stratigraphic/Lithological condition of the Project area.

(Source: Ngaresero Valley Company Limited (NVCL), 2024)

4.2.5 Mineralization of Sodium Carbonate

Carbonate mineralisation is controlled by a hydrologically closed lake system developed within an active rift volcanic setting. The lake has no effective surface or subsurface outflow, and evaporation is the dominant mechanism of water loss. Inflow from seasonal streams and local runoff is sufficient to maintain a persistent water body but remains lower than evaporative losses, resulting in progressive concentration of dissolved ions. These site-specific hydrological conditions, together with an arid to semi-arid climate characterised by high mean temperatures and low annual rainfall, provide an optimal environment for the development of soda-rich lake waters and carbonate precipitation.

The source of carbonate mineralisation is closely linked to carbonatitic volcanism in the surrounding catchment. Carbonate-rich volcanic materials derived from nearby lava flows and pyroclastic deposits are mechanically eroded and transported into the lake by ephemeral drainage systems. Within the closed basin, repeated cycles of inflow and evaporation concentrate sodium, bicarbonate, and carbonate ions, leading to the precipitation of sodium carbonates. The absence of significant flushing from the system allows these minerals to accumulate and be preserved within surface crusts and shallow subsurface sediments.

The site hosts a characteristic assemblage of carbonate minerals dominated by calcite and sodium carbonates, particularly trona, with subordinate thermonatrite and gaylussite. Calcite occurs both as detrital grains derived from nearby volcanic and sedimentary units and as authigenic precipitates formed when calcium bearing floodwaters and hydrothermal inputs interact with alkaline, sodium rich lake water. Aragonite is locally associated with hydrothermal spring deposits, reflecting favourable temperature and pressure conditions at discharge points rather than within the lake water itself. Progressive removal of calcium from solution, coupled with ongoing evaporation, enhances sodium enrichment and drives widespread precipitation of sodium carbonate minerals, making trona the principal economic carbonate phase at the site. Figure 4.12 shows the mineralisation potential within the Project area.

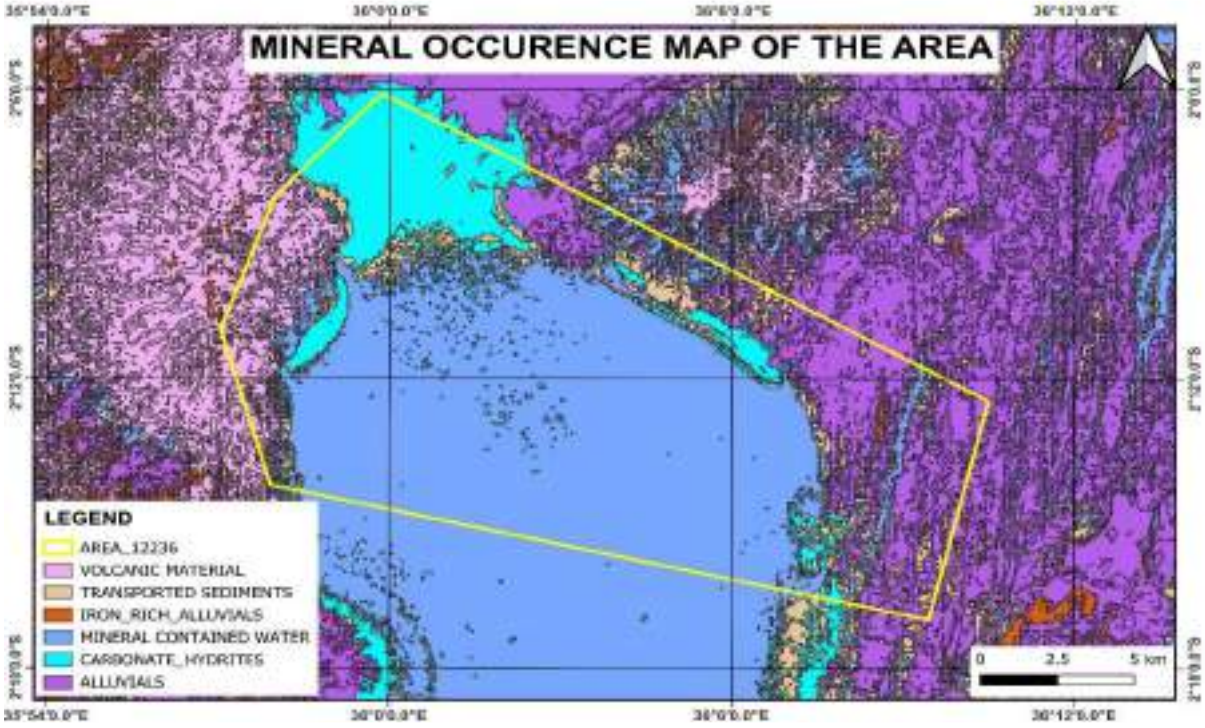


Figure 4.12: Mineralisation potential within the Project area.

(Source: Ngaresero Valley Company Limited Geological report, 2026)

4.2.6 Seismicity Potential

The Project area at Lake Natron is located within the North Tanzanian Divergence of the East African Rift System, a tectonically active extensional province characterized by crustal thinning, active faulting, and volcanism. Seismicity in the Lake Natron area is primarily associated with normal faulting along rift-bounding and intra-rift faults that accommodate ongoing east–west crustal extension. The dominant structural trends are north–south to northeast–southwest, consistent with the regional rift architecture of the Gregory (Eastern)

Rift. Earthquake activity reflects both tectonic extension and localized deformation within unconsolidated lacustrine and volcanic deposits along the rift floor (Ebinger et al., 1997; Foster et al., 1997).

The seismic regime of Lake Natron is notable for episodic earthquake swarms linked to magma-assisted rifting processes. A well-documented rifting episode occurred in 2007, when a sequence of moderate earthquakes (maximum moment magnitude approximately Mw 5.8–5.9) was recorded south of Lake Natron. This event was associated with fault slip and subsurface magmatic intrusion (dyke emplacement), indicating strong coupling between tectonic and magmatic processes in the area (Calais et al., 2008; Biggs et al., 2009). Such swarm-type seismicity is characteristic of the North Tanzanian Divergence and differs from classical single mainshock–aftershock sequences, resulting instead in repeated ground shaking over short periods.

Volcanic activity further contributes to the local seismic hazard. The presence of the active carbonatite volcano Oldoinyo Lengai, located immediately south of Lake Natron, introduces additional sources of low- to moderate-magnitude seismic events related to magma movement, hydrothermal circulation, and eruptive processes. Although volcanic earthquakes are generally of lower magnitude than major tectonic events, they may occur at shallow depths and can contribute to localized ground vibrations and surface cracking. Overall, the Lake Natron area is therefore classified as having moderate to locally high seismicity potential, with implications for infrastructure design and environmental risk management in unconsolidated lake-margin and alluvial sediments.

4.2.7 Soil

The soils of the project area reflect the volcanic–sedimentary origin of the Lake Natron basin and are largely influenced by the semi-arid climate and closed-basin hydrology. The parent materials are derived from volcanic ash, basaltic lavas, pyroclastic deposits, and evaporitic sediments, resulting in spatially variable soil textures and chemical compositions.

In the lake margin and floodplain zones, soils are predominantly saline alkaline clays and silts, enriched with sodium carbonate and bicarbonate minerals. These soils are poorly structured, exhibit high pH values, and have low permeability, often forming crusted and sodic surfaces due to high evaporation rates. Further from the lake, on the alluvial and piedmont plains, soils transition to sandy loams and clay loams developed from weathered volcanic materials, which are relatively more stable and moderately fertile.

Topsoil is typically thin to moderately developed, with low organic matter and poor drainage capacity. The high salinity and alkalinity restrict agricultural potential but provide favorable geochemical conditions for soda ash deposition. For engineering and construction purposes, soils near the lake are considered weak to moderately compressible, requiring proper geotechnical assessment before any structural development. Further soil sampling and laboratory testing are recommended to evaluate bearing capacity, compaction characteristics, and chemical reactivity of soils in relation to proposed infrastructure.

4.2.8 Hydrology

The hydrology of the Lake Natron Basin is a delicate equilibrium shaped by the interplay of rainfall, evaporation, and groundwater discharge within a closed drainage system. The basin lies in the Eastern Rift Valley, where endorheic conditions prevail meaning that all inflows terminate in Lake Natron, with no surface outflow. The hydrological regime is therefore

evaporation-dominated, highly sensitive to both seasonal precipitation and groundwater seepage from the rift escarpments.

Seasonal streams and springs, born of distant highlands, deliver freshwater pulses that breathe life into this saline expanse. Yet, most inflows are ephemeral, surging during the wet months (March–May and November–December) and vanishing in the long dry spells. The hydrological processes are intimately linked with the lake's chemistry and ecology: small variations in inflow volume or timing alter salinity and alkalinity, cascading into ecosystem-level responses observable in the flamingo breeding cycles and microbial mat formations.

a) Regional Hydrology

The Lake Natron catchment is the part of Internal Drainage Basin (IDBWB). Regionally, Lake Natron forms the terminal basin of a hydrological network draining the southern slopes of Mount Gelai, Mount Shombole, and the Ngorongoro highlands, extending northwards into southern Kenya. The principal inflow is the Ewaso Ng'iro River, which originates in Kenya's Mau Escarpment and enters Tanzania near Shompole before spreading into a deltaic fan feeding the northeastern shores of the lake.

Other tributaries include the Engare Sero, Peninj, Magadini, Moinik, and Lengijape Rivers, which descend from the western rift escarpment and deliver intermittent freshwater flows. Numerous geothermal springs discharge along the lakeshore, particularly in the southern and eastern margins, contributing both heat and dissolved minerals that sustain the lake's high alkalinity.

Rainfall across the basin is sparse and erratic, ranging from 400-800 mm/year in the escarpments to below 300 mm/year in the valley floor. Potential evapotranspiration exceeds 2,500 mm/year, ensuring that the lake remains hypersaline throughout the year. Thus, the regional hydrology is governed not by rainfall input alone, but by the balance between episodic runoff and relentless evaporation.

b) Local Hydrology

Within the project area located along the southern and southeastern margins of Lake Natron hydrological features are defined by short, flashy catchments and numerous minor springs discharging from fractured volcanic rocks. These springs sustain small channels and wetlands that serve as critical watering points for wildlife and pastoralist communities.

During the wet season, surface runoff collects in ephemeral channels and depressions, many of which terminate directly into the saline flats surrounding the lake. Flow persistence rarely exceeds a few days after rainfall events. However, these transient flows are ecologically significant, transporting sediments, nutrients, and organic matter to the littoral zones that support cyanobacterial growth the primary food source for Lesser Flamingos (*Phoeniconaias minor).*

In the dry season, the hydrological activity recedes underground. Subsurface seepage from the escarpments and geothermal vents maintains a subtle but continuous inflow to the lake margin, moderating its chemical concentration and preventing complete desiccation.

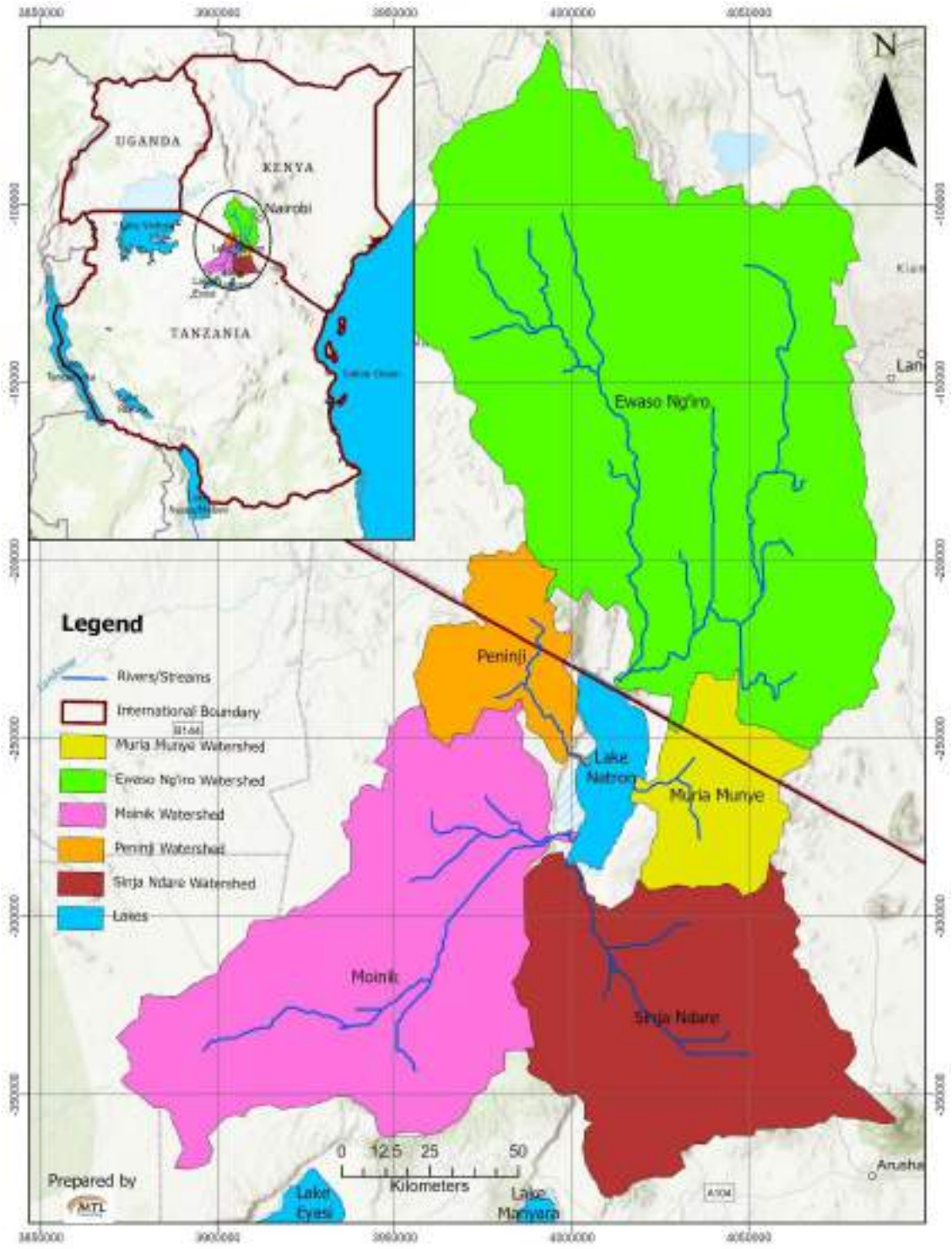


Figure 4.13: Lake Natron Catchments

(Source: MTL Consulting, 2025)

Table 4.4 below provides the summary of site hydrological conditions.

Table 4.4: Summary of Site Hydrological Conditions

Parameter	Regional Range / Trend	Local Observations (Project Area)
Annual Rainfall	400–800 mm (highlands) → <300 mm (valley)	250–350 mm, erratic
Main Inflows	Ewaso Ng'iro, Engare Sero, minor streams	Small ephemeral channels, springs
Evaporation	>2,500 mm/year	Dominant hydrological loss

*(*Source: MTL Consulting, *2025*)

4.2.9 Hydrogeology

Hydro-geologically, the Lake Natron Basin lies within the Eastern Rift volcanic system, characterized by alternating layers of basalt, trachyte, tuff, and lacustrine deposits, interspersed with faulted zones that control groundwater occurrence and movement. The aquifers are generally fracture- and fault-controlled, with primary porosity often low but secondary permeability high where fissures are well developed.

Groundwater occurrence is strongly influenced by the tectonic structure: north–south rift faults act as both conduits and barriers, creating a complex hydrogeological mosaic. Recharge occurs primarily along the escarpments where rainfall infiltration and stream seepage penetrate fractured zones.

The lake itself represents a discharge area, a hydrological sink where groundwater emerges as springs or seeps on the basin floor. This groundwater-surface water interaction sustains the lake's water balance, mineral chemistry, and biological productivity.

a) Regional Hydrogeology

Regionally, the groundwater system extends across the Natron-Magadi sub-basin, linking Tanzania's Lake Natron with Kenya's Lake Magadi through a shared rift structure. The upper aquifers are composed of recent volcanic ash and alluvium, while deeper aquifers occur in basaltic and trachytic formations of Miocene to Pleistocene age.

Recharge zones lie predominantly along the Ngorongoro Highlands, Mount Gelai, and the Monduli–Longido highlands, where mean annual rainfall exceeds 800 mm. Infiltration from ephemeral streams along the escarpment margins also contributes seasonal recharge. Groundwater generally flows eastwards and northwards toward the central rift depression, discharging at the lake margin as springs or diffuse seepage.

Salinity increases progressively toward the rift floor due to evaporation concentration and mineral dissolution from volcanic rocks. Thus, the hydrogeology transitions from fresh to brackish to hypersaline conditions from upland recharge areas to the central playa.

b) Local Hydrogeology

At the project site, hydrogeological investigations and previous regional studies (e.g., Maji Department reports, 2016–2023) indicate two main aquifer systems:

i). Shallow unconfined aquifer within recent alluvium and lacustrine sediments (0-20 m depth), characterized by variable salinity and high electrical conductivity (>5,000 µS/cm) due to evapoconcentration.

ii). Deeper fractured volcanic aquifer in trachyte and basalt formations (20–150 m depth), containing relatively fresh groundwater with total dissolved solids between 800-2,000 mg/L in the recharge zones, increasing toward the lake margin.

Groundwater occurrence is often controlled by fracture density and fault alignment. Springs emerging near the lakeshore represent natural upwelling points of the deeper aquifer, heated in some locations by underlying geothermal activity.

c) Groundwater Levels

Groundwater levels across the Lake Natron Basin show strong topographic and seasonal dependence. In the upland recharge zones, static water levels are typically 30-60 m below ground surface, while toward the lake plain, levels rise to 1-5 m below ground surface, and in some cases appear as surface springs.

During wet seasons, groundwater levels respond rapidly to infiltration pulses, particularly in fractured zones near the escarpments. However, in the dry season, levels decline due to high evapotranspiration and limited recharge. Long-term monitoring records suggest gradual seasonal fluctuations of 1-3 m, with localized declines observed near boreholes used for livestock watering.

The shallow water table in the project area implies a high vulnerability to contamination, especially where permeable alluvial soils and saline crusts dominate.

d) Groundwater Flow

Groundwater flow generally follows the regional topographic gradient from the western and southern highlands toward the central lake depression. The principal direction of flow is eastward and northward, converging beneath the saline flats of Lake Natron, where groundwater discharges as springs, seeps, or diffuse upwelling.

In the project area, shallow groundwater moves laterally through alluvial deposits toward the lake, while deeper groundwater within the fractured volcanic aquifer migrates through fault conduits before surfacing near the lake margin. The hydraulic gradient is gentle (1-3 m/km), reflecting the low relief of the basin floor.

Thermal and chemical signatures from spring discharges indicate a mixing regime fresh recharge from highlands blends with deep-seated mineralized water ascending along fault planes. This process governs both the lake's chemistry and the stability of its unique hypersaline ecosystem.

e) Hydrogeological setting

The project area is located within a hydrologically closed (endorheic) rift-lake basin characterised by high evaporation rates, alkaline lake waters, and evaporite (trona) deposition. Groundwater occurrence and movement at the site are strongly controlled by lacustrine stratification, evaporitic mineralisation, and structural features associated with the East African Rift. The hydrogeological system is dominated by brine-influenced shallow groundwater, with limited freshwater potential within the lake flat itself, except where isolated by low-permeability strata or located at basin margins.

f) Hydrostratigraphy (based on drilled boreholes)

Interpretation of drilled boreholes SL/B2/BH-1, 2, 3, 4, 5, 6, 9, 10 and 12 (Figure 4.11) indicate a layered evaporitic–lacustrine sequence comprising trona, clay, mixed trona–clay units, and local coarse clastic lenses. The principal hydrostratigraphic units are summarised in Table 4.5.

Table 4.5: Interpreted Hydro stratigraphic Units

HSU	Unit description	Typical depth range*	Hydraulic behaviour	Hydrogeological role
HSU-1	Surface trona/soil and trona–clay crust	0–1/2 m	Variable permeability; may crack when dry	Shallow infiltration and near-surface seepage zone
HSU-2	Main trona unit (economic horizon)	~1–2 to ~9–12 m	Low to moderate permeability; locally higher where fractured/solution-affected	Brine-bearing unit; potential lateral seepage if disturbed
HSU-3	Interbedded trona–clay and clay	~9–12 to ~15–18 m	Low permeability; leaky aquitard	Partial vertical barrier to groundwater movement
HSU-4	Basal lacustrine clay	~15–18 m to end of hole (up to ~25 m)	Very low permeability	Regional aquitard/confining unit
HSU-5	Local clay–gravel / clay–gravel–boulder lenses and core-loss zones	Localised at various depths	Moderate to high permeability	Preferential flow paths (localized aquifers)

**Depth ranges vary locally between boreholes.*

(Source: MTL Consulting, 2026)

g) Conceptual hydrogeological mode

Groundwater at the site occurs predominantly as alkaline porewater within trona-bearing and mixed evaporitic sediments. Vertical groundwater movement is generally restricted by thick clay and trona–clay horizons, resulting in a system where horizontal flow dominates over vertical flow. Localised coarse lenses (HSU-5) form discontinuous preferential pathways that may transmit groundwater laterally where hydraulically connected.

At a basin scale, regional groundwater recharge occurs primarily from upland catchments and ephemeral inflows, with groundwater discharging toward the lake and associated thermal springs along structurally controlled zones. Within the lake flats, groundwater is strongly influenced by evaporation, leading to concentration of dissolved salts and formation of interstitial brines within trona units. Under natural (pre-project) conditions, the clay-rich units act as an effective containment system limiting widespread groundwater exchange.

h) Sensitivity statement (key receptors and pathways)

The hydrogeological sensitivity of the site is controlled by:

- Localised coarse lenses (HSU-5), which represent the most significant potential pathways for lateral migration of process-affected water if hydraulically connected to dredged zones.
- Clay and trona–clay aquitards (HSU-3 and HSU-4), which provide natural protection by limiting vertical groundwater flow but are sensitive to disturbance if breached.

- Faults and spring zones, which may enhance vertical or upward groundwater movement and introduce highly mineralised waters

Overall, the site functions as a low-permeability, brine-dominated system with discrete transmissive features, requiring careful management during dredging to maintain the integrity of natural hydraulic barriers. Table 4.6 below provides the summary of site hydrological/hydrogeological conditions.

Table 4.6: Summary of Hydrological and Hydrogeological Conditions

Parameter	Regional Range / Trend	Local Observations (Project Area)
Aquifer Type	Fractured volcanic & alluvial	Dual (alluvial shallow + volcanic deep)
Groundwater Depth	1–60 m (topographic dependent)	1–5 m in plains
Flow Direction	W/S highlands → E/NE toward Lake	Lateral toward lake margin
Water Quality	Fresh to hypersaline	Brackish saline; EC >5,000 µS/cm near lake

(Source: MTL Consulting, 2025)

4.2.10 Water Quality Assessment

This section presents a professional evaluation of the water quality conditions within the Lake Natron Basin based on laboratory results obtained from three sampling locations: spring inflow (LN/SA/EIA/01), confluence zone (LN/SA/EIA/02), and open lake water (LN/SA/EIA/03). The results (Appendix 13 of Volume 2) illustrate a clear hydrochemical gradient influenced by inflow characteristics, basin geology, and strong evaporative forces typical of endorheic saline lake systems.

a) Physicochemical Characteristics

i). pH and Alkalinity

All samples exhibit highly alkaline conditions, with pH values ranging from 9.81 to 10.16, increasing toward the lake interior. This reflects the dominance of sodium carbonate-bicarbonate chemistry, consistent with soda lake environments. Bicarbonate alkalinity remains extremely high across all sites (17,600-21,600 mg/L), with the highest concentration observed in the lake water, confirming strong evaporative concentration and sustained geochemical inputs from groundwater and geothermal sources.

ii). Electrical Conductivity, Total Dissolved Solids, and Salinity

The data in the Table 4.7 show a progressive increase in mineral concentration along the sampling transect:

Table 4.7: Mineral concentration

Parameter	Spring Inflow	Confluence	Lake Water
Salinity (ppt)	19.04	17.40	64.00
EC (µS/cm)	38,080	34,800	128,000
TDS (mg/L)	19,040	17,400	64,000

(Source: MTL Consulting, 2025)

These results confirm the hypersaline nature of Lake Natron, driven by high evaporation rates and minimal dilution. The open lake exhibits the highest concentrations, characteristic of the terminal point of an endorheic system.

iii). Turbidity, Colour, and Suspended Solids

Turbidity and colour values indicate substantial variation between inflow zones and the lake body. The lake water shows markedly elevated turbidity (268 NTU) and colour (1,095 Hazen units), primarily due to:

- High particulate mineral content
- Dense microbial and algal communities
- Resuspension of fine sediments by wind and wave action

Total Suspended Solids (TSS) follow the same pattern, increasing from 8–45 mg/L in the inflow samples to 428 mg/L in the lake. These conditions are typical of alkaline–saline lakes and do not imply anthropogenic impact.

b) Major Ions and Nutrients

i). Major Ions

The dominant ions include sodium, chloride, bicarbonate, and potassium, all of which increase significantly toward the lake. Sodium concentrations rise from approximately 10,200 mg/L (spring inflow) to 26,800 mg/L (lake water). Chloride increases from 6,450 mg/L to 29,700 mg/L across the same gradient. These patterns reflect strong evaporative concentration and mineral dissolution from volcanic formations.

ii). Nutrients

Nutrient concentrations remain relatively low and consistent across sampling points:

- Nitrate-N: 18.0–19.9 mg/L
- Phosphate: 0.04–0.12 mg/L
- Ammonia-N: below 0.5 mg/L
- Nitrite-N: <0.05 mg/L

The nutrient profile does not indicate significant anthropogenic input and is instead driven by natural recycling processes within sediments and groundwater.

c) Organic Load Indicators

Organic load parameters demonstrate a substantial increase in chemical oxygen demand (COD) within the lake:

- COD: 138–240 mg/L (inflows) compared to 2,774 mg/L (lake water)
- BOD: 19–35 mg/L (inflows) to 79 mg/L (lake water)

The elevated COD in the lake reflects the presence of refractory organic compounds common in soda lakes, including microbial biomass and dissolved organic matter. The BOD:COD ratio indicates that most organic content is not readily biodegradable, consistent with natural conditions in high-alkalinity waters.

d) Trace Metals

Trace metal concentrations exhibit increasing trends toward the lake but remain characteristic of geogenic origins within volcanic terrains:

- Fluoride: extremely high values (171–939 mg/L), consistent with geothermal and volcanic inputs
- Lead, chromium, nickel, and cadmium: present at measurable but expected concentrations for rift-related saline environments
- Copper and zinc: detected at lower levels without evidence of anthropogenic enrichment

These results point to natural geochemical processes rather than external contamination.

e) Spatial Interpretation of Water Quality Trends

The results reveal a logical and consistent spatial pattern:

- Spring Inflow (LN/SA/EIA/01):
    - Represents relatively fresher groundwater-fed inflows
    - Lower salinity, turbidity, and organic load
- Confluence (LN/SA/EIA/02):
    - Transitional water mixing zone
    - Slight dilution or redistribution of some parameters
    - Elevated but less extreme mineral concentrations
- Lake Water (LN/SA/EIA/03):
    - Highly concentrated alkaline brine
    - Maximum salinity, major ions, organic load, and fluoride
    - Characteristic of a terminal evaporitic environment

The hydrochemical gradient observed is consistent with the lake's endorheic nature, strong evaporation, and influence from geothermal and volcanic systems.

f) Implications for Project Activities

The water quality conditions of Lake Natron have important implications for project planning:

i. The hypersaline and hyper-alkaline conditions require avoidance of interventions that may alter freshwater inflow patterns.

ii. Groundwater abstraction must be carefully managed to prevent changes to spring discharge volumes and chemistry.

iii. Wastewater discharge into the basin is unsuitable due to the sensitivity of the lake's ionic and nutrient balance.

iv. Monitoring should emphasize spring zones, as these represent the most dynamic and vulnerable components of the system.

The assessed water quality data confirm that Lake Natron's chemistry is shaped primarily by natural processes evaporation, volcanic geology, groundwater discharge, and microbial activity. The progressive increase in salinity, alkalinity, major ions, and fluoride from the inflow areas to the open lake reflects a stable and characteristic hydrochemical regime for a soda lake system. The results provide a robust baseline for evaluating potential project impacts and guiding environmental management within the basin.

4.2.11 Lakebed Sediment Quality

Sediment quality assessment was undertaken on the lakebed material within the proposed dredging area for the Trona/Soda Ash Project at Lake Natron to establish a baseline understanding of the chemical characteristics of the lakebed sediments. In addition, this assessment was also conducted to identify potential contaminants that may become mobilized during dredging activities.

a) General Observation of the Sediment Environment

The analytical results indicate that the lakebed sediment is characterized by highly alkaline conditions, elevated dissolved salts, naturally mineralized chemistry and presence of several trace/heavy metals.

These characteristics are generally consistent with the geochemical environment of a saline-alkaline lake system such as Lake Natron, where evaporative concentration, trona mineralization, sodium-rich brines, and volcanic inputs strongly influence sediment chemistry.

b) Interpretation of Key Parameters

pH = 10.64: The sediment exhibits strongly alkaline conditions. This is expected within Lake Natron due to high sodium carbonate and bicarbonate concentrations, evaporitic trona mineralization and saline lake geochemistry.

The environmental Implication will include high alkalinity may increase solubility and mobility of certain metals during sediment disturbance; dredging may temporarily elevate pH in suspended sediment plumes and aquatic organisms sensitive to rapid pH changes may be affected locally during dredging.

However, because the lake is naturally alkaline, the measured pH itself does not necessarily indicate anthropogenic contamination.

Electrical Conductivity (EC) = 46.82 mS/cm: The EC value confirms extremely saline conditions, high dissolved ionic content and strong evaporitic influence. This is characteristic of soda lakes and reflects Sodium-rich brines, Carbonate accumulation and evaporation-driven concentration

Dredging activities may re-suspend saline sediments, temporarily increase turbidity and ionic concentrations and modify localized water chemistry near the dredging front. However, the impact is expected to be localized if sediment plume control measures are implemented.

c) Heavy Metal Assessment

Lead (Pb) = 0.393 mg/L: Lead is present at relatively low concentration, though detectable. This implies potential ecological concern if large quantities of fine sediment become suspended, bioavailability may increase under changing redox conditions and this trigger monitoring during dredging operations.

Copper (Cu) = 0.452 mg/L: Copper concentration is moderate. This might become toxic to aquatic microorganisms and algae at elevated concentrations, accumulate within suspended sediment plumes. However, within saline alkaline systems, copper mobility is often reduced due to precipitation and adsorption processes.

Zinc (Zn) = 2.381 mg/L: Zinc appears comparatively elevated relative to other trace metals. This might be likely associated with natural evaporitic concentration, volcanic/geothermal inputs as well as mineralized sediment chemistry

Potential release into the water column during dredging should be considered, particularly for fine-grained sediments.

Cadmium (Cd) = 0.148 mg/L: Cadmium is environmentally sensitive even at low concentrations since it may pose toxicity risks to aquatic biota, accumulate in sediments and organisms and become more mobile during sediment agitation. This parameter requires continued monitoring during project implementation.

Chromium (Cr) = 0.293 mg/L: Chromium is present in moderate concentration. However, its its environmental significance depends on Oxidation state (Cr III vs Cr VI) and mobility under alkaline conditions. Further speciation would be required for detailed risk characterization.

Nickel (Ni) = 1.171 mg/L: Nickel concentration is relatively elevated. This is likely related to volcanic lithology, geothermal influence and natural sediment mineralization. As such, disturbance of fine sediment may increase temporary nickel concentrations within the water column.

d) Major Ions and Salinity

The tested major ion and salinity indicators include Sodium (Na) = 135.1 mg/L, Potassium (K) = 147.35 mg/L and Magnesium (Mg) = 186.52 mg/L. These elevated ions strongly confirm Soda Lake geochemistry, Evaporative concentration and Trona-related mineralization processes.

The chemistry is therefore largely consistent with the natural geochemical setting of Lake Natron rather than industrial contamination.

e) Dredging Related Environmental Implications

The sediment quality results suggest that the primary environmental concern during dredging is likely to be:

i. Sediment Re-suspension

Dredging may mobilize fine alkaline sediments, saline particulates and trace metals adsorbed to sediments.

ii. Increased Turbidity

Suspended sediment plumes may reduce water clarity, affect flamingo feeding zones and alter localized benthic habitats. This is particularly important within the sensitive Ramsar ecosystem of Lake Natron.

iii. Temporary Water Quality Changes

Potential short-term increases may occur in pH, EC/salinity, suspended solids and dissolved trace metals.

iv. Ecological Sensitivity

Because Lake Natron supports Lesser flamingo breeding habitats, specialized saline aquatic ecosystems even temporary disturbances require careful management.

f) Conclusion

The analyzed lakebed sediment demonstrates geochemical characteristics typical of a naturally saline-alkaline soda lake environment associated with trona mineralization within Lake Natron. The elevated alkalinity, salinity, sodium, potassium, and magnesium concentrations are interpreted to reflect natural evaporitic and hydrochemical processes rather than anthropogenic pollution.

Trace metals including zinc, nickel, cadmium, chromium, copper, and lead are present in detectable concentrations and may become temporarily mobilized during dredging activities through sediment re-suspension and increased turbidity. Although the concentrations appear generally consistent with mineralized soda lake sediments, dredging operations have potential to cause localized and short-term deterioration of water quality if not properly controlled.

The principal environmental risks associated with dredging therefore include:

- Sediment plume generation,
- Temporary increases in turbidity,
- Mobilization of trace metals,
- Localized salinity fluctuations, and
- Disturbance to ecologically sensitive habitats, including flamingo feeding and breeding areas.

g) Recommended Mitigation Measures

- Controlled dredging depth and rate
- Use of sediment plume management measures
- Continuous turbidity monitoring during dredging
- Routine monitoring of pH EC TSS dissolved metals
- Establishment of environmental threshold/action levels
- Avoidance of dredging near sensitive flamingo breeding zones
- Progressive environmental monitoring throughout operation

4.2.12 Air Quality

a) Particulate Matter ($PM_{2.5}$ & PM_{10})

The Air Quality baseline assessment for the Soda Ash Project was carried out to establish, evaluate, and categorize the key environmental and health considerations potentially linked to the proposed mining activities. Monitoring was conducted at four strategically selected

sampling locations, chosen based on their proximity to the project site and distance from sensitive receptors. Particulate matter concentrations were measured using a CEL-712 Microdust Pro Casella Real-time Dust Monitor, a hand-held instrument designed to provide rapid and reliable dust measurements.

The four sampling points were chosen to establish baseline information as follows and are presented in Table 4.8.

Table 4.8: Air Quality (Particulate Matter $PM_{2.5}$ & PM_{10}) Sampling Locations

Sampling Locations	Sample ID	Coordinates (Zone 36L UTM 1960)		
		Easting	Northing	Elevation (m)
Proposed Processing Plant Site 1	SDASH - AQ SP1	0178881	9735342	1424
Proposed Processing Plant Site 2	SDASH – AQ SP2	0180336	9737956	1400
Wosi Wosi Village	SDASH – AQ SP3	0182823	9731359	1411
Residential House	SDASH – AQ SP4	0181903	9735694	1450

(Source: MTL Consulting, 2025)

Results from particulate matter ($PM_{2.5}$ & PM_{10}) concentrations measured during the daytime field assessment are indicated in Table 4.9.

Table 4.9: $PM_{2.5}$ & PM_{10} Concentration Levels

Sampling Locations	Sampling Code	Easting	Northing	Elevation	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)
Proposed Processing Plant Site 1	SDASH - AQ SP1	0178881	9735342	1424	3	6
Proposed Processing Plant Site 2	SDASH – AQ SP2	0180336	9737956	1400	2	5
Wosi Wosi Village	SDASH – AQ SP3	0182823	9731359	1411	0.9	1.5
Residential House	SDASH – AQ SP4	0181903	9735694	1450	0.11	0.08
Tanzania Permissible Limit					**N/A**	**100**
WHO/IFC Standard					**25**	**50**

(Source: MTL Consulting, 2025)

Air Quality daytime PM_{10} concentrations ranged from 0.8 to 6 µg/m³, while $PM_{2.5}$ levels averaged 0.11 – 3 µg/m³. Since there is no activity that is on-going with very limited number of vehicles passing, the measured PM levels across the sampling points are all below the guidelines set by the International Finance Corporation (IFC), World Health Organization (WHO), and Tanzanian Air Quality Standards.

b) Pollutant Gases

Pollutant Gas Levels were measured by using the Bosean K-600 Multi-gas Monitor with sensor detectors for the targeted gases that are common in similar projects (Carbon Monoxide (CO), Carbon Dioxide (CO2), Nitrogen Oxides (NO), Hydrogen Sulphide (H2S) and Sulphur Dioxide (SO2). All the measured parameters were found to be within Tanzanian and international guidelines. Concentration values that recorded a zero reading (0.00 mg/m3) do not necessarily indicate the absence of the measured gases but rather that the levels present (if any) may be below the detection levels of the measuring device and that the measured parameters are well below the pollution limit/thresholds (Table 4.10).

Table 4.10: Pollutant Gas Concentration Levels

Sampling Points	Measured Parameters				
	Daytime				
	CO_2	CO	NO	SO_2	H_2S
	%	mg/m^3	mg/m^3	mg/m^3	mg/m^3
Proposed Processing Plant Site 1	0.0	0.0	0.0	0.0	0.0
Proposed Processing Plant Site 2	0.0	0.0	0.0	0.0	0.0
Wosi Wosi Village	0.1	0.1	0.01	0.0	0.1
Residential House	0.0	0.0	0.01	0.0	0.0
TBS Standards	**-**	**10**	**0.12**	**0.5**	**-**
WHO Standards	**-**	**30**	**0.12**	**0.5**	**-**

(Source: MTL Consulting, 2025)

c) Noise and Vibration

Background Noise levels were measured at 4 locations (Table 4.8) using a high-tech sound level meter (CEL-633C1/K11/3 Octave Band Sound Level Meter (Class 1). The instrument recorded average noise levels (LAeq) during the daytime. These readings were then compared against the allowable limits set by Environmental Management (Noise and Vibration Pollution) Regulations, 2015 and IFC standards. The daytime noise levels ranged from 39.6 to 58.1.0 dBA, Traffic, especially cars and motorcycles, was the main source of noise at all the locations measured. All measured noise levels were below or within the limits set by the Tanzanian Bureau of Standards (TBS) or IFC/WHO guidelines.

Table 4.11: Daytime Average Noise Levels

Offsite Measured Stations		Daytime Measured Data (dBA)$_{8hrs}$					
Code	Location	L_{Aeq}	L_{90}	L_{Amax}	L_{Amin}	L_{Cpeak}	L_{10}
SDASH - AQ SP1	Proposed Processing Plant Site 1	35.2	30.4	70.2	20.7	80.4	25.0
SDASH – AQ SP2	Proposed Processing Plant Site 2	29.1	21.8	69.7	21.6	79.1	30.1
SDASH – AQ SP3	Wosi Wosi Village	39.2	25.0	49.1	24.7	80.5	32.6
SDASH – AQ SP4	Residential House	29.5	29.5	85.4	25.5	89.7	35.0
TBS-NES Limits	Any building used as a hospital, convalescence home, home for the aged, sanatorium, learning institution, conference room, public library, and environmental and recreational site	45		<114			
	Residential building	50					
	Mixed residential (with some commercial and entertainment)	55					
	Residential and industry/small-scale production and commerce	60					
	Industrial area	70					
WHO/IFC/WBG Guideline	Residential, institutional, educational	<55					
	Industrial, commercial	70					

(Source: MTL Consulting, 2025)

Ground vibration was measured using a Vibration Monitor Extech 407860 Heavy-Duty real-time vibration monitor. On taking measurements, the accelerometer transducer was mounted on the ground to secure direct contact with the ground at a specified location to produce accurate results. Results show that measured ground vibrations were not more than 2 mm/s Peak to Peak Velocity (PPV) during regular working hours (Table 4.12). Results are in line with The Environmental Management (Noise and vibration) Regulation 2015, limit of 5 mm/s.

Table 4.12: Vibration Levels

Sampling Code	Sampling Location	Background vibrations (in mm/s)
SDASH - AQ VSP1	Proposed Processing Plant Site 1	1.5
SDASH – AQ VSP2	Proposed Processing Plant Site 2	1
SDASH – AQ VSP3	Wosi Wosi Village	1.9
SDASH – AQ VSP4	Residential House	1.8
The Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulation, 2015		**5 mm/s**

(Source: MTL Consulting, 2025)

4.2.13 Biological Characteristics

a) Flora

i) Flora Characteristics

Floristically, the vegetation of the study area falls within the Somali–Masai *Acacia–Commiphora* bushland and thicket phytochorion, as described by White (1983). It is characterized by a mosaic of edaphic grasslands developed on volcanic soils, halophytic vegetation occurring near saline zones, and thicket bushland communities on better-drained upland areas.

For the flora assessment, seven sampling plots were established and evenly distributed across the identified vegetation zones. These plots were selected to represent the main community types and species assemblages, which were classified based on their physiognomic characteristics and dominant growth forms, following the methodology outlined by White (1983).

Table 4.13: Sampling Location for the Vegetation Survey

Plot Code	Latitude	Longitude	Elevation	Vegetation
1	-2.22115	36.12495	611	Edaphic Grassland
2	-2.25981	36.13363	632	Bushed grassland
3	-2.26053	36.13536	635	Bushed grassland
4	-2.26055	36.13533	635	Edaphic grassland
5	-2.25984	36.13277	628	Thicket bushland
6	-2.22096	36.12598	613	Thicket bushland
7	-2.25993	36.13210	625	Edaphic grassland

(Source: MTL Consulting, 2025)

The flora diversity and abundance in the area were low, primarily due to its monotypic nature and the survey being conducted during the dry season, which made species identification challenging. A total of 15 plant species from 13 different families were recorded, representing various growth forms including shrubs, grasses, trees, a climber, and a sedge. Shrub species such as *Salvadora persica*, *Boscia mossambicensis*, *Cordia sinensis*, *Barleria grandicalyx* subsp. *mucronata*, and *Barleria acanthoides* were dominant throughout the surveyed plots. Grasses, including *Sporobolus* species and *Dactyloctenium aegyptium* predominated in the grassland zones. Most of the recorded species were halophytes, reflecting the area's ecological characteristics.

Table 4.14: Dominant Species recorded in the Project Area

Species	Family	IUCN Status	Growth form
Salvadora persica	Salvadoraceae	LC	Shrub
Sporobolus spicatus	Poaceae	LC	Grass
Stropobolus robustus	Poaceae	NE	Grass
Cissus quadraquantis	Vitaceae	LC	Climber
Commiphora africana	Burseraceae	LC	Tree

Species	Family	IUCN Status	Growth form
Commiphora sp	Burseraceae	NE	Tree
Maytenus senegalensis	Celastraceae	LC	Shrub
Barleria grandicalyx subsp. *Mucronata*	Acanthaceae	NE	Shrub
Barleria acanthoides	Acanthaceae	NE	Shrub
Cordia sinensis	Cordiaceae	LC	Shrub
Dactyloctenium aegyptium	Poaceae	LC	Grass
Acacia tortilis	Fabaceae	LC	Tree
Boscia mosambiancesis	Capparaceae	LC	Shrub
Cyperus laevigatus	Cyperaceae	LC	Sedge
Grewia spp	Malvaceae	LC	Shrub

(Source: MTL Consulting, 2025)

ii) Vegetation Categories of the study area

The vegetation within the surveyed Project area is relatively homogeneous, exhibiting a monotypic structure dominated by three principal vegetation formations: edaphic grassland**,** bushed grassland**,** and thicket bushland**.** These formations were consistently recorded across all surveyed transects, reflecting the arid to semi-arid climatic conditions typical of the Lake Natron Basin**.**

The edaphic grassland formation is characterized by a continuous grass cover interspersed with sparse herbs and occasional isolated trees. It is primarily dominated by *Stropobolus* species and *Dactyloctenium aegyptium*, which occur extensively across the low-lying plains.

The bushed grassland formation comprises a mosaic of grasses, dwarf shrubs, and woody herbs occurring on rocky volcanic soils. Common lower shrubs, including *Barleria grandicalyx* subsp. *mucronata* and *Barleria acanthoides*, were recorded within these grass-dominated zones, providing moderate ground cover and contributing to vegetation diversity.

The thicket bushland formation is represented by dense assemblages of woody species less than 5m in height, forming an impenetrable understorey. Dominant taxa include *Salvadora persica*, *Commiphora* spp., *Boscia mossambicensis*, and *Cissus quadrangularis*, which constitute the main woody and climbing components. *Salvadora persica* and *Boscia mossambicensis* are also locally significant for their traditional medicinal uses**,** highlighting the vegetation's ecological and socio-economic value.

Overall, the vegetation exhibits a distinct zonation pattern**,** with grasslands dominating areas closer to the lake and a gradual transition to bushland and shrubland communities further inland. This spatial distribution corresponds to variations in soil salinity, moisture availability, and topographic gradient across the project area (Plate 4.1).

Plate 4.1: Vegetation Types observed in the Project Area

(Source: MTL Consulting, 2025)

iii) Species of Ecological Conservation

Species of Ecological Conservation are those plants which needs conservation concern globally and locally due to either habitat loss, restricted habitat, declining its number of individuals due to over exploitation as well as climate changes. Those key plant species are categorized in the following groups: IUCN Red listed of threatened species categories, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Endemic plant species.

All recorded species are classified as Least Concern (LC) on the IUCN Red List of Threatened Species (2025), reflecting their stable populations both globally and locally.

iv) Invasive Alien Species

Alien species are defined as species that are introduced beyond their original range (PS6 GN99). Although many environments already support a wide variety of alien species, the focus during the survey was on those that have the highest potential to harm biodiversity by invading natural environments and out-competing native species; hence the term 'invasive alien species'

No evidence of biological invasion was observed within the study area, and no invasive alien species (IAS) were recorded during the survey. It is therefore recommended that WWSL operations implement strict preventive measures to avoid the introduction of any invasive or exotic species into the project area.

v) Lake Natron Game Controlled Area

The Project area (PL 12236/2023 and PL 13290/2025) all falls within the Lake Natron Game Controlled Area. The Lake Natron GCA covers 3,000 square kilometres, which was designated by government notice of 1974 (TAWA, 2025). The GCA includes a wetland of international importance with 224,781ha (2,248km^2) squeezed between Monduli and Longido districts to the east and Ngorongoro to the west at (2° 30’ S, 36 °E).

It has the Lake with a maximum of 57 kilometres long and 22 kilometres wide equivalent to an area of 1,254km^2. The surrounding area receives irregular seasonal rainfall, mainly between December and May totalling 800 millimetres per year. Temperatures at the lake are frequently above 40 °C (104 °F). The alkalinity of the lake can reach a pH between 9.5-12.

Lake Natron was also designated as a Ramsar Site, Wetland of International Importance on 4th July 2001. It also lies low in the Great Rift Valley surrounded by a landscape blotched with thorn trees and bush, nearby is the Africa’s highest active volcano- Oldonyo Lengai known to the Maasai as “The Mountain of God”. Lake Natron is the world’s most important breeding site for Lesser Flamingos, a species which is classified as “Near Threatened” in IUCN’s red list.

Activities in Lake Natron GCA involve Sport or Tourist hunting and Photographic/ Eco-Tourism such as walking safaris, game viewing, filming, Birds (Lesser flamingos) watching at the Lake shore, Mountain climbing to experience sunrise and volcanic activity in the Mt. Oldonyo Lengai (Figure 4.14).

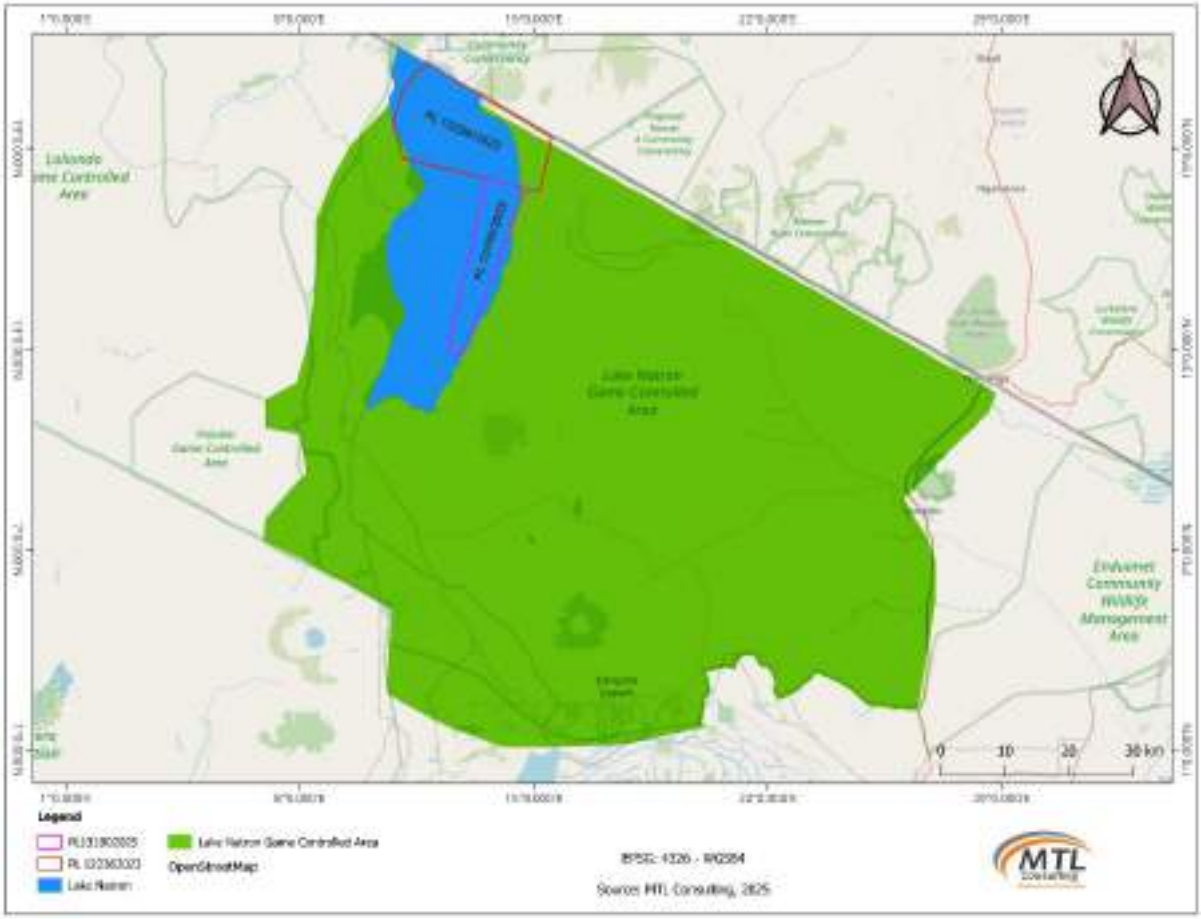


Figure 4.14: Lake Natron Game Controlled Area

(Source: MTL Consulting, 2025)

vi) Ecosystem Services

The project area is located at a considerable distance from major settlements, and local communities are not primarily dependent on agriculture due to the lake's high alkalinity and limited soil fertility. The surrounding landscape, however, provides important ecosystem services, including grazing resources for pastoral livelihoods, salt collection, and the harvesting of plant species used in traditional medicine. Additionally, the area supports significant cultural and tourism values, being situated within the Lake Natron Game Controlled Area (GCA), a region recognized for its ecological importance and attraction to both domestic and international visitors (see Section 4.16 (iv)).

Plate 4.2: Ecosystem Services observed at the Project Area during the Site Visit

(Source: MTL Consulting, 2025)

vii) Ngorongoro Lengai UNESCO Global Geopark and Project Overlap

The Ngorongoro Lengai UNESCO Global Geopark is designated under the UNESCO Global Geoparks Programme to promote conservation of geological heritage, education, and sustainable development. While the UNESCO framework emphasizes protection of geoheritage and discourages activities that may degrade such resources, it does not constitute a direct permitting authority, and project approvals remain governed by national legislation, including the Environmental Management Act and Mining Act. Spatial analysis undertaken for this study confirms that the geopark boundary, as obtained and georeferenced from official sources, does not overlap with the project area. The proposed mining licence areas, infrastructure, and associated facilities are all located outside the geopark boundary, as presented in Chapter 2, Section 3. Therefore, no direct impacts on the geopark area or its geoheritage values are anticipated.

b) Fauna

- Mammals

Lake Natron and its surrounding environs host a remarkable diversity of wildlife species adapted to the area's unique saline-alkaline ecosystem and semi-arid conditions. A total of 15 large and medium-sized mammal species (Table 4.13 and Plate 4.3) were recorded during the field survey. Mammals were identified through direct sightings, footprints/tracks, through droppings, joint assessment interview as well as through body part remains. Zebra and Grants gazelle were the most recorded species through their droppings and footprints along the

shoreline as well as in grassland or scrubland along Lake Natron which then confirm their use of freshwater spring found along Lake Natron (Appendix 9 of Volume 2).

Table 4.15: Species of Medium and Large Sized Mammals as per field surveys (October 2025)

SN	Common name	Scientific name	IUCN status
1	Giraffe	*Giraffa camelopardalis*	VU
2	Kirk's Dik-dik	*Madoqua kirkii*	LC
3	Plains Zebra	*Equus quagga*	NT
4	Grant's Gazelle	*Nanger granti*	LC
5	Common Wildebeest	*Connochaetes taurinus*	LC
6	Lesser kudu	*Tragelaphus imberbis*	NT
7	Thomson's gazelle	*Eudorcas thomsonii*	LC
8	Warthog	*Phacochoerus africanus*	LC
9	Spotted hyena	*Crocuta crocuta*	LC
10	Gerenuk	*Litocranius walleri*	NT
11	Fringe-eared Oryx	*Oryx beisa ssp. callotis*	VU
12	African Savanna Hare	*Lepus victoriae*	LC
13	Southern African hedgehog	*Atelerix frontalis*	LC
14	Common Genet	*Genetta genetta*	LC
15	African Civet	*Civettictis civetta*	LC
Note: VU = Vulnerable; NT = Near Threatened; LC = Least Concern			

Southern African hedgehog

Plains Zebra Carcas

Spotted hyena faeces

Grant's Gazelle pellets

Plate 4.3: Mammals identified during the field day

(Source: MTL Consulting, 2025)

- Birds

Lake Natron is internationally recognized as one of the most important bird areas (IBAs) in East Africa supporting a rich diversity of avifauna adapted to its saline and alkaline environment. Lake Natron serves as a critical breeding and feeding habitat for both the Lesser Flamingo and Greater Flamingo, forming one of the most important flamingo breeding sites in East Africa. Field surveys confirmed the presence of both species, with notable concentrations of Lesser Flamingos along shallow saline margins and mudflats. During the breeding season, hundreds of thousands of flamingos congregate on the shallow mudflats, feeding primarily on cyanobacteria (*Spirulina platensis*).

In total the survey revealed 76 species of avifauna (Appendix 9 of Volume 2) composed of two near threatened (NT) species Lesser Flamingo - *Phoeniconaias* minor and Kori Bustard - *Ardeotis kori*; one endangered (EN) species Steppe eagle - *Aquila nipalensis*; and one Vulnerable (VU) species Tawny Eagle - *Aquila rapax*, but none of them was considered invasive. Lake Natron and nearby habitats support numerous waterbird and migratory species making it an important stopover for migrant's avifauna. Moreover, 26 species were of different migration type (Table 4.16).

Table 4.16: Migratory Bird Species Recorded During Site Visit

S/N	Order	Family	English Name	*Scientific Name*	IUCN Status	Migration type
1	Phoenicopteriformes	Phoenicopteridae	Greater Flamingo	Phoenicopterus roseus	LC	Nomadic migrant
2	Phoenicopteriformes	Phoenicopteridae	Lesser Flamingo	*Phoeniconaias minor*	**NT**	Nomadic migrant
3	Pelecaniformes	Ardeidae	Grey Heron	*Ardea cinerea*	LC	Palearctic Migrant
4	Pelecaniformes	Ardeidae	Intermediate Egret	*Ardea intermedia*	LC	Partial Migrant
5	Pelecaniformes	Ardeidae	Little Egret	*Egretta garzetta*	LC	Partial Migrant
6	Pelecaniformes	Ardeidae	Cattle Egret	*Bubulcus ibis*	LC	Partial Migrant
7	Pelecaniformes	Threskiornithidae	Sacred Ibis	*Threskiornis aethiopicus*	LC	Intra-African Migrant
8	Anseriformes	Anatidae	Spur-winged Goose	*Plectropterus gambensis*	LC	Nomadic migrant
9	Anseriformes	Anatidae	Cape Teal	*Anas capensis*	LC	Nomadic migrant
10	Podicipediformes	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	LC	Palearctic Migrant
11	Columbiformes	Columbidae	Laughing Dove	*Spilopelia senegalensis*	LC	Nomadic migrant
12	Columbiformes	Columbidae	Emerald-spotted Wood Dove	*Turtur chalcospilos*	LC	Nomadic migrant
13	Columbiformes	Columbidae	Red-eyed Dove	*Streptopelia semitorquata*	LC	Nomadic migrant
14	Columbiformes	Columbidae	Ring-necked Dove	*Streptopelia capicola*	LC	Nomadic migrant
15	Columbiformes	Columbidae	Namaqua Dove	*Oena capensis*	LC	Nomadic migrant
16	Cuculiformes	Cuculidae	Diederik Cuckoo	*Chrysococcyx caprius*	LC	Partial Migrant
17	Charadriiformes	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	LC	Partial Migrant
18	Charadriiformes	Charadriidae	Common Ringed Plover	*Charadrius hiaticula*	LC	Palearctic Migrant
19	Charadriiformes	Scolopacidae	Little Stint	*Calidris minuta*	LC	Palearctic Migrant
20	Charadriiformes	Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	LC	Palearctic Migrant
21	Ciconiiformes	Ciconiidae	Abdim's Stork	*Ciconia abdimii*	LC	Intra-African Migrant

S/N	Order	Family	English Name	*Scientific Name*	IUCN Status	Migration type
22	Ciconiiformes	Ciconiidae	Black Stork	*Ciconia nigra*	LC	Palearctic Migrant
23	Accipitriformes	Accipitridae	Tawny Eagle	*Aquila rapax*	**VU**	Nomadic migrant
24	Accipitriformes	Accipitridae	Steppe eagle	*Aquila nipalensis*	**EN**	Palearctic Migrant
25	Coraciiformes	Alcedinidae	Grey-headed Kingfisher	*Halcyon leucocephala*	LC	Intra-African Migrant
26	Passeriformes	Hirundinidae	Barn Swallow	*Hirundo rustica*	LC	Palearctic Migrant
Note: EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern						

(Source: MTL Consulting, 2025)

- Reptiles and Amphibians

There was no herpetofauna recorded either seen or heard during the field survey in Lake Natron core area and this can be accounted by the Lake Natron's extreme saline and alkaline waters which may limit the occurrence of true aquatic amphibians within the lake itself.

During the joint assessment interview with locals, they identified three (03) amphibian's species which are known to occur in the surrounding environment especially in seasonal streams, temporary pools formed during the rainy season and freshwater springs along the lake margins.

Additionally, seven (07) reptile's species were identified during joint assessment interview (Table 4.17). None of them is of conservation significance.

Table 4.17:Reptiles and Amphibians identified during interview in October 2025

SN	Common name	Scientific name	IUCN status
1	Guttural Toad	*Sclerophrys gutturalis*	LC
2	Parker's Toad	*Poyntonophrynus parkeri*	LC
3	Senegal Land Frog	*Kassina senegalensis*	LC
4	Red spitting Cobra	*Naja pallida*	LC
5	Link-marked Sand Snake	*Psammophis biseriatus*	LC
6	Red-spotted Beaked Snake	*Rhamphiophis rubropunctatus*	LC
7	Speckle-lipped Mabuya	*Trachylepis maculilabris*	LC
8	Spotted Bush Snake	*Philothamnus semivariegatus*	LC
9	Rhombic Egg Eater	*Dasypeltis scabra*	LC
10	Puff Adder	*Bitis arietans*	LC
Note: LC = Least Concern			

(Source: MTL Consulting, 2025)

- Fauna Species of Conservation Concern

Most of the terrestrial fauna species recorded during October 2025 survey were categorized as Least Concern (LC) in the IUCN Red List as Threatened and Nationally/Locally Reserved Species. However, nine (09) species including four (04) avifauna and five (05) large mammals are considered species of conservation significance according to IUCN Red List of Threatened Species.

Avifauna: Two near threatened (NT) species Lesser Flamingo - *Phoeniconaias* minor and Kori Bustard - *Ardeotis kori*; one endangered (EN) species Steppe eagle - *Aquila nipalensis*; and one Vulnerable (VU) species Tawny Eagle - *Aquila rapa*, Table 4.14.

Mammals: Three near threatened species Plains Zebra (*Equus quagga*), Lesser Kudu (*Tragelaphus imberbis*) and Gerenuk (*Litocranius walleri*); two Vulnerable Species Giraffe (*Giraffa Camelopardalis*) and Fringe-eared Oryx (*Oryx beisa ssp*. *callotis*), Table 4.13.

- Critical Habitat Assessment

A Critical Habitat Assessment (CHA) is an essential component of environmental and biodiversity management for projects located within or near sensitive ecosystems. The

proposed Lake Natron Soda Ash Project lies within a globally recognized biodiversity hotspot requiring a comprehensive evaluation of habitats that are vital for maintaining species of global, national or regional conservation concern. The CHA follows the principles outlined in the International Finance Corporation (IFC) Performance Standard 6 (PS6) and the Equator Principles, which require the identification, protection and sustainable management of critical habitats before project implementation.

According to IFC PS6, critical habitat refers to areas with high biodiversity value, including:

- Habitats supporting globally or regionally significant concentrations of threatened species.
- Endemic or restricted range species habitats.
- Key biodiversity areas (KBAs), including protected or internationally recognized conservation sites.
- Habitats supporting unique assemblages or ecological processes essential for ecosystem functioning.
- Areas providing vital ecosystem services for human well-being and biodiversity persistence.

Portions of the Lake Natron project area qualify as Critical Habitat under IFC due to the presence of globally significant species and vital ecological functions due to being the only regular breeding site for the Lesser Flamingo (*Phoeniconaias minor*) in East Africa. Freshwater inflows and springs provide essential freshwater inflows maintaining the lake's ecological balance and these areas host amphibians and macroinvertebrates which then forms important microhabitats for biodiversity. Meanwhile the surrounding environment serves as buffer ecosystems mitigating dust, erosion and nutrient flows into the lake system.

- Priority Wildlife Resources and Ecosystem Services in the Project Footprint

The Lake Natron area represents one of the most ecologically significant landscapes in northern Tanzania, hosting important wildlife populations and ecosystem functions. The most critical wildlife resource is the Lesser Flamingo (*Phoeniconaias minor*) which relies exclusively on Lake Natron as its sole regular breeding site in East Africa. The lake's salinity conditions dominated by *Spirulina* algae provide both food and a natural barrier against predators which then creating a safe breeding environment. Other notable avifauna resources include the Greater Flamingo (*Phoenicopterus roseus*), Pied avocet (*Recurvirostra avosetta*) and Chestnut-banded Plover (*Charadrius pallidus*) all of which depend on the lake natron for foraging and nesting.

In the terrestrial habitats surrounding the lake environment, wildlife species such as Grant's gazelle, zebra, giraffe, lesser kudu and hyena form essential parts of the ecosystem and maintain ecological connectivity with nearby conservation areas such as the Lake Natron Game Controlled Area (Appendix 9 of Volume 2).

The ecosystem services provided by Lake Natron are equally valuable, supporting both ecological integrity and local livelihoods. Key provisioning services include freshwater from inflowing streams and springs, grazing lands and seasonal forage for pastoral communities as well as usage of salt deposits by locals. Regulating services involve microclimate regulation and soil stabilization by grassland. Additionally, cultural services are significant as Lake Natron is not only a Ramsar Site but also a center for eco-tourism, traditional knowledge and spiritual value to local Maasai communities.

Salt extracted from Lake Natron to be used by locals

Livestock grazing along Lake Natron

Plate 4.4: Ecosystem Services Found in Lake Natron during Field Survey

(Source: MTL Consulting, 2025)

c) Avifauna

Lake Natron serves as a critical breeding and feeding habitat for both the Lesser Flamingo and Greater Flamingo, forming one of the most important flamingo breeding sites in East Africa. Field surveys confirmed the presence of both species, with notable concentrations of Lesser Flamingos along shallow saline margins and mudflats. The species relies on the lake's high alkalinity and the abundance of cyanobacteria (*Spirulina spp*.) as its primary food source. The observed breeding colonies and feeding behaviour underline the ecological significance of Lake Natron as an essential refuge for these species (Brown, 1954; Childress *et al*., 2007; Pálmai *et al.*, 2024).

The area also supports a variety of other waterbirds and terrestrial avifauna, including stilts, sandpipers, plovers, and Egyptian geese, particularly in the less saline sections and inflowing streams. The persistence of these bird communities is directly dependent on maintaining the hydrological and physicochemical integrity of the lake system. Any alteration in salinity, water inflow, or shoreline habitat may adversely affect the distribution and reproductive success of flamingos and associated bird species.

Breeding Zone for Lesser Flamingo.

During joint assessment interview conducted in Wosiwosi, Pinyinyi and Magadini village, it highlighted that the locals are aware about the breeding sites for Lesser flamingo. According to literature review, the main breeding areas for Lesser Flamingos in Lake Natron are located on the central and northeastern parts of the lake, where the soda crust islands and shallow saline flats form naturally isolated and predator-free nesting grounds and as shown in the map and coordinates (Figure 4.15), locations were sourced from a previous Environmental Impact Assessment conducted for the Lake Natron area and have been adopted as the reference dataset for this study. The mapped breeding points and their descriptions are consistent with the findings of that assessment and provide a reliable basis for understanding the spatial relationship between the project area and known flamingo breeding habitats.

Central Soda Islands (Mid lake region)

These are raised soda crust platforms that emerge during the dry season (July–October) as lake levels drop which then creates the islands isolation by hypersaline water offers protection from terrestrial predators such as hyenas. This is where most large breeding colonies (up to 1 million birds) are concentrated during favorable years. The main breeding area falls within Pinyinyi Ward (Centroid coordinate for a breeding site; Easting 823534.14 m E and Northing 9727221.95 m S from the map Figure 4.15).

Northeastern lake surfaces

Located near the inflow of the Ewaso Ng'iro River, this area maintains a balance between freshwater input and saline concentration, supporting dense blooms of Spirulina platensis which is the main food for flamingos. Presence of shallow, warm waters encourage algal productivity, ensuring adequate food supply for both adults and chicks lesser flamingo. The area falls within Pinyinyi and Engaresero Wards (Centroid coordinate for a breeding site; Easting 170416.59 m E and Northing 9759619.57 m S from the map Figure 4.15).

Eastern Shoreline

Most of the eastern shoreline falls within Engaresero and these areas serve as pre-breeding congregation and feeding zones, where adults feed and prepare before moving to nesting sites. They also function as chick-rearing zones once chicks begin to forage independently in shallower waters (Centroid coordinate for a breeding site; Easting 166887.75 m E and Northing 9723314.70 m S from the map Figure 4.15).

Southern shoreline

The area within Engaresero and Magadini Villages acts as seasonal feeding areas during water level fluctuations whereby seasonal algal mats form here (Centroid coordinate for a breeding site; Easting 166887.75 m E and Northing 9723314.70 m S from the map Figure 4.15).

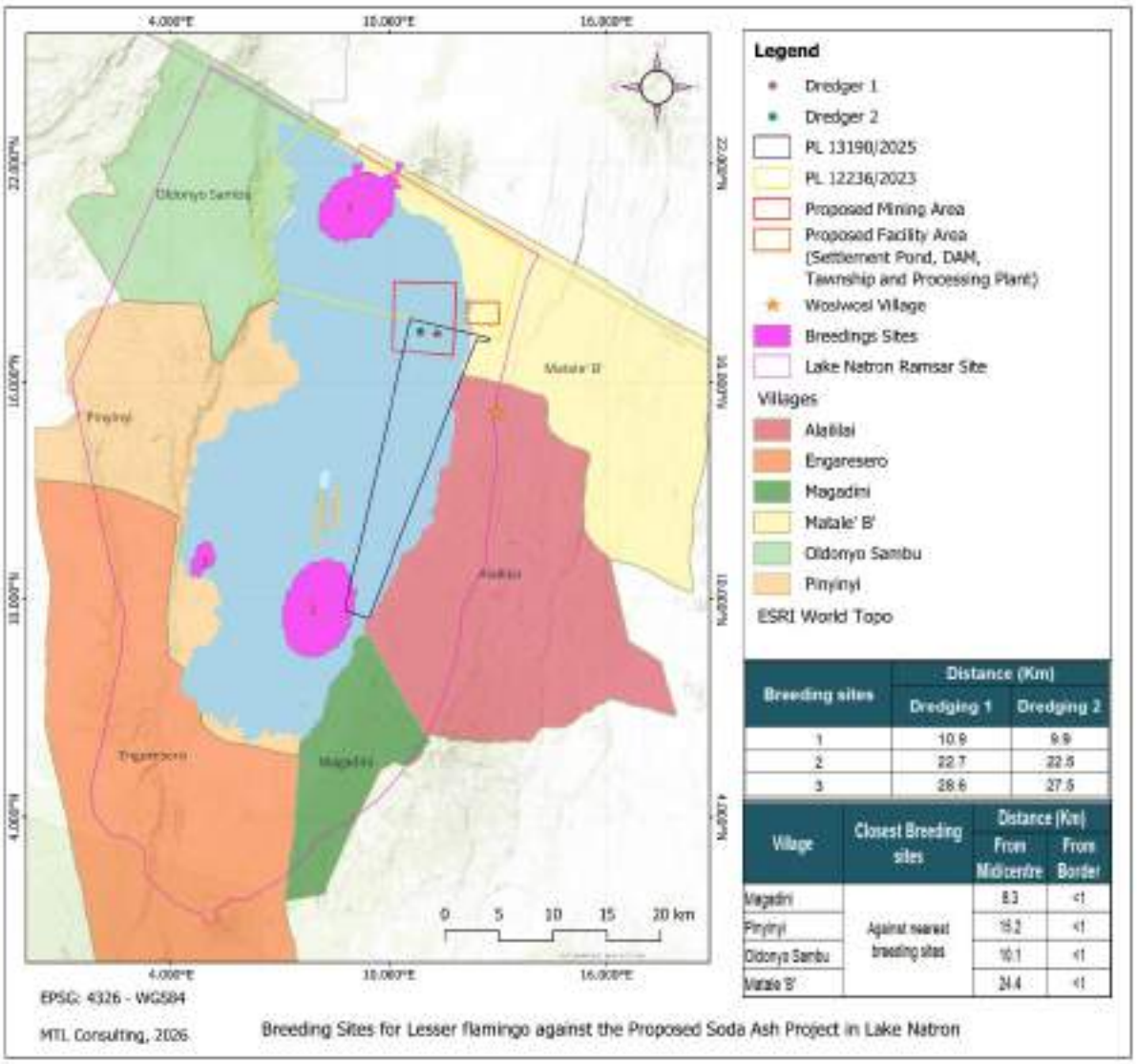


Figure 4.15: Breeding Zones for Lesser Flamingo in Lake Natron

(Source: MTL Consulting, 2026)

d) Aquatic biology

The study assumed that aquatic habitats, as well as macroinvertebrate and fish populations, were evenly distributed across the sampling stations. Hence, the chosen sampling points were considered representative of the most common aquatic habitat types found in the Project area. Two sampling points were assessed during the survey. Sampling Point 1, located in an inflowing stream, featured muddy substrates, slow-moving water, and moderate aquatic vegetation conditions that supported three *Alcolapia* species (*Alcolapia alcalica, Alcolapia ndalalani,* and *Alcolapia latilabris*), highlighting the ecological importance of inflowing streams as key refugia and feeding habitats. In contrast, Sampling Point 2, near the proposed dredging area along the lake shoreline, had rocky substrates, no freshwater inflow, and extreme alkalinity, with no fish or macroinvertebrates observed, reflecting the harsh physicochemical conditions of Lake Natron's open waters (Table 4.18 and Appendix 7 of the Volume 2).

Table 4.18: Location and habitat characteristics of the sampling points

SN	Sampling point	Sampling Code	Coordinates (37 UTM)	Habitat characteristics
1	Point 1	LN/SA/EIA/02	0180698 9750066	Inflowing stream entering Lake Natron, characterized by a muddy substrate and shallow water conditions.
2	Point 2	LN/SA/EIA/01	2.22095S 36.122429 E	Shoreline area adjacent to the proposed dredging point, characterized by rocky-gravel substrate, absence of stream inflow, and high alkalinity levels.

(Source: MTL Consulting, 2025)

i) Macro Invertebrates

The assessment of benthic macroinvertebrates in the inflowing streams feeding Lake Natron identified assemblages adapted to slightly alkaline and variable water conditions. The dominant taxa included Gerridae (pond skaters), indicative of moderate tolerance to environmental fluctuations, and Chironomidae (non-biting midges), reflecting high tolerance to chemical and thermal variations (Table 4.19 and Appendix 7 of the Volume 2).

Table 4.19: Benthic Macroinvertebrates Collected from Inflow Streams of Lake Natron

Taxonomic Group	Family	Pollution Tolerance
Hemiptera	Gerridae (Pond skaters)	Moderately tolerant
Diptera	Chironomidae (non-biting midges)	Highly tolerant

(Source: MTL Consulting, 2025)

These findings indicate that the inflowing freshwater streams constitute the primary benthic habitats within the Lake Natron basin, as the main lake's hypersaline and alkaline waters are unsuitable for most invertebrates. The results establish an important baseline for assessing freshwater ecosystem health and highlight the ecological significance of these streams in maintaining aquatic biodiversity under extreme environmental conditions.

ii) Fish Diversity and Abundance

The aquatic survey of the inflowing streams feeding Lake Natron recorded a low-diversity but specialized fish assemblage, comprising three cichlid species of the genus Alcolapia: *Alcolapia alcalica* (Common Natron tilapia), *Alcolapia latilabris* (Wide-lipped Natron tilapia), and *Alcolapia ndalalani* (Narrow-mouthed Natron tilapia). A total of 33 individuals were observed across the sampled inflows, with *Alcolapia latilabris* being the most abundant. All three species were found coexisting within the same stream habitats discharging into the southern part of Lake Natron, indicating overlapping ecological preferences and high tolerance to the lake's variable physicochemical conditions (Table 4.20, Plate 4.3 and Appendix 7 of the Volume 2).

Table 4.20: Diversity and abundance of fish identified at the proposed Project area

SN	Scientific name	Common/Local name	Number Of individuals	IUCN Status	Geographical range
1	*Alcolapia alcalica*/Oreochromis alcalicus	Common Natron tilapia	14	Endangered (EN)	Lake Natron drainage, Shompole swamps and Lake Magard
2	*Alcolapia Ndalalani/oreochromis ndalalani*	Narrow-mouthed Natron tilapia	4	Vulnerable (VU)	Endemic to Lake Natron basin
3	*Alcolapia latirabris/ oreochromislatilabris*	Wide-lipped Natron tilapia	15	Vulnerable (VU)	Endemic to Lake Natron basin

(Source: MTL Consulting, 2025)

iii) Species of Conservation Concern and Restricted Range Species

Two species, *Alcolapia latilabris* and *Alcolapia ndalalani*, are strictly endemic to the Lake Natron basin, while *Alcolapia alcalica* has a slightly wider distribution, occurring also in the Shombole swamps and Lake Magadi (Kenya). According to the IUCN Red List (2025), *Alcolapia alcalica* is classified as Endangered, while *Alcolapia latilabris* and *Alcolapia ndalalani* are Vulnerable. The restricted range and conservation status of these species underscore the global ecological significance of Lake Natron and the need to maintain the natural hydrological and physicochemical balance of its inflowing streams (Table 4.20 and Plate 4.5).

Alcolapia alcalica *Alcolapia ndalalani* *Alcolapia latirabris*

Plate 4.5: Representative fish species observed at the proposed project site

(Source: MTL Consulting, 2025)

iv) Breeding zone

The assessment recognizes that lesser flamingos and associated avifauna within the Lake Natron ecosystem are behaviourally sensitive species, particularly during breeding, nesting, and chick-rearing periods. The ESIA therefore does not assume that biological receptors will automatically adapt to mining-related disturbances but instead evaluates the sensitivity of key species in relation to the scale, location, timing, and nature of proposed project activities.

The nearest known flamingo breeding site is located approximately 9.9 km from the proposed dredging area. In addition, the nearest settlement, Pinyinyi Village, is located approximately 15.2 km from the breeding site (Refer to Figure 2.1 in Chapter 2) and is characterized by ongoing human activities including livestock grazing, movement of people, settlement activities, and transportation. Existing observations indicate that flamingo breeding continues within the wider ecosystem despite the presence of these ongoing anthropogenic activities, suggesting a degree of tolerance to low-intensity and distant human disturbance under existing environmental conditions.

The breeding season for lesser flamingos generally occurs between August and January, with peak nesting and chick-rearing commonly occurring from September to December. During this period, flamingos are particularly sensitive to repeated disturbances that may interfere with nesting behaviour, chick survival, feeding patterns, or colony stability. The ESIA therefore recognizes the importance of minimizing disturbance during these ecologically sensitive periods. The proposed mining operations will utilize electrically powered dredgers, which are generally associated with lower airborne noise and vibration levels compared to conventional diesel-powered dredging systems. Underwater sound source levels are estimated at approximately 168–185 dB re 1 µPa at source. However, underwater noise levels are expected to decrease substantially with distance due to sound attenuation, shallow saline water conditions, environmental absorption, and dispersion effects within the lake environment. Considering the approximate 8 km separation distance between dredging operations and flamingo breeding areas, direct acoustic disturbance reaching breeding colonies is anticipated to be significantly weakened. Nevertheless, the ESIA acknowledges that repeated or cumulative disturbances, even at relatively low levels, may potentially trigger behavioural responses in sensitive species. Potential responses may include temporary avoidance behaviour, increased vigilance, localized movement away from disturbance sources, interruption of feeding activities, or reduced breeding success if disturbances occur during critical nesting and chick-rearing periods.

The ESIA further identifies that breeding habitats for aquatic fauna are primarily confined to freshwater inflow systems, spring-fed areas, stream–lake interfaces, and vegetated littoral zones that provide suitable nursery conditions for juvenile development of recorded *Alcolapia* species. These habitats are spatially distinct from the proposed dredging area and will be protected through implementation of ecological protection measures.

To minimize potential impacts on flamingos and other ecological receptors, mitigation measures have been proposed in the biodiversity management plans in Chapter 8.

v) Invasive Alien Fish Species

Surveys of the inflowing streams and adjacent areas of the proposed soda ash project found no invasive fish species within the project footprint. The fish community consisted exclusively of native and endemic *Alcolapia* species (*Alcolapia alcalica, Alcolapia ndalalani*, and *Alcolapia latilabris*), which are uniquely adapted to Lake Natron's saline-alkaline environment. To maintain the integrity of this fragile ecosystem, it is recommended that strict biosecurity measures be enforced during construction and operation to prevent the introduction of invasive species.

4.3 Socio-Economic Description

4.3.1 Longido District

Longido District Council was established in July 2007 and is located between 36°00' and 37°30' East and 1°00' and 3°00' South of the Greenwich Meridian. The council covers an area of approximately 7,782 square kilometers, of which 9.4% (73,164 hectares) is arable land, 82.14% (639,235 hectares) is designated as grazing land, and about 4.7% (365.75 square kilometers or 36,575 hectares) is covered by forests and rocky areas. The district is among the driest regions in Tanzania, with temperatures ranging from 20°C to 35°C and annual rainfall varying from less than 500 mm in the lowlands to around 900 mm in the higher elevations of West Kilimanjaro, Ketumbeine, and Gelai mountains. Longido shares its northern border with the Republic of Kenya, making it strategically located for cross-border trade and cultural exchange.

a) Administrative Structure

Longido District is one of the seven districts in the Arusha Region of Tanzania. It shares borders with Ngorongoro District to the east, Monduli District to the southwest, Arusha Rural and Meru Districts to the southeast, Siha District of the Kilimanjaro Region to the far east, and the Republic of Kenya to the north. The district is administratively organized into four divisions Longido, Ketumbeine, Engarenaibor, and Enduiment which are further subdivided into 16 wards and 41 villages, forming the basic units of local governance. For parliamentary representation, the district forms a single constituency, Longido Constituency, ensuring representation in the national legislature.

b) Population

According to the 2022 National Population Census, Longido District had a total population of 175,915, of which 82,887 were males and 93,028 were females. This represents an annual population growth rate of approximately 3.64% compared to the 2012 census, which recorded a total of 123,153 people (62,954 females and 60,199 males). The population growth reflects both natural increase and migration patterns within the district. At the local level, Gelai Lumbwa Ward, where the project is located, has a population of 9,932, with 4,621 males and 5,311 females, while Wosiwosi Village, also within the project area, has a total population of 3,672.

c) Ethnic Group and Language

The Maasai are the dominant ethnic group in Longido District, having migrated from Kenya during the 18th and 19th centuries. The district was originally inhabited by the Rwa (Meru), Chagga, and Sonjo communities. The primary languages spoken in the district are Maasai

and Swahili, with Swahili serving as a common language for communication between different ethnic groups.

d) Land Use and Tenure

Longido District covers a total area of approximately 7,782 square kilometers, with diverse land uses reflecting both agricultural and pastoral activities. About 9.4% (73,164 hectares) of the district is arable land suitable for crop cultivation, while the majority, approximately 82.14% (639,235 hectares), is designated as grazing land, supporting the district's extensive livestock production. Additionally, forests and rocky areas occupy roughly 4.7% (36,575 hectares) of the land, contributing to biodiversity conservation and providing natural resources for local communities.

Land tenure in the district is primarily customary, particularly among the Maasai, who dominate livestock grazing areas. Most of the arable and grazing lands are communal, with families and clans holding traditional rights to use the land for cultivation or grazing. Formal land ownership and registered titles are limited, with some parcels of arable land held under leasehold or granted by the district council for development purposes. This land use pattern reflects the district's semi-arid climate, low rainfall in the lowlands, and reliance on livestock as the main livelihood for a large portion of the population.

e) Economic Activities

i. Livestock Keeping

Livestock keeping is the primary economic activity in Longido District and forms the backbone of livelihoods for the majority of residents, particularly the Maasai community. The district's extensive grazing lands, covering over 82% of the total area, support large herds of cattle, goats, pigs , donkeys and sheep. Livestock provides multiple benefits, including food, income, cultural value, and social status, and is central to the district's pastoralist lifestyle. Seasonal migration of herds is common in search of water and pasture, reflecting traditional pastoral management practices. Livestock products such as milk, meat, hides, and ghee are either consumed locally or sold in nearby markets, contributing significantly to household income and the local economy. At the local level, in Wosiwosi Village, livestock numbers are substantial. According to data provided by the Village Executive Officer (VEO) during the ESIA study, the village has 4,663 cattle, 6,056 goats, 14,366 sheep, and 1,959 donkeys (Plate 4.6). These figures highlight the village's heavy dependence on pastoralism and the critical role livestock play in supporting both livelihoods and cultural practices within the community. According to Longido District Council Strategic Plan 2023, Longido District has 24 cattle dips, 5 livestock development centres, 6 bull centres, 2 slaughterhouses, 14 slaughter slabs, 2 milk collection centres, and 14 livestock input outlets, providing essential support for animal health, breeding, and production.

Plate 4.6: Livestock Keeping in Wosiwosi Village

(Source: MTL Consulting, 2025)

ii. Farming

Farming in Longido District is largely subsistence-based and complements livestock keeping as a key economic activity. Due to the district's semi-arid climate, farming is concentrated in areas with relatively higher rainfall, particularly in the highlands around Ketumbeine, Gelai, and Oldonyo Lengai, and near available water sources. The main food crops grown include maize, beans, sorghum, millet, and various horticultural crops such as onions, tomatoes, and carrots, which provide both household food and surplus for local markets. In Pinyinyi Village, residents cultivate okra, maize, and a variety of fruits, reflecting their adaptation to local soil and climatic conditions. However, due to the predominantly rocky soil in most parts of the district, particularly in Wosiwosi Village, crop farming is limited, and residents largely rely on purchasing crops from other parts of the district

iii. Tourism

Tourism is an important economic activity in Longido District, leveraging its unique natural landscapes, wildlife, and cultural heritage. The district is home to Lake Natron, a key attraction known for hosting millions of flamingos and other bird species, as well as being a critical breeding site for migratory birds. Visitors also come to view the active volcano Oldonyo Lengai, which is culturally and geologically significant.

The district offers a variety of campsites and eco-tourism facilities on the flatlands surrounded by mountains such as Oldonyo Lengai (active volcano), Gelai, Mount Longido, and Ketumbeine, providing opportunities for hiking, birdwatching, and nature-based experiences. Approximately 95% of the district is a Game-Controlled Area (GCA), making it a prime destination for wildlife viewing and sport or trophy hunting in its designated hunting blocks. The district has seven hunting blocks, operated by six hunting companies, located within the Lake Natron GCA and the Longido GCA. The blocks include Longido GCA North (Michel Mantheakis Safaris Ltd), Lake Natron GCA North (Adam Clements Safaris Ltd), Lake Natron GCA West (Kilombero North Safaris Ltd), Lake Natron GCA South (Robin Hurt Safaris Ltd), Lake Natron GCA East (Green Mile Safaris Ltd), Monduli Juu Open Area (Tanzania Big Game Safaris Ltd), and Engasurai Hunting Area -EWMA (Kilombero North Safaris Ltd). Recognition of these hunting blocks is important during the Soda Ash Project implementation to avoid conflicts with the hunting companies.

The district hosts over 40 species of wildlife and a wide variety of birds, including flamingos, inhabit the district, contributing to its attractiveness to both domestic and international tourists. Tourism in Longido not only provides employment opportunities but also contributes to local income generation and foreign exchange earnings, enhancing the district's economic development while promoting environmental conservation.

iv. Mining

Mining is a significant economic activity in Longido District, as the area is endowed with a variety of mineral resources. The most commonly extracted minerals include rubies, soda ash, limestone, and sand, which support both local livelihoods and broader economic activities. Ruby mining is particularly important and has gained recognition nationally and internationally due to the quality of gemstones found in the district. Soda ash extraction occurs in areas with saline deposits, while limestone and sand are mainly used for construction and building purposes within the district and neighbouring regions.

Mining activities in the district are largely small- to medium-scale, with artisanal miners playing a key role, particularly in ruby extraction. These activities provide employment and income opportunities for local communities, although they are often informal and seasonal. While mining contributes to the local economy, it also presents environmental and social challenges, including land degradation, water scarcity, and the need for proper regulation to ensure sustainable practices.

f) Social Services

i. Education Services

Longido District Council operates 845 primary schools with a total of 216 classrooms and eight secondary schools, including seven government institutions and one private school, with a total of 64 classrooms. Despite this infrastructure, many schools face significant challenges, including a lack of classrooms, insufficient teaching and learning materials, and inadequate housing for staff and their families, all of which negatively impact the quality of education and the working conditions for teachers.

In the project area, Wosiwosi Primary School is located just 100 meters from the village office, serving the local community. There is no secondary school in the village, so students attend Lekule Secondary School, a ward boarding school located approximately 50 km from Wosiwosi Village. In Matale B village, where the railway infrastructure is planned to be constructed, there are three primary schools: Emurutoto Primary School, Emisera Primary School, and Oltrotobor Primary School (Plate 4.7) Student dropout remains a major concern, primarily due to truancy, long distances to school, early marriage, pregnancy, and negative attitudes toward formal education among some Maasai communities. Addressing these challenges is essential to improving educational outcomes and ensuring that children in Longido District have access to quality education.

Plate 4.7: Emurutoto Primary School in Matale B Village

(Source: MTL Consulting, 2025)

ii. Health Services

Health services in Longido District are limited and face significant challenges in both coverage and staffing. The district has two government health clinics, one faith-based organization (FBO) health facility, 22 government dispensaries, and three FBO dispensaries

In the project area, Wosiwosi Village has no operational health facility, and residents currently access services at Lumbwe Ward Dispensary, located approximately 50 km from the village. However, during the ESIA study, it was observed that the Wosiwosi Village dispensary building has been completed but is not yet operational (Plate 4.8). Common health issues in the district include acute respiratory infections (ARI), pneumonia, malaria, intestinal worms, diarrhoea, minor surgical conditions, eye disorders, skin illnesses, ear conditions, urinary tract infections (UTI), pelvic inflammatory disease (PID), and neurosis. The limited availability of health services, combined with understaffing and inadequate infrastructure, significantly affects the accessibility and quality of healthcare for the population.

Plate 4.8: Completed Wosiwosi Dispensary Building (Not Operational)

(Source: MTL Consulting, 2025)

iii. Water services

Access to safe and reliable water remains a major challenge in Longido District, particularly in rural areas. The district's water supply is limited due to a lack of perennial rivers, few natural water sources such as springs, and the semi-arid climate, which reduces water availability for both human and livestock use. Currently, only 42% of the district's population has access to safe and clean drinking water from upgraded sources, including springs, boreholes, water taps, rainwater harvesting systems, streams, rivers, and shallow wells. (Plate 4.9)

Plate 4.9: Community Water Tap in Matale B Village

(Source: MTL Consulting, 2025)

In the project area, residents of Wosiwosi Village face severe water scarcity, which forces residents especially women to travel long distances to obtain water. The community relies on hand-dug wells constructed in riverbeds, which are often seasonal and may not provide sufficient water year-round. Although Lake Natron is nearby, it is not utilized for water due to its high alkalinity and salinity, making it unsuitable for consumption or irrigation. Seasonal water scarcity, coupled with long distances to water sources, significantly affects household water security, livestock productivity, and overall community health. Improving water infrastructure and expanding access to safe water is critical for the well-being of both people and livestock in the district.

g) Infrastructures

i. Road Infrastructure

Longido District's Road network is vital for connecting communities, facilitating trade, and providing access to social services. The district has a total road network of 563.9 kilometers, comprising 229 km of district roads, 355.9 km of feeder roads, 36 km of urban roads, and 244 km managed by TANROADS. Feeder roads are secondary or local roads that connect villages and rural areas to main or trunk roads, providing essential access to markets, schools, and health facilities.

The condition of the roads varies: approximately 15.5% are in good condition, 45.4% are in medium condition, and 35.9% are in poor condition. About 81.3% of the network is accessible throughout the year, while 18.7% becomes impassable during the rainy season, affecting mobility and access to essential services. (Plate 4.10)

Plate 4.10: Access Road to the Project Area

(Source: MTL Consulting, 2025)

A major trunk road, T2, connecting Arusha to the Kenyan border town of Namanga, passes through the district, providing an important route for trade and regional connectivity. Despite the presence of this trunk road, rural areas, particularly remote villages like Wosiwosi, often rely on poorly maintained feeder roads, which limits transportation of goods, access to markets, and mobility for residents. Improving road infrastructure, especially feeder roads and

seasonal access routes, is critical for enhancing economic activities, service delivery, and overall development in the district.

ii. Electricity

Electricity access in Longido District remains limited, particularly in rural areas. While the district has been gradually electrified, not all villages and households have access to power, and many residents continue to rely on alternative energy sources such as solar power, kerosene, and firewood for lighting and cooking.

In the project area, Wosiwosi Village has access to electricity through the Government Rural Electrification Agency (REA), enabling residents to benefit from basic electrical services. However, electricity coverage is still sparse in other parts of the district, and infrastructure challenges, including limited grid connectivity and inconsistent supply, affect the reliability and availability of power.

Plate 4.11: Electricity Supply in Magadini Village

(Source: MTL Consulting, 2025)

iii. Telecommunications

Telecommunication services in Longido District have improved in recent years, but coverage remains limited in remote and rural areas. Cellular coverage is provided by companies such as Vodacom, Airtel, Yas, and Halotel, with stronger signals along trunk roads and in larger villages. However, smaller and more remote villages often experience weak or intermittent connectivity.

In Wosiwosi Village, the network is very limited, with weak signals and few available mobile services, including M-Pesa, Mix by Yas, and Airtel Money. As a result, residents often travel to Longido district or Ngeresero village to access these services. In some of the more remote areas of the district, there is no network coverage at all, limiting communication, access to mobile financial services, and overall connectivity for the communities.

4.3.2 Ngorongoro District

Ngorongoro District is one of the seven districts in the Arusha Region of northern Tanzania, covering an area of approximately 14,036 km². It shares borders with Kenya to the north, Monduli District to the east, Longido District to the northeast, Karatu District to the south, and Serengeti District in Mara Region to the west. The district derives its name from the Ngorongoro Crater, one of the world's most renowned natural landmarks and part of the Ngorongoro Conservation Area (NCA), a UNESCO World Heritage Site that occupies about 59% of the district's total area. The district is characterized by diverse landscapes, ranging from open savannahs and volcanic highlands to the Great Rift Valley escarpments, with elevations rising to include Mount Loolmalasin, Tanzania's third tallest mountain.

a) Administrative Structure

Ngorongoro District is administratively organized into three divisions Ngorongoro, Loliondo, and Sale which together form the primary levels of local governance. These divisions are further subdivided into 21 wards and numerous villages, ensuring decentralized administration and effective community representation. For parliamentary purposes, the district forms a single constituency known as the Ngorongoro Constituency, which provides representation in the National Assembly. The district headquarters is in Loliondo, serving as the main administrative and service center. A significant portion of the district is covered by the Ngorongoro Conservation Area (NCA), managed collaboratively by the Ngorongoro Conservation Area Authority (NCAA) and the Ngorongoro District Council (NDC). This shared management structure promotes coordination in governance, conservation, and community development within the district.

b) Population

According to the 2022 National Population and Housing Census, Ngorongoro District had a total population of 273,549 people, of whom 127,850 were males and 145,699 were females. Within the district, Pinyinyi Village accounted for a population of 3,322 individuals, including 1,800 males and 1,522 females.

c) Ethnic Group and Language

Ngorongoro District is predominantly inhabited by the Maasai, a pastoralist community known for their rich cultural heritage and strong attachment to traditional livelihoods centered around livestock keeping. Other ethnic groups residing in the district include the Datoga, Sonjo (Batemi), and a few Iraqw and Sukuma migrants who have settled in specific areas for trade, farming, or employment opportunities.

The Maasai language (Maa) is the most widely spoken language across the district, serving as a key medium of daily communication. However, Swahili, the national language, is also commonly used particularly in administrative centers, schools, and business transactions facilitating interaction among diverse ethnic communities. English is used mainly in official and educational settings. The multilingual nature of the population reflects the district's cultural diversity and the gradual integration of traditional and modern lifestyles.

d) Land Use and Tenure

Land in Ngorongoro District is primarily managed under a unique system that balances conservation, pastoralism, and limited agriculture. A significant portion of the district lies within the Ngorongoro Conservation Area (NCA), where land ownership and management fall under the jurisdiction of the Ngorongoro Conservation Area Authority (NCAA). Within this area, land

is held communally, and residents mainly the Maasai do not possess individual land titles. Instead, they have customary user rights for grazing, settlement, and access to water resources, as stipulated under the NCA Ordinance.

Outside the conservation area, particularly in divisions such as Loliondo and Sale, land tenure follows the village land system governed by the Village Land Act No. 5 of 1999, which allows for individual, communal, and institutional ownership. The main land uses across the district include pastoralism, small-scale agriculture, wildlife conservation, and human settlement, with limited commercial and tourism-related development. Despite the legal restrictions on cultivation within the NCA, subsistence farming continues to be practiced by some households due to food security needs and the limited productivity of grazing lands. This has occasionally resulted in conflicts between conservation objectives and local livelihood practices. Overall, land use in Ngorongoro District reflects the delicate balance between preserving ecological integrity and supporting the traditional livelihoods of its indigenous communities.

e) Economic Activities

i. Farming Activities

Farming in Ngorongoro District is generally practiced on a small scale and serves mainly for subsistence rather than commercial purposes. The district's semi-arid climate and extensive rangelands make livestock keeping the dominant economic activity; however, crop cultivation is increasingly becoming important in some areas outside the Ngorongoro Conservation Area (NCA), such as Loliondo, Sale etc

Farmers typically grow drought-resistant crops, including maize, beans, millet, sorghum, and potatoes, depending on soil fertility and rainfall patterns. In Pinyinyi Village, access to water sources and fertile grazing grounds provides favourable conditions for both crop cultivation and livestock rearing. Most agricultural practices rely on rain-fed systems, though some residents engage in small-scale irrigation where water is available.

Despite its importance for household food security, farming in the district faces challenges such as unpredictable rainfall, soil erosion, limited access to modern farming technologies, and human-wildlife conflicts due to proximity to conservation areas.

ii. Livestock Keeping

Livestock keeping is the main economic activity in Ngorongoro District and forms the backbone of the local economy, especially among the Maasai pastoralist communities. The district's vast rangelands and semi-arid environment provide suitable conditions for grazing livestock such as cattle, goats, sheep, and donkeys. In areas like Pinyinyi Village, residents depend heavily on livestock for their livelihoods, using it as a primary source of income, food (milk and meat), and social value, including dowries and traditional ceremonies.

Pastoralism in Ngorongoro is largely extensive and traditional, characterized by seasonal migration in search of pasture and water. The availability of grazing grounds and water sources supports year-round livestock rearing, although herders face challenges such as periodic droughts, livestock diseases, and conflicts between wildlife and livestock over limited resources. To improve productivity and sustainability, various interventions have been introduced by the Ngorongoro District Council, the Ngorongoro Conservation Area Authority (NCAA), and other partners. These include veterinary support services, vaccination campaigns, construction of cattle dips, and education on improved animal husbandry

practices. However, the mobility of pastoralists and limited access to modern veterinary and market infrastructure continue to constrain progress in the livestock sector.

iii. Tourism

Tourism is one of the most significant economic activities in Ngorongoro District, attracting both domestic and international visitors due to its globally renowned natural and cultural heritage. The district is home to the Ngorongoro Conservation Area (NCA) a UNESCO World Heritage Site featuring the Ngorongoro Crater, one of the world's largest intact volcanic calderas, and a sanctuary for diverse wildlife including elephants, lions, rhinos, and numerous bird species. Other major attractions within the district include the Olduvai Gorge, known as the cradle of humankind, Lake Natron, famous for its flamingos, and the Mount Loolmalasin the third tallest mountain in Tanzania.

Tourism in Ngorongoro operates under a multiple land-use model, balancing wildlife conservation with the traditional lifestyles of the Maasai pastoralists who inhabit the area. The Ngorongoro Conservation Area Authority (NCAA) oversees tourism management, ensuring that conservation objectives align with community development. Lodges, campsites, and cultural tourism enterprises contribute significantly to local revenue through concession fees, employment opportunities, and community development funds. Despite its potential, tourism faces challenges including limited community participation, inadequate tourism infrastructure in remote areas, and seasonal accessibility issues due to poor road conditions. However, ongoing efforts by the district council and the NCAA aim to promote eco-tourism and cultural tourism initiatives that directly benefit local communities while preserving the district's unique natural and cultural heritage.

iv. Handcraft

Handcrafts play a significant role in the economic and cultural life of communities in Ngorongoro District. Traditional crafts such as beadwork, leather products, and carvings are primarily made by Maasai women and youth, reflecting their rich cultural heritage and artistic skills. Beadwork, in particular, is an important income-generating activity, with items such as necklaces, bracelets, belts, and decorative ornaments sold to both local buyers and tourists visiting the area. The production and sale of these crafts provide an alternative source of livelihood, especially for women who often depend on livestock-related income. Handicraft activities also serve as a means of preserving Maasai traditions while promoting cultural tourism in the district. Despite their potential, artisans often face challenges such as limited market access, lack of business skills, and inadequate exposure to larger markets. However, ongoing tourism and conservation initiatives within the Ngorongoro Conservation Area continue to create opportunities for the growth of this sector.

v. Mining

Mining activities in Ngorongoro District are relatively small-scale but contribute to the local economy in specific areas. The district is known for deposits of gemstones such as spessartine garnets, rubies, sapphires which are found in some parts of the district, although large-scale commercial mining is not yet developed. Most of the mining operations are artisanal and are carried out using traditional methods by local communities. These activities provide supplementary income, particularly for youth and small-scale miners who engage in gemstone extraction and trade. However, mining in the district is limited due to conservation restrictions within the Ngorongoro Conservation Area (NCA), where environmental protection regulations prohibit large-scale mineral exploitation. As a result, mining is primarily conducted outside the

conservation area, under regulated conditions. With proper management and value addition, small-scale mining has the potential to enhance local livelihoods while maintaining environmental sustainability.

vi. Beekeeping

Beekeeping is one of the emerging economic activities in Ngorongoro District, practiced mainly by local communities as a source of income and livelihood diversification. The district's diverse vegetation and favourable climatic conditions provide a suitable environment for honey production. Most beekeepers use traditional hives made from logs or bark, though some have started adopting modern beekeeping technologies to increase productivity and improve honey quality. Honey and beeswax are sold in local markets and occasionally to external buyers, contributing to household income. Beekeeping also plays an important ecological role by promoting pollination and supporting biodiversity. With proper training, equipment, and market access, beekeeping holds significant potential for expansion and economic empowerment, especially for youth and women in the district.

vii. Trade and Small Businesses

Trade and Small Businesses play a vital role in the economic development of Ngorongoro District, particularly in urban centers such as Loliondo and major trading villages. Local markets serve as key hubs for the exchange of goods and services, where residents trade livestock, hides, honey, handcrafts, grains, and household products. Small businesses, including retail shops, food vendors, tailoring, and motorcycle transport services, provide employment opportunities and support the daily needs of the community. Despite challenges such as poor road infrastructure, limited access to financial services, and low business capital, trade continues to grow, driven by tourism, livestock markets, and cross-border interactions with Kenya. Strengthening entrepreneurship skills and improving access to credit could further enhance the contribution of small businesses to the district's local economy.

viii. Employment in Public and Private Sectors

In Ngorongoro District, a portion of the population is employed in both the public and private sectors. Public sector employment includes teachers, healthcare workers, local government officials, and staff working with the Ngorongoro Conservation Area Authority (NCAA). These roles are crucial in providing social services such as education, health, and administration. The private sector, on the other hand, offers opportunities in tourism, hospitality, trade, transport, and non-governmental organizations (NGOs) involved in community development and conservation. However, overall formal employment levels remain low compared to the working-age population, with most residents relying on pastoralism, small-scale farming, and informal businesses for their livelihoods.

f) Social Services

i. Education services

Education in Ngorongoro District faces both progress and persistent challenges. As of 2023, the district has a total of 82 primary schools and 13 secondary schools, including six high schools, with most of these institutions located in Loliondo. The total student population stands at approximately 9,494 learners. Despite ongoing efforts by the government and the Ngorongoro Conservation Area Authority (NCAA) to expand access to education, many children especially from the Maasai communities still face barriers such as long distances to school, early marriages, cultural attitudes, and poverty.

Traditionally, the Maasai community placed limited emphasis on formal education; however, this perception is gradually changing as community leaders recognize the importance of education in adapting to social and economic transformations. The NCAA has supported several initiatives to promote education, including sponsoring students from each ward to attend secondary school and funding the construction of the first secondary school in Endulen Ward. Additionally, vocational training programs have been introduced to equip youth with practical skills such as carpentry, masonry, and tailoring. These combined efforts aim to improve literacy rates and empower the local population to participate more effectively in development and conservation activities.

ii. Health Services

Health services in Ngorongoro District are limited and face significant challenges in accessibility, staffing, and infrastructure due to the district's vast size and scattered settlements. The district has a small number of health facilities, including dispensaries, health centers, and a few faith-based health institutions, but many residents especially those in remote areas must travel long distances to access care. The Ngorongoro Conservation Area Authority (NCAA), in collaboration with the District Council, provides essential health services within the conservation area, focusing on basic healthcare delivery, maternal and child health, and disease prevention programs.

Common health problems in the district include malaria, respiratory infections, diarrheal diseases, eye infections, pneumonia, and maternal health complications. Access to healthcare is further constrained by poor road infrastructure, a shortage of qualified medical staff, and inadequate medical supplies. To address these challenges, the NCAA and the Ministry of Health have initiated programs to improve service delivery, train community health workers, and promote health awareness campaigns within the Maasai and Sonjo communities.

iii. Water Services

Water services in Ngorongoro District face significant challenges due to the semi-arid climate, scattered settlements, and limited infrastructure. Residents rely primarily on natural sources such as rivers, streams, shallow wells, and seasonal springs. In many villages, including remote areas, water scarcity is a persistent issue, forcing residents especially women and children to travel long distances to fetch water.

In Pinyinyi Village, for example, the community depends on hand-dug wells constructed in riverbeds, which are often seasonal and may not provide adequate water year-round. Lake Natron, although nearby, is not utilized for drinking or irrigation because of its high alkalinity and salinity. Access to improved water sources such as boreholes or piped water is limited, and only a small portion of the population benefits from treated or reliable water supply. The scarcity of water significantly affects domestic use, livestock rearing, and small-scale agriculture, highlighting the need for continued investment in sustainable water infrastructure and management programs in the district.

g) Infrastructures

i. Road Infrastructure

Road infrastructure in Ngorongoro District is characterized by a mix of paved and unpaved roads, with significant disparities in accessibility between urban and rural areas. The district's road network comprises approximately 86,472 km of roads in the formal inventory, with 12,786 km categorized as trunk roads and 21,105 km as regional roads The main road from Arusha

to the Loduare Gate, which serves as the primary entry point to the Ngorongoro Conservation Area, is paved. However, the internal road network within the conservation area consists largely of gravel roads, requiring robust vehicles for access. These roads are critical for tourism and conservation activities but are limited in number and quality.

In rural areas, particularly in remote villages such as Pinyinyi, road access is limited, with many roads being seasonal and impassable during the rainy season. This lack of reliable road infrastructure hampers access to essential services, including education, healthcare, and markets, and affects the mobility of pastoral communities.

ii. Electricity

Electricity access in Ngorongoro District is limited, particularly in rural and remote areas. The district benefits from the national grid in some towns and settlements, such as Loliondo, where government-supplied electricity (through the Rural Energy Agency, REA) is available. However, many villages, especially those within or near the Ngorongoro Conservation Area, rely on alternative sources such as solar power, kerosene, and generators.

iii. Telecommunications

Telecommunication services in Ngorongoro District have improved in recent years, yet coverage remains uneven, especially in remote and rural areas. Cellular networks are provided by major companies such as Vodacom, Airtel, Tigo, Halotel, and Yas, with stronger signals concentrated along trunk roads, towns, and more populated villages.

In more remote settlements, including those such as Pinyinyi village, network coverage is weak or intermittent. Residents often face limited access to mobile services such as mobile money (e.g., M-Pesa, Airtel Money, and Mix by Yas), requiring them to travel to nearby towns with better connectivity to perform financial transactions or communicate. Internet access is similarly constrained, impacting educational, health, and business services.

4.4 Archaeology and Cultural Heritage

4.4.1 Introduction

This section presents an assessment of the archaeological and cultural heritage resources within the Project Area of Influence (PAI) for the proposed Trona Extraction and Soda Ash Production Project.

4.4.2 Archaeology Context

The Lake Natron Basin is one of the world's most significant paleoanthropological landscapes. It is situated within the East African Rift System, a region renowned for yielding fossils of early hominins. The project area is in close proximity to major archaeological sites, including:

- Olduvai Gorge (approximately 50 km south): A UNESCO World Heritage candidate site with a fossil record spanning over 2 million years;
- Peninj (Pinyinyi), West of Lake Natron: This site is best known for the Australopithecus boisei mandible, which fits the famous Olduvai Zinjanthropus skull (OH 5) as if they belonged to the same individual. The area is also renowned for containing the earliest Acheulean sites, contemporary with the KBS (Kay Behrensmeyer Site) sites in Ethiopia (Isaac & Curtis, 1974). Palaeoanthropological work at Pinyinyi was first initiated by R.E.F. Leakey and G.Ll. Isaac between 1963 and 1964 (Isaac, 1967). Between 1981 and 1983, an international team under the direction of Isaac investigated the area, followed by a hiatus until 1995, when a Spanish team resumed work in the area. and

- Engaruka (southeast of the lake): An extensive system of ruined stone structures representing a complex of late Iron Age irrigation and settlement.

To date, a total of 27 palaeontological and 8 archaeological localities have been discovered along the western shore of the lake. Most of these sites are located in the Humbu Formation, the lower member of the "Pinyinyi Group" at the top of the Plio-Pleistocene stratigraphical sequence. Archaeological materials and fossil bones appear unevenly distributed in three main areas around the modern Pinyinyi River: the Type Section (Maritanane, Kamare, and Kipalagu), the Southern Escarpment (Bayasi, Karonga North, Karonga South, and East Mugure), and the Northern Escarpment (Mgudulu). These are among the better-known localities, demonstrating the exceptionally high archaeological sensitivity of the project's surrounding landscape.

4.4.3 Cultural Heritage Context

The contemporary cultural landscape is shaped by the indigenous Maasai and Sonjo (Batemi) communities, who have a deep historical connection to the area.

- Maasai Community: The project area is situated within traditional Maasai manyatta (homestead) territories. Key cultural heritage elements identified include:
    - Ereto (Ceremonial Sites): Several ereto (ritual meeting places) used for ceremonies, including the Eunoto (warrior graduation ceremony), were identified within the broader PAI, particularly around the base of the Gelai Volcano. These sites are of supreme spiritual and social importance.
    - Graves and Burial Sites: Isolated burial sites (imanyat) of respected elders are located in the foothills surrounding the lake, including areas near Wosiwosi Village. These are sacred and inviolable. Additionally, the majority of the community bury their beloved deceased within their own land, meaning that burial sites are widely distributed across the landscape and are not limited to a few known locations.
    - Water Sources and Salt Licks: Traditional water wells (laga) and natural salt licks (enkare), which are critical for livestock, hold significant cultural and economic value.
- Sonjo (Batemi) Community: While primarily located in the Engaruka area, the Sonjo community has historical irrigation furrows (mfereji) and settlements in the broader landscape that are of cultural and archaeological significance.
- Lake Natron Itself: The lake is not just an economic resource (for trona) but is a central feature in local oral traditions, considered a sacred landscape element that supports the unique ecology upon which local livelihoods (e.g., pastoralism) depend.

5 STAKEHOLDERS PARTICIPATION AND CONSULTATION

5.1 Introduction

This chapter outlines the stakeholder participation and consultation process undertaken for the Environmental and Social Impact Assessment (ESIA) of the proposed Trona Extraction and Soda Ash Production Project at Lake Natron. Stakeholder engagement is defined as a broad, inclusive, and continuous process between a project proponent and those potentially affected or interested, encompassing a range of activities and approaches throughout the project's life cycle (IFC, 2012).

Effective stakeholder engagement is fundamental to building constructive and responsive relationships that are critical for managing the project's environmental and social impacts. The main objective is to establish and sustain meaningful dialogue with external stakeholders, ensuring early access to relevant project information and providing opportunities for public input into project design and impact mitigation measures.

Stakeholders include individuals, groups, and institutions directly or indirectly affected by the proposed Project, as well as those with an interest or influence over its outcomes, whether positive or negative. For this Project, stakeholder engagement has been an integral part of the ESIA process and serves as the foundation for securing and maintaining the social license to operate. Consultations have been undertaken by MTL Consulting in collaboration with the appointed representatives from WWSL.

5.2 Stakeholder Engagement Principles

The following principles guided the stakeholder engagement process undertaken as part of the ESIA for the proposed Project:

i. Open and Transparent: Relevant information on project activities was shared openly with stakeholders to ensure they had a clear understanding of the project and its potential impacts, except where confidentiality was required for legitimate commercial reasons or to protect stakeholders;

ii. Listening and Dialogue-Based: Stakeholders were given the opportunity to voice their concerns during consultations. Their inputs were taken seriously, and responses were provided to address issues raised;

iii. Participatory: Stakeholders were invited and encouraged to actively participate in the process. The approach was inclusive, considering gender and other factors to ensure that all participants felt valued and had sufficient opportunity to share their perspectives;

iv. Impact-Focused: Consultations prioritized communities potentially affected by the project, addressing both actual and potential negative impacts, and jointly identifying appropriate avoidance and mitigation measures. Other stakeholders indirectly affected were also engaged to ensure a comprehensive understanding of project implications;

v. Safe: Engagement activities were carried out in an environment free from manipulation, interference, coercion, or intimidation;

vi. Effective: Engagement methods and communication materials were tailored to suit the intended audience, ensuring accessibility, transparency, and alignment with human rights standards;

vii. Appropriate: Information was presented in formats adapted to stakeholder needs, with additional support provided to explain technically complex aspects of the project;

viii. Empowering and Responsive: The process empowered stakeholders to express their views and provided clarity on how their feedback would be considered in project planning and decision-making;

ix. Equal and Human Rights Respectful: All stakeholders were given equal opportunity to participate, without discrimination, and in full respect of human rights.

In addition to these principles, the ESIA process applied specific guidelines and protocols to ensure respectful and consistent engagement, manage sensitivities and expectations, and prevent mixed messaging. These included:

i. A protocol for seeking consent when taking and using stakeholder photographs; and

ii. Observance of cultural dos and don'ts during meetings.

5.3 Aim and Objectives

- Formally inform stakeholders on the proposed Project including planned infrastructure developments;
- Involve stakeholders in assessing Project impacts;
- Collect socio-economic baseline data to provide an accurate and current understanding of existing conditions;
- Provide an opportunity for the community to express their views and concerns on the proposed project for positive economic development; and
- Enhance the good relations between WWSL and the communities surrounding the project.

5.4 Identification of Stakeholders

Prior to the site visit, a list of stakeholders was drawn to aid the planning for consultations and data collection. The identification of stakeholders for this Project followed the procedures outlined in IFC Performance Standard 1 (2012) para 26 which requires, the proponent to identify the range of stakeholders that are directly or indirectly affected by the Project. The process considered the surrounding communities, local institutions, agencies, or organizations that are directly or indirectly affected either positively or negatively by the Project. The initial list of stakeholders was compiled based on the literature reviews and mapping results. This was then refined further through consultations with the WWSL while on site. The list of stakeholders identified has been used for the design of the stakeholders' engagement and communication plan.

Table 5.1 provides the full list of key stakeholders that were consulted during the stakeholder engagement process.

Table 5.1: Identified Project Stakeholders

Stakeholder Group	Stakeholders	Relevance to the project
Government Ministries/ Regulatory Authorities	Ministry of Minerals, Resident Mine Office (RMO)	Responsible for issuing a license for the development of the Soda Ash Project and to ensuring enforcement of laws and regulations for mining and protection of the environment in accordance with the Mining Act, Cap. 123, R.E. 2023.
	Ministry of Water Internal Drainage Basin	Responsible for issuing water permits and rights, enforcing laws

Stakeholder Group	Stakeholders	Relevance to the project
	Water Board	and regulations for water quality and utilization as well and ensuring that effluent standards are met
	Ministry of Natural Resource and Tourism	Responsible for overseeing protected areas, conserving biodiversity, and ensuring that development activities, like the proposed Project at Lake Natron, do not harm the environment or tourism resources.
	Ministry of Land, Housing and Human Settlements Development	Issuing right of occupancy on land oversees land use planning and issues related to compensation and resettlement.
	Vice President's Office (Division of Environment) (VPO - DoE)	The Vice President's Office has overall responsibility for planning and implementation of all environmental matters and the articulation of policy and guidelines necessary for the promotion & protection of the environment.
	National Environment Management Council (NEMC)	Enforcement of laws and regulations for environmental management and protection, advisor to the government on all environmental matters, enforce pollution control, and perform the technical arbitration role in undertaking of Environmental Audits and ESIAs.
Government Agencies /Institutions	Tanzania National Roads Agency (TANROADS)	Issuing road works guidelines, standards, and other specifications; and management of road transport infrastructure and associated facilities.
	Tanzania Wildlife Research Institute (TAWIRI).	Responsible for conducting wildlife research, monitoring biodiversity, and providing scientific guidance to ensure that development projects, such as the proposed Trona Extraction and Soda Ash Production Project, do not negatively impact wildlife and critical habitats.
	Tanzania Rural and Urban Roads Agency (TARURA)	Develop and maintain rural and urban road network
	Occupational Safety and Health Authority (OSHA)	Responsible for occupational health and safety in the workplace and the surrounding environment
	Government Chemist Laboratory Agency (GCLA)	Dealing with permits related to chemical handling, management, and usage

Stakeholder Group	Stakeholders	Relevance to the project
	Tanzania Forest Services Agency (TFS)	Dealing with the enforcement of laws and regulations for forest resources management, issuance of permits to conduct activities in the forest reserve areas and oversees the implementation of forest policy.
	Tanzania Electric Supply Company (TANESCO)	Responsible for the generation, transmission, distribution and supply of electricity to consumers.
	Tanzania National Parks Authority (TANAPA)	Management and development of all national parks in Tanzania
	Tanzania Meteorological Authority (TMA)	Responsible for providing weather and climate information/ data, monitoring meteorological conditions, and offering guidance to ensure that project activities, consider climate risks and seasonal variations
	National Development Cooperation (NDC)	Responsible for coordinates and manages development partnerships, including mobilizing and aligning donor support with national development priorities.
	Tanzania Bureau of Standards (TBS)	Responsible for developing, promoting, and enforcing national standards in Tanzania to ensure the quality, safety, and reliability of products and services. It also conducts product certification, testing, inspection, and metrology services to protect consumers and support fair trade and industrial development.
Regional Administration	Arusha Region Region Management Team Regional Commissioner (RC) Regional Administrative Secretary (RAS)	In charge of the regional community welfare, investment development, environmental management, and security. The respective Regional Secretary coordinates and oversees all the developmental programs and projects in the region.
District Administration	Longido District Council Ngorongoro District Council District Management Team including District Commissioner (DC), District Administrative Secretary (DAS), District Executive Director (DED) Heads of Departments	Responsible for people's welfare in the district and responsible for district development. They oversee the general community's welfare (people's rights, environment, security)

Stakeholder Group	Stakeholders	Relevance to the project
Ward Administration	Gelai Lumbwa Ward, Pinyinyi Ward, Mirrugoi Ward	Responsible for ward administration, community development, social welfare, environment and land management
Village Administration	Wosiwosi Village, Magadini Village, Pinyinyi Village, Engaresero Village, Matale Village, Alaililai Village, Ilchang'it Sapukin Village	Responsible for people's welfare in the village and the village development. They oversee the general community's welfare (in terms of people's rights, environment security, and welfare, etc.)
Institution and other International Organisation	United Nations Educational, Scientific and Cultural Organization (UNESCO)	Responsible for promoting the protection and conservation of World Heritage Sites, providing guidance on cultural and natural heritage management, and ensuring that development projects do not negatively impact internationally recognized heritage values
	Ramsar Site Department	Responsible for the conservation and wise use of wetlands designated under the Ramsar Convention, providing guidance to ensure that development projects, do not adversely affect wetland ecosystems and their ecological functions.
	Worldwide Fund for Nature (WWF)	Responsible for promoting biodiversity conservation and sustainable natural resource management, providing guidance and support to ensure that development projects minimize environmental impacts and protect critical ecosystems.
	International Union for Conservation of Nature and Natural Resources (IUCN)	Responsible for providing scientific knowledge, guidance, and policy support on biodiversity conservation and ecosystem management helping to ensure that development projects are designed and implemented in ways that minimize impacts on species and natural habitats.
	Ngorongoro Conservation Area Authority (NCAA)	Responsible for managing and conserving Ngorongoro Area ensuring sustainable use of natural and cultural resources and providing guidance to ensure that development projects do not negatively impact on the area's wildlife, ecosystems, or cultural heritage.

Stakeholder Group	Stakeholders	Relevance to the project
	Tanzania Association of Tour Operators (TATO)	Responsible for promoting sustainable tourism development, representing tour operators' interests, and ensuring that projects do not negatively affect tourism activities or the attractiveness of key natural and cultural sites.
Hunting Companies	Longido GCA North (Michel Mantheakis Safaris Ltd),	Managing wildlife resources within their concession areas and ensuring conservation practices are followed in accordance with national laws and regulations.
	Lake Natron GCA West (Kilombero North Safaris Ltd),	
	Lake Natron GCA South (Robin Hurt Safaris Ltd),	
	Lake Natron GCA East (Green Mile Safaris Ltd),	
	Monduli Juu Open Area (Tanzania Big Game Safaris Ltd),	
	Engasurai Hunting Area - EWMA (Kilombero North Safaris Ltd).	
Groups	Women and Youth Groups	These are groups located at the footprint of the Project and may directly be impacted by the Project,
Community Members	Community members in the villages of Wosiwosi Village, Magadini Village, Pinyinyi Village, Engaresero Village, Matale Village, Alaililai Village and Ilchang'it Sapukin Village, Loondolwa Esirwa Village	These are communities in proximity to the project area, are responsible for providing necessary inputs during project planning, and could potentially be impacted by the mining activities
Individuals	Landowners (community members who own land in villages, generally used for residential, agricultural, hunting and livestock-keeping purposes). Politicians	Community members located in the footprint of the Project may directly be impacted by the Project, in terms of economic and physical displacement
Kenya Relevant Stakeholders	National Environment Management Authority (NEMA)	Responsible for coordinating environmental management and ensuring compliance with environmental laws and policies in Kenya.

(Source: MTL Consulting, 2025)

5.5 Stakeholder Engagement Process

Stakeholder participation was undertaken through a participatory approach where consultations were done in a transparent way, allowing each of the identified stakeholders to comment on the ESIA study specifically on critical issues pertaining to environmental and social concerns through examining potential risks associated with the Project as well as possible mitigation measures. Prior to the consultation meeting, stakeholders were officially

informed through invitation letters. The invitation letter disclosed Project information so as to foster community awareness on the proposed ESIA study and to provide opportunities for stakeholder input and involvement. During discussions, stakeholders were proactively asked for comments in a two-step way to ensure information sharing as well as the reflection of stakeholder views. The methods employed for consultation include meetings, interactive focus group discussions, and informal interviews with the key informants. All participants involved are presented on the consultation form which was signed by each respective stakeholder (Appendix 2 in Volume 2) and the stakeholder consultation pictures are attached in Appendix 5 in Volume 2)

5.6 Stakeholders' Views

5.6.1 Issues Raised by Government Ministries / Regulatory Authorities

a) Vice President's Office (VPO)

The Vice President's Office has overall responsibility for planning and implementation of all environmental matters and the articulation of policy and guidelines necessary for the promotion & protection of the environment. The following views were raised;

- Lake Natron is a Ramsar Wetland of International Importance (Site No. 1050) and the primary breeding site for 75% of the world's Lesser Flamingo population. Its hydrological and ecological sensitivity demands strict environmental protection;
- Any proposed development must meet the highest international environmental standards to prevent irreversible ecological damage. WWSL is required to conduct comprehensive scientific studies demonstrating full compliance with sustainability and accountability frameworks;
- WWSL must adopt only verified clean technologies that protect biodiversity, maintain water quality, and preserve flamingo breeding habitats;
- While Tanzania supports sustainable industrial development, it must never come at the cost of irreplaceable ecosystems like Lake Natron; and
- The VPO expects WWSL to uphold global best practices in environmental management, serving as a model for responsible resource extraction in the country.

b) Ministry of Mineral - Resident Mine Office (RMO) Arusha Region

The ministry is responsible for issuing a license for the development of the project, enforcement of laws and the protection of the environment in accordance with the Mining Act, 2010. RMO was among the listed key stakeholders whom we consulted and raised the following recommendations;

- The proposed project is expected to create employment opportunities for residents of Wosiwosi Village and neighbouring communities;
- The project will contribute to increased income generation for both the local community and the nation at large; and
- The RMO expressed willingness to collaborate closely with the project proponent throughout all phases of the project

c) Ministry of Water- Internal Drainage Basin Water Board (IDBWB)

The ministry is responsible for issuing water permits and rights, enforcing laws and regulations for water quality and utilization, and ensuring effluent standards are met. The following views were raised;

- Lake Natron has been designated as a protected zone since 2019 due to its unique ecological features, particularly as a breeding and nesting site for the Lesser Flamingo. In this regard, the Basin Authority advised that the project proponent should consult the Tanzania Wildlife Authority (TAWA) before proceeding with the project.
- The project proponent should conduct a bathymetric study of Lake Natron and submit the results to the Basin Authority for review.
- A baseline water quality analysis report should be conducted and submitted to the Basin Authority.
- As Lake Natron is a transboundary water body shared between Tanzania and Kenya, the Basin Authority requires the project proponent to notify the Kenyan authorities of the proposed activities.

d) Ministry of Natural Resource and Tourism

The ministry is responsible for overseeing protected areas, conserving biodiversity, and ensuring that development activities, like the proposed Project at Lake Natron, do not harm the environment or tourism resources. The following views were raised;

- A Strategic Environmental Assessment (SEA) should be conducted to assist the Government in determining the most appropriate way forward for this initiative. This process will also help evaluate both the potential benefits and the possible adverse impacts of the proposed project;
- All communities and relevant authorities within and around the project area including the Tanzania Wildlife Authority (TAWA) and local residents should be fully involved through public meetings to gather their views and address any concerns that may arise within the community;
- The Ministry of Natural Resources and Tourism should be fully engaged in all stages of the SEA process to ensure proper coordination and consideration of tourism and conservation interests.
- Lake Natron is protected under the Ramsar Convention. Establishing industries in this area would damage its international reputation and create diplomatic tension with the Ramsar Secretariat;
- The project endangers the breeding grounds of 1.5 - 2.5 million Lesser Flamingos (about 75-80% of the global population) and rare fish species found only in Lake Natron;
- Mining will disrupt the lake's hydrology and the algae that feed flamingos, leading to a decline or loss of the species;
- The project area forms part of a vital wildlife corridor linking Ngorongoro, Lake Manyara, and Tarangire ecosystems. Industrial development would obstruct migratory routes, threatening wildlife movement and genetic diversity;
- Given that the area is semi-arid, with limited rainfall and extreme temperatures exceeding 40°C, the project would intensify water shortages. This scarcity is likely to trigger conflicts among communities, livestock keepers, and wildlife competing for the same limited water sources;
- Dust and chemical emissions from industrial activities would increase local temperatures and release pollutants harmful to biodiversity, human health, and air quality around Lake Natron;
- Regional research from Lake Magadi, Kenya, demonstrates that similar soda ash mining projects have led to environmental degradation, water scarcity, poor public health, and minimal community benefits even after 150 years of operation;

- Lake Natron's unique landscape and large flamingo colonies are major tourist attractions that contribute significantly to the local and national economy. Environmental degradation would harm the tourism industry, particularly in Engaresero Village a key tourism hub leading to the closure of lodges, campsites, and loss of community income;
- Establishing the factory would likely result in the displacement of pastoralist and tourism-dependent communities, disrupting their livelihoods, culture, and socio-economic stability; and
- The proposed site overlaps with a licensed tourist hunting block operated by Adam Clemence Safari Ltd under TAWA's management. Proceeding without involving these key stakeholders could lead to legal disputes and potential litigation against the Government.

5.6.2 Issues Raised by Government Agencies / Institutions

a) Occupational Safety and Health Authority (OSHA)

This institution is responsible for occupational health and safety in the workplace and the surrounding environment. The following views were raised;

- The Project should be registered with OSHA during both the construction and operation phases in accordance with Section 16 of the Occupational Safety and Health (OHS) Act;
- An Occupational Health and Safety (OHS) Policy Statement should be prepared as required under Section 96 of the OHS Act;
- Detailed OHS Policy Implementation Guidelines should also be developed in compliance with Section 96 of the OHS Act;
- An OHS Risk Assessment Report should be conducted in line with Section 60 of the OHS Act;
- A comprehensive First Aid Program should be established, including the provision of first aid facilities, training of first aiders certified by OSHA, and preparation of an emergency evacuation plan. All cases (minor or major) must be recorded in compliance with Section 58 of the OHS Act and the OSH First Aid and Welfare Facilities Rules, 2015;
- Safety and Health Representatives should be trained in accordance with Section 11 of the OHS Act;
- An OHS Committee should be formed as required under Section 13 of the OHS Act;
- The OHS Committee should hold regular meetings and maintain records of discussions and resolutions in compliance with Sections 13 and 14 of the OHS Act;
- Health and welfare provisions must adhere to OHS standards, including the supply of clean and safe drinking water (Section 54), proper sanitary conveniences (Section 55), adequate washing facilities (Section 56), accommodation for clothing (Section 57), and appropriate facilities for resting (Section 59); and
- Appropriate Personal Protective Equipment (PPE) should be provided to all workers in compliance with Section 62 of the OHS Act.

b) Tanzania Wildlife Research Institute (TAWIRI).

The Institute was consulted through its researchers, Dr. Asanterabi Lowasa and Dr. Wilfred Marealle, who visited both the proposed project site and Magadi, Kenya, for comparative analysis. Based on their assessment, the following recommendations were provided:

- The project should implement bird collision prevention measures to protect migratory and resident bird species;

- The project should manage water quality to sustain the ecological conditions necessary for flamingo conservation;
- The project should monitor brine and recycled water regularly for potential heavy metal contamination;
- The project should conduct continuous monitoring of flamingo populations and their habitats to detect and address ecological changes;
- The project should enforce air pollution control measures and adopt emission reduction strategies in all project operations;
- The project should ensure compliance with national regulations and international environmental agreements relevant to wildlife and habitat protection;
- The project should prevent land-use conflicts with investors by prioritizing community engagement and ensuring socio-economic benefits for local residents;
- The project should support government revenue generation through transparent and effective resource management;
- The project should designate and regulate trona extraction points to minimize environmental and social impacts; and
- The project should organize public hearings to enhance transparency and promote stakeholder participation in decision-making processes.

c) Tanzania Meteorological Authority (TMA)

This institution is responsible for providing weather and climate information/ data, monitoring meteorological conditions, and offering guidance to ensure that project activities, consider climate risks and seasonal variations. The following views were raised;

- The project should obtain weather data, including rainfall, wind patterns, and relative humidity, from the Authority throughout the project implementation period to support effective environmental monitoring and management

d) Tanzania National Park (TANAPA)

This institution is responsible for management and development of all national parks in Tanzania. The following views were raised;

- The project is expected to bring substantial economic benefits to the adjacent communities and the country at large;
- TANAPA recommends that all residual impacts of the project be carefully addressed and that practical mitigation measures be effectively implemented.
- Based on the anticipated economic benefits, TANAPA expresses positive support for the project.

e) Ngorongoro Conservation Area Authority (NCAA)

The institute is responsible for managing and conserving Ngorongoro Area ensuring sustainable use of natural and cultural resources. The following issues were raised;

- The ESIA should be comprehensively address all aspects of the proposed project from baseline conditions and potential environmental and social impacts (including cumulative effects) to detailed mitigation measures, monitoring plans, and compliance with relevant legal and regulatory frameworks;
- All stakeholders, especially local communities and conservation entities, must be fully involved throughout the project planning and implementation stages to ensure their concerns and interests are properly integrated;

- Although local communities around Lake Natron do not depend directly on the lake for fishing or water supply, they should still be actively engaged to ensure their social and economic interests are respected and incorporated into project decisions;
- To prevent irreversible environmental and social impacts, a rigorous, multi-component monitoring program should be implemented. This should include regular monitoring of avifauna adaptation, lake-water chemistry, air quality (especially nitrogen and phosphorus deposition), and wildlife populations. The program should set baselines, establish thresholds, enable stakeholder participation, and include adaptive management mechanisms;
- The project should integrate sustainability into its operations by adopting eco-industrial tourism models, combining mineral production with conservation education to promote both ecological protection and economic development; and
- NCAA has no objection to the proposed project, provided that the ESIA is conducted thoroughly and that the project incorporates strong environmental safeguards, community engagement, and continuous monitoring to ensure long-term conservation and sustainable development.

f) Tanzania Wildlife Authority (TAWA)

- Lake Natron hosts about 75% of the world's Lesser Flamingo population, making it a globally significant breeding site. Any industrial activity, including soda ash extraction, could adversely affect the ecology of this species. Therefore, a comprehensive Environmental and Social Impact Assessment (ESIA) should be conducted before project implementation; and
- The proposed project area falls under TAWA's jurisdiction and is part of a licensed tourist hunting block managed by Adam Clement Hunting Company. Hence, TAWA should be fully consulted and involved throughout the project planning and implementation stages.

g) Tanzania Association of Tour Operators (TATO)

- The project is not expected to negatively affect biodiversity or tourism activities in the area;
- The project will bring economic and social benefits to the surrounding communities if implemented responsibly;
- TATO acknowledges that the project appears to consider both conservation concerns and national development goals; and
- WWSL is encouraged to implement logical and effective mitigation measures during project implementation to ensure environmental and social sustainability.

h) National Development Cooperation (NDC)

- The Soda Ash Project at Lake Natron can be implemented, given that the Lesser Flamingo population is not significantly disturbed to an extent that would affect their breeding

i) Tanzania Rural and Urban Roads Agency (TARURA)

The proposed project should prioritize the improvement of key access roads connecting Longido to Wosiwosi to enhance accessibility and mobility. Currently, the following roads are in poor condition and require urgent rehabilitation:

- The Matale-Wosiwosi Road (60 km), which is presently in poor condition.
- The Gelai Lumbwa-Magadini Road (45.8 km), which is also in poor condition.

j) Tanzania Bureau of Standards (TBS)

The project proponent is advised to ensure product certification through the Tanzania Bureau of Standards online platform (TBS website) by utilizing the e-service application system. In addition, the project should comply with the following applicable standards: TZS 860 and TZS 845. Adherence to these standards will ensure product quality, safety, and compliance with national regulatory requirements.

k) Tanzania National Roads Agency (TANROADS)

- The project proponent should ensure that transportation of soda ash complies with the requirements of Tanzania National Roads Agency, particularly with respect to axle load control regulations. All vehicles used for transporting materials must adhere to the prescribed axle load limits to prevent damage to road infrastructure.
- The project proponent should ensure that soda ash products comply with relevant national standards, including adherence to applicable Tanzania Standards to guarantee product quality and safety.
- the project should consider the potential impact of heavy vehicle traffic on road conditions and ensure that appropriate measures are in place to minimize deterioration of roads and maintain safety standards.

5.6.3 Issues raised by District Authorities

a) Longido District Council

- The proposed Soda Ash Project at Wosiwosi Village is expected to generate revenue and promote development at both local and national levels, bringing significant benefits to the community if implemented and managed sustainably;
- The owner of the hunting block within the Lake Natron Game Controlled Area (North), Mr. Adam Clemence, should be consulted and engaged during the implementation of the proposed Soda Ash Project to prevent potential conflicts in the future;
- All stakeholders involved in flamingo conservation should be engaged during the assessment to gather their views and ensure that the Project is implemented without adversely affecting the flamingo population in the area;
- All stakeholders should be involved in all phases of the Project;
- The positive impacts of the Project can be maximized through a strong commitment to:
  - Environmental conservation and responsible resource management;
  - Transparent and continuous engagement with communities and other stakeholders; and
  - Promotion of health, safety, and cultural preservation initiatives.
- The Project should prioritize employment opportunities for local residents during both construction and operation phases to improve livelihoods and enhance community well-being;
- The Project is expected to improve local infrastructure, particularly roads within Wosiwosi Village, and stimulate economic growth in the surrounding communities.
- The District Council is expected to benefit from the proposed Project through the payment of service levies by the project proponent;
- Grievances from Project Affected Persons (PAPs) should be addressed carefully, and adequate guidance should be provided to help them use their compensation funds wisely;

- Awareness campaigns on the prevention and control of HIV/AIDS and other communicable diseases should be conducted throughout the Project implementation period;
- Continuous community engagement should be maintained throughout the implementation of the Project to ensure transparency and local participation;
- Measures should be put in place to prevent Gender-Based Violence (GBV) and Violence Against Children (VAC) during all stages of Project implementation; and
- The Council expressed its willingness to support the implementation of the project, provided that all statutory requirements, including the ESIA certificate and other relevant approvals, are duly followed

b) Ngorongoro District Council

The proposed project may result in several environmental and social impacts that require careful consideration and mitigation:

- Impacts on Water Resources:
- Increased water demand for soda ash extraction may place pressure on available water resources.
- Potential reduction in freshwater availability could affect local communities, wildlife, and livestock.
- Water Pollution and Soil Contamination:
- Discharge of saline waste may degrade water quality.
- Improper handling of chemical residues could lead to soil contamination.
- Impacts on Biodiversity:
- The project area is part of a globally significant ecosystem.
- It serves as a breeding site for lesser flamingos and other wildlife species, which may be affected by project activities.
- Land Degradation:
- Project activities may lead to land degradation and disruption of natural habitats.

Given these potential impacts, the project should be implemented in full compliance with established Environmental Impact Assessment (EIA) frameworks, ensuring that appropriate mitigation measures are identified and applied to address all anticipated impacts.

c) Ngorongoro District Executive Director (DED)

The proposed project is acknowledged for its potential socio-economic benefits; however, the following key concerns were raised:

- There is a need to ensure that the project is sustainable in the long term, particularly in relation to environmental protection and resource use.
- The project may affect natural resources within the area, and appropriate measures should be in place to safeguard them.
- The economic feasibility of the project should be clearly demonstrated, including how benefits will be distributed to local communities.
- The project appears to rely heavily on water availability, which may pose risks given the sensitivity of the area.
- The project is located in an ecologically sensitive area, which requires careful planning and strict adherence to environmental regulations

- The area supports important socio-economic activities such as livestock keeping and other livelihood practices, which should not be negatively affected by the project.
- The Government and local authorities rely significantly on tourism revenues generated from the Engaresero/Lake Natron area. Therefore, the project should be implemented in a manner that does not interfere with or reduce opportunities for revenue collection from tourism activities.
- The project should ensure inclusive participation of all relevant stakeholders, particularly local communities surrounding the Lake Natron area, throughout the project lifecycle.
- Project benefits should be clearly defined, communicated, and equitably shared among relevant stakeholders, especially the local communities.
- Site validation is essential and should be conducted through a participatory approach involving key stakeholders to enhance transparency and acceptance.
- The final Environmental Impact Assessment (EIA) report should be shared with all relevant key stakeholders to ensure transparency and promote informed decision-making.

5.6.4 Issues raised by International Organisations

a) Bird life International and Nature Tanzania

- The proposed Soda Ash mining at Lake Natron would critically disrupt the lake's fragile ecosystem, threatening the world's only regular breeding ground for the Lesser Flamingo and damaging the unique cyanobacteria-based food chain that sustains it;
- Mining operations would alter salinity and water levels, cause pollution, and fragment habitats leading to long-term biodiversity loss and degradation of surrounding freshwater sources;
- The project would displace local Maasai communities, restrict access to grazing lands and water, erode cultural heritage, and potentially trigger resource-based conflicts and health risks from water contamination;
- Short-term industrial gains would undermine long-term economic opportunities such as ecotourism, which currently provides sustainable income and employment while preserving the area's ecological and cultural integrity;
- Similar soda ash mining at Lake Magadi, Kenya, and the previously rejected TATA proposal for Lake Natron demonstrate that such projects lead to environmental degradation, community grievances, and minimal socio-economic benefits underscoring the need to prioritize conservation and sustainable development alternatives;
- Investors seeking soda ash extraction opportunities should focus on less ecologically sensitive sites, such as Lake Engaruka, or consider sustainable ventures like ecotourism that provide socio-economic benefits without compromising biodiversity and local livelihoods.

b) International Union for Conservation of Nature and Natural Resources (IUCN)

- Lake Natron, a Ramsar-designated wetland, is the only regular breeding site for East Africa's Lesser Flamingo. The proposed dredging, chemical processing, and infrastructure development threaten to alter its chemistry and disrupt the food chain that supports flamingos and other endemic species;
- The Lesser Flamingo's breeding success relies on a narrow range of hydrological and chemical conditions, including specific water depth, salinity, and predator-free nesting islands. Any alteration to water levels, salinity, or shoreline structure caused by the

proposed project could eliminate or flood nesting areas, making successful breeding impossible;

- The proposed extraction of one million metric tons of soda ash annually, regardless of technology or method, represents a major ecological risk. The scale of this operation could severely disrupt the delicate balance between conservation and industrial development at Lake Natron;
- Habitat loss and degradation from construction, pollution, and hydrological disturbance would not only affect flamingos but also other waterbirds and aquatic biodiversity, leading to long-term ecosystem collapse;
- The project's large water demand poses severe risks to freshwater availability and groundwater integrity, potentially leading to aquifer depletion, pollution, and degradation of the lacustrine habitat;
- Assertions that the project can coexist with flamingo populations, as seen at Lake Magadi, are scientifically inaccurate. The hydrology and ecology of Lake Natron differ significantly, and evidence from Magadi shows that flamingo breeding attempts there have been unsuccessful. Any changes to salinity, water levels, or shoreline morphology will disrupt the delicate conditions necessary for flamingo nesting success;
- Lake Natron's hydrology and ecology are interconnected with Kenya through the Ewaso Ng'iro River. The ESIA should assess cumulative and transboundary impacts, including potential conflicts over shared water resources, in line with the Transboundary Ecosystems Management Bill (2010);
- All key stakeholders should be actively involved in all phases of the project to ensure their views, concerns, and insights inform the project's planning and decision-making process;
- The project threatens the livelihoods and cultural identity of local Maasai communities who rely on the surrounding landscape for grazing, water, and cultural practices. Industrialization in this sensitive area may lead to displacement, health risks, and social conflict over limited resources;
- IUCN emphasizes that a Strategic Environmental Assessment (SEA) at the basin level is required before any project approval. Independent studies by qualified experts must reassess ecological, hydrological, and socio-economic impacts using updated, peer-reviewed scientific data;
- Given the environmental sensitivity of Lake Natron, industrial soda ash mining is not a viable option. The government's initiative to develop soda ash extraction at Engaruka Basin offers a more suitable alternative that avoids critical ecological zones.

c) United Nations Educational, Scientific and Cultural Organization (UNESCO)

- Lake Natron's protection is a global responsibility, as it is a Ramsar and transboundary ecosystem shared by Tanzania, Kenya, and Uganda. Its degradation would disrupt the regional tourism circuit and risk diplomatic tensions over shared natural resources;
- The Commission notes that sustainable soda ash extraction can be compatible with conservation if development integrates environmental protection, poverty reduction, and economic growth;
- Mining should be restricted to areas outside critical breeding zones of the Lesser Flamingo. The shallow salt flats and inner lake areas must remain undisturbed, while peripheral zones may be considered for controlled extraction;
- Solution mining should be prioritized as it minimizes surface disturbance, reduces ecological impact, and enhances miner safety compared to conventional methods;

- WWSL should enforce all proposed mitigation plans protecting breeding habitats, maintaining water quality and flow, and preventing disturbance or predation at nesting sites to ensure long-term conservation of flamingos;
- Regular Environmental Monitoring and Environmental Audits (EA) should be conducted to assess air and water quality impacts. The project should comply fully with national and international environmental standards, including Ramsar obligations.; and
- The Commission advises adopting sustainable extraction practices modelled on successful approaches at Lake Magadi, ensuring environmental integrity and socioeconomic benefits coexist.

d) Consultation with Coordinator for the Ngorongoro Lengai UNESCO Global Geopark and Head of Museum Geopark Programs at the Ngorongoro Conservation Area Authority (NCAA)

- Although the proposed trona extraction activities will be conducted within Lake Natron, which lies outside the Ngorongoro Lengai UNESCO Global Geopark (UGGp) boundary, some permanent project facilities and logistical activities are proposed to be located within the Geopark boundary, as indicated on the project layout map;
- According to the UNESCO Global Geoparks Operational Guidelines, Article 3(vii), extraction of minerals, fossils, or rock products for business purposes is prohibited within UNESCO Global Geopark territories
- It was recommended that the project facilities be relocated outside the Geopark boundary, particularly towards the Gwara, Hemah, or Mtowabaga areas.

e) Worldwide Fund for Nature (WWF)

- WWSL should conduct a Strategic Environmental Assessment (SEA) at the ecosystem level, covering Engaruka, Lake Natron, and cross-border systems, including cumulative impacts of water use, infrastructure, and climate variability, in line with EAC protocols;
- WWSL should conduct a high-standard Environmental Impact Assessment (EIA) with independent ecological reviewers, including data on transboundary water systems and migratory species, and make the EIA publicly available for peer review;
- WWSL should identify and legally protect no-go zones such as hydrological recharge areas, flamingo breeding sites, and wildlife corridors, maintaining 3 - 5 km buffer zones around key wetlands;
- WWSL should apply the Free, Prior, and Informed Consent (FPIC) principle through genuine community consultations, ensuring benefit-sharing, livelihood co-development, and land tenure protection;
- WWSL should establish a Regional Environmental and Social Monitoring Platform, jointly managed by communities, conservation groups, and government, to monitor groundwater, air quality, bird nesting, and grazing access;
- WWSL should strengthen regional and transboundary governance by working with the EAC and Lake Natron-Magadi Basin stakeholders to co-develop water governance, early warning systems, and disaster risk reduction plans; and
- WWSL should adopt clean technologies and circular production systems, committing to zero-liquid discharge, renewable energy, and low-carbon soda ash production aligned with climate-smart industrial goals.

5.6.5 Issues Raised by Local Government Authority

- The project will lead to loss of grazing areas for livestock keepers;

- The community is concerned that the project will cause destruction of flamingo breeding habitats;
- The community requests the WWSL to clearly demarcate and communicate project boundaries before implementation to prevent future land disputes;
- The community requests to be involved in all phases of the project and to be given an
- opportunity to provide their views;
- The WWSL is requested to allow surrounding communities to collect soda ash for domestic use;
- The project will contribute improved social services, including schools, health facilities, and transport infrastructure;
- Employment opportunities be given first to local youth, especially those from villages surrounding Lake Natron who currently migrate in search of work;
- If the project extracts water from River Ewaso-Ngiro , it will deprive the community of water for domestic use and agriculture;
- Beyond legal CSR obligations, the community requested WWSL to implement additional community development projects that will benefit surrounding villages;
- Employment opportunities should be shared fairly among all neighbouring communities to promote inclusiveness;
- CSR revenues should be distributed equitably to avoid potential conflicts between WWSL and local communities;
- The project is expected to reduce available pastureland for livestock, which may negatively affect pastoral livelihoods and threaten food security for local communities;
- Dust, chemical emissions, and effluent from the project may contaminate air and water sources, posing health risks to humans, livestock, and aquatic life;
- Industrial activity and reduced flamingo populations will negatively affect tourism, impacting local income and businesses that rely on eco-tourism;
- Increased industrial activity and interaction with outsiders could undermine traditional customs, social cohesion, and the cultural identity of the community;
- Without fair allocation, local youth may lose opportunities in tourism-related and other economic activities, leading to economic inequality;
- The project may trigger disputes over land ownership and use, especially if boundaries are unclear or local communities are excluded from planning decisions;
- Communities that depend on collecting Magadi for domestic use may be deprived of this resource, affecting household livelihoods and traditions;
- Industrial operations, including factories and heavy machinery, may raise local temperatures and create microclimatic changes in the area;
- Construction and industrial activities could destroy habitats for native wildlife, disrupt migration routes, and reduce biodiversity in the area;
- The project may compromise the natural scenic beauty and ecological integrity of the area, affecting both wildlife and the environment's aesthetic value;
- The influx of workers could strain local resources, increase demand for land, water, and social services, and create social tensions within the community;
- The WWSL should establish and implement effective mitigation measures to prevent land conflicts during project implementation;
- Transportation of soda ash, including by train, could pose risks to livestock, wildlife, and community members if safety protocols are not strictly enforced;

- Without proper education and awareness programs, vulnerable groups may be exposed to social risks and exploitation;
- Water is still a challenge hence the local community requests WWSL to support efforts in addressing the ongoing water shortage. They suggest utilizing the Engasero River as a reliable water source through proper pumping and distribution systems;
- The community requests WWSL's assistance in constructing a residential house for the health worker to strengthen healthcare delivery in the village;
- The community requests for WWSL's support in building three teachers' houses at the existing primary school to improve learning conditions; and
- The community requests WWSL to improve the access road from Gelai Lumbwa to Wosiwosi, which is currently in poor condition and limits transportation and service delivery.

5.6.6 Issues Raised by Hunting Blocks Companies

a) Lake Natron GCA North (Adam Clements Safaris Ltd),

- Adam Clements Safaris Ltd is a tenant within the proposed project area. However, since the area falls under the jurisdiction of the Tanzania Wildlife Management Authority (TAWA), the company recommends consulting the authority to obtain official comments on the project.

5.6.7 Issues raised by National Environment Management Authority (NEMA) in Kenya

- Flamingo breeding sites should be clearly identified, demarcated, and strictly protected from mining and development activities.
- Processing facilities, including factories and associated infrastructure, should be located at least 500 meters away from residential settlements to minimize potential impacts.
- Continuous monitoring of both surface water and groundwater should be undertaken, focusing on water levels, quality, and chemical characteristics.
- Given the environmental sensitivity of the area, a water treatment plant should be established prior to any discharge of effluent to ensure compliance with environmental standards.
- The use of advanced and environmentally sound technologies is strongly recommended. It is noted that appropriate technology can significantly reduce environmental impacts, potentially mitigating up to 75% of anticipated effects.

5.7 Analysis of Key Issues Raised

5.7.1 Project Benefits

The proposed Soda Ash project is expected to bring substantial benefits to both the nation and local communities. At the national level, WWSL will contribute through payment of all statutory taxes, government fees, and service levies, while employees will also contribute via PAYE, supporting public revenue and regional development. At the local level, the project will create employment opportunities for approximately 300 people, who will reside in accommodations constructed by WWSL. Their presence will generate demand for food and other goods, providing local farmers and traders with a reliable market, thereby stimulating economic activity and money circulation within the villages and district.

Moreover, the project will promote capacity building and skills transfer, addressing the limited technical knowledge of local communities in soda ash extraction and production. Through targeted training programs, residents can acquire both technical and managerial skills, enhancing long-term employability, self-reliance, and participation in industrial activities.

These combined benefits are expected to foster sustainable local economic development and improved livelihoods.

5.7.2 Employment Opportunities

Employment was a key concern raised during engagement meetings with stakeholders, including local communities and government officials. In Tanzania, employment is governed by the National Employment and Labour Relations Act (No. 6 of 2004), which under Section 7(1) provides for equal employment opportunities. Additionally, Regulation 21(1) of the Mining (Local Content) Regulations, 2018, requires mineral license holders to report quarterly to the Mining Commission on the number of Tanzanians employed, along with their job descriptions.

For the proposed Soda Ash project, employment opportunities will be open to all qualified Tanzanians. During the construction phase, the project plans to employ approximately 100 workers, with this number expected to increase to 300 during the operation phase. Community representatives are encouraged to support local youth in acquiring relevant skills through vocational training in Longido District and the Arusha Region. WWSL can further assist by promoting awareness of skill development and its importance for accessing employment opportunities.

Stakeholders emphasized that employment should prioritize local communities in the project area. Where local skills are insufficient, the project may source workers externally, but opportunities should be distributed fairly across all surrounding wards and villages. Job advertisements should be transparent and circulated through village offices, allowing qualified community members to apply. For positions that do not require specialized skills, equal distribution among surrounding villages is recommended. This approach ensures broader community participation, helps build trust, and contributes to the project securing a social license to operate.

5.7.3 Corporate Social Responsibility (CSR

Corporate Social Responsibility (CSR) was a key issue raised by consulted stakeholders, who emphasized the importance of ensuring that communities benefit directly from the proposed project through CSR programs. Stakeholders also highlighted the need for the project to support additional community development initiatives beyond legally mandated CSR obligations to maintain positive relations and trust with local communities.

CSR initiatives by the project not only provide direct benefits to surrounding communities but are also a legal requirement under Section 105 of the Mining Act Cap 123 (R.E 2023). Given the high levels of poverty in communities around the proposed project, CSR programs can play a critical role in addressing social and environmental challenges. Typical initiatives focus on improving public services, including healthcare, education, water supply, and skills development for the local workforce.

Furthermore, implementing CSR programs serves as a practical mitigation measure against potential social and environmental impacts of the project, such as population influx and increased demand on local services. By enhancing local infrastructure and service delivery, CSR initiatives can help alleviate pressure on existing community resources. WWSL is committed to working closely with the Longido and Ngorongoro District Councils to design sustainable CSR programs that provide long-term socio-economic benefits to the districts, even beyond the life of the mine. These programs will be aligned with national legislation and

international development frameworks, including the Millennium Development Goals, to ensure they are both effective and sustainable

5.7.4 Loss of Grazing Land and Property

WWSL holds two sodium carbonate prospecting licenses PL 12236/2023 covering approximately 291.41 sq. km and PL 13190/2025 covering approximately 88.65 sq. km. The proposed Soda Ash project will require a significant portion of this land to accommodate the processing plant and supportive infrastructure, including worker accommodations, recreational facilities, sanitation facilities, workshops, market spaces, schools, places of worship, weighbridges, radio communication towers, and management estates.

During stakeholder consultations, villagers raised concerns about potential relocation, referencing the Engaruka Soda Ash project where local communities were displaced. WWSL clarified that the proposed mining will occur in Lake Natron, and unlike Engaruka, it will not require relocation of existing homes. Nonetheless, villagers requested that WWSL clearly communicate and demarcate project boundaries before implementation. This will ensure that local communities are aware of the project area, prevent future land disputes, and facilitate transparency.

The issue of fair and timely compensation for land and any property or land-use rights was highlighted as a critical concern. Villagers emphasized that land-use value and compensation are often the most significant negative impacts of large development projects. The current project site primarily consists of pasture lands near Lake Natron, with no houses within the immediate area (approximately 1 km from the lake), which reduces the risk of displacing residential properties but underscores the importance of addressing compensation for grazing land and other community resources.

5.7.5 Flamingo Conservation and Ramsar Site Considerations

Different stakeholders raised concerns that Lake Natron is a Ramsar-designated wetland of international importance and serves as the primary breeding site for approximately 75% of the world's Lesser Flamingo population. The lake's unique hydrology, salinity, and shallow mudflats are critical for flamingo nesting and breeding. Any alteration to water levels, salinity, or shoreline morphology due to industrial activities, such as soda ash extraction, dredging, or infrastructure development, could disrupt the breeding cycle, reduce food availability, and lead to long-term population declines. Additional potential impacts include disturbance from increased human activity, noise, and the presence of machinery, which could drive flamingos away from traditional breeding sites.

Some stakeholders also highlighted that the soda ash project might not pose significant impacts on flamingos, citing existing operations at Lake Magadi in Kenya, where flamingos continue to thrive. WWSL clarified that it has conducted comprehensive studies to determine the optimal location for the project, identifying Wosiwosi Village as the most suitable site for the plant and mining activities. WWSL further confirmed that it will implement mitigation measures to ensure that all identified impacts on the flamingos and their habitat are minimized during project implementation.

5.7.6 Stakeholder Engagement and Participation

Consulted stakeholders expressed the need to receive feedback on all studies conducted to address fears and negative perceptions about the project. Stakeholder engagement is a requirement under both Tanzanian legislation and international standards, particularly the IFC

Performance Standards. Specifically, Section 89 (subsections 1 & 2) of the Environmental Management Act CAP 191 R.E 2023, Regulation 17 of the EIA & Audit Regulations 2005 (as last amended in 2024), and IFC PS1, paragraphs 25-36, all advocate for meaningful and continuous stakeholder consultation. During consultations, stakeholders acknowledged that WWSL has actively involved the community and kept them informed about the project's development, including during feasibility studies.

As part of the ESIA process for the Soda Ash Production Project, various stakeholders provided comments and raised concerns. They emphasized the importance of understanding how WWSL plans to address these concerns, the potential risks or impacts, the mitigation measures to be implemented, and the monitoring mechanisms that will be applied. Therefore, it is essential that all consulted stakeholders receive timely and transparent feedback on the issues raised during engagement sessions. Appendix 6 of Volume 2 provides a detailed summary of stakeholder concerns and the corresponding responses provided by WWSL.

Given that the Soda Ash Production Project will have environmental and social impacts, stakeholder consultation is an ongoing process rather than a one-off exercise. Continuous engagement enables stakeholders to better understand the project, provides an avenue for them to express their concerns, and allows WWSL to obtain valuable insights that can improve project design and implementation. By actively listening to stakeholder feedback, WWSL can enhance its management of potential risks and ensure that project outcomes are socially acceptable, environmentally sustainable, and aligned with community expectations.

5.7.7 Community Health, Safety and Security

Community health, safety, and security were key concerns raised during stakeholder consultations. Community members expressed apprehension that the influx of people into the project area seeking employment and business opportunities could increase the transmission of infectious diseases, including HIV/AIDS, due to heightened social interactions. Without adequate education and access to preventive measures, the risk of sexually transmitted infections (STIs), such as HIV/AIDS, may rise.

Other potential health and safety impacts associated with the increased population include heightened social disturbances, such as alcohol and drug misuse, which could negatively affect public safety. Additionally, if employment opportunities are insufficient for those relocating to or already residing in the project area, some individuals may resort to theft or other criminal activities to access the increased wealth associated with the project.

Project activities, infrastructure development, and equipment use may also expose the community to various risks. These include changes in traffic and transportation patterns, water and sanitation challenges, handling of hazardous materials, impacts on natural resources and ecosystems, and potential abuses by security personnel. The IFC Performance Standard 4 (Community Health, Safety, and Security) emphasizes the need to avoid or minimize risks and impacts on communities arising from project activities, with particular focus on vulnerable and marginalized groups. Furthermore, IFC Performance Standard 2 (Labor and Working Conditions) addresses occupational health and safety issues, ensuring safe working conditions for employees. The project will need to comply fully with these standards to maintain community health, safety, and security throughout its implementation.

5.7.8 Awareness Raising on road safety and HIV/AIDs

Consulted stakeholders highlighted the importance of road safety awareness for the entire community, particularly for residents living along the project access roads, to minimize the risk of traffic accidents. They also emphasized the need for comprehensive education on reproductive health and sexually transmitted diseases (STDs), including HIV/AIDS. This concern is particularly relevant during both the construction and operational phases, when increased interactions between people from different areas could elevate the risk of disease transmission. HIV/AIDS poses significant challenges to the construction sector, affecting workers, enterprises, and the broader economy, with construction workers being vulnerable due to their mobility and separation from families.

To mitigate these risks, stakeholders recommended implementing targeted awareness programs for both the community and project workers. These programs should actively involve key local actors such as community development officers, teachers, religious leaders, and traditional leaders to ensure broad reach, cultural relevance, and effective behaviour change. By engaging these stakeholders, the project can promote safer practices, reduce health risks, and foster community well-being throughout the project lifecycle.

5.7.9 Cultural Interference

The influx of people drawn by employment and project-related activities will inevitably create cultural interference, presenting both opportunities and risks for the indigenous Maasai and Sonjo communities. On the positive side, interaction with a diverse workforce can foster cross-cultural exchange, introduce new skills and ideas, and provide local residents with economic opportunities that enhance livelihoods without requiring them to abandon their cultural identity. The project's local employment and procurement initiatives can further empower the community, while improved infrastructure may strengthen social services that support traditional settlement patterns. However, unmanaged cultural interference carries significant risks, including the erosion of traditional values and norms, land-use conflicts, and social tensions arising from differences in language, ethnicity, and economic status. The concentration of a transient population may also lead to challenges such as competition for natural resources, strain on traditional governance structures, and behaviors that conflict with local customs. To harness the positive aspects while mitigating negative impacts, the project will implement a robust stakeholder engagement framework, enforce a workforce code of conduct, provide cultural orientation training, and maintain accessible grievance mechanisms that respect traditional decision-making processes. Through these measures, the project aims to manage cultural interference proactively, ensuring that the benefits of economic development do not come at the expense of the cultural heritage and social cohesion of the host communities.

5.8 Post ESIA Engagement

Post-ESIA engagement is a essential component of the Environmental and Social Impact Assessment (ESIA) process, ensuring that all stakeholders continue to be informed, consulted, and involved throughout the life cycle of the proposed Soda Ash Project. After the completion of the ESIA study, WWSL has committed to maintaining an open and transparent dialogue with all relevant stakeholders, including local communities, government authorities, non-governmental organizations, and international conservation bodies. The objective of post-ESIA engagement is to provide feedback on the findings of the ESIA, address concerns raised

during earlier consultations, clarify mitigation measures, and strengthen stakeholder confidence in the project.

Stakeholders consulted during the ESIA highlighted the need for continuous engagement to remove fears, misconceptions, and negative perceptions about the project. They emphasized that feedback should be provided on how their concerns have been addressed, the potential environmental and social impacts identified, and the mitigation measures planned by WWSL. Post-ESIA engagement also includes keeping stakeholders informed about project implementation progress, monitoring activities, and any adjustments to mitigation strategies based on observed outcomes.

Furthermore, post-ESIA engagement aligns with both Tanzanian legislation and international best practices, including the Environmental Management Act, CAP 191 R.E 2023, EIA & Audit Regulations (2005, as last amended in 2024), and IFC Performance Standards 1 and 4 on stakeholder engagement and community health, safety, and security. By maintaining an ongoing dialogue with stakeholders, WWSL ensures that the project is implemented responsibly, fosters trust, and promotes sustainable socio-economic and environmental outcomes for the communities surrounding Lake Natron.

5.9 Grievance Redress Mechanism

A Grievance Redress Mechanism (GRM) is an important component of the proposed Project, providing a formal process for receiving, addressing, and resolving concerns raised by Project Affected Persons (PAPs) and other stakeholders. The GRM ensures that complaints related to environmental, social, or operational impacts are handled transparently, fairly, and in a timely manner. Its objective is to build trust between WWSL, local communities, and other stakeholders while minimizing potential conflicts and promoting responsible project implementation.

The GRM will be accessible to all affected parties, including local communities, employees, service providers, and other interested stakeholders. WWSL will establish multiple channels for grievance submission, including community liaison officers, suggestion boxes, dedicated phone lines, email, and periodic stakeholder meetings. Special attention will be given to vulnerable and marginalized groups to ensure that they can raise concerns without fear of retaliation or discrimination.

Once a grievance is submitted, WWSL will acknowledge receipt within a defined timeframe and conduct an investigation to determine the cause and appropriate corrective action. The grievance will then be addressed through consultation with the complainant, and a resolution will be communicated clearly and promptly. Records of all grievances, actions taken, and outcomes will be maintained to facilitate monitoring and continuous improvement.

The GRM will also align with Tanzanian legal requirements, including the Environmental Management Act, CAP 191 R.E 2023, EIA & Audit Regulations (2005, as last amended in 2024), and international standards such as IFC Performance Standard 1 on stakeholder engagement and grievance mechanisms. By implementing an effective GRM, WWSL aims to mitigate project-related social risks, foster community cooperation, and enhance overall project sustainability.

6 ANALYSIS OF PROJECT ALTERNATIVES

6.1 Overview

This chapter presents an evaluation of feasible alternatives considered for the proposed Trona Extraction and Soda Ash Production Project. The purpose of the analysis is to identify the most appropriate project configuration that balances technical feasibility, economic viability, and environmental and social sustainability.

The alternatives analysis focuses on key components of the project, including:

- Mining methods
- Processing technologies
- Project location
- Infrastructure and design options

The assessment is aligned with the confirmed project approach, which involves the extraction of solid trona deposits using dredging methods. Alternatives involving brine abstraction and evaporation-based processing were considered at a conceptual level but were not selected due to their higher environmental footprint and land requirements

6.2 Mining Method Alternatives

A range of mining methods were evaluated to determine the most appropriate approach for extracting trona from the Lake Natron deposits. The selection of the mining method is critical as it directly influences the extent of environmental disturbance, operational efficiency, and overall project feasibility.

The assessment considered methods applicable to both solid and submerged mineral deposits, with particular emphasis on their suitability for evaporitic trona formations within a lake environment. The comparison below (Table 6.1) evaluates each method based on technical, environmental, social, and economic criteria.

Table 6.1: Comparative Analysis of Mining Methods

Criteria	Mechanical Excavation	Drill & Blast Mining	Cutter Suction Dredging
Technical Suitability	Not suitable for submerged or semi-solid trona deposits. Requires dewatering and stable ground conditions which are not present in Lake Natron.	Unsuitable due to soft, evaporitic nature of trona which does not require fragmentation. Blasting would be ineffective and excessive.	Specifically designed for soft and submerged materials. Capable of continuous extraction of trona slurry directly from the lakebed.
Lakebed Disturbance	Requires physical entry of heavy machinery, leading to compaction and permanent alteration of lakebed morphology.	Causes fracturing and widespread disturbance beyond extraction zone due to shockwaves.	Localized cutting head limits disturbance to targeted zones. Sediment disruption is controlled and confined.
Water Quality Impacts	High turbidity due to sediment agitation and re-suspension from machinery movement. Potential oil and fuel contamination.	Significant increase in suspended solids and potential chemical contamination from explosives residues.	Temporary and localized turbidity near dredging point. Managed through controlled dredging rates and monitoring.
Biodiversity Impact	Direct habitat destruction, especially for benthic organisms and bird feeding areas along shorelines.	Severe ecological disruption due to noise, vibration, and habitat destruction.	Reduced habitat disturbance due to controlled footprint. Avoidance of sensitive ecological zones possible through planning.
Air & Noise Emissions	High due to operation of heavy machinery and haul trucks.	Very high due to blasting noise and dust emissions.	Low airborne emissions; noise mainly from dredger and limited in spatial extent.
Occupational & Community Safety	Increased risk due to movement of heavy machinery and potential accidents.	High safety risks associated with explosives handling and blasting operations.	Safer operation with controlled equipment and fewer high-risk activities.
Operational Efficiency	Intermittent and weather-dependent. Requires multiple equipment units.	Inefficient for this deposit type; high preparation time and low recovery efficiency.	Continuous operation with high recovery rates and lower downtime.
Economic Implications	High capital and operational costs due to multiple equipment and logistics.	High cost with low return due to unsuitability of method.	Cost-effective due to continuous operation and direct slurry transport.

6.2.1 Selected Option: Cutter Suction Dredging

Cutter Suction Dredging (CSD) is selected as the preferred mining method due to:

- High efficiency in extracting submerged trona deposits
- Minimal disturbance to surrounding ecosystems
- Controlled and localized extraction
- Reduced environmental and social impacts

6.3 Processing Technology Alternatives

Alternative processing technologies for converting trona into soda ash were assessed to identify the most efficient and environmentally sustainable option. The evaluation focused on commonly used industrial processes, considering their performance in terms of recovery efficiency, energy consumption, environmental emissions, and product quality. Table 6.2 presents the comparative analysis of the key processing technologies alternatives considered for the project.

Table 6.2: Comparative Analysis of Processing Alternatives

Criteria	Sesquicarbonate Process	Monohydrate Process
Process Efficiency	Lower recovery efficiency due to additional processing steps and impurities.	Higher efficiency with direct conversion of trona to soda ash.
Product Quality	Produces soda ash with relatively lower purity, requiring further refining.	Produces high-purity soda ash suitable for industrial applications.
Energy Consumption	Higher due to multiple heating and purification stages.	Optimized energy use with integrated heat recovery systems.
Water Usage	Requires more water for dissolution and purification processes.	Lower water consumption due to efficient recycling systems.
Waste Generation	Higher generation of waste by-products require disposal.	Reduced waste generation with better recovery of usable materials.
Environmental Impact	Greater emissions and waste handling requirements.	Lower emissions with modern pollution control technologies.
Operational Reliability	More complex with higher chances of inefficiencies.	Proven and widely used technology with stable performance.
Economic Viability	Higher operating costs due to inefficiencies.	Lower operating cost and higher profitability due to efficiency.

6.3.1 Selected Option: Monohydrate Process

The Monohydrate process is selected due to:

- Higher recovery efficiency
- Production of high-quality soda ash
- Proven industrial application
- Better environmental performance with appropriate controls

6.4 Project Location Alternatives

Site selection is a critical factor influencing both the economic viability and environmental impact of the project. Several potential locations were considered based on resource availability, environmental sensitivity, accessibility, and infrastructure requirements.

The comparison below (Table 6.3) evaluates the suitability of alternative locations relative to the selected project site within the Lake Natron area.

Table 6.3: Comparative Analysis of Project Location Alternatives

Criteria	Alternative Locations (Outside Lake Natron)	Lake Natron (Project Site)
Resource Availability	No proven or economically viable trona deposits identified in alternative locations. Any development would require importing raw material,	Contains naturally occurring, high-grade trona deposits within the lakebed, allowing direct extraction

	significantly increasing operational complexity and cost.	at source and eliminating the need for raw material transport.
Geological Suitability	Geological conditions in alternative areas do not support trona formation (evaporitic environment absent). Exploration uncertainty remains high.	Unique evaporitic basin with confirmed trona deposits formed through natural geochemical processes, making it geologically ideal for soda ash production.
Environmental Sensitivity	Some alternative areas may have lower ecological sensitivity; however, new sites would still require land clearing, habitat conversion, and potential disruption of terrestrial ecosystems.	Environmentally sensitive (Ramsar site), but impacts can be minimized through controlled, localized dredging without large-scale land transformation.
Land Use Requirements	Requires acquisition and conversion of large land areas for mining and processing facilities, potentially affecting agriculture, grazing land, or settlements.	Minimal additional land take required for extraction since operations occur within the lake. Land use is mainly limited to processing plant and infrastructure footprint.
Impact on Biodiversity	Likely to affect terrestrial ecosystems, including vegetation clearance and habitat fragmentation for land-based species.	Potential impacts on aquatic and bird life (e.g., flamingos), but these are localized and manageable through zoning, seasonal controls, and monitoring.
Hydrological Impact	May require development of new water sources for processing, potentially affecting local water availability.	Utilizes existing lake system; dredging does not significantly alter overall water balance when properly managed.
Infrastructure Requirements	Requires development of full infrastructure network (roads, water supply, energy), increasing cost and environmental footprint.	Some infrastructure already exists or can be developed efficiently due to proximity to resource, reducing overall footprint and cost.
Transport and Logistics	Increased transportation requirements for raw materials and finished products, leading to higher fuel consumption, emissions, and operational costs.	Reduced transport requirements as extraction and initial processing occur near the resource, improving efficiency and lowering emissions.
Economic Viability	Lower viability due to absence of raw materials, high infrastructure costs, and increased logistics expenses.	High economic viability due to direct access to trona, reduced transport costs, and efficient integration of extraction and processing.
Social Impacts	Potential displacement of communities depending on selected site; conflicts over land use may arise.	Limited displacement expected; however, project must manage interactions with local communities and protect cultural and livelihood practices.
Regulatory Considerations	May face fewer ecological restrictions depending on location but still subject to environmental approvals and land acquisition challenges.	Located in an environmentally sensitive area requiring strict regulatory compliance, but project design incorporates mitigation to meet these requirements.
Climate and Operational Conditions	Conditions may not support natural processing advantages (e.g., evaporation characteristics), increasing processing complexity.	Favorable climatic conditions (high evaporation rates) support efficient processing and overall project performance.

6.5 Conclusion

Based on the comparative analysis, the Lake Natron site is selected as the preferred project location due to the presence of economically viable trona deposits, favorable geological conditions, and overall operational efficiency.

Although the area is environmentally sensitive, the project design incorporates controlled dredging methods and targeted mitigation measures to minimize impacts, making it the most feasible option when balancing environmental, social, and economic considerations.

6.6 Infrastructure and Design Alternatives

6.6.1 Slurry Transport Alternatives

The transportation of extracted trona from the dredging site to the processing plant is an important component of the project design. Different transport options were evaluated to determine the most efficient, safe, and environmentally sustainable method.

The assessment considered factors such as emissions, safety risks, operational efficiency, and long-term costs, as summarized in the table 6.4 below.

Table 6.4: Slurry Transport Alternatives

Criteria	Truck Haulage	Pipeline Transport
Air Quality Impact	Generates dust and exhaust emissions affecting local air quality.	Minimal emissions as material is transported in enclosed system.
Noise Levels	Continuous noise from truck movement affecting nearby communities and wildlife.	Low noise levels limited to pumping stations.
Road Infrastructure Impact	Requires construction and maintenance of roads, leading to land disturbance.	Minimal land disturbance once pipeline is installed.
Safety Risks	Increased risk of road accidents and material spillage.	Lower risk due to enclosed and controlled transport system.
Operational Cost	High recurring fuel and maintenance costs.	Lower long-term cost after initial installation.
Efficiency	Slower and dependent on road conditions.	Continuous and efficient transport system.

6.6.2 Conclusion

Based on the comparative assessment, pipeline transport of trona slurry is selected as the preferred option over truck haulage. This option significantly reduces air emissions, dust generation, and noise levels associated with continuous truck movements, thereby minimizing impacts on local air quality, communities, and wildlife. In addition, the enclosed nature of the pipeline system reduces the risk of material spillage and environmental contamination, while improving overall operational safety.

Although pipeline installation requires higher initial capital investment, it offers greater long-term economic efficiency due to lower operating and maintenance costs, as well as improved transport reliability.

Therefore, pipeline transport provides the most environmentally sustainable, socially acceptable, and economically viable solution for the project

6.6.3 Pipeline Design Alternatives

Different pipeline design configurations were considered to minimize environmental and social impacts while ensuring operational reliability. The key consideration was whether to install the pipeline on the surface or underground.

The comparison below (Table 6.5) outlines the advantages and limitations of each option in relation to environmental disturbance, safety, and long-term sustainability.

Table 6.5: Pipeline Design Alternatives

Criteria	Surface Pipeline	Buried Pipeline
Visual Impact	Highly visible and alters landscape aesthetics.	Minimal visual impact as pipeline is underground.
Wildlife Interaction	May obstruct movement of wildlife and grazing patterns.	Minimal interference with wildlife movement.
Risk of Damage	Exposed to weather, vandalism, and accidental damage.	Protected from external damage and environmental exposure.
Maintenance Requirements	Easier access but more frequent repairs due to exposure.	Less frequent maintenance but requires planned access.
Environmental Disturbance	Continuous disturbance along pipeline corridor.	Temporary disturbance during installation only.

6.6.4 Conclusion

Based on the analysis, the buried pipeline configuration is selected as the preferred design option. Compared to surface pipelines, the buried system minimizes visual intrusion and landscape alteration, thereby preserving the natural character of the project area. It also significantly reduces interference with wildlife movement and grazing patterns, which is particularly important in ecologically sensitive environments such as the Lake Natron area.

Furthermore, a buried pipeline is less exposed to external risks such as weather-related damage, vandalism, and accidental impacts, enhancing the long-term integrity and safety of the system. While installation may involve temporary ground disturbance, these impacts are short-term and can be effectively mitigated through proper reinstatement measures.

Overall, the buried pipeline option provides a more secure, environmentally responsible, and sustainable solution for slurry transport.

6.6.5 External Transport Alternatives for Soda Ash Distribution

The transportation of processed soda ash from the project site to external markets, including export destinations such as Kenya, is a critical component of the project value chain.

Alternative transport modes were evaluated to determine the most efficient, cost-effective, and environmentally sustainable option for long-distance bulk transport. The key options considered include road transport (truck haulage) and railway transport, Table 6.6.

Table 6.6: External Transport Alternatives

Criteria	Road Transport (Truck Haulage)	Railway Transport
Transport Efficiency	Requires multiple trips using heavy-duty trucks, leading to logistical complexity and delays, especially over long distances.	Capable of transporting large volumes of soda ash in a single trip, significantly improving efficiency for bulk export.
Air Emissions	High greenhouse gas emissions due to diesel-powered trucks operating continuously over long distances.	Lower emissions per ton of material transported, making it more environmentally sustainable for bulk cargo.

Road Infrastructure Impact	Accelerates road degradation due to heavy axle loads, leading to increased maintenance requirements and associated environmental disturbance.	Minimal impact on road infrastructure as transport is shifted to rail systems.
Traffic and Safety Risks	Increased risk of road accidents, especially along long-distance corridors involving heavy truck traffic.	Lower accident rates due to controlled rail operations and reduced interaction with public traffic.
Noise and Community Disturbance	Continuous truck movement contributes to noise, dust, and disturbance in communities along transport routes.	Noise is localized along railway lines and occurs less frequently compared to continuous truck movement.
Cost Efficiency (Long Distance)	Higher operational costs due to fuel consumption, vehicle maintenance, and labor. Costs increase significantly with distance.	More cost-effective for long-distance bulk transport due to economies of scale.
Reliability	Subject to delays due to road conditions, traffic congestion, and weather impacts.	More reliable with fixed schedules and less susceptibility to traffic-related disruptions.
Handling Capacity	Limited capacity per truck requiring multiple trips.	High carrying capacity per train, reducing number of trips required.
Environmental Footprint	Larger cumulative footprint due to emissions, road wear, and dust generation along routes.	Lower overall footprint per unit transported, making it more sustainable.

6.6.6 Conclusion

Based on the comparative analysis, railway transport is selected as the preferred mode for transporting soda ash to external markets, including Kenya. Railway transport offers significant advantages in terms of bulk handling capacity, reduced greenhouse gas emissions, improved safety, and lower long-term operational costs, particularly for long-distance transport. While road transport provides flexibility, its higher environmental footprint, increased safety risks, and greater infrastructure impacts make it less suitable for large-scale, continuous export operations.

Therefore, railway transport represents the most efficient, environmentally sustainable, and economically viable option for product distribution.

6.7 Power Supply Alternatives

The proposed project requires a reliable and continuous power supply to support dredging operations, slurry pumping, and soda ash processing. The project requires power for high-load processing operations (11–15 MW) and low-load domestic/auxiliary services. The alternatives considered include reliance on the national grid, solar power, and a hybrid system.

Table 6.7 provides a detailed analysis of the power supply options.

Table 6.7: Power Supply Alternatives

Criteria	National Grid Only	Solar Power Only	Hybrid System
Capacity to Meet Processing Demand (11–15 MW)	Capable of meeting full demand	Not capable of reliably supporting high-load industrial demand	Grid meets processing demand; solar handles auxiliary loads
Reliability	Generally reliable but subject to outages	Intermittent and dependent on sunlight availability	High reliability due to combination of solar generation and grid backup

Environmental Impact	Moderate (depends on national energy mix)	Very low emissions during operation	Reduced overall emissions through partial use of renewable energy
Operational Cost	Moderate and predictable tariffs	Low operating cost but high initial investment	Balanced cost with reduced grid dependency for auxiliary loads
Capital Cost	High for grid connection infrastructure	High initial investment for solar installation	Moderate to high due to combined infrastructure
Suitability for Continuous Operations	Suitable for all operations	Not suitable for continuous industrial processing	Suitable for both processing and auxiliary operations
Land Requirement	Minimal	Requires approximately 2 hectares for solar installation	Moderate land use for solar component
Sustainability	Moderate	High	High due to integration of renewable energy

6.7.1 Conclusion

Based on comparative analysis, the project will adopt a hybrid power supply system, whereby processing operations are powered by the national grid, while solar energy is used for domestic and auxiliary services, with the grid providing backup where necessary. This approach ensures reliability while reducing environmental impacts.

6.8 Water Sources Alternatives

Water is a critical resource for the proposed trona extraction and soda ash processing operations, particularly for slurry preparation, mineral processing, cooling systems, and domestic use. Given the ecological sensitivity of the Lake Natron environment, careful consideration was given to alternative water supply sources to ensure sustainable utilization while minimizing environmental impacts.

The main water supply options evaluated include abstraction from Lake Natron, abstraction from the Ewaso-Ngiro River, and a combined system utilizing both sources for different purposes.

Table 6.8 provides a detailed comparative analysis between options.

Table 6.8: Water Sources Alternatives

Criteria	Lake Natron Only	Ewaso-Ngiro River Only	Combined System (Lake Natron + Ewaso-Ngiro)
Water Quality Suitability	High salinity makes it suitable for trona slurry and processing but unsuitable for domestic use without extensive treatment.	Freshwater suitable for domestic use, sanitation, and auxiliary services but not ideal for direct use in trona processing due to chemical composition differences.	Optimizes use by matching water quality to purpose: saline lake water for processing and freshwater for domestic and auxiliary needs.
Resource Availability	Abundant within the lake; readily accessible at the project site.	Seasonal variability in river flow may affect reliability during dry periods.	Ensures continuous supply by diversifying sources and reducing dependency on a single water body.
Hydrological Impact	Continuous abstraction may affect lake water	Abstraction may affect downstream users and	Reduced impact on both sources by distributing

	balance and salinity if not properly controlled.	ecosystems, particularly during low-flow periods.	demand and limiting abstraction from each.
Ecological Impact	Potential disturbance to lake ecosystem if abstraction is excessive or poorly managed.	Potential impact on riverine ecosystems and aquatic habitats if flow is significantly reduced.	Lower ecological risk due to controlled abstraction from both sources and reduced pressure on each system.
Water Use Efficiency	Moderate; may result in inefficient use if freshwater needs are met using saline water requiring treatment.	Moderate; inefficient for processing needs, requiring additional treatment or chemical adjustment.	High efficiency by allocating each source to its most suitable use, minimizing treatment needs and wastage.
Operational Reliability	Reliable for processing needs but insufficient for potable and domestic requirements.	May be unreliable as a sole source due to seasonal flow variations.	High reliability through diversification of sources, ensuring both industrial and domestic demands are met.
Treatment Requirements	Minimal for industrial use but extensive treatment required for domestic use.	Minimal treatment required for domestic use but may require conditioning for industrial processes.	Reduced overall treatment requirements due to appropriate allocation of water sources.
Cost Implications	Lower cost for abstraction but higher cost if treatment for domestic use is required.	Moderate to high cost due to pumping infrastructure and potential seasonal storage needs.	Optimized cost by reducing treatment requirements and balancing infrastructure investments.
Sustainability	Potentially unsustainable if used as sole source for all needs.	Risk of over-abstraction during dry seasons.	More sustainable approach by balancing demand across two sources and reducing environmental stress.

6.8.1 Conclusion:

Based on the comparative analysis, the project will adopt a combined water supply system, utilizing Lake Natron as the primary source for processing water and the Ewaso Ngiro River for domestic and auxiliary uses. This approach ensures that each water source is used according to its natural suitability, thereby minimizing the need for extensive treatment and improving overall water use efficiency. Additionally, the combined system reduces pressure on both the lake and river systems by distributing water demand, thereby lowering potential hydrological and ecological impacts.

Overall, the selected option provides a balanced solution that enhances operational reliability, environmental sustainability, and cost-effectiveness.

6.9 “No Project Alternative

The “No-Project” alternative considers the scenario in which the proposed soda ash extraction and processing activities will not be implemented at Lake Natron.

Environmental Considerations

Under this scenario:

- The Lake Natron ecosystem would remain undisturbed
- No impacts on lakebed sediments, water quality, or biodiversity would occur

- Sensitive habitats, including breeding grounds for waterbirds, would be preserved

Social Considerations

- No job creation opportunities for local communities
- Continued limited access to social infrastructure and services
- No enhancement of local economic activities

Economic Considerations

- Loss of potential revenue at local and national levels
- Missed opportunity for industrial development and export earnings
- Continued underutilization of natural resources

Conclusion

While the No Project Alternative offers environmental protection benefits, it does not support socio-economic development objectives. Therefore, a controlled and environmentally responsible trona extraction approach is preferred.

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7 ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS

7.1 Introduction

This section outlines the potential impacts of the proposed Trona Extraction and Soda Ash Production Project and evaluates them through analysis and classification. The assessment of significant Environmental and Social Impacts is conducted in an integrated manner. This evaluation is based on the Project Description in Chapter 2, the Policy, Legal, and Administrative Framework outlined in Chapter 3, the Environmental and Social settings described in Chapter 4, and the outcomes of Stakeholder Consultations presented in Chapter 5. The assessment process covers the entire life cycle of the Project, including the construction, operational, decommissioning, and post-closure phases.

7.2 Methodology of Assessment of Impact Significance

Key potential impacts were identified, described, and assessed by various specialists. Each impact was analyzed to determine its level of significance and risk to the environment and the community.

The impact prediction approach involves assigning ratings (quantification) to each identified potential impact and creating a matrix that maps these impacts against the Project activities planned for the construction, operation, and decommissioning phases.

Determining the "significance" of an impact is a crucial part of analyzing and classifying these impacts. To assess significance, various methods are employed, including professional judgments, quantitative models, experiments, physical models, and case studies. The evaluation considers multiple criteria, such as the magnitude, scale, duration, exposure, and likelihood of occurrence. Each criterion is assigned a score, and these scores are combined to determine the impact's "consequence and likelihood," as outlined in Tables 7.1 to 7.4.

Table 7.1: Assessment of Significance in Terms of Magnitude, Scale, and Duration

Criterion	Description	Possible Results		
		Term	Description	Score
The magnitude of the Impact	An indication of the severity of the impact, either positive or negative.	Very high	**Extreme effect** – where natural, cultural, or social functions or processes permanently cease.	5
		High	**Severe effect** – where natural, cultural, or social functions are altered to the extent that they temporarily cease.	4
		Moderate	**Moderate effect** – the affected environment is altered but natural, cultural, or social functions continue, albeit in a modified way.	3
		Low	**Minimal effect** – affects the environment in such a way that natural, cultural, or social functions and processes are not affected.	2
		Very low	Minimal or negligible effect	1
		Unknown	The magnitude of the impact is unknown.	5
The scale of the Impact	An indication of the	National	Affects the resources of the country	5
		Regional	Affects the resources of the region	4

Criterion	Description	Possible Results		
		Term	Description	Score
	geographical extent of the impact	District	Affects the resources of the district	3
		Local	Affects the Project area and surrounding villages	2
		Site-specific	Localized, confined within the license area.	1
		Unknown	The extent of the impact is unknown	5
Duration of the Impact	An indication of the duration or time over which the impact will be experienced.	Permanent	Will remain permanently	5
		Long term	Extends into the post-closure phase, but not permanently	4
		Medium-term	During the operational life of the Project	3
		Short term	Shorter than the operational life of the Project	2
		Transient	Very short duration	1
		Unknown	The duration of the impact is unknown	5

(Source: MTL Consulting, 2025)

Table 7.2: Assessment of Significance in Terms of Exposure and Probability

Criterion	Description	Possible Results			
		Term	Description		Score
			Discrete Event	Prolonged Exposure from a single activity or event	
Exposure to Impact	Indication of frequency of the activity that may cause the impact, or the continuity of exposure.	Very high	Daily or continuous	Exposure in perpetuity	5
		High	Weekly/once per week	Continuous exposure to closure or post-closure phases	4
		Moderate	Monthly/once per month	Continuous exposure during construction and operations phases	3
		Low	Bi-annually	Continuous exposure throughout one phase	2
		Very low	Annually or less frequently	Prolonged exposure yet finishes before the end of a phase	1
		Unknown	The frequency of activity is unknown	Continuity of exposure unknown	5
Probability of the Occurrence	Assessment of the degree of certainty associated with a potential impact	Highly likely	Very likely or certain to occur		5
		Likely	Likely to occur		4
		Possible	May occur		3
		Unlikely	Unlikely to occur		2
		Highly Unlikely	Very unlikely to occur, or almost impossible		1
		Unknown	The probability of the occurrence is unknown		5

(Source: MTL Consulting, 2025)

Table 7.3: Consequence and Likelihood Assessment According to Score/Scale

Consequence	**Magnitude + Scale + Duration**	**3-4**	**5-7**	**8-11**	**12-14**	**15**
		Very Low	Low	Moderate	High	Very High
Likelihood	**Exposure + Probability**	**2-3**	**4-5**	**6-7**	**8-9**	**10**
		Very Low	Low	Moderate	High	Very High

(Source: MTL Consulting, 2025)

To determine the overall significance of the impacts, a matrix of the scores of the "Consequence" and "Likelihood" was then used as shown in Figure 7.1. The colour codes in Figure 7.1 are used to show the significance of the impact, and their implications and descriptions of the impact's significance are shown in Table 7.1 to 7.4.

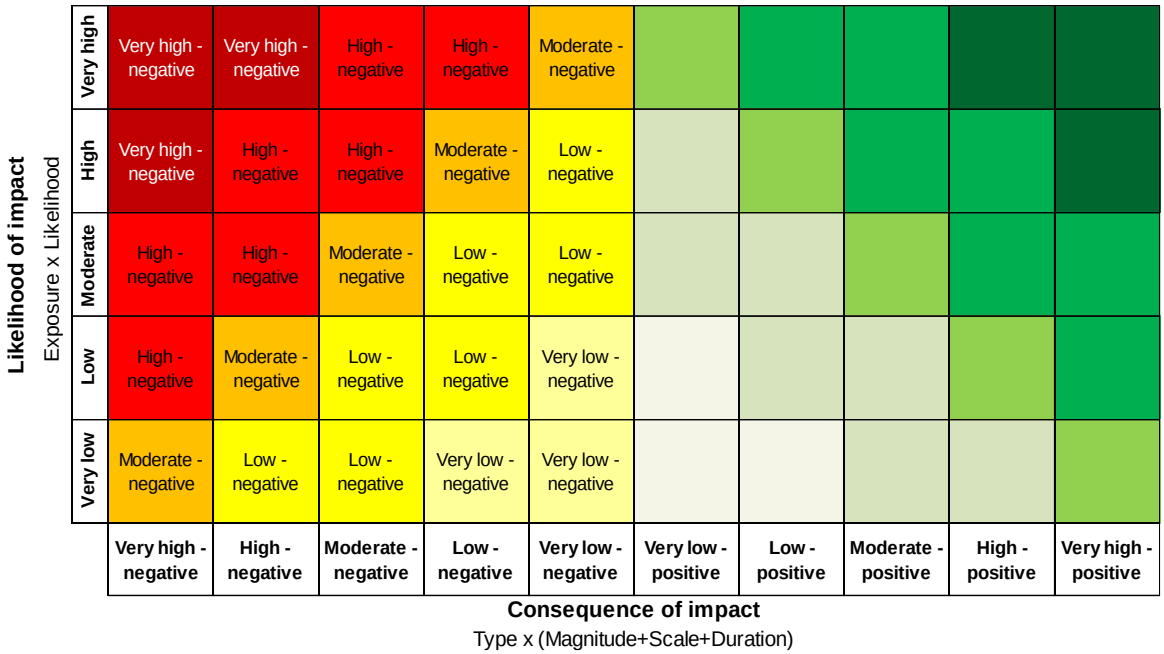

Figure 7.1: Significance Analysis from the Consequences vs Likelihood Assessment

(Source: MTL Consulting, 2025)

Table 7.4: Interpretation of Significance Analysis

Significance of Residual Impacts	Implication for Project
Very low significance	Negligible effects
Low significance	Acceptable effect
Moderate significance	The effect is serious enough to cause concern. Changes to the Project design should be considered.
High significance	Unacceptable effect. The Project should not proceed unless the design is changed so that the significance of this impact is reduced to acceptable levels.
Very high significance	An automatic fatal flaw. The Project should not proceed unless the design is changed so that this impact is eliminated, or its significance is reduced to acceptable levels.

(Source: MTL Consulting, 2025)

7.3 Identification of Impact

The potential impacts identified in this section are based on investigations conducted by various specialists and key issues raised by stakeholders during the consultation process.

The comprehensive assessment of impacts, covering identification, analysis, and classification, was also directed by the requirements set forth in the IFC Performance Standards and the WBG General EHS Guidelines (2007).

To identify significant environmental impacts, one approach is to focus on environmental components that could be impacted by or influence the proposed Project. This method highlights components of high value and sensitivity, which are particularly relevant to the development under review and likely to experience meaningful impacts. A common practice is to identify Valued Ecosystem Components (VECs), as defined by the Canadian Environmental Assessment Agency (1999):

“Any part of the environment that is considered important by the proponent, public, scientists, and government involved in the assessment process. Importance may be determined based on cultural values or scientific concerns”.

VECs can incorporate both natural and human environments. Examples of natural environment VECs are species, assemblages of plants or animals, habitats, environmental features, or indicators of environmental health (biodiversity ecosystem). Examples of human environment VECs are activities or sites of social and cultural importance or commercial and economic value, infrastructure, recreational or aesthetic features, or indicators of community well-being and quality of life. These are often referred to as Valued Social or Socio-economic Components (VSC). The identification of VECs serves to identify and focus monitoring efforts, both during the Project and after closure, on those components that would be at greater risk of adverse effects.

7.3.1 Identification of VECs in the Project Area

Identifying VECs helps to direct mitigation and monitoring efforts towards the components most at risk of adverse impacts during the project and after its closure.

The natural environment VECs assessed include the following:

- Land and Soils;
- Surface water quality and quantity;
- Groundwater quality and quantity;
- Terrestrial Biodiversity;
- Aquatic Biodiversity;
- Air Quality;
- Greenhouse Gas (GHG) emissions; and

The human environment VECs assessed in this report include the following:

- Community Health, Safety, Security, and Human Rights;
- Labour and Working Conditions;
- Public infrastructure (including roads);
- Noise and Vibration;
- Visual Amenity; and
- Local Economy and Employment.

Table 7.5 summarizes the VECs identified in the project area and the rationale for their inclusion in this assessment.

Table 7.5: Identified VECs in the Project Area

VEC	Rationale for Inclusion as VEC
Soil	• Site clearance, physical degradation of soil quality, and contamination of soils during construction to decommissioning of the Trona Extraction and Soda Ash Production Project can influence soil erosion, sedimentation, compaction of soil structures and profile, reduction in soil qualities as well as removal of topsoil.
Surface water	• Erosion and sedimentation from construction and decommissioning, chemical and oil & grease spillage, liquid waste generation can deteriorate water quality and harm aquatic habitats. Pollutant runoff from machinery and operational areas can introduce contaminants into surface water, affecting its health. Alterations in drainage patterns can disrupt natural water flow and lead to flooding or changes in water availability.
Groundwater	• Soil disturbance and contamination during construction and decommissioning can result in groundwater pollution. Alterations in groundwater flow and recharge caused by construction and operational activities may impact groundwater levels and availability. Furthermore, the risk of leachate generation and seepage from pollution control systems during operation requires vigilant monitoring to prevent groundwater contamination in the event of containment failure.
Terrestrial Biodiversity	• The development of the Trona Extraction and Soda Ash Production Project may significantly result in land disturbance, including the removal of vegetation (grasses and scattered trees) that provide habitat for animal species.
Air Quality	• Risk to respiratory health from increased dust particles and pollutant gases during the project activities. • Emissions from types of equipment can result in health impacts on the surrounding communities and project workers
Community Health, Safety, Security, and Human Rights	• An increase in road traffic accidents associated with transportation activities using the public roads (Ngoma). • The influx of people to the area could impact community health through an increase in infectious diseases such as HIV/AIDS, STIs, and tuberculosis. • The influx of people in the area may increase pressure on existing health facilities to provide basic health care. • Potential increase in competition for natural resources such as water, fuel sources, food, etc., which may result in conflict.
Noise and Vibration	• Noise and Vibration due to construction and operation activities which involve the use of machinery, vehicles and other equipment's potential to generate noise and vibration as well.
Public infrastructure	• An increase in truck movement during the construction phase may lead to the deterioration of road conditions, including potholes, ruts, and corrugations. • The Project through CSR programs have the potential to improve the existing public infrastructures like schools and health facilities
Visual amenity	• Visual receptors with the potential to be affected by the proposed Project include the surrounding communities such as Wosiwosi etc.
Local economy and employment	• The existing local economy within the Project area is largely based on small-scale farming, livestock keeping, and small-scale mining. Development that

VEC	Rationale for Inclusion as VEC
	stimulates and diversifies the local economy could benefit the local community
GHGs	• The project has the potential to generate GHGs from fossil fuels during the construction and operation phases.
Land and Soil	• Waste generation, such as (Scrap metals, plastic, glass, cardboard, domestic and office waste, including food waste, plastic, and paper waste) associated with construction and operation, can potentially to affect land also the health of the surrounding community through the occurrence of diseases.
Labour and Working Conditions	• Project activities such as use of heavy equipment, heavy lifting, and manual handling, use of vehicles, and earthworks, use of hazardous materials such as fuels, oils, and chemicals, working at height, exposure to high noise levels, powered tools and machinery for long periods and working in confined spaces, working in high temperature, etc in all phases may potentially results to different hazards of which workers are to be exposed. However, unsafe or unhealthy working conditions can cause injuries and illnesses, ranging from minor ailments to fatalities.

(Source: MTL Consulting, 2025)

7.4 Potential Impacts

7.4.1 Impacts Related to Construction Phase

a) Water Resources

i. Surface Water

- **Sedimentation and Turbidity Increase**

Construction activities such as site clearing, grading, and excavation will expose soils, increasing the potential for erosion during rainfall events. Runoff from disturbed areas may transport suspended sediments into nearby drainage channels that ultimately discharge into Lake Natron.

Increased sediment loads may result in:

- o Elevated turbidity in surface water
- o Deposition of fine sediments in shallow lake margins
- o Potential disturbance of benthic microbial communities, including cyanobacteria (Arthrospira), which contribute to the lake's ecological functioning

Given the sensitivity of Lake Natron and the potential for sediment transport during intense rainfall events, the pre-mitigation impact significance is Moderate.

Mitigation measures include:

- o Scheduling earthworks during dry periods where feasible
- o Installation of silt fences, sediment traps, and retention ponds
- o Preservation of natural drainage pathways
- o Progressive rehabilitation and revegetation of disturbed areas
- o Minimization of exposed soil surfaces

lesidual Impact: Very Low to Moderate Negative

- **Hydrocarbon and Chemical Contamination**

Construction activities will involve the use of fuels, lubricants, and construction materials, which may pose a risk of contamination if improperly managed. Potential sources include refuelling operations, equipment maintenance, and handling of construction materials such as cement.

Spills or leaks may be transported by runoff into drainage systems and subsequently into Lake Natron, potentially affecting water quality and aquatic ecosystems.

The pre-mitigation impact significance is Moderate to High, due to the potential toxicity of contaminants and the sensitivity of the receiving environment.

Mitigation measures include:

- Storage of fuels and chemicals in bunded and lined areas (minimum 110% capacity)
- Designation of controlled refuelling and maintenance zones
- Availability of spill kits and trained personnel
- Proper handling and disposal of construction materials and wastes
- Routine inspection of equipment for leaks

Residual Impact: Very low Negative

ii. Groundwater

- **Contamination from Temporary Sanitation and Waste Systems**

Temporary construction camps may generate domestic wastewater and solid waste, which, if not properly managed, could infiltrate into the subsurface and affect groundwater quality.

Potential impacts include:

- Increased nutrient levels (e.g., nitrates)
- Microbial contamination
- Degradation of groundwater quality in shallow systems

The pre-mitigation impact significance is Moderate, considering the temporary nature of construction activities and the potential for localized contamination.

Mitigation measures include:

- Use of lined septic tanks or mobile sanitation facilities
- Regular collection and disposal of wastewater by licensed contractors
- Proper solid waste management systems
- Monitoring of groundwater quality where necessary

Residual Impact: Very low Negative

- **Reduced Groundwater Recharge Due to Soil Compaction**

The use of heavy machinery during construction may compact soils, reducing their permeability and limiting infiltration of rainfall into the subsurface.

This may result in:

- Increased surface runoff
- Reduced groundwater recharge in localized areas

Given the temporary nature of construction activities and the potential for rehabilitation, the pre-mitigation impact significance is Moderate.

Mitigation measures include:

- Restricting movement of heavy machinery to designated routes
- Minimizing unnecessary disturbance of land
- Post-construction soil loosening (ripping/tilling)
- Revegetation to restore soil structure and infiltration capacity

Residual Impact: Very low Negative.

b) General Environmental Pollution due to Waste Generation Impact

During the construction phase, a significant volume of both solid and liquid waste will be generated. Sources include leftover, construction materials (e.g., concrete, wood, steel), packaging materials (plastics, cardboard), used oil and lubricants from machinery, and domestic waste from worker camps (e.g., food waste, sewage). If not properly managed, this waste can contaminate the surrounding land and marine environment, clog drainage systems, and introduce pollutants into lake natron waters. Wastewater or concrete washout can raise turbidity and alter water chemistry, harming marine organisms. Additionally, improper waste handling can attract disease vectors and pose health risks to workers and nearby communities. The impact is expected to be moderately negative before mitigation measures but will be reduced to low negative after their implementation.

c) Community Health, Safety, Security and Human Right Related Impacts

i. Road Safety Risks and Traffic Accidents

During construction of the proposed Trona Extraction and Soda Ash Production Project, the transportation of materials, heavy machinery, and equipment will significantly increase traffic volumes on local access roads (Londigo to Katubaine, Gelai Lumbwa to Wosiwosi weather rough roads). This presents potential hazards such as road accidents involving community members, pedestrians, and livestock. The risk is elevated in rural areas where roads are narrow and often shared by both vehicles and people on foot. Without adequate traffic control, signage, and driver awareness, accidents could lead to injuries or fatalities, making road safety a major community concern. Before mitigation measure the impact is assessed to be moderate negative and will be reduced to low negative after effective implementation of mitigation measures.

ii. Spread of Communicable Diseases

The influx of workers and job seekers during the construction phase may potentially pose a significant public health risk to host communities. Large numbers of non-local workers often living in temporary camps interacting closely with residents can facilitate the spread of communicable diseases such as HIV/AIDS, sexually transmitted infections (STIs), tuberculosis (TB), and respiratory diseases including COVID-19. The risk is heightened by limited health infrastructure and low disease awareness in remote communities around Lake Natron.

Additionally, construction camps can become hotspots for disease transmission if they lack adequate sanitation, waste management, and access to clean water. Overcrowding, poor hygiene, and limited medical screening can result in outbreaks. Commercial sex work and informal social interactions may also increase the risk of sexual transmission of diseases. The impact is anticipated to be moderate negative and low negative before and after implementation of mitigation measures.

iii. Violation of Human Right

Security personnel are typically deployed during construction to safeguard equipment, materials, and workers. If not adequately trained in human rights and conflict-sensitive engagement, security forces may resort to intimidation, harassment, or the use of excessive force against local residents. Such actions can lead to human rights violations, including unlawful arrest, physical assault, or suppression of peaceful assembly.

Local community members, particularly pastoralists and women, may face restrictions in movement or loss of access to traditional lands if security perimeters are not clearly defined or if access control is implemented without community consultation. Additionally, failure to establish a functional grievance redress mechanism can result in unresolved complaints, escalating tensions between the company and local residents. The impact is predicted to be low negative before mitigation measures and will be lowered to very low negative significance after implementation.

d) Social Economic

i. Restriction of Access to grazing land and natural resources

The local communities, particularly the Maasai, heavily depend on the project area and nearby hills for grazing livestock as well as for gathering natural resources such as soda ash , firewood, medicinal plants, and building materials (e.g., wood and thatch grass). During the construction phase, access to some of these areas may be restricted to ensure safety and comply with the requirements of the Mining Act Cap 123 (R.E. 2019). The significance of this impact is assessed to be moderate negative before the implementation of mitigation measures, as the project will occupy a relatively small portion of land (approximately 150 acres) for the plant, accommodation, and other project facilities. Mitigation measures include adjusting the project layout to avoid key grazing and resource gathering areas and providing culturally appropriate compensation, including alternative grazing and collection areas agreed upon with local leaders. With these measures in place, the impact significance is expected to be low negative after mitigation.

ii. Public Infrastructure

- Increased pressure on existing public infrastructure services

During the construction phase, the influx of workers and supporting activities will increase pressure on existing public infrastructure and services such as water supply, health facilities etc. The current social services in the project area are already limited, and additional demand could strain these systems, affecting both the host community and project workers. The significance of this impact is assessed as moderate negative before mitigation. To mitigate the impact, WWSL should coordinate with local authorities to strengthen basic services and infrastructure, and establish project-specific facilities such as water points, waste disposal systems, and health support services for workers. With the implementation of these measures, the impact significance is expected to be low negative after mitigation.

iii. Loss of tourism value of the lake

- Reduction in the Tourism and Ecological Value of Lake Natron Ramsar Site.

Lake Natron is a Ramsar-designated wetland of international importance, renowned for its ecological value and as the world's main breeding ground for Lesser Flamingos. Construction activities, increased human presence, noise and dust pollution could degrade the lake's visual appeal, disturb wildlife, and reduce the area's attractiveness to tourists. These changes may

negatively affect eco-tourism activities, which are a key source of income for local communities. The significance of this impact is assessed as high negative before mitigation. To mitigate this, WWSL should strictly implement environmental management plans to minimize noise, pollution, and habitat disturbance, and collaborate with tourism authorities and conservation stakeholders to protect sensitive ecological zones and promote eco-friendly project practices. With these measures, the impact significance is expected to be moderate negative after mitigation.

iv. Social Interaction

- Increase of HIV/AIDS and STDs

During the construction phase, an influx of workers and job seekers into the project area may lead to increased social interactions between workers and local communities. This could heighten the risk of transmission of HIV/AIDS and other sexually transmitted diseases (STDs), especially in communities with limited access to health services and awareness programs. The significance of this impact is assessed as moderate negative before mitigation. Mitigation measures include implementing community and worker awareness programs on HIV/AIDS and STD prevention in collaboration with local health authorities and NGOs and providing access to preventive measures such as free condoms and voluntary counselling and testing (VCT) services. With these measures, the impact significance is expected to be low negative after mitigation.

- Cultural Interference

The influx of non-local workers during the construction phase may introduce different lifestyles, behaviours, and cultural practices that could influence or conflict with the traditional values of the Maasai community. Such interactions may lead to social tension, erosion of cultural norms, or reduced community cohesion. The significance of this impact is assessed as moderate negative before mitigation. To mitigate this, WWSL should conduct cultural awareness and sensitivity training for all workers before deployment, emphasizing respect for local customs and traditions, and establish a clear code of conduct regulating worker-community interactions. With these measures implemented, the significance of the impact is expected to be low negative after mitigation.

v. Local economy

- Price Inflation

The influx of workers and increased demand for goods and services during the construction phase may lead to a rise in the prices of basic commodities, housing, and transport within nearby communities. This could disadvantage vulnerable households with limited income. The significance of this impact is assessed as moderate negative before mitigation. Mitigation measures include prioritizing the sourcing of food, goods, and services locally to maintain market supply, and collaborating with local authorities to monitor prices and support community-based supply initiatives. With these measures, the impact significance is expected to be low negative after mitigation.

- Employment Opportunities

The project is expected to employ approximately 100 people during the construction phase, creating both direct and indirect job opportunities for local communities. This will enhance household incomes and improve livelihoods, particularly for youth and women. The significance of this impact is assessed as moderate positive before enhancement. After

implementing enhancement measures such as prioritizing local residents for employment where skills allow and providing short-term training to build capacity and facilitate skills transfer, the impact significance is expected to be high positive after enhancement.

- Increased in Business Opportunities

The construction phase of the project is expected to create demand for goods and services, providing new business opportunities for local traders, suppliers, and service providers. This can stimulate the local economy through increased sales of food, construction materials, transport services, and other related products. The significance of this impact is assessed as moderate positive before enhancement. With enhancement measures, such as offering capacity-building programs for local entrepreneurs and ensuring transparent procurement processes that favour local suppliers, the impact significance is expected to be high positive after enhancement.

- Fiscal Benefits

The proposed project is expected to generate fiscal benefits for both the local and national government through payment of taxes, service levies, and other statutory contributions. These revenues can support public services, infrastructure development, and socio-economic growth in the district and beyond. The significance of this impact is assessed as moderate positive before enhancement. With enhancement measures, such as timely and transparent remittance of taxes and collaboration with local authorities to prioritize community development projects, the impact significance is expected to be high positive after enhancement.

vi. Archaeology and Cultural Heritage

- Loss and destruction of Archaeological Artifacts

During the ESIA, no archaeological or cultural heritage sites were identified within the proposed project area. However, nearby areas, such as Mount Gelai, are used for cultural rituals and ceremonies by local communities. The construction of the project may inadvertently lead to disturbance or loss of any undiscovered artifacts or culturally significant items. The significance of this impact is assessed as low negative before mitigation. Mitigation measures include conducting a chance-find procedure to manage any unexpected discoveries and ensuring that local cultural leaders are consulted before and during construction activities. With these measures, the impact significance is expected to be negligible to low negative after mitigation.

e) Impacts on Soils

The construction phase will involve land clearance, grading, excavation, and infrastructure installation, including access roads, and the processing plant. These activities will disturb the natural soil profile and expose soils to erosion, compaction, and contamination risks.

i. Soil Erosion and Sedimentation

Clearing and grading expose soils to wind and water erosion. Fine-textured soils, particularly weakly aggregated saline clays near the lake margin, are highly vulnerable to runoff and crusting. Sedimentation may affect drainage channels or adjacent wetlands, degrading water quality and habitats.

Significance: Moderate negative before mitigation; Low negative after mitigation, with erosion control measures such as silt fences, sediment traps, and revegetation.

ii. Soil Compaction

Heavy machinery used for excavation, grading, and material transport compresses soil layers, reducing porosity, infiltration, and root penetration. Compaction increases surface runoff and impedes vegetation regrowth.

Significance: Moderate negative before mitigation; Low negative after mitigation, with controlled machinery movement and post-construction decompaction.

iii. Soil Contamination

Accidental spills of fuels, lubricants, or chemicals can contaminate soils, especially those sensitive to pH and salinity changes, impairing fertility and microbial activity.

Significance: Moderate negative before mitigation; Low negative after mitigation, with proper chemical handling, storage, and spill response protocols.

iv. Loss of Soil Structure and Profile Mixing

Excavation for ponds, foundations, and access roads may mix topsoil and subsoil layers, altering texture, nutrient balance, and natural horizons.

Significance: Moderate negative before mitigation; Low negative after mitigation, with topsoil stockpiling and careful restoration.

v. Changes in Soil Moisture and Drainage

Alteration of natural drainage during grading and site preparation may change infiltration and runoff patterns, leading to localized waterlogging or desiccation.

Significance: Moderate negative before mitigation; Low negative after mitigation, with proper drainage planning.

vi. Reduction in Organic Matter

Topsoil removal and vegetation clearance will reduce organic matter, essential for microbial life and soil structure maintenance.

Significance: Moderate negative before mitigation; Low negative after mitigation, with organic amendment application during restoration.

vii. Soil Stability

Localized instability may occur along cut slopes or embankments, increasing erosion risk.

Significance: Low negative before mitigation; Very low negative after mitigation, with slope stabilization and erosion control.

f) Impacts on Biodiversity

i. Loss of Vegetation Cover

Vegetation clearing for construction of access roads, processing plant, evaporation ponds, and associated infrastructure will result in the direct removal of shrubs, grasses, and small trees within the project footprint. This loss will reduce ground cover, alter local plant community composition, and expose soil to erosion and desiccation. Given that the area falls within a semi-arid ecosystem with slow natural regeneration rates, the disturbance will be moderately significant prior to mitigation. However, with effective vegetation clearance control, topsoil preservation, and restoration planning, the residual impact is expected to reduce to low significance after mitigation.

ii. Dust Deposition

Construction activities such as excavation, transportation of materials, and increased vehicular movement along unpaved roads will generate dust that may settle on the leaves of nearby vegetation. Excessive dust deposition can interfere with photosynthesis, respiration, and transpiration processes, particularly affecting grasses and shrubs in the vicinity. In arid and semi-arid environments like Lake Natron, where vegetation is already adapted to stress conditions, prolonged dust accumulation can further reduce productivity and vigour. The impact is assessed as moderate before mitigation but likely to reduce to low significance after consistent dust control proposed measures are implemented.

iii. Risk of Invasive Species Introduction

The movement of construction machinery, vehicles, and building materials from external locations poses a risk of introducing invasive or exotic plant species that can outcompete native vegetation and alter the ecological balance of the area. Given that Lake Natron supports unique halophytic and xerophytic species adapted to saline and dry environments, the introduction of invasive plants could disrupt this delicate ecological equilibrium. The likelihood of occurrence is moderate to high before mitigation, but through effective implementation of the proposed mitigation measures, the impact can be reduced to low significance.

iv. Loss and Fragmentation of Fauna Habitats and Ecological Connectivity

During the construction phase, activities such as site clearing, establishment of processing facilities, road construction, and installation of utilities will inevitably lead to loss and fragmentation of terrestrial habitats within the project area. The removal of vegetation and surface disturbance will displace the resident fauna including *Equus quagga* (Plains Zebra), *Gazella granti* (Grant's Gazelle), *Tragelaphus imberbis* (Lesser Kudu), and small mammals that depend on open shrubland and grassland habitats. Such fragmentation may also limit access to foraging and breeding grounds, restricting movement between Lake Natron and surrounding plains. Considering the ecological sensitivity of the area, the impact significance is moderate negative before mitigation. However, through effective mitigation such as minimizing construction footprints, avoiding critical flamingo zones, progressive site rehabilitation using native vegetation, and restricting unnecessary clearing, the residual impact is expected to reduce to low negative significance.

v. Disturbance to Fauna from Noise, Light, and Human Activity

Construction activities are anticipated to introduce continuous noise, vibration, and artificial light, which can disrupt wildlife behaviour, particularly for nocturnal and migratory species. Heavy machinery operations, vehicle movement, and lighting at night can alter normal feeding, resting, and breeding activities. The most affected species are expected to include *Phoeniconaias minor* (Lesser Flamingo) and other avifauna species nesting along the lake, as well as grazing mammals active during dawn and dusk. Increased human presence and machinery noise could trigger avoidance behaviour or displacement from critical habitats, and in some cases, cause temporary abandonment of breeding areas. The impact significance is moderate negative before mitigation, particularly near sensitive fauna zones, but can be reduced to low negative with effective mitigation. The use of low-intensity directional lighting, limiting noisy operations to daylight hours, enforcing restricted zones, and awareness training for workers are considered highly effective measures.

The Project acknowledges that flamingos and associated species are highly sensitive to disturbance, particularly during breeding periods, and does not assume that they will adapt to project-related activities. Evidence from the ESIA and fauna study confirms that even low-level but repeated disturbances such as noise, light, and human presence can cause behavioural responses, including avoidance, displacement, and potential abandonment of nesting areas, which may reduce breeding success and lead to population-level impacts over time, even without visible mortality.

Disturbance tolerance is species-specific and influenced by factors such as breeding status, type and frequency of disturbance, and habitat conditions. For flamingos, tolerance is low during breeding, when disturbance may trigger nest abandonment or disrupt feeding and nesting behaviour, whereas outside breeding periods, tolerance may be slightly higher but remains limited under repeated disturbance.

The Project adopts a precautionary, species-specific approach that includes avoiding critical habitats, implementing buffer zones, restricting high-disturbance activities during sensitive periods, minimising noise and light emissions, and conducting targeted monitoring of behavioural indicators such as movement patterns, nesting success, and habitat use. This ensures that impacts are actively managed based on species sensitivity rather than relying on assumptions of ecological adaptation.

vi. Impacts on Species of Conservation Concern

The Lake Natron Game Controlled Area including the Lake Natron basin supports a number of species of conservation concern, including *Phoeniconaias minor* (Lesser Flamingo – Near Threatened), *Ardeotis kori* (Kori Bustard – Near Threatened). Among mammals, *Giraffa camelopardalis* (Giraffe – Vulnerable), *Equus quagga* (Plains Zebra – Near Threatened), *Tragelaphus imberbis* (Lesser Kudu – Near Threatened), and *Litocranius walleri* (Gerenuk – Near Threatened) and others listed in Section 4.2.16 are present. Disturbance from construction, hydrological change, and habitat degradation may result in reduced access to breeding and foraging areas, directly threatening these species' survival. Given the Ramsar designation of Lake Natron and its international ecological importance, this impact is rated high negative before mitigation. With targeted measures such as maintaining wildlife corridors, scheduling activities outside breeding seasons, and implementing continuous biodiversity monitoring, the residual impact can be reduced to moderate negative, and it requires sustained collaboration with conservation agencies such as IUCN, BirdLife International, TAWA, TAWIRI, and others conservative authority around the Lake Natron Game Controlled Area.

vii. Water Pollution and Contamination

Activities such as dredging, excavation, handling of construction materials, and machinery operation may introduce pollutants into the inflowing streams and adjacent shoreline areas through runoff or accidental spills. Potential contaminants include hydrocarbons, lubricants, and cement residues, which can reduce water quality and impair survival and reproduction of sensitive aquatic fauna. Although only a few fish species were recorded and no macroinvertebrates were observed at the shoreline site, pollution could further limit habitat suitability and threaten stream populations.

viii. Alteration of Water Flow

Dredging and installation of processing infrastructure may modify local flow patterns in inflowing streams and along the shoreline. Such disturbances can disrupt natural water

movement, alter sediment transport, and affect shallow breeding and feeding habitats for fish. These hydrological changes may also reduce habitat quality and food availability for fish

ix. Sedimentation and Erosion

Site preparation and dredging activities associated with the establishment of access routes and construction platforms are expected to increase soil disturbance within the shoreline and inflowing stream zones. Earthworks, excavation, and vehicle movement on unpaved surfaces can loosen fine sediments, which are then transported into nearby streams and the lake through runoff, especially during rainfall events. Elevated sediment loads can reduce light penetration, smother benthic substrates, and degrade habitat quality for fish and benthic macroinvertebrates.

x. Noise Pollution

Noise and vibration are among the most immediate and unavoidable environmental impacts expected during the construction phase of the soda ash extraction infrastructure and processing plant. Key noise generating activities will include dredging, pile driving, the operation of heavy machinery (such as excavators, bulldozers, and pumps), and vehicle traffic associated with material transport along the shoreline and inflowing stream zones. These activities will introduce both airborne and underwater acoustic disturbances into the aquatic environment. Underwater noise is particularly significant as it can propagate efficiently in shallow saline water bodies like Lake Natron, where sound transmission is enhanced by high mineral content and limited depth. Fish species recorded during the baseline survey, including *Alcolapia alcalica, Alcolapia latilabris*, and *Alcolapia ndalalani*, are adapted to calm, spring fed environments and may be sensitive to abrupt acoustic disturbances. Studies have shown that exposure to intense or continuous underwater noise can cause stress responses in fish, including elevated cortisol levels, erratic swimming, reduced feeding efficiency, and temporary or permanent hearing threshold shifts (Popper & Hawkins, 2012; Slabbekoorn *et al.,* 2010).

Chronic or impulsive noise may also disrupt key biological behaviours such as spawning, parental care, and migration within shallow stream channels, especially during the breeding period.

xi. Loss, Disturbance, and Degradation of Aquatic Habitats

Construction activities such as site clearing, dredging, and installation of processing plant will cause direct loss and alteration of shoreline and stream habitats, which serve as breeding and feeding areas for *Alcolapia* species and other aquatic organisms. Disturbance of sediments and vegetation removal will reduce habitat complexity, leading to the displacement of fish and macroinvertebrates and a decline in local biodiversity.

xii. Wastewater and Solid Waste

During the construction phase, the establishment of access roads, plant foundations, and workers' camps will generate substantial volumes of domestic sewage, greywater, and solid waste. Untreated wastewater from kitchens, sanitation facilities, and cleaning activities could easily enter the inflowing streams or shoreline through surface runoff, particularly during rainfall events. Such discharges would introduce high organic loads and nutrients, increase biochemical oxygen demand (BOD) and foster eutrophic conditions that reduce dissolved oxygen levels, threatening aquatic life. The endemic *Alcolapia* species recorded in the baseline survey are physiologically adapted to alkaline but oxygen stable waters, and even short-term oxygen depletion can lead to stress or mortality.

g) Impact on Air Quality

i. Deterioration of Ambient Air Quality and Exceedance of the Ambient Air Quality Standards and Regulations

Deterioration of Air Quality is likely to occur from the construction activities that will take place during this phase. This levelling activity generates a lot of dust as vegetation must be removed with heavy vehicles and machinery. Therefore, the residents that are located close to the project location (Wosi Wosi Village) are likely to be affected by dust. It is anticipated that dust will have a negligible effect on the known breeding sites of the Lesser Flamingo based on the the distance of the closest known breeding site of the lesser flamingo in relation to project area and the overall wind direction of the area. The closest known breeding site in relation to the proposed site for construction of infrastructure is approximately 12.6km, which is far enough for the atmosphere to naturally remove and breakdown the particulate matter. In addition, the wind direction general points in the opposite direction of the known breeding sites. The predominant wind direction of the project area moves in the direction of Wosi Wosi village with occasional changes in direction.

Activities such as vegetation clearing, soil stripping, transportation of building materials to and from the site, use of heavy construction machinery and so forth can produce and emit large volumes of particulate matter/dust (PM2.5 and PM10) and exhaust emissions of Carbon Dioxide (CO2), Nitrogen Dioxide (NO2), Sulphur Dioxide (SO2) and Volatile Organic Compounds (VOCs). If not mitigated effectively, these emissions can be carried by the wind towards the receiving receptors and harm their health. With effective implementation of the proposed mitigation measures, the effect will be very low and will not extend to the next phase.

ii. Health Impacts Risks to workers and surrounding Communities from Construction Activities

Construction of mining infrastructures usually results in high levels of dust creation as such is the nature of the activities. Besides the communities close to the project who will be affected (Wosi Wosi Village), the immediate receptors are the workers that are participating in the construction of infrastructures. These workers are likely to be exposed to high volumes of particulate matter/dust (PM2.5 and PM10) and exhaust emissions of Carbon Dioxide (CO2), Nitrogen Dioxide (NO2), Sulphur Dioxide (SO2) and Volatile Organic Compounds (VOCs). This can lead to respiration and health issues if exposed for long periods of time. With effective implementation of the proposed mitigation measures, the effect can be very low and will not extend into the next phase.

h) Impact on Noise and Vibrations

The construction activities of the Project will likely to be the main source of noise and vibration at the project site and the surrounding community. The movement of heavy vehicles and other activities associated with construction can produce high level of noise and vibration that can negatively affect the sensitive receptors who will work during the construction phase. Noisy construction activities will include vegetation clearing, vehicle and machinery movements, excavation. All noisy construction activities will be done during the day. The closest known breeding site in relation to the project is approximately 12.5 km. This distance is far enough for the effects of noise and vibration to be reduced before it reaches the known breeding sites. The nuisance and deterioration of ambient noise levels after the effective implementation of the proposed mitigation measures will be negligible as it will neither hinder nor cease the

natural functions of the environment and the sensitive receptors. In addition, the mitigation measures will ensure that the effects do not extend to the next phase.

i) Impact on Greenhouse Gases

Climate Change in its simplest definition, is the long-term shifts in temperatures and weather patterns. This shift can occur naturally at an extremely slow pace, but due to anthropogenic activities since the 1800s from the use of fossil fuels, these shifts occur at a faster and more widespread rate. Unlike other impacts in ESIA, the impacts of GHG emissions are global in nature and difficult to link to a specific receptor. Although the construction phase involves the usage of several heavy machinery and vehicles, it is anticipated that the effects of Greenhouse Gases (Climate Change) will be very low compared to the operation phase of the project. With the implementation of the mitigation measures, these effects will further be reduced, which will result in the effects being negligible.

j) Labour and Working Condition Related Impacts

i. Occupational Health and Safety Risks

During the construction phase, workers will face increased risks of occupational injuries and health hazards due to exposure to dust, noise, heat, sharp tools, and heavy machinery. Activities such as site clearing, excavation, material handling, and equipment installation present risks of falls, cuts, collisions, and accidents involving construction vehicles. Without adequate safety measures, these incidents could lead to serious injuries or fatalities. The impact was evaluated to be moderately negative before the mitigation measure and expected to be lowered to low negative significance after effective application of mitigation measures.

ii. Labour Disputes and Right Violation

Labour disputes and rights violations may arise during the construction period due to unclear employment terms, delayed payments, discrimination, or a lack of grievance mechanisms. These can lead to strikes, absenteeism, or a hostile working environment. Prior to mitigation, the impact is evaluated as low negative. However, the effective enforcement of mitigation measures will protect workers' rights and diminish the impact to a very low negative significance.

Table 7.6: Analysis and Classification of Impacts During the Construction Phase

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Access to Resources	Restriction of access to natural resources (soda ash, firewood, thatch, medical plants etc.)	Construction of project infrastructures.	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	• Provide access to the project areas for community members to harvest the medicinal plants and rootstock prior to construction for self-cultivation. • Develop a strategy to allow controlled access to specific areas. • Conduct environment campaigns to raise awareness on conservation and biodiversity among employees and local community. • Donate trees and resources species to be cleared during construction to surrounding communities for use as fuel wood to reduce pressure on the other natural forest/woodland	Low - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	Preparation & Construction
Access to Grazing Land	Loss of grazing land and pastures	Land Acquisition activity	High - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Adjust project design to avoid or reduce taking key grazing areas and ensure only a minimal portion of land is affected. Offer culturally appropriate compensation through replacement grazing areas or monetary payment agreed upon with Maasai elders. Identify and improve new grazing zones with adequate pasture and water points to support livestock. Introduce programs for livestock health, fodder production, and water harvesting to sustain pastoral livelihoods.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											Continue consultation with Maasai leaders and respect traditional decision-making and cultural practices. Establish a joint plan for sustainable grazing, regular monitoring, and grievance handling.									
Terrestrial Flora	Loss of Vegetation Cover	Construction activities such as Vegetation Clearance	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Limit vegetation clearance strictly to designated and approved project areas. • Clearly demarcate construction zones and enforce “no-go” boundaries to protect surrounding vegetation. • Restore disturbed areas progressively using native and locally adapted species once construction concludes.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Terrestrial Flora	Dust Deposition	Earthworks and construction traffic may generate dust that can settle on surrounding vegetation	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Cover trucks transporting loose materials. • Avoid vegetation clearance and excavation during high wind conditions where possible. • See the mitigation measures for “Deterioration of Air Quality and Exceedance of the Ambient Air Quality Standards and Regulation” during the construction phase	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Terrestrial Flora	Risk of Invasive Species Introduction	Importation of construction materials and equipment could introduce non-native plant species	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Inspect and clean all machinery, vehicles, and equipment before entering the project site. • Conduct periodic inspection of disturbed and restored areas for early detection of invasive species. • Immediately remove and dispose of any invasive plants using manual or approved mechanical methods before establishment.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Terrestrial Fauna	Loss and Fragmentation of Fauna Habitats and Ecological Connectivity	Construction activities such as site clearing, establishment of processing facilities, road construction, and installation of utilities	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• To avoid construction of the project facilities within sensitive zones used by lesser flamingo and a perfect project layout must be designed to minimize the project footprint. • Implement progressive rehabilitation and re-vegetation of disturbed sites using native plant species. • Prohibit off-road vehicle movement and unnecessary vegetation clearing. • Design project layout to minimize habitat disturbance and overall project footprint.	Low - negative	Local	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	#N/A
Terrestrial Fauna	Disturbance to Fauna from Noise, Light, and Human Activity	Construction activities such as Heavy machinery operations, vehicle movement, and lighting at night	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Restrict construction activities to daylight hours near sensitive fauna habitats. • Use of low-intensity bulbs to reduce light pollution, especially near flamingo breeding zones. • Enforce buffer zones and exclusion areas where human	Low - negative	Local	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											access is restricted during critical breeding seasons. • Provide awareness training to workers on wildlife sensitivity and behavior near fauna habitats.									
Terrestrial Fauna	Impacts on Species of Conservation Concern	Disturbance from construction, hydrological change, and habitat degradation may result in reduced access to breeding and foraging areas, directly threatening Species of conservation survival. Ramsar designation of Lake Natron and its international ecological importance.	High - negative	District	Long-term	Moderate - negative	High	Highly likely	High	High - negative	• Maintain buffer zones and avoid project activities near nesting and feeding areas of conservation species. • Schedule project works outside known breeding or migration seasons. • Monitor wildlife populations regularly, focusing on indicator and threatened species. • Collaborate with responsible authority including NEMC, TAWIRI, TAWA, WWF, IUCN, BirdLife International and Nature Tanzania for joint biodiversity monitoring and adaptive management. • Maintain wildlife corridors and connectivity between Lake Natron and surrounding ecosystems.	Moderate - negative	District	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Aquatic biodiversity	Water Pollution and Contamination	Activities such as dredging, excavation, handling of construction materials, and machinery operation	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• To minimize water pollution and contamination, all fueling, mixing, and chemical handling must occur on impermeable, contained platforms to prevent spills. • Wastewater and trona slurry effluent should be treated before discharge using sedimentation or neutralization ponds. • Natural vegetation buffers must be retained along shorelines to filter runoff. • Regular maintenance and spill response plans will reduce leak risks from machinery and storage areas. • Continuous water quality monitoring should detect early contamination.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Aquatic biodiversity	Alteration of water flow	Dredging and installation of trona extraction infrastructure may modify local flow patterns in inflowing streams and along the shoreline	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Construction designs should maintain natural drainage to avoid altering stream discharge or lake inflow. • Preserve riparian vegetation for bank stability and flow regulation. • Regularly monitor flow patterns and sediment movement. • Restore drainage and stabilize channels to recover natural flow regimes.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Aquatic biodiversity	Sedimentation and Erosion	Site preparation and dredging activities associated with the establishment of access routes, construction platforms, and trona slurry intake systems	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Minimize vegetation clearing to control runoff. Stockpiles and exposed soils should be covered or compacted. • Disturbed sites must be revegetated with native species immediately after construction. • Maintain embankments and drainage structures during operation to prevent erosion. • Limit vehicle movement near water bodies. • After decommissioning, grade and stabilize slopes using bioengineering methods to prevent renewed sedimentation.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Aquatic biodiversity	Noise Pollution	Noise generating activities will include dredging, pile driving, the operation of heavy machinery (such as excavators, bulldozers, and pumps), and vehicle traffic associated with material transport along the shoreline and inflowing stream zones	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Use modern, well-maintained machinery fitted with silencers to reduce noise. • Restrict noisy works like pile driving to daylight hours and low sensitivity periods like breeding season. • Employ vibratory techniques instead of impact hammers when feasible. • Establish buffer zones and noise barriers near aquatic habitats. • Monitor underwater noise levels during operation and control vessel speeds near the site. • Apply similar measures during decommissioning to limit disturbance.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Aquatic biodiversity	Loss, Disturbance, and Degradation of Aquatic Habitats	Construction activities such as site clearing, dredging, and installation of trona slurry intake systems	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Implement a comprehensive waste management plan covering collection, treatment, and safe disposal. • Treat sewage through constructed wetlands or oxidation ponds before discharge. • Solid waste must be segregated, covered, and sent to approved disposal sites. • Keep waste storage areas away from watercourses to prevent leachate. • Train workers on waste handling and emergency spill response. • Remove and rehabilitate all waste and sanitation facilities to restore site integrity.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Aquatic biodiversity	Wastewater and Solid Waste	Construction activities such as the establishment of access roads, plant foundations, trona extraction infrastructure, and workers' camps	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Restrict construction to already disturbed zones and mark sensitive habitats to avoid damage. • Limit dredging to defined areas and avoid breeding seasons. • Restore disturbed vegetation using native riparian species immediately after works. • Design embankments with gentle slopes to support recolonization. • Maintain environmental flows during operation. • Regrade and replant all disturbed shorelines to restore natural habitats and biodiversity.	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Public Infrastructure	Increased pressure on existing public infrastructure services	Influx of people	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Develop and Implement Community and social responsibility Programmes • Ensure collaboration with beneficiaries and stakeholder to ensure sustainability of initiatives. • Expand skills development and capacity building programmes to non-employees	Low - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Loss of tourism value of the lake	Reduction in the Tourism and Ecological Value of Lake Natron Ramsar Site.	Construction activities	High - negative	Regional	Long-term	High - negative	Moderate	Possible	Moderate	High - negative	Restrict project activities near sensitive zones, especially flamingo breeding and nesting areas, to preserve ecological and visual integrity. Establish and enforce adequate buffer distances between the project footprint and the lake shoreline to protect scenic views and wetland ecosystems. Control dust, noise, and wastewater discharge to prevent pollution and maintain the lake's natural appearance and habitat quality. Collaborate with local authorities and tour operators to enhance sustainable tourism through conservation education and community-based tourism programs. Restore any disturbed areas using native vegetation to retain the natural landscape and visual appeal important for tourism. Work with the	Moderate - negative	Regional	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											Ramsar Site Management Committee and TANAPA to monitor environmental conditions and ensure compliance with Ramsar conservation standard									
Social Interaction	Increase of HIV/AIDS and STDs	Influx of people	Moderate - negative	District	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	•Conduct regular HIV/AIDS and STD awareness sessions for workers and nearby communities. •Provide free and easy access to condoms at work sites and camps •Facilitate voluntary HIV counseling and testing (VCT) for project staff and willing community members •Partner with community leaders and youth groups to deliver HIV/STDs messages.	Moderate - negative	District	Short-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Local Economy	Price Inflation	Influx of people	Moderate - negative	District	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Promote Local Supply and Production: Support local farmers, traders, and producers to increase supply of food and basic goods to meet project-related demand. Work with local authorities to monitor commodity prices and discourage exploitation or unfair pricing in nearby markets. Prioritize procurement of goods and services from local suppliers to stabilize the local economy and strengthen livelihoods. Provide small business training and access to microfinance to help local entrepreneurs adapt to new market opportunities. Where possible, employ local residents to reduce sudden population pressure and demand for limited goods. Collaborate with district authorities to plan and monitor inflation trends and develop measures for market stabilization.	Moderate - negative	District	Short-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Local Economy	Employment Opportunities	Construction activities	High - positive	National / international	Short-term	Moderate - positive	High	Highly likely	High	High - positive	• Priorities local employment. • Set target and monitor the progress to reach targets. • Verify local resident status of applicants in consultation with community representatives. • Set target for the employment of local women and youth. • Provide training for local recruits to enable them to apply for permanent position during the operation phase	Very high - positive	National / international	Short-term	High - positive	Very high	Highly likely	Very high	Very high - positive	Preparation & Construction
Local Economy	Increased in Business Opportunities	Procurement of Construction materials	High - positive	National / international	Short-term	Moderate - positive	Moderate	Likely	Moderate	Moderate - positive	• Priorities sourcing of goods, material and services from local businesses. Set target and monitor progress to reach target. • Verify local status of interested business.	Very high - positive	National / international	Short-term	High - positive	Very high	Highly likely	Very high	Very high - positive	Preparation & Construction
Local Economy	Fiscal Benefits	Payment of taxes and levies	High - positive	National / international	Short-term	Moderate - positive	Moderate	Likely	Moderate	Moderate - positive	Ensure all revenues are paid in compliance with legal requirements. This includes remitting employee taxes to the Tanzania Revenue Authority (TRA) and contributing to social security through the National Social Security Fund (NSSF). Additionally, encourage contractors to fulfill their tax obligations to the government and the Ngara District Council.	Very high - positive	National / international	Short-term	High - positive	Very high	Highly likely	Very high	Very high - positive	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Archaeology and Cultural Heritage	Loss and destruction of Archaeological Artifacts	Vegetation clearance, land clearance	High - negative	Site-specific	Short-term	Low - negative	High	Likely	High	Moderate - negative	• Avoid disturbance of archaeological sites within the proposed project area and beyond the disturbance footprint where possible. • Demarcate and place a buffer of 50m around site to be avoided where practicable. • Follow procedure for preservation and protection of sites and artefacts of archaeological significance specified by the Antiquities Act. • Undertake clearing of sites within the project disturbance footprint in accordance with the requirement permits. • Develop and implement a cultural heritage Management Plan	Moderate - negative	Site-specific	Permanent	Moderate - negative	Low	Possible	Low	Low - negative	Preparation & Construction
Archaeology and Cultural Heritage	Impacts on Social Practices and Relationships	Interaction of people from diverse backgrounds and cultures	Low - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Support initiatives that promote the preservation and revitalization of local traditions and cultural practices. Respect and Integration. Provide cultural sensitivity training for project staff, contractors, and stakeholders. Develop and implement a Cultural Heritage Management Plan.	Moderate - negative	Local	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Local Content and Procurement	Increased number employment of in local community and local sourcing of goods and services	Local procurement. Employment of local personnel	Very high - positive	National / international	Short-term	High - positive	High	Likely	High	High - positive	• Reinforcing the use of local Tanzanian workforce and contractors through training programs and support to local companies. • Incorporating national content programs in all project contracts to encourage and develop local procurement of goods and services. • Transparent mechanisms for competitive bidding from small businesses, aggregators and cooperatives and clear detailed instruction of requirements. • Support supplier development by reducing the complexity of contracts as a way of making them accessible to the local contractors. • Support local supplier development with programs aimed at building capacity at national and community level. • Promote internships and attachment of Tanzanian citizens in the Project activities. • Support of existing institutions in Tanzania by providing knowledge, technology, mentorships and scholarships. • Ensuring Project sustainability and post project succession to Tanzanian citizens	Very high - positive	National / international	Short-term	High - positive	Very high	Highly likely	Very high	Very high - positive	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											applying training schemes.									
Local content	Procurement of Goods and Services	Procurement of Projects supplies	Moderate - positive	National / international	Short-term	Moderate - positive	Moderate	Possible	Moderate	Moderate - positive	• Reinforcing the use of local Tanzanian workforce and contractors through training programs and support to local companies. • Incorporating national content programs in all project contracts to encourage and develop local procurement of goods and services. • Transparent mechanisms for competitive bidding from small businesses, aggregators and cooperatives and clear detailed instruction of requirements. • Support supplier development by reducing the complexity of contracts as a way of making them accessible to the local contractors. • Support local supplier development with	High - positive	National / international	Medium-term	High - positive	High	Possible	Moderate	High - positive	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											programs aimed at building capacity at national and community level. • Promote internships and attachment of Tanzanian citizens in the Project activities. • Support of existing institutions in Tanzania by providing knowledge, technology, mentorships and scholarships. • Ensuring Project sustainability and post project succession to Tanzanian citizens applying training schemes.									
Soil	Soil Erosion & Sedimentation	Land clearing, grading, excavation, site prep (construction)	High - negative	Local	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Silt fences, sediment traps, limit cleared areas, phased clearing, prompt revegetation, drainage design, temporary covers.	Moderate - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Soil	Soil Compaction	Heavy machinery movement during earthworks (construction)	High - negative	Local	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Designated haul routes, limit vehicle footprint, use of lighter equipment where possible, post-construction decompaction (ripping), monitoring.	Moderate - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Soil	Soil Contamination	Spills/leaks of fuels, lubricants, chemicals (construction)	Moderate - negative	District	Long-term	Moderate - negative	High	Possible	Moderate	Moderate - negative	Bunded storage, spill kits, trained response team, secondary containment, inspection, waste management, emergency procedures.	Moderate - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Soil	Loss of Soil Structure & Profile Mixing	Excavation for ponds, foundations, access roads	High - negative	Local	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Separate and stockpile topsoil, minimise unnecessary excavation, canonical re-spreading of topsoil,	Moderate - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											progressive restoration.									
Soil	Reduction in Organic Matter	Clearing vegetation and topsoil stripping (construction)	Very high - negative	Site-specific	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Topsoil stockpiles, re-application, organic amendments (compost), mulching, replanting with native species.	Moderate - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Soil	Changes in Soil Moisture & Drainage	Grading, cut/fill, infrastructure installation	High - negative	Local	Medium-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Maintain natural drainage where possible, design drainage channels, infiltration features, monitoring of wetted areas and contours.	Moderate - negative	Local	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	Preparation & Construction
Soil	Soil Stability (cut slopes/embankments)	Cut/fill works on slopes (construction)	Low - negative	Site-specific	Short-term	Low - negative	Low	Possible	Low	Low - negative	Slope stabilization (benching, geotextiles, retaining structures), temporary erosion blankets and revegetation.	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction
Air Quality	Deterioration of Air Quality and Exceedance of the Ambient Air Quality Standards and Regulation	Construction Activites such as Vegetation Clearance and Soil Stripping. This includes removal of any structures and buildings	Low - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Impose speed limit on all vehicles in the construction site and on the main roads leading to construction site. • Implement dust surpressing techniques in the construction site. (Water or Chemical Binding agents.) • Cover lose trucks transporting fine materials (soil, sand, etc) to prevent wind-blown dust. • Locate stockpiles away from sensitive receptors •Clear vegetation and strip topsoil only in areas recquired for immidiate construction •Schedule clearance in phases to minimize the area of exposed soil at any one time. •Preserve natural	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											vegetation buffers near watercourses and settlements.									
Air Quality	Health Impacts Risks to Workers and surrounding Communities from Construction Activities	Generation of Pollutant Gases Fossil Fuel power equipment and and Generation of Particulate Matter (Dust) from movement of vehicles during constrction phase	Low - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Conduct regular maintenance schedule for construction vehicles and equipment to minimize emissions. • Use low sulphur fuels in machinery and vehicles. • Install catalytic converters on vehicles that still have long life of service, and replace vehicles which are near the end of life. • Use fuel with low sulphur content • Avoid unnecessary idline of engines in unused vehicles.	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction
Noise and Vibration	Disturbances and Nuisances to sensitive receptors	Generation of Noise Machinery and Vehicle during the construction stage	Low - negative	Local	Short-term	Low - negative	Moderate	Likely	Moderate	Low - negative	• Utilize noise surpression techniques or equipment such as silcencers on the exhaust of vehicles site. • Restrict operation of high noise equipment to daytime houes (06:00 - 18:00). • Develop a noise criteria document that relate to relevant work practices and nearby receptors. •Schedule noisy activites to avoid	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											simultaneous operation of multiple high-noise sources near sensitive receptors. • Maintain proper balancing of equipment and machinery to minimize vibrations.									
Green House Gases (GHG)	Climate Change	Energy Consumption Transportation of Goods and Materials to and from site	Moderate - negative	National / international	Permanent	High - negative	Moderate	Likely	Moderate	High - negative	• All work schedules and journey logists to be done effectively to reduse unessessary usage of fuel for vehicles and onsite equipment. • Undertake regular servicing of all machinery to reduce the amount of GHG's released into the atmosphere. • Utilize vehicles that are compliant with the most recent emissions standards. • Implement a fuel management plan to monitor and optimize fuel usage on-site. • Optimize transportation routes and schedules to minimize fuel consumption	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction
Surface Water	Sedimentation & turbidity increase	Site clearing, grading, road and foundation construction	Moderate - negative	Regional	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	• Schedule earthworks in dry months • Provide sediment traps & silt fences • Preserve drainage paths • Progressive re-vegetation	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Surface Water	Hydrocarbon & chemical contamination	Fuel storage, refuelling, concrete batching	Moderate - negative	Regional	Permanent	High - negative	Moderate	Likely	Moderate	High - negative	• Bunded, lined fuel storage • Dedicated maintenance area • Immediate spill response • Worker training	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction
Groundwater	Contamination from temporary waste / sanitation systems	Workers' camps, septic pits, waste storage	Moderate - negative	Regional	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	• Lined septic tanks • Off-site sludge disposal • Groundwater quality monitoring (nitrates, EC, pH)	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction
Groundwater	Reduced recharge due to compaction	Heavy machinery traffic, foundation works	Moderate - negative	Regional	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	• Limit machinery movement • Restore infiltration capacity post-works • Maintain natural drainage corridors	Very low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Preparation & Construction
General Environment	General environmental pollution due to Waste Generation	Generation of construction debris, packaging materials, and domestic waste.	Moderate - negative	Local	Short-term	Low - negative	High	Likely	High	Moderate - negative	• Prioritize the application of a waste management hierarchy i.e. prevention, re-use, recycling, recovery, and disposal at site; • Ensure waste minimization through measures such as using less material in design, reduction (e.g., keeping products for longer or designing to last longer), and reuse; • Encourage waste recycling, particularly used oils, containers, equipment, paper, and plastics; • Encourage on-site segregation of construction waste into categories such as metal, wood, concrete, and hazardous materials; • Ensure storage and treatment of waste undertaken in a manner that protects the environment; • Emphasize use of specific installations,	Low - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											authorization prior to burying waste, accreditation of specialized companies; • Traceability of hazardous waste, detailing the type of waste, quantity, and identification of both carrier and destination; • Regularly inspect and maintain vehicles and equipment to prevent leaks of oil or other fluids; • Provide training to responsible personnel on proper methods for transporting, transferring, and handling hazardous substances that have the potential to impact surface and groundwater resources; • Ensure proper management of wastewater from the kitchen and sanitary facility at the site and, where necessary, apply the recycling method of wastewater for other water use purposes; and • Where possible, substitute hazardous materials with safer alternatives; and • Use licensed waste collectors for disposal and recycling.								

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Community Health, Safety, Security, and Human Rights	Road safety risks and traffic accidents	Transportation of materials in and out during construction activities.	High - negative	Regional	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Avoid transportation of project equipment and materials through busy trading centers and towns by using bypasses as appropriate; • Ensure regular maintenance of machinery, vehicles, and equipment as per the manufacturer's recommendation. • Ensure regular maintenance of access roads to be used for transportation activities; • Ensure establishment and implementation of safety speed limits; and Post safety signage along the route where transportation activities will be undertaken to safeguard the safety of the surrounding community and other road users.	Low - negative	Regional	Short-term	Moderate - negative	Low	Possible	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Community Health, Safety, Security, and Human Rights	Spread of communicable diseases	Construction activities of the project may result in population influx, which makes it easy to spread communicable and sexually related diseases.	High - negative	Regional	Medium-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Develop training and awareness programs on communicable, infectious, and sexually transmitted diseases and provide them to workers and surrounding communities; • In the event of a new disease, increased transmission, or outbreak compared to the baseline, interact with local health care facilities and workers to ensure there is an appropriate response in place to make workers aware and to ensure proper precautionary measures are implemented; • Ensure contractors adhere to the NVCL Code of Conduct, providing a worker code of behavior including worker-worker interactions, worker-community interactions, and development of personal relationships with members of the local communities; • Providing workers with appropriate sanitary facilities, which are appropriately designed to prevent contamination; • Developing a robust waste handling system to avoid the creation of new vector breeding grounds or attracting rodents to the area; • Ensuring appropriate food preparation and	Low - negative	Regional	Medium-term	Moderate - negative	Low	Possible	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											monitoring measures are in place; • Ensure workers are provided with access to selected treatment at health facilities at or near the Project Site as deemed necessary for this Project. The requirements for these health facilities should be based on a risk assessment considering access to existing health facilities and travel time to facilities that offer international standards of care. Access to health care should include direct employees and subcontractors working on-site; • Prepare and implement a communicable and infectious disease management plan. This plan is to be explained and communicated clearly to the workforce and surrounding communities; • Ensure the provision of appropriate PPE to workers; and • Align awareness campaigns with those of other organizations in the area (i.e., NGOs, the Ministry of Health, etc.). These campaigns should use various common practice methodologies to ensure social and cultural sensitivity.								

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Community Health, Safety, Security, and Human Rights	Violation of human rights	Activity related to security (Use of security forces)	Moderate - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Ensure transparent communication about the role and responsibilities of security forces; • Clearly articulate the purpose of their presence and the measures being taken to safeguard the community and the project; • Where necessary, provide comprehensive training to security personnel on human rights, cultural sensitivity, and community engagement; • Sensitize security forces to the local culture and customs to avoid unintentional offenses; • Ensure that security forces operate in line with local and international laws and adhere to ethical standards; • Implement accountability measures for any misconduct or human rights violations; • Adopt a community policing approach, where security forces work collaboratively with the community to address security concerns; and • Build positive relationships between security personnel and community members to foster trust.	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Labour and Working Condition	Occupational Health and Safety Risks	Workers to be exposed to various occupational hazards (ergonomic, biological, chemical, mechanical, and physical hazards) due to Site clearing, excavation, heavy equipment operation, and handling of materials	High - negative	Site-specific	Medium-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Conduct Risk Assessment covering all activities associated with the project; • Undertake medical check-up, which includes pre-entry, periodic, as well as pre-existing medical check-up; • Ensure providing appropriate PPE to all workers to safeguard their health; • Emphasize the application of the hazard control hierarchy when mitigating hazards; • Develop and implement the health and safety management plan associated with all activities at site; • Ensure provision of OHS training to workers; • Conduct periodic site inspection to identify existing hazards at workplace; • Ensure compliance with the OSHA Act, 2003, and other OHS International Good Practices; • Ensure posting of the safety signage in different areas of the site to inform of the associated hazards present in the area; • Ensure provision of welfare facilities at each project working site; and • Ensure provision of facilities and other supporting safety material, such as SOPs, procedures, etc., for the protection of workers against various hazards to	Very low - negative	Local	Short-term	Low - negative	Low	Possible	Low	Low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											which they are exposed.									
Labour and Working Condition	Labor Disputes and Rights Violations	Unfair working conditions, such as discrimination, unfair treatment, prevention of freedom of association, use of child/forced labor, and poor working conditions (i.e. provision of breaks, access to sanitary facilities, working hours, terms of payment, lack of	Moderate - negative	Site-specific	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Establish and implement GRM procedures for workers; • Ensure provision of clear and understandable information regarding rights under national labor and employment law, and any applicable collective agreements, including those related to hours of work, wages, overtime, compensation, etc. • Ensure provision of reasonable working conditions and terms of employment; • Ensure provision of employment, compensation/remuneration, and	Low - negative	Site-specific	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Preparation & Construction

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:							Post-mitigation:	Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
		contracts in place etc.).									working conditions, including working hours, based on equal opportunity and fair treatment, avoiding discrimination on any aspects; • Ensure provision of adequate welfare facilities on site; • Ensure the adoption and implementation of a sexual harassment policy in all sections and • Ensure adoption of an open attitude towards freedom of association.									

(Source: MTL Consulting, 2025)

7.4.2 Impacts Related to Operation Phase

a) Water Resources

i. Surface Water

- **Alteration of Lake Salinity and Hydrodynamics**

The project will abstract approximately 240 m^3/day of water from Lake Natron for processing purposes. This represents a direct interaction with the lake's hydrological and chemical system, which is characterized by a balance between inflow, evaporation, and mineral concentration.

Given the relatively small abstraction volume compared to the overall size of the lake, significant changes to the overall hydrological regime are not anticipated. However, localized effects may occur at abstraction points, including:

- Minor variations in salinity
- Localized disturbance of water circulation
- Temporary alteration of microhabitats supporting microorganisms such as Arthrospira

Considering the ecological sensitivity of Lake Natron, the pre-mitigation impact significance is Moderate, driven more by environmental sensitivity than by the scale of abstraction.

Mitigation measures include:

- Establishment of sustainable abstraction limits
- Design of intake structures to minimize disturbance
- Avoidance of ecologically sensitive zones
- Monitoring of lake levels and salinity
- Implementation of adaptive management practices

Residual Impact: Low to Moderate Negative

- **Effluent and Runoff Contamination**

The proposed project involves the use of water in trona processing and associated activities, generating process water, wastewater, and surface runoff that may pose a risk of environmental contamination if not properly managed.

Potential contamination sources include:

- Process water from trona handling and washing operations
- Surface runoff from operational areas
- Accidental spills of fuels, lubricants, or chemicals
- Leakage from water storage and handling systems

During heavy rainfall events, there is a risk that runoff from disturbed or operational areas may carry suspended solids or contaminants into surrounding land or water bodies, including Lake Natron and nearby drainage channels. Additionally, failure of storage systems or pipelines could result in localized contamination.

The potential impacts include:

- Deterioration of surface water quality
- Soil contamination in affected areas
- Localized disturbance to aquatic and terrestrial ecosystems

The pre-mitigation significance is considered Moderate, given the relatively low volumes involved but the sensitivity of the receiving environment.

Mitigation measures will focus on containment, control, and prevention, including:

- Implementation of proper drainage systems to separate clean and contaminated runoff
- Construction of bunded areas around storage tanks and operational zones
- Installation of spill prevention and response systems
- Regular inspection and maintenance of pipelines and storage infrastructure
- Treatment and controlled discharge or reuse of wastewater
- Monitoring of water quality in nearby receptors

With the implementation of these measures, the residual impact is expected to be Low Negative.

ii. Groundwater

- **Groundwater Contamination**

The project does not involve direct groundwater abstraction; however, indirect impacts may occur through contamination pathways.

Potential risks include:

- o Seepage from storage tanks or pipelines
- o Infiltration of contaminated runoff
- o Accidental spills of hazardous substances

These impacts are expected to be localized but may affect shallow groundwater systems if not controlled.

The pre-mitigation impact significance is Moderate.

Mitigation measures include:

- o Use of lined storage systems and containment structures
- o Proper drainage design
- o Spill prevention and response measures
- o Routine inspection and maintenance
- o Monitoring of groundwater quality where applicable

Residual Impact: Low Negative

b) General Environmental Pollution due to Waste Generation

During operation, the soda ash processing activities will produce industrial effluents, sludge, and other waste streams that could affect the environment if discharged without treatment. Inadequate waste management may lead to contamination of soil and groundwater around the processing plant. Without mitigation measures in place, the impact is expected to be moderately negative and will be reduced to low negative significance after effective implementation of mitigation measures.

c) Community Health, Safety, Security, and Human Rights Related Impacts

- Road Accident and Traffic Safety Risks

Transportation of raw materials during (such as trona ore, chemicals, and finished soda ash products during operational phase will be continued. Truck movements will be frequent and

often long-distance, linking the processing plant with storage and export points. The continued use of local roads poses persistent risks of traffic accidents, spillage of hazardous materials, and vehicle-related injuries. Inadequate enforcement of road safety rules or driver fatigue from long shifts could further increase accident frequency. Additionally, heavy vehicle traffic may damage road infrastructure, making travel unsafe for local communities who rely on the same routes for daily movement. The impact is assessed to be moderately negative before the mitigation measure and will be reduced to low negative significance after effective application.

- Spread of Communicable Diseases

During operation, the continuous employment of workers and the periodic arrival of visitors or contractors sustain interaction between the project workforce and the community. Long-term exposure to the workforce may normalize risky behavior, sustaining high rates of HIV or STI infections. If untreated wastewater is released or sanitation systems fail, waterborne diseases such as cholera, dysentery, and typhoid could also spread.

The project may attract population influx (migrant workers, traders, and small business owners), resulting in higher demand for water, sanitation, and healthcare services, potentially overwhelming existing facilities and increasing public health risks. The impact is assessed as moderate negative prior to the implementation of mitigation measures and is expected to be reduced to low negative significance following the effective application of these measures.

- Violation of Human Rights

Security risks persist during the operational phase, especially as the project continues to protect valuable infrastructure, equipment, and materials. If private or government security forces operate without oversight or training in the Voluntary Principles on Security and Human Rights (VPSHR)**, i**ncidents of harassment, intimidation, and gender-based violence may occur. Local conflicts over land, employment opportunities, or resource access could also lead to confrontation between security personnel and community members, with potential for escalation into violence.

Furthermore, community members may experience indirect human rights infringements if project operations continue restrict access to water sources, grazing lands, or sacred cultural sites without fair compensation or alternative arrangements. Before implementing mitigation measures, the impact is considered moderate negative significance, however, with effective mitigation, it is expected to decrease to a low negative.

d) Social Economic

i. Public Infrastructure

- Improved Public Infrastructure

During the operation phase, the project will support community development initiatives through CSR programs aimed at enhancing social services and local infrastructure. These programs are expected to improve access to water, education, and healthcare, as well as assist in upgrading facilities. Wosiwosi Village currently has only one primary school (Wosiwosi Primary School) and no secondary school. Through CSR initiatives, social services such as schools and water supply will be enhanced, in line with the legal requirements under Section 105 of the Mining Act Cap 123 (R.E. 2023). Additionally, the poor road infrastructure in the area, which becomes impassable during the rainy season, limits access to essential services. Currently, residents rely on motorcycles costing approximately TZS 150,000 to reach Longido Town. Through CSR-supported road improvements will be enhanced, providing long-term

benefits to the local communities. The significance of this impact is assessed as moderate positive before enhancement. With enhancement measures, such as prioritizing CSR investments in critical social services and coordinating with local authorities to ensure sustainable infrastructure improvements, the impact significance is expected to be high positive after enhancement.

- Increased pressure on existing public infrastructures and Services

During the operations phase, the influx of people moving to the area in search of employment opportunities may increase demand for existing public infrastructure and services, including water supply, healthcare, schools, and transportation. The project will construct facilities such as a hospital and school, which will be used by both workers and surrounding communities. The increased pressure is not expected from the project workers, but from the additional people relocating to the area seeking jobs. The significance of this impact is assessed as moderate negative before mitigation. With mitigation measures, such as upgrading infrastructure through CSR initiatives and coordinating with local authorities to enhance service capacity, the impact significance is expected to be low negative after mitigation.

ii. Loss of Tourism Value of the Lake

- Reduction in the Tourism and Ecological Value of Lake Natron Ramsar Site.

Lake Natron is a Ramsar-designated wetland of international importance, hosting the world's main breeding site for Lesser Flamingos and supporting unique ecological systems. During the operations phase, ongoing soda ash production, increased human presence, noise, dust, and other operational activities may disturb wildlife, degrade habitats, and reduce the area's attractiveness for eco-tourism. These changes could negatively affect tourism income, which is a key livelihood source for local communities. The significance of this impact is assessed as high negative before mitigation. Mitigation measures include implementing strict environmental management practices to minimize pollution, noise, and habitat disturbance, and collaborating with tourism and conservation authorities to protect sensitive ecological zones. With these measures in place, the impact significance is expected to be moderate negative after mitigation.

iii. Social Interaction

- Increase of HIV/AIDS and STDs

During the operations phase, continued interactions between project workers and local communities, along with an influx of people seeking employment, may increase the risk of HIV/AIDS and other sexually transmitted diseases (STDs). Limited access to health services and awareness programs could exacerbate this risk. The significance of this impact is assessed as moderate negative before mitigation. Mitigation measures include implementing regular community and worker awareness programs on HIV/AIDS and STD prevention in collaboration with local health authorities and NGOs and ensuring access to preventive measures such as voluntary counselling and testing (VCT) services and condoms. With these measures, the impact significance is expected to be low negative after mitigation.

- Cultural interaction

During the operations phase, the influx of people seeking employment and the interaction between project workers and local communities may lead to increased social and cultural interactions. These interactions can result in potential negative social impacts, including increased crime, prostitution, early pregnancies, and other socially disruptive behaviours.

Communities may also experience conflicts over resources, changes in traditional practices, and pressure on local social norms. The significance of this impact is assessed as moderate negative before mitigation. Mitigation measures include implementing awareness and education programs on social issues, reproductive health, and responsible behaviour, in collaboration with local leaders, schools, and community organizations, and establishing community policing and monitoring mechanisms to reduce crime and social disruption. With these measures in place, the impact significance is expected to be low negative after mitigation.

iv. Local economy

- Price Inflation

During the operations phase, the influx of people seeking employment and the increased demand for goods and services may lead to a rise in the prices of food, basic commodities, housing, hotels, and transportation in the surrounding communities. Vulnerable households with limited income may be disproportionately affected. The significance of this impact is assessed as moderate negative before mitigation. Mitigation measures include prioritizing local sourcing of goods, food, and services to stabilize supply, and collaborating with local authorities to monitor prices and support community-based supply initiatives. With these measures implemented, the impact significance is expected to be low negative after mitigation.

- Employment Opportunities

The project is expected to create over 300 direct employment opportunities during the operations phase, providing jobs for skilled and unskilled workers from the surrounding communities. This will enhance local livelihoods, increase household income, and contribute to overall socio-economic development. The significance of this impact is assessed as high positive before enhancement. Enhancement measures include prioritizing recruitment from local communities and implementing training and capacity-building programs to improve workers' skills and career prospects. With these measures, the impact significance is expected to be very high positive after enhancement.

- Increase in Business Opportunities

The operations phase of the project is expected to stimulate local business opportunities, including the supply of food, accommodation, transport, construction materials, and other services required by the project and its workforce. This will create new income streams for local entrepreneurs, boost sales for small businesses, and support the development of service-based enterprises in surrounding communities. The significance of this impact is assessed as moderate positive before enhancement. Enhancement measures include supporting local suppliers through capacity-building programs and prioritizing procurement from surrounding communities to maximize local economic benefits. With these measures, the impact significance is expected to be high positive after enhancement.

- Fiscal Benefit

The operations phase of the project is expected to generate significant fiscal benefits for both local and national government through taxes, royalties, and service levies. These revenues can support the provision of public services, infrastructure development, and local economic growth. The significance of this impact is assessed as moderate positive before enhancement. Enhancement measures include ensuring transparent and timely payment of all applicable taxes, fees, and royalties, and collaborating with local authorities to channel a portion of

revenues toward community development projects. With these measures, the impact significance is expected to be high positive after enhancement.

- Capacity Building and skills transfer

The operations phase of the project offers opportunities for capacity building and skills transfer to local communities, particularly the Maasai, many of whom currently lack the technical skills required to access employment in the project. By involving local workers and providing on-the-job training, internships, and formal skills development programs in plant operations and mining, the project can enhance employability, promote long-term economic empowerment, and enable local communities to benefit directly from project activities. The significance of this impact is assessed as moderate positive before enhancement. Enhancement measures include implementing structured training programs for local employees and collaborating with local institutions to provide vocational courses, workshops, and mentorship initiatives tailored to plant operations and mining activities. With these measures, the impact significance is expected to be high positive after enhancement.

e) Impact on Soils

During operation, soil impacts will arise from trona extraction activities, processing operations, transportation, and waste handling. Although less extensive than construction activities, these operations may result in gradual soil degradation if not properly managed.

i. Soil Erosion and Sedimentation

Wind erosion and runoff from unpaved roads, stockpile areas, and disturbed surfaces may contribute to soil loss and sediment movement. This may alter local drainage patterns and lead to sediment deposition in adjacent areas.

Significance: Moderate negative before mitigation; Low negative after mitigation, with stabilized surfaces and regular maintenance.

ii. Soil Compaction

Continuous movement of vehicles and machinery along access roads and operational areas may compact soils, particularly sandy loams, reducing infiltration capacity and soil aeration.

Significance: Moderate negative before mitigation; Low negative after mitigation, with traffic management and periodic soil loosening.

iii. Soil Contamination

Soil contamination may occur due to, spills or leaks of fuels and lubricants, improper handling of chemicals used in processing and poor waste management practices. These may affect soil quality, reduce fertility, and impact soil organisms.

Significance: Moderate negative before mitigation; Low to very low negative after mitigation, with proper containment systems, spill response measures, and monitoring.

iv. Alteration of Soil Properties (Salinity and Structure)

Handling and processing of trona, as well as dust deposition from operations, may lead to localized increases in soil salinity and changes in soil structure, particularly near processing and storage areas.

Significance: Moderate negative before mitigation; Low negative after mitigation, with proper containment, dust control and soil management practices.

v. Loss of Topsoil Integrity

Frequent movement in operational areas may limit vegetation recovery and degrade previously restored surfaces.

Significance: Low to moderate negative before mitigation; Very low negative after mitigation, with restricted access zones and revegetation.

vi. Soil Stability and Localized Disturbance

Localized disturbance from operational activities, including equipment use and material handling, may affect soil stability in specific areas.

Significance: Low negative before mitigation; Very low negative after mitigation, with monitoring, and site design.

vii. Reduction in Soil Biological Activity

Changes in soil conditions, including reduced vegetation cover, compaction, and localized salinity, may reduce microbial activity and nutrient cycling.

Significance: Low negative before mitigation; Very low negative after mitigation, with soil rehabilitation and organic matter improvement where necessary.

f) Impacts on Biodiversity

i. Alteration of Local Microhabitats

The operation of the trona extraction and soda ash processing plant and associated infrastructure may alter natural surface drainage and soil moisture regimes, particularly through modification of runoff pathways and compaction of soils around infrastructure. These changes can affect vegetation growth and distribution, especially among halophytic and grassland communities that depend on localized moisture gradients. Without mitigation, this impact is expected to be moderate, primarily localized around the operational areas. However, through proper effective implementation of the recommended mitigation measures such as site drainage design and ongoing vegetation monitoring, the impact can be minimized to low significance after mitigation.

ii. Disruption and Loss of Ecosystem Services

The project area provides various ecosystem services, including grazing grounds, medicinal plant sources, and natural vegetation cover that supports wildlife and tourism activities within the Lake Natron Game Controlled Area. Continued operations and restricted access to the project site may limit community use of certain resources and disrupt ecological connectivity. Before mitigation, the impact is considered moderate due to the area's social and ecological importance. Following the implementation of proposed mitigation measures such as access management and community engagement programs, the residual impact is expected to reduce to low significance.

iii. Continued Loss of Vegetation Cover

Continuous vehicular movement, maintenance works, and human activity during operation may prevent natural vegetation regeneration in disturbed areas, resulting in slow but progressive degradation. Without intervention, this could lead to bare patches and localized soil erosion. The impact is moderate before mitigation but can be reduced to low significance through active vegetation management and restoration programs.

iv. Hydrological Alteration and Pollution Risks

During operation, the extraction and processing of soda ash will require abstraction of freshwater from inflowing rivers and springs, which may alter the hydrological balance of Lake Natron. Reduced inflow can elevate salinity levels, potentially exceeding the tolerance limits of *Spirulina platensis*, the cyanobacterium forming the primary diet of the Lesser Flamingo. This would diminish food availability and affect flamingo breeding success and population stability. In addition, accidental spills, effluent discharge, and dust fallout from processing and transport may cause pollution and contamination of aquatic habitats, threatening amphibians, reptiles, and other aquatic fauna. The impact is considered high negative before mitigation due to the potential for long-term ecological disruption. However, implementing strict controls such as a Water Management Plan, wastewater treatment, effluent containment, and consistent monitoring is expected to be highly effective, reducing the residual impact to moderate negative significance based on compliance.

v. Continue Loss and Fragmentation of Fauna Habitats and Ecological Connectivity

During the operational phase, habitat loss and fragmentation become less severe but persist through continuous use of developed areas and traffic movement along haul roads. The maintenance of open operational zones will limit wildlife access to formerly used habitats, while increased activity may further deter fauna movement. The significance remains moderate, particularly for wide-ranging species like fringe-eared oryx and lesser kudu. However, maintaining rehabilitated buffer zones and enforcing off-road restrictions will ensure habitat recovery and ecological connectivity, reducing residual impacts to low.

vi. Disturbance to Fauna from Noise, Light, and Human Activity

Disturbance from noise, light, and human activity will continue from processing operations, vehicle movement, and 24-hour lighting at the plant site. This can disrupt breeding and feeding behaviour of birds and nocturnal fauna. The impact is moderate, especially near the lake margins, but can be reduced through using directional lighting, maintaining buffer distances, and noise suppression systems. Regular monitoring of fauna behaviour and adjusting operational practices can keep the residual impact at low.

vii. Impacts on Species of Conservation Concern

Impacts on species of conservation concern are more pronounced in this phase due to sustained disturbance and potential habitat degradation. The Lesser Flamingo (NT), and other listed in Section 4.2.16 may experience reduced foraging or breeding success near disturbed areas. Continuous biodiversity monitoring and stakeholder collaboration (including IUCN, NEMC, TAWA, TAWIRI, and WWF) will be essential to ensure adaptive management. The significance remains high negative, but with proper mitigation and monitoring, it can be reduced to moderate negative.

iv. Alteration of Water Quality and Hydrological Regime

Continuous water pumping and soda ash processing during the operation phase are likely to modify both the hydrological and physicochemical conditions of the inflowing streams and shoreline zones of Lake Natron. Abstraction of large volumes of water may alter flow direction, velocity, and seasonal water balance, disrupting natural flooding and drying cycles that sustain aquatic biodiversity. Similarly, process effluents containing elevated concentrations of sodium carbonate, chlorides, and suspended solids, if inadequately treated, could significantly raise salinity and alkalinity beyond the natural range. Such alterations can lead to physiological

stress among the few aquatic species adapted to narrow environmental conditions, particularly the endemic *Alcolapia* fish species that depend on stable ionic and oxygen conditions. This impact is considered moderate significant due to the lake's ecological sensitivity and the restricted distribution of endemic fauna but can be mitigated through effective hydrological and effluent proposed management practices.

v. Sedimentation, Erosion, and Habitat Degradation

Operation activities such as continuous vehicle movement, maintenance of abstraction channels, and trona transportation may cause localized erosion and sedimentation along access roads, streambanks, and near shoreline infrastructure. Vegetation removal for maintenance access can destabilize soils, resulting in chronic sediment inflow to the aquatic system. Over time, sediment deposition near intake or discharge points may change the substrate from coarse gravel or sand to finer silt and mud, reducing habitat complexity necessary for benthic macroinvertebrates and fish spawning. These processes can degrade aquatic habitats and reduce biological productivity. Given the fragile nature of the Lake Natron ecosystem and its shallow hydrology, this impact is considered moderate but reversible with effective implementation of the proposed management interventions.

vi. Noise Pollution and Disturbance to Aquatic Fauna

The operation of pumps, and other machinery will generate persistent low-frequency noise that may propagate through the trona extraction channels and shoreline areas. Although less intense than construction noise, continuous acoustic disturbances can lead to chronic stress and behavioural changes in aquatic organisms. Endemic *Alcolapia* species, adapted to quiet, spring-fed habitats, may experience reduced feeding efficiency, avoidance behaviour, or fragmentation of populations if exposed to constant noise. Given the small distribution range of these species, the impact is assessed as moderate, but manageable through proper implementation of the proposed mitigation measures.

vii. Solid Waste Mismanagement

Operational activities will generate various solid wastes including packaging materials, process residues, and maintenance debris. If not properly handled, these materials can be transported by wind or surface runoff into the lake or inflowing streams, introducing physical pollutants and potential contaminants such as metals, plastics, or hydrocarbons. Solid waste accumulation near the shoreline could indirectly degrade aquatic habitats by altering substrate conditions or leaching contaminants into water bodies during rainfall events. Given the project's proximity to a sensitive aquatic ecosystem, improper waste management poses a moderate significance but with proper implementation of the proposed mitigation measures the impact is manageable.

viii. Water Pollution and Contamination

Continuous water pumping for processing may alter the salinity and alkalinity of inflowing streams or nearshore zones if not properly managed may affect the few aquatic fauna adapted to specific physicochemical conditions like in that of Lake Natron.

ix. Alteration of water flow

During operation, continuous water pumping and abstraction activities may further alter the hydrological balance of the shoreline and inflowing streams. Modifications in flow direction, velocity, and discharge patterns could interfere with the natural seasonal flooding and drying

cycles that sustain aquatic biodiversity. Reduced inflow or localized drawdown may also increase salinity and alkalinity, affecting the survival of aquatic species adapted to narrower environmental ranges.

x. Sedimentation and Erosion

During the operational phase, continuous vehicle movement, maintenance works, and trona extraction activities may perpetuate localized erosion, especially along the inflow channels and access roads. Disturbance of streambanks and removal of vegetation for maintenance access can destabilize soils, causing chronic sediment input into the aquatic system. Sediment deposition near the trona slurry intake or discharge points may gradually change substrate composition from coarse gravel or sand to fine silt and mud reducing habitat complexity essential for macroinvertebrate colonization and fish spawning.

xi. Noise Pollution

During the operation of the soda ash processing plant and pumping system, persistent low-frequency mechanical noise from pumps may continue to propagate through the trona extraction channels and shoreline areas. Although less intense than construction noise, its continuous nature can lead to chronic stress and behavioural modification among aquatic organisms. For endemic species with small distribution ranges such as *A. ndalalani* and *A. latilabris*, these disturbances can fragment populations and limit access to feeding or breeding habitats.

xii. Loss, Disturbance, and Degradation of Aquatic Habitats

Continuous abstraction and infrastructure presence may modify hydrological regimes, alter flow patterns, and promote sediment deposition around intake points. These gradual physical and chemical shifts can reduce the productivity of littoral zones, limit recolonization by benthic fauna, and fragment habitats critical to the lake's endemic fish populations.

g) Wastewater and Solid Waste

The operational phase presents more complex and sustained risks associated with industrial wastewater and saltwater management. Effluent streams from soda ash processing and other related activities will likely contain elevated concentrations of sodium carbonate, chlorides, and suspended solids, which if inadequately treated, can significantly alter the lake's chemical balance. Discharge of such alkaline effluents may elevate pH beyond the natural range, disrupt ionic balance, and compromise the survival of sensitive aquatic organisms, including macroinvertebrates that serve as bioindicators of water quality.

h) Impacts on Air Quality

i. Exceedance of the Ambient Air Quality standards and regulations resulting in air quality deterioration (Noxious Gasses, Particulate Matter)

The proposed project has several emission sources that can contribute to the exceedance of Air Quality standards and regulations. It is highly likely that emissions from the operation activities will impact on the sensitive receptors that are near the proposed project specifically Wosi Wosi village. The mining and refining of Soda Ash requires a lot of movement from vehicles. This results in creation of high levels of dust and noxious gases.

Activities such as machinery for operation purposes and transportation of the ores from the processing plant to suppliers can produce and emit large volumes of particulate matter/dust

(PM2.5 and PM10) and exhaust emissions of Carbon Dioxide (CO2), Nitrogen Dioxide (NO2), Sulphur Dioxide (SO2) and Volatile Organic Compounds (VOCs). Although the nature of the proposed project requires movement of vehicles (Light and Heavy), it is highly unlikely the impacts will affect the known breeding sites close to the project. The closest known breeding site to the project is approximately 12.5km from the proposed project area. This distance is far enough for particulate matter and noxious gases to be reduced naturally in the atmosphere and will not affect the known area of the breeding sites. With effective implementation of the proposed mitigation measures, the effect will be negligible.

ii. Disturbances or Nuisance to Sensitive Receptors

The operation phase of the project will involve a high number of vehicles moving from the processing plant to local and international markets. These movements of heavy and light vehicles have the potential to create high levels of particulate matter/dust that can affect the sensitive receptors that outside the SML as well as the employees in the mining project. With effective implementation of the proposed mitigation measures, the effect will be very low.

i) Impacts on Noise and Vibration

iii. Nuisance/Deterioration of ambient noise levels to sensitive receptors outside the boundary of project site

The operation phase of the Project is likely to cause the effects of noise and vibration of the Project. The movement of vehicles and other activities associated with operation can produce noise and vibration that can negatively affect the sensitive receptors who work within the mining site and the residents at Wosi Wosi village. The distance of the closest known breeding site in relation to the proposed project area is approximately 12.5 km. This distance is far enough for the noise to have minimal effect on the lesser flamingos and for the vibration to be absorbed by in the water. The nuisance and deterioration of ambient noise levels after the effective implementation of the proposed mitigation measures will be negligible as it will neither hinder nor cease the natural functions of the environment and the sensitive receptors.

iv. Hearing Loss to workers due to prolong exposure to high noise levels

Heavy equipment drivers and users of heavy equipment during the operation phase have the potential to cause hearing loss to workers who are not equipped with essential PPE (Personal Protection Equipment). Equipment's such as Heavy Haul trucks, Motor Rollers, Motor Grader and Vibratory Rollers generate high levels of noise while operation them and proper PPE equipment is need for longer usage at a time. With efficient mitigation methods, the effects will be low on the workers.

j) Impacts from Greenhouse Gases

i. Climate Change

Climate change resulting from GHG emissions will lead to social, environmental, and economic impacts felt globally, regardless of where the GHGs are emitted. While acknowledging this fact, the GHG contributions from the Soda Ash Project is not expected to trigger significant or irreversible changes to the global climate system or considered to place any commitments made with respect to international agreements at risk. However, like most operations of its nature, it will contribute marginally to greenhouse gas (GHG) emissions through fuel combustion, electricity use, and associated activities. These emissions, while relatively small in scale compared to national or global totals, will add incrementally to the

broader challenge of climate change. With implementation of effective mitigation measures, the effects can be considered low.

k) Impact on Visual Amenities

i. Lighting from the Processing Plant, Vehicles and Other Equipment

The operational activities are anticipated to run for 24 hours with a day and night shift. This means during the nighttime, there will be a number of light sources being emitted from the project site. The introduction of lighting effect at night is likely to impact the sensitive receptors that are near the project sites. Sleeping patterns may be disturbed. Implementation of the proposed mitigation measures will make the impact negligible.

l) Labor and Working Conditions Related Impacts

i. Occupational Health and Safety Risks

In the operation phase, workers will be exposed to risks associated with high-temperature processes, handling of chemicals, machinery operation, and potential exposure to dust or gas emissions from the soda ash production process. Prolonged exposure can lead to respiratory issues, skin irritation, or chemical burns if not well controlled. The project will need to maintain stringent OHS management through continuous monitoring, equipment maintenance, provision of specialized PPE, and regular health checkups for workers. These measures will help reduce the risk significance from high negative to low negative.

ii. Labor Disputes and Right Violation

During operations, disputes may stem from poor communication between management and workers, a lack of collective representation, or violations of labor rights. The company should promote open dialogue through worker management committees and maintain a functioning grievance mechanism that guarantees confidentiality and fairness. These initiatives will help sustain a fair and respectful working environment, reducing the impact from moderate negative to low negative.

Table 7.7: Analysis and Classification of Impacts During the Operation Phase

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Public Infrastructures	Improved Public Infrastructure and social services	Community development initiatives support	Moderate - positive	District	Long-term	Moderate - positive	Moderate	Likely	Moderate	Moderate - positive	Develop and implement a community social responsibility program in close collaboration with beneficiaries and stakeholders to ensure the long-term sustainability of the initiatives. Additionally, expand skills development and capacity-building programs to encompass non-employees.	High - positive	District	Long-term	Moderate - positive	High	Highly likely	High	High - positive	Operation
Public Infrastructures	Increased pressure on existing public infrastructures and Services	Increase of people in search of employment opportunities	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Focus on hiring locally, assist local government authorities through community development programs to strengthen their capacity to provide essential social services, and provide health insurance for permanent employees, allowing them to access healthcare services beyond the district	Low - negative	Local	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation
Access to Natural Resources	Restriction of access to natural resources (firewood, thatch, pastures, medical plants etc.)	Operation Activities	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Provide access to the project areas for community members to harvest the medicinal plants and rootstock prior to construction for self-cultivation. • Develop a strategy to allow controlled access to specific areas. • Conduct environment campaigns to raise awareness on conservation and biodiversity among employees and local community. • Donate trees and resources species to be cleared during construction to surrounding communities for use as fuel wood to reduce pressure on the other natural forest/woodland	Low - negative	Local	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation
Access to Grazing Land	Loss of grazing land	Operation Activities	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Adjust project design to avoid or reduce taking key grazing areas and ensure only a minimal portion of land is affected. Offer culturally appropriate compensation through replacement grazing areas or monetary payment agreed upon with Maasai elders. Identify and improve new	Low - negative	District	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											grazing zones with adequate pasture and water points to support livestock. Introduce programs for livestock health, fodder production, and water harvesting to sustain pastoral livelihoods. Continue consultation with Maasai leaders and respect traditional decision-making and cultural practices. Establish a joint plan for sustainable grazing, regular monitoring, and grievance handling.									
Terrestrial Flora	Alteration of Local Microhabitats	Operation Activities	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Maintain natural drainage pathways where possible and design engineered drainage systems to prevent waterlogging or erosion. • Inspect vegetation health and composition periodically in areas surrounding operational facilities.	Low - negative	District	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Decommissioning/ closure
Terrestrial Flora	Disruption and Loss of Ecosystem Services	Operation Activities	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Refer the proposed mitigation measures for “Restriction of access to natural resources” impact during construction and operation phase • Refer the proposed mitigation measures for “Loss of grazing land” impact during construction and operation phase • Refer the proposed mitigation measures for “Reduction in the Tourism and Ecological Value of Lake Natron Ramsar Site” impact during construction and operation phase	Low - negative	District	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	#N/A
Terrestrial Flora	Continued Loss of Vegetation Cover	Continuous vehicular movement, maintenance works, and human activity during operation	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Restrict vehicle movement to designated routes within the site. • Implement and periodically update a vegetation management and restoration plan. • Conduct regular inspection of ground cover and promptly restore degraded patches using native species.	Low - negative	District	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	#N/A

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Terrestrial Fauna	Hydrological Alteration and Pollution Impacts on Fauna Habitats	Operation activities such as extraction and processing of soda ash will require abstraction of freshwater from inflowing rivers and springs, which may alter the hydrological balance of Lake Natron	High - negative	Local	Long-term	Moderate - negative	High	Likely	High	High - negative	• Limit freshwater abstraction to sustainable levels approved by the water authorities. • Develop and implement a comprehensive Water Management Plan to monitor abstraction and inflow levels into Lake Natron. • Construct lined waste containment systems and install wastewater treatment prior to discharge. • Monitor surface and groundwater quality regularly for early detection of contamination. • Promote water recycling and reuse within processing and support facilities.	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	#N/A
Terrestrial Fauna	Continue Loss and Fragmentation of Fauna Habitats and Ecological Connectivity	Operational activities such as continuous use of developed areas and traffic movement along haul roads	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Refer to the mitigation measures of "Loss and Fragmentation of Fauna Habitats and Ecological Connectivity" during the construction phase	Moderate - negative	Local	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	#N/A
Terrestrial Fauna	Disturbance to Fauna from Noise, Light, and Human Activity	Noise, light, and human activity from processing operations, vehicle movement, and 24-hour lighting at the plant site	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Refer to the mitigation measures of "Disturbance to Fauna from Noise, Light, and Human Activity" during the construction phase	Moderate - negative	Local	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	#N/A
Terrestrial Fauna	Impacts on Species of Conservation Concern	Sustained disturbance and potential habitat degradation	High - negative	Local	Long-term	Moderate - negative	High	Likely	High	High - negative	Refer to the mitigation measures of "Impacts on Species of Conservation Concern" during the construction phase	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	#N/A
Aquatic biodiversity	Alteration of Water Quality and Hydrological Regime	Continuous trona slurry pumping and soda ash processing during the	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Design and operate a closed-loop trona slurry circulation system to minimize discharge into natural water bodies. • Establish a comprehensive water quality monitoring	Low - negative	District	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	#N/A

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
		operation phase									program (pH, salinity, conductivity, TSS, and temperature) at inflow and discharge points. • Treat all effluents to comply with Tanzanian Water Quality Standards (2007) and IFC Environmental Guidelines before discharge. • Restrict abstraction rates to within the environmental flow thresholds determined through hydrological assessment. • Develop and implement a spill prevention and emergency response plan to address accidental leaks or overflow events.									
Aquatic biodiversity	Sedimentation, Erosion, and Habitat Degradation	Operation activities such as continuous vehicle movement, maintenance of abstraction channels, and trona slurry transportation	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Implement erosion and sediment control plans, including silt fences, sediment traps, and vegetative buffer zones. • Restrict vehicle movement to designated and stabilized access routes. • Regularly maintain drainage and containment structures to prevent sediment wash-off. • Re-vegetate disturbed areas with native grass or shrub species after maintenance activity • Install sediment retention ponds at discharge points to capture fine particulates before water returns to the natural system.	Low - negative	District	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Preparation
Aquatic biodiversity	Noise Pollution and Disturbance to Aquatic Fauna	Operation of pumps, and other machinery will generate persistent low-frequency noise that may propagate through the trona extraction channels and shoreline areas	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Use low-noise equipment and ensure proper maintenance to minimize mechanical noise emissions. • Install acoustic dampeners or vibration isolators on pumps, and other stationary machinery. • Locate stationary noise-generating units away from sensitive inflowing streams or fish refuge areas. • Schedule high-noise activities during daytime hours to reduce cumulative disturbance. • Implement a noise monitoring program (both airborne and underwater) to ensure compliance with acceptable limits.	Low - negative	District	Permanent	Moderate - negative	Low	Unlikely	Low	Low - negative	Preparation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Aquatic biodiversity	Solid Waste Mismanagement	Operational activities may generate various solid wastes including packaging materials, process residues, and maintenance debris	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Implement a comprehensive solid waste management plan emphasizing waste minimization, segregation, and recycling. • Designate impermeable waste storage areas with secondary containment and located far from drainage lines or water bodies. • Prohibit direct disposal of any solid waste into aquatic or shoreline zones. • Conduct regular clean-up and waste collection schedules for all operational sites. • Partner with licensed waste contractors for offsite disposal of non-recyclable materials. • Train all staff on waste handling and spill prevention protocols.	Low - negative	District	Permanent	Moderate - negative	Low	Unlikely	Low	Low - negative	Preparation
Loss of tourism value of the lake	Reduction in the Tourism and Ecological Value of Lake Natron Ramsar Site.	Operation Activities	High - negative	Regional	Long-term	High - negative	Moderate	Possible	Moderate	High - negative	Restrict project activities near sensitive zones, especially flamingo breeding and nesting areas, to preserve ecological and visual integrity. Establish and enforce adequate buffer distances between the project footprint and the lake shoreline to protect scenic views and wetland ecosystems. Control dust, noise, and wastewater discharge to prevent pollution and maintain the lake's natural appearance and habitat quality. Collaborate with local authorities and tour operators to enhance sustainable tourism through conservation education and community-based tourism programs. Restore any disturbed areas using native vegetation to retain the natural landscape and visual appeal important for tourism. Work with the Ramsar Site Management Committee and TANAPA to monitor environmental conditions and ensure compliance with Ramsar conservation standard	Moderate - negative	Regional	Medium-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Social Interaction	Increase of HIV/AIDS and STDs	Influx of people	Moderate - negative	District	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	•Conduct regular HIV/AIDS and STD awareness sessions for workers and nearby communities. •Provide free and easy access to condoms at work sites and camps •Facilitate voluntary HIV counseling and testing (VCT) for project staff and willing community members •Partner with community leaders and youth groups to deliver HIV/STDs messages.	Moderate - negative	Local	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation
Social Interaction	Cultural interaction	Influx of people	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Ensure all project staff and contractors are sensitized to Maasai customs, dress codes, and social etiquette through cultural awareness training. Maintain continuous consultation with Maasai elders and cultural leaders in all decision-making and community engagement processes. Establish a clear code of conduct for project workers to prevent cultural disrespect, harassment, or discrimination. Support initiatives that foster positive interaction, such as cultural induction sessions or joint community events promoting understanding. Identify, map, and avoid disturbance of areas with spiritual or cultural importance, ensuring access for traditional practices is not restricted. Include culturally appropriate procedures for reporting and resolving issues arising from cultural misunderstandings or disrespect.	Moderate - negative	Local	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation
Local Economy and Employment	Price Inflaction	Influx of people	Moderate - negative	District	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Promote Local Supply and Production: Support local farmers, traders, and producers to increase supply of food and basic goods to meet project-related demand. Work with local authorities to monitor commodity prices and discourage exploitation or unfair pricing in nearby markets. Prioritize procurement of goods and services from local suppliers to stabilize the local	Moderate - negative	Local	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											economy and strengthen livelihoods. Provide small business training and access to microfinance to help local entrepreneurs adapt to new market opportunities. Where possible, employ local residents to reduce sudden population pressure and demand for limited goods. Collaborate with district authorities to plan and monitor inflation trends and develop measures for market stabilization.									
Local Economy and Employment	Employment Opportunities	Project Operation activities	High - positive	Regional	Long-term	High - positive	High	Likely	High	High - positive	Focus on local employment by establishing specific targets and consistently tracking progress towards meeting them. Work with community representatives to verify the residency of applicants. Set objectives for hiring local women and youth, and provide training programs to enable local recruits to qualify for permanent roles during the operations phase.	Very high - positive	Regional	Long-term	High - positive	Very high	Highly likely	Very high	Very high - positive	Operation
Local Economy and Employment	Increase in Business Opportunities	Project Operation activities	Very high - positive	National/ international	Long-term	High - positive	Moderate	Unlikely	Low	Moderate - positive	Prioritize obtaining goods, materials, and services from local businesses. Set specific targets and regularly track progress to ensure these objectives are met. Confirm the local status of interested businesses and establish a comprehensive register of local small businesses, including the types of goods and services they provide.	Very high - positive	National/ international	Long-term	High - positive	High	Likely	High	High - positive	Operation
Local Economy and Employment	Fiscal Benefits	Statutory Payments (Taxes, NSSF, WCF, and levies	Very high - positive	National/ international	Long-term	High - positive	Moderate	Unlikely	Low	Moderate - positive	Ensure that all revenues are paid in compliance with legal requirements. Remit employee taxes to the Tanzania Revenue Authority (TRA) and make social security contributions to the National Social Security Fund (NSSF) and Workers Compensation Fund. Encourage contractors to fulfill their tax obligations to both the government and the Ngara District Council.	Very high - positive	National/ international	Long-term	High - positive	High	Likely	High	High - positive	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Local Economy and Employment	Capacity Building and skills transfer	Project Operation activities	Very high - positive	National/ international	Long-term	High - positive	Moderate	Unlikely	Low	Moderate - positive	Develop tailored training for Maasai youth and interested community members on plant operations, safety, and environmental management. Offer apprenticeship or internship opportunities during the operation phase to enable practical skill transfer to local residents. Partner with vocational training centers or NGOs to deliver technical and business-related capacity-building programs. Adopt a local recruitment policy giving preference to qualified Maasai individuals for semi-skilled and unskilled positions. Organize community workshops to explain plant operations, safety procedures, and environmental protection practices. Create a structured plan with measurable targets for local employment, training participation, and progress monitoring.	Very high - positive	National/ international	Long-term	High - positive	High	Likely	High	High - positive	Operation
Soil	Soil Erosion and Sedimentation	Wind/runoff from unpaved roads and open areas (operation)	Moderate - negative	Local	Medium-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Stabilise roads, dust suppression, maintain surface cover, routine maintenance and vegetation buffers.	Moderate - negative	Local	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Soil	Soil Compaction	Continuous vehicle movement (operation)	Moderate - negative	Local	Medium-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Limit heavy vehicle movement, designated parking, periodic ripping/loosening, monitor infiltration.	Moderate - negative	Local	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation
Soil	Soil Contamination	Leaks/spills from fuels and lubricants, omproper handling of chemicals and poor waste management(operation)	Moderate - negative	Local	Long-term	Moderate - negative	High	Possible	Moderate	Moderate - negative	Proper containment systems, spills response measures and monitoring	Very low - negative	Local	Medium-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Soil	Salinization & Altered Soil Structure	Prolonged exposure to trona and dust deposition from operations (operation)	High - negative	Local	Long-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Proper containment, dust control and soil management practices	Moderate - negative	Local	Long-term	Moderate - negative	Low	Unlikely	Low	Low - negative	Operation
Soil	Loss of Topsoil Integrity	Prevented vegetation recovery due to frequent movement (operation)	Low - negative	Site-specific	Medium-term	Low - negative	Low	Possible	Low	Low - negative	Restricted access zones, rehabilitation patches, resting areas for vegetation regeneration.	Very low - negative	Local	Long-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Soil	Soil Stability and Localized Disturbance	Operational activities, including equipment use and material handling (operation)	Low - negative	Local	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	Maintenance, monitoring and proper site design.	Very low - negative	Local	Long-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Operation
Soil	Reduction in Soil Biological Activity	Localized salinity, reduced vegetation cover and compaction (operation)	Low - negative	Site-specific	Long-term	Low - negative	Low	Possible	Low	Low - negative	Soil rehabilitation and organic matter improvement where necessary	Very low - negative	Local	Long-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Operation
Air Quality	Disturbances or Nuisance to sensitive receptors	Generation of particulate matter/dust from	Moderate - negative	Local	Short-term	Low - negative	Moderate	Likely	Moderate	Low - negative	• Conduct regular maintanence on transportation boats and other machinery to reduce the amount Noxious Gas being released into the	Very low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
		operation activities									ambient air. •Limit vehicle speeds on the access roads and enforce dust control schedules during dry periods									
Green House Gasses (GHG)	Climate Change	Energy Consumption during operations	Moderate - negative	National/ international	Short-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	• Undertake regular servicing of all machinery to reduce the amount of GHG's released into the atmosphere. • Conduct regular energy audits to assess the power needs and use of the infrastrucure. • Implement a fuel management plan to monitor and optimize fuel usage on-site. • Optimize transportation routes and schedules to minimize fuel consumption	Very low - negative	National/ international	Short-term	Moderate - negative	Very low	Highly unlikely	Very low	Low - negative	Operation
Noise and Vibration	Nuisance/Deteroration of ambient noise levels to sensitive receptors outside the boundary of project site	Operation activities (Movement of boats & vehicles	Moderate - negative	Local	Short-term	Low - negative	Moderate	Likely	Moderate	Low - negative	• Utilize noise surpression techniques or equipment such as silcencers on the exhaust of vehicles. • Maintain the noise levels of alarms to be contained within the boundary of the Project site by locating alarms in a direction away from sensitive receptors • Develop a noise criteria document that relate to relevant work practices and nearby receptors. • The document to be placed on a noticeboard so that all site workers can quickly reference noise information	Low - negative	Local	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Operation
Visual Amenities	Lighting from the Processing Plant, Vehicles and other equipment	Operation Activties	Low - negative	Site-specific	Medium-term	Low - negative	Moderate	Likely	Moderate	Low - negative	• Direct the main bean angle of lights directed towards any potential observer to not be more that 70 degrees • Glare to be kept to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70%.	Very low - negative	Site-specific	Medium-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Air Quality	Exceedance of the Ambient Air Quality standards and regulations resulting in air quality deterioration (Noxious Gasses, Particulate Matter)	Operation Activities on the TSF, Mining Pits, Waste Rock Dumps and Processing Plant	Moderate - negative	Local	Short-term	Low - negative	Moderate	Likely	Moderate	Low - negative	• Conduct regular maintanence on transportation vehicles and other machinery to reduce the amount Noxious Gas being released into the ambient air. • Regularly water haul roads, pit benches and loading areas to suppress dust. •Limit vehicle speeds and enforce dust control schedules during dry periods • Maintain a moist surface on active tailing areas to reduce the creation of dust from TSF area • Restrict dumping of materials during high windy days. • Conduct regular visual inspection of all possible sources of emissions (Gas Pipes, etc)	Very low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Operation
Surface Water	Alteration of lake salinity & hydrodynamics	Continuous water abstraction for processing	Moderate - negative	National/ international	Short-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	Establishment of sustainable abstraction limits Design of intake structures to minimize disturbance Avoidance of ecologically sensitive zones Monitoring of lake levels and salinity Implementation of adaptive management practices	Very low - negative	National/ international	Short-term	Moderate - negative	Very low	Highly unlikely	Very low	Low - negative	Operation
Surface Water	Effluent / runoff contamination	process water from trrona handling and washing operations, surface runoffs from operational areas, accidental spills of fuels, lubricants or chemicals	Moderate - negative	National/ international	Short-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	•Implementation of proper drainage systems to separate clean and contaminated runoff •Construction of bunded areas around storage tanks and operational zones •Installation of spill prevention and response systems •Regular inspection and maintenance of pipelines and storage infrastructure •Treatment and controlled discharge or reuse of wastewater •Monitoring of water quality in nearby receptors	Very low - negative	National/ international	Short-term	Moderate - negative	Very low	Highly unlikely	Very low	Low - negative	Operation
Groundwater	Groundwater contamination	seepage from storage tanks or pipelines, inflitration of contaminated runoff	Moderate - negative	National/ international	Short-term	Moderate - negative	Moderate	Likely	Moderate	Moderate - negative	oUse of lined storage systems and containment structures oProper drainage design oSpill prevention and response measures oRoutine inspection and maintenance	Very low - negative	National/ international	Short-term	Moderate - negative	Very low	Highly unlikely	Very low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											oMonitoring of groundwater quality where applicable									
General Environment	General environmental pollution due to Waste Generation	Maintenance waste, packaging, sludge, and domestic refuse, soda ash processing, chemical reactions, and cooling systems	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Prioritize the application of a waste management hierarchy i.e. prevention, re-use, recycling, recovery, and disposal at site; • Ensure waste minimization through measures such as using less material in design, reduction (e.g., keeping products for longer or designing to last longer), and reuse; • Encourage waste recycling, particularly used oils, containers, equipment, paper, and plastics; • Encourage on-site segregation of construction waste into categories such as metal, wood, concrete, and hazardous materials; • Ensure storage and treatment of waste undertaken in a manner that protects the environment; • Emphasize use of specific installations, authorization prior to burying waste, accreditation of specialized companies; • Traceability of hazardous waste, detailing the type of waste, quantity, and identification of both carrier and destination; • Regularly inspect and maintain vehicles and equipment to prevent leaks of oil or other fluids; • Provide training to responsible personnel on proper methods for transporting, transferring, and handling hazardous substances that have the potential to impact surface and groundwater resources; • Ensure proper management of wastewater from the kitchen and sanitary facility at the site and, where necessary, apply the recycling method of	Low - negative	Local	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											wastewater for other water use purposes; and • Where possible, substitute hazardous materials with safer alternatives; and • Use licensed waste collectors for disposal and recycling.									
Community Health, Safety, Security, and Human Rights	Road safety risks and traffic accidents	Transportation of materials or products in and out of the project during the operation phase	Moderate - negative	Regional	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Avoid transportation of project equipment and materials through busy trading centers and towns by using bypasses as appropriate; • Ensure regular maintenance of machinery, vehicles, and equipment as per the manufacturer's recommendation. • Ensure regular maintenance of access roads to be used for transportation activities; • Ensure establishment and implementation of safety speed limits; and Post safety signage along the route where transportation activities will be undertaken	Low - negative	Regional	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											to safeguard the safety of the surrounding community and other road users.									
Community Health, Safety, Security, and Human Rights	Spread of communicable diseases	Operation of the project may result in a continual population influx, which makes it easy to spread communicable and sexually transmitted diseases.	Moderate - negative	Regional	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Develop training and awareness programs on communicable, infectious, and sexually transmitted diseases and provide them to workers and surrounding communities; • In the event of a new disease, increased transmission, or outbreak compared to the baseline, interact with local health care facilities and workers to ensure there is an appropriate response in place to make workers aware and to ensure proper precautionary measures are implemented; • Ensure contractors adhere to the NVCL Code of Conduct, providing a worker code of behavior including worker-worker interactions, worker-community interactions, and development of personal relationships with members of the local communities; • Providing workers with appropriate sanitary facilities, which are appropriately designed to prevent contamination; • Developing a robust waste handling system to avoid the creation of new vector breeding grounds or attracting rodents to the area; • Ensuring appropriate food preparation and monitoring measures are in place; • Ensure workers are provided with access to selected treatment at health	Low - negative	Regional	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											facilities at or near the Project Site as deemed necessary for this Project. The requirements for these health facilities should be based on a risk assessment considering access to existing health facilities and travel time to facilities that offer international standards of care. Access to health care should include direct employees and subcontractors working on-site; • Prepare and implement a communicable and infectious disease management plan. This plan is to be explained and communicated clearly to the workforce and surrounding communities; • Pre-employment screening protocols to be put in place within the framework of equal opportunities and non-discrimination. This includes pre-employment medicals and follow-up medicals as appropriate. The screening protocols to consider health conditions related to the nature of the work undertaken, employee residential details, and legal requirements; • Ensure the provision of appropriate PPE to workers; and Align awareness campaigns with those of other organizations in the area (i.e., NGOs, the Ministry of Health, etc.). These campaigns should use various common practice methodologies to ensure social and cultural sensitivity.								

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Community Health, Safety, Security, and Human Rights	Violation of human rights	Activity related to security (Use of security forces)	Moderate - negative	Local	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Ensure transparent communication about the role and responsibilities of security forces; • Clearly articulate the purpose of their presence and the measures being taken to safeguard the community and the project; • Where necessary, provide comprehensive training to security personnel on human rights, cultural sensitivity, and community engagement; • Sensitize security forces to the local culture and customs to avoid unintentional offenses; • Ensure that security forces operate in line with local and international laws and adhere to ethical standards; • Implement accountability measures for any misconduct or human rights violations; • Adopt a community policing approach, where security forces work collaboratively with the community to address security concerns; and • Build positive relationships between security personnel and community members to foster trust.	Low - negative	Local	Long-term	Moderate - negative	Low	Possible	Low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Labour and Working Condition	Occupational Health and Safety Risks	Workers are to be exposed to various occupational hazards (ergonomic, biological, chemical, mechanical, and physical hazards) due to operational activities	High - negative	Site-specific	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Conduct Risk Assessment covering all activities associated with the project; • Undertake medical check-up, which includes pre-entry, periodic, as well as pre-existing medical check-up; • Ensure providing appropriate PPE to all workers to safeguard their health; • Emphasize the application of the hazard control hierarchy when mitigating hazards; • Develop and implement the health and safety management plan associated with all activities at site; • Ensure provision of OHS training to workers; • Conduct periodic site inspection to identify existing hazards at workplace; • Ensure compliance with the OSHA Act, 2003, and other OHS International Good Practices; • Ensure posting of the safety signage in different areas of the site to inform of the associated hazards present in the area; • Ensure provision of welfare facilities at each project working site; and • Ensure provision of facilities and other supporting safety material, such as SOPs, procedures, etc., for the protection of workers against various hazards to which they are exposed.	Very low - negative	Local	Long-term	Low - negative	Low	Possible	Low	Low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Labour and Working Condition	Labor Disputes and Rights Violations	Operation activities - Unfair working conditions, such as discrimination, unfair treatment, prevention of freedom of association, use of child/forced labor, and poor working conditions (i.e., provision of breaks, access to sanitary facilities, working hours, terms of payment, lack of contracts in place etc.	Moderate - negative	Site-specific	Long-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Establish and implement GRM procedures for workers; • Ensure provision of clear and understandable information regarding rights under national labor and employment law, and any applicable collective agreements, including those related to hours of work, wages, overtime, compensation, etc. • Ensure provision of reasonable working conditions and terms of employment; • Ensure provision of employment, compensation/remuneration, and working conditions, including working hours, based on equal opportunity and fair treatment, avoiding discrimination on any aspects; • Ensure provision of adequate welfare facilities on site; • Ensure the adoption and implementation of a sexual harassment policy in all sections and • Ensure adoption of an open attitude towards freedom of association.	Low - negative	Site-specific	Long-term	Low - negative	Low	Possible	Low	Low - negative	Operation

(Source: MTL Consulting, 2025)

7.4.3 Impacts Associated with Project Closure and Decommissioning

a) Water Resources

i. Surface Water

- **Mobilization of Residual Contaminants**

During decommissioning, activities such as dismantling infrastructure, excavation of foundations, and removal of pipelines may disturb soils that have been exposed to operational materials (e.g., salts, fuels, lubricants). If not properly managed, rainfall events may mobilize residual contaminants, resulting in runoff entering nearby drainage channels and ultimately Lake Natron.

Potential impacts include:

- Temporary deterioration of surface water quality
- Transport of contaminants to sensitive receiving environments

The pre-mitigation impact significance is Moderate, considering the temporary nature of decommissioning activities and the sensitivity of the receiving environment.

Mitigation measures include:

- Scheduling major decommissioning works during dry periods
- Identification and removal of contaminated soils for appropriate disposal
- Installation of temporary runoff control systems (e.g., lined containment areas, sediment traps)
- Proper handling and disposal of waste materials

Residual Impact: Low Negative.

- **Erosion and Sediment Discharge During Rehabilitation**

Land regrading and rehabilitation activities will expose soils, increasing susceptibility to erosion before vegetation is re-established. Rainfall during this period may result in sediment-laden runoff entering nearby watercourses.

Potential impacts include:

- Increased turbidity in surface water
- Sediment deposition in drainage channels and lake margins

The pre-mitigation impact significance is Moderate.

Mitigation measures include:

- Stabilization of slopes using appropriate engineering techniques (e.g., terracing, check structures)
- Rapid revegetation using native, site-appropriate species
- Maintenance of erosion and sediment control measures until vegetation is established
- Design of drainage systems to reduce runoff velocity

Residual Impact: Low Negative.

ii. Groundwater

- **Residual Soil and Groundwater Contamination**

Following decommissioning, residual contamination may remain in soils due to historical operational activities. If not properly addressed, these contaminants may leach into underlying groundwater systems over time.

Potential impacts include:

- Localized degradation of groundwater quality
- Long-term contamination risks if contaminated materials are not removed

The pre-mitigation impact significance is Moderate to High, depending on the extent of contamination.

Mitigation measures include:

- Conducting pre-closure environmental site assessments to identify contaminated areas
- Excavation and safe disposal of contaminated soils
- Proper decommissioning and sealing of any monitoring infrastructure
- Implementation of a post-closure groundwater monitoring program

Residual Impact: Low to Moderate Negative.

- **Alteration of Groundwater Recharge**

Landform reshaping during rehabilitation may alter natural drainage and infiltration patterns if not properly designed. Changes in surface runoff may reduce localized groundwater recharge.

Potential impacts include:

- Increased surface runoff
- Reduced infiltration in certain areas

The pre-mitigation impact significance is Moderate.

Mitigation measures include:

- Designing final landforms to reflect natural drainage patterns
- Incorporating infiltration features where appropriate
- Restoring soil structure through ripping and conditioning
- Monitoring post-closure hydrological performance

Residual Impact: Low Negative.

b) General Environmental Pollution due to Waste Generation

Decommissioning activities will generate demolition waste, including concrete debris, scrap metal, and possibly contaminated materials. Improper disposal of this waste could lead to long-term environmental degradation. A Decommissioning Waste Management Plan to be prepared, emphasizing recycling and reuse where feasible, and safe disposal of residual

materials in designated facilities. Also, post-closure monitoring would ensure no residual contamination remains. With proper implementation, the impact will reduce from moderate negative to low negative.

c) Impacts on Biodiversity

i. Temporary Disturbance from Demolition Activities

During decommissioning, demolition of infrastructure and removal of materials may cause short-term disturbance to existing vegetation through dust generation, soil compaction, and accidental trampling. These effects will be temporary but may hinder the early stages of site recovery if not managed properly. The impact significance is low negative before mitigation but expected to be very low negative afterward with appropriate site management and rehabilitation efforts.

ii. Opportunities for Habitat Recovery

The decommissioning phase will create favourable conditions for ecosystem restoration, allowing the re-establishment of native vegetation and gradual recovery of ecological functions. With a well-implemented rehabilitation plan, the site can regain much of its pre-disturbance vegetation cover and ecological value. The impact is therefore positive, shifting from low negative to very low positive significance following active intervention of the proposed mitigation measures.

iii. Disturbance to Fauna from Noise, Light, and Human Activity

Decommissioning activities, including facility dismantling, site clearing, and restoration, may temporarily increase disturbance from noise, movement, and waste generation, similar to the construction phase. Fauna may again be displaced due to human activity and equipment use. However, since activities are short-term and conducted under controlled conditions, the impact is low to very low negative and can be minimized by applying the same noise and lighting control measures used during earlier phases.

iv. Impacts on Species of Conservation Concern

For species of conservation concern, the phase offers a chance for population recovery through restoration and reduced human interference. Monitoring of indicator species like the Lesser Flamingo and other IUCN Red List Species as Threatened as indicated in Section 4.2.16 during post-decommissioning will help evaluate ecosystem recovery success. Overall, the impact trend transitions from low negative to Very low positive, supporting long-term biodiversity regeneration in the Lake Natron Game Controlled Area including the Lake Natron basin.

v. Water Pollution and Contamination

During decommissioning, dismantling of pipelines, tanks, and ponds can release residual saltwater, lubricants, or alkaline sludge into nearby inflows or lake edges. Such discharge could temporarily increase water salinity and alkalinity, affecting sensitive aquatic organisms, especially endemic fish species adapted to narrow ecological ranges. If unmanaged, these effects can delay water quality recovery and harm the ecosystem, however with proper implementation of the mitigation measures the impact is well preventable.

vi. Sediment Disturbance and Increased Turbidity

Decommissioning activities, including the removal of pipelines, intake structures, and associated foundations, may resuspend accumulated sediments and disturb shoreline

substrates. Also, the removal of submerged or nearshore structures may disturb bottom sediments, leading to short-term turbidity increases. Elevated turbidity can reduce light penetration, affect aquatic plant photosynthesis, and smother benthic habitats, though the effect is expected to be temporary and localized and easily mitigated.

vii. Habitat Disturbance and Recovery Potential

Decommissioning activities may disturb aquatic and riparian habitats through vegetation clearing and physical removal of infrastructure such that without proper rehabilitation, these actions can prolong habitat degradation. However, in other term, once the operations cease and contaminants are removed, natural habitat recovery can occur, improving ecological integrity in the long-term making the impact a very low positive if well manageable through proposed mitigation measures.

d) Community Health, Safety, Security, and Human Rights Related Impacts

i. Road Accident and Traffic Safety Risks

Decommissioning will again require the movement of heavy machinery and demolition waste, increasing traffic and potential for accidents, albeit for a shorter duration. The removal of large equipment or waste materials may block or damage access routes, posing hazards to both workers and residents if not properly managed.

Road accidents can result in fatalities, serious injuries, and long-term disability for community members. Damage to property, livestock, and livelihoods can also occur, alongside social unrest or community resentment, if such incidents are not addressed transparently. Beyond immediate physical harm, frequent accidents can lead to loss of trust in the project, community protests, and reputational risks for the company. The impact is initially rated as moderate negative, but with the successful implementation of the proposed mitigation measures, it is expected to decline to a low negative significance.

ii. Spread of Communicable Diseases

When operations end, downsizing and relocation of workers may also disrupt local health programs or HIV/AIDS awareness campaigns previously supported by the project. Reduced health surveillance and discontinuation of health services can lead to a resurgence of infections. Movement of workers to new project sites may also contribute to the spread of diseases to other areas. The impact is assessed as moderate negative prior to the implementation of mitigation measures and is expected to be reduced to low negative following the effective application of these measures.

iii. Violation of Human Rights

During decommissioning, the reduction or withdrawal of security personnel could expose both the site and nearby communities to new risks such as theft, vandalism, or uncontrolled access to hazardous areas. Conversely, if security forces remain active but are not reoriented toward community-sensitive engagement, conflicts may re-emerge, particularly during asset removal or land handover. Before applying mitigation measures, the impact is considered low negative; however, with effective implementation of these measures, it is expected to be minimized to a very low negative significance.

e) Socio Economic

i. Local economy and employment
ii. Loss of government revenue

The decommissioning and closure of the project will result in a reduction of government revenue previously generated from corporate taxes, Pay-As-You-Earn (PAYE) income taxes, and other levies paid to the Tanzania Revenue Authority (TRA). Additionally, foreign exchange earnings from the procurement and sale of soda ash will cease. The significance of this impact is assessed as moderate negative before mitigation. Mitigation measures include exploring opportunities for the government to sustain revenue through the promotion of alternative economic activities in the region and supporting the local community to continue with other resource-based enterprises. With these measures in place, the impact significance is expected to be low negative after mitigation.

iii. Loss of jobs

With approximately 300 employees expected during the operation phase, the project's closure will result in the loss of these job opportunities. This will directly affect the livelihoods of workers, their families, and the broader local community, leading to reduced purchasing power and a decline in local economic activity. The significance of this impact is assessed as moderate negative before mitigation. Mitigation measures include supporting workforce transition programs, such as job placement assistance, vocational training, and skills transfer to help employees secure alternative employment or engage in local economic activities. With these measures implemented, the impact significance is expected to be low negative after mitigation.

iv. Decrease in Business Opportunities

The closure of the project will reduce demand for goods and services that supported the operation phase, affecting local businesses such as suppliers, traders, transport providers, and service establishments. Hotels, restaurants, shops, and transport services that benefited from project-related activities may experience reduced income, potentially leading to business downsizing or closure. The significance of this impact is assessed as moderate before mitigation. Mitigation measures include supporting local businesses through capacity-building programs, facilitating access to alternative markets, and encouraging diversification of products and services to reduce reliance on project-related demand. With these measures, the impact significance is expected to be low negative after mitigation.

v. Loss of Community Development Support

During the project's operational phase, residents in surrounding communities benefit from WWSL's CSR initiatives, which support education, healthcare, infrastructure, and other community programs. Upon project closure, this support will cease, leaving a gap in services and development opportunities that the community has come to rely on. The termination of these benefits could affect the well-being and socio-economic development of local residents. Mitigation measures include collaborating with local authorities and community organizations to establish sustainable programs or alternative funding sources to continue key services. The significance of this impact is assessed as moderate negative before mitigation and low negative after mitigation.

f) Impacts on Soils

The closure phase will involve removal of infrastructure, decommissioning of evaporation ponds, and site restoration to a stable, self-sustaining condition. While initial soil disturbance may occur, this phase provides opportunities for significant restoration and improvement.

i. Negative Impacts:

- Soil Erosion and Sedimentation: Exposed soils during dismantling may erode and sediment into drainage lines.
- Significance: Moderate negative before mitigation; Low negative after mitigation, with regrading and revegetation.
- Soil Compaction: Demolition and transport machinery may further compact soils, limiting infiltration and vegetation regrowth.
- Significance: Moderate negative before mitigation; Low negative after mitigation, with mechanical loosening and traffic cessation.
- Soil Contamination: Residual soda ash, fuel, or waste materials may persist if not remediated, altering pH and salinity.
- Significance: Moderate negative before mitigation; Low negative after mitigation, with soil remediation and safe disposal.
- Disturbance of Soil Structure: Excavation and regrading may disrupt soil horizons and reduce fertility.
- Significance: Moderate negative before mitigation; Low negative after mitigation, with careful soil handling and restoration.

ii. Positive Impacts:

- Site Remediation and Restoration: Soil cleanup, reconditioning, and organic enrichment will improve structure and fertility. Significance: Moderate positive.
- Reduction of Soil Compaction: Cessation of heavy traffic and mechanical loosening restore porosity and infiltration. Significance: Moderate positive.
- Vegetation Re-establishment: Planting native grasses and shrubs stabilizes soils, enhances organic matter, and reduces erosion. Significance: High positive.
- Improved Soil Moisture and Drainage Management: Recontouring and landform design restore natural drainage, minimize runoff, and maintain soil moisture balance. Significance: Moderate positive.

a) Impact on Air Quality

i. Disturbances or Nuisance to sensitive receptors

The Decommissioning phase may be less active as compared to the Operational Phase but that does not mean it does not have any impact on Air Quality. During this phase the sources of emissions will be the vehicles that transport the equipment away from the project site and the heavy machinery used to dismantle the facilities. It is highly likely that emissions from the decommissioning phase will impact on the sensitive receptors that are in close proximity to the proposed project sites. Activities such as the transportation of dismantled equipment can produce and emit considerable volumes of particulate matter/dust (PM2.5 and PM10) and exhaust emissions of Carbon Dioxide (CO2), Nitrogen Dioxide (NO2), Sulphur Dioxide (SO2) and Volatile Organic Compounds (VOCs). With effective implementation of the proposed mitigation measures, the effect will be negligible.

b) Impacts on Noise and Vibration

i. Nuisance/Deterioration of ambient noise levels to sensitive receptors outside the boundary of project site

The Decommissioning phase of the Project is likely to cause effects of noise and vibration of the Project. Activities such as dismantling facilities and equipment in the project sites can produce noise and vibration that can negatively affect the sensitive receptors close to the project site. The mitigation measures will ensure that the effects are minimized as much as possible.

c) Labor and Working Condition Related Impacts

i) Occupational Health and Safety Risks

During decommissioning, the dismantling of structures, handling of demolition waste, and use of heavy equipment may reintroduce occupational risks similar to those during construction. Workers may face injuries from sharp objects, falls, and exposure to dust and debris. Proper decommissioning procedures, training on safe dismantling techniques, and provision of PPE will be critical. The decommissioning phase OHS Plan will be developed in alignment with best industry practices to ensure safety. With adherence to these protocols, the risk will decline from moderate to low negative significance.

Table 7.8: Analysis and Classification of Impacts During the Decommissioning Phase

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Local economy and employment	Loss of government revenue	Decommissioning activities of the Project	Moderate - negative	National/ international	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Make sure to notify government agencies, including the Tanzania Revenue Authority (TRA), of the projected closure timelines well before the decommissioning and shutdown activities begin.	Moderate - negative	National/ international	Short-term	Moderate - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure
Local economy and employment	Loss of Employment	Decommissioning activities of the Project	Moderate - negative	National/ international	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Throughout the operation period, all employees will be provided with pension schemes. If possible, and if the Company has other operations in the country, skilled employees will be considered for positions at these locations. Skills training programs will be established to improve	Moderate - negative	National/ international	Short-term	Moderate - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											employment prospects for employees following the closure. Furthermore, the closure plan will address potential job losses and involve consultations with stakeholders to effectively manage these impacts.									
Local economy and employment	Decrease in Business Opportunities	Decommissioning activities of the Project	Moderate - negative	National/ international	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Encourage people to invest in alternative sectors such as agriculture.	Moderate - negative	National/ international	Short-term	Moderate - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Local economy and employment	Loss of Community Development Support	Decommissioning activities of the Project	Moderate - negative	District	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Collaborate with local government and community organizations to take over management of ongoing initiatives. Create a sustainable fund to continue supporting priority community projects after decommissioning. Train local leaders and committees to manage projects and resources independently. Involve beneficiaries in planning the closure of programs to ensure needs are prioritized and expectations managed. Track the effectiveness of program handover and adjust support measures as needed	Moderate - negative	District	Short-term	Moderate - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											during the transition period.									
Terrestrial flora	Temporary Disturbance from Demolition Activities	Decommissioning activities such as demolition of infrastructure and removal of materials	Low - negative	Site-specific	Short-term	Low - negative	Low	Unlikely	Low	Low - negative	• Conduct demolition activities in a phased and controlled manner to limit the area of disturbance. • See the mitigation measures of "Dust Deposition" impact during the construction phase	Moderate - negative	Site-specific	Short-term	Low - negative	Low	Highly unlikely	Very low	Very low - negative	#N/A
Terrestrial flora	Opportunities for Habitat Recovery	Decommissioning activities	Very low - negative	Site-specific	Short-term	Very low - negative	Moderate	Possible	Moderate	Low - negative	• Implement a detailed restoration and re-vegetation plan using native species typical of the Lake Natron basin. • Undertake	Very low - positive	Site-specific	Short-term	Very low - positive	Low	Possible	Low	Very low - positive	#N/A

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											post-rehabilitation monitoring to evaluate vegetation establishment success. • Prevent reintroduction of invasive or exotic species during the restoration process.									
Terrestrial fauna	Disturbance to Fauna from Noise, Light, and Human Activity	Decommissioning activities, including facility dismantling, site clearing, and restoration	Low - negative	Local	Transient	Low - negative	Low	Possible	Low	Low - negative	• Refer to the mitigation measures of "Disturbance to Fauna from Noise, Light, and Human Activity" during the construction and operation phase	Very low - negative	Local	Transient	Very low - negative	Very low	Unlikely	Very low	Very low - negative	#N/A
Terrestrial fauna	Impacts on Species of Conservation Concern	Chance for population recovery through restoration and reduced human interference	Low - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Habitat restoration and vegetation re-establishment: Rehabilitate disturbed areas by replanting native vegetation and restoring shoreline and wetland habitats to	Very low - positive	Local	Short-term	Low - positive	Very low	Unlikely	Very low	Very low - positive	#N/A

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											support species of conservation concern. • Post-decommissioning monitoring of key species: Regularly monitor indicator species, such as the Lesser Flamingo and other IUCN-listed threatened species, to track ecosystem recovery and guide adaptive management if needed.									
Aquatic biodiversity	Water Pollution and Contamination	Decommissioning activities	Moderate - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Drain, neutralize, and clean all tanks and pipelines before dismantling. • Collect and safely dispose of residual trona slurry and sludge through licensed facilities. • Implement emergency spill response procedures. • Conduct	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Preparation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											post-decommissioning water quality monitoring (pH, salinity, TDS, alkalinity).									
Aquatic biodiversity	Sediment Disturbance and Increased Turbidity	Decommissioning activities	Moderate - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Conduct decommissioning works during dry or low-flow seasons to minimize sediment dispersal. • Avoid dragging heavy equipment directly on sediment substrates. • Stabilize disturbed banks immediately using natural materials or vegetation.	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Construction
Aquatic biodiversity	Habitat Disturbance and Recovery Potential	Decommissioning activities	Moderate - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Implement a site restoration and rehabilitation plan targeting re-vegetation with native riparian species. • Regrade and stabilize disturbed soils to	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Operation

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											prevent erosion. • Monitor recovery of riparian vegetation and aquatic habitats post-decommissioning.									
Air Quality	Disturbances or Nuisance to sensitive receptors	Generation of particulate matter/dust from Decommissioning Activities (Dismantling of Infrastructure, Transportation of dismantled infrastructure away from project site, etc)	Moderate - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Apply dust suppressants or dust control products on surfaces with the potential to release dust particles	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Decommissioning/ closure
Noise and Vibration	Nuisance/Deterioration of ambient noise levels to sensitive receptors outside the boundary of project site	Decommissioning phase activities (Dismantling Facilities and Equipment, etc)	Moderate - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Utilize noise suppression techniques such as silencers on the exhaust of transportation vehicles. • Use acoustic barriers around the decommission project site.	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Decommissioning/ closure
Surface Water	Mobilization of residual contaminants during closure	Demolition, waste removal, rainfall events	Moderate - negative	Regional	Medium-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Decommission in dry season • Neutralize	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											& remove residues • Temporary runoff collection basins									
Surface Water	Erosion & sediment discharge	Site rehabilitation, backfilling, grading	Moderate - negative	Local	Medium-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Stabilize slopes • Vegetate with native halophytes • Maintain diversion drains until stabilization	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Decommissioning/ closure
Ground water	Residual leachate contamination	Unremoved liners, underground pipes, contaminated soils	Moderate - negative	Local	Medium-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Pre-closure contamination survey • Excavate polluted soils • Seal boreholes • 5-year post-closure monitoring	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Decommissioning/ closure
Ground water	Altered recharge after landform reshaping	Backfilling, grading during rehabilitation	Moderate - negative	Local	Medium-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Design closure topography for natural drainage • Add infiltration trenches • Verify hydraulic conductivity	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Decommissioning/ closure
soil	Soil Erosion & Sedimentation	Dismantling, exposure during decommissioning (closure)	High - negative	Local	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Regrading, mulching, progressive revegetation, erosion control blankets, controlled demolition sequence	Moderate - negative	Local	Short-term	Low - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure
soil	Soil Compaction	Demolition machinery & transport	High - negative	Local	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Limit heavy equipment footprint,	Moderate -	Local	Short-term	Low - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
		(decommissioning)									mechanical decompaction, rest periods for areas, monitoring.	negative								
soil	Soil Contamination (residual)	Residual soda ash, fuels, wastes (closure)	High - negative	Local	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Soil testing, targeted remediation, removal and safe disposal, pH/salinity amendments, monitoring.	Moderate - negative	Local	Short-term	Low - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure
soil	Disturbance of Soil Structure	Excavation & regrading during restoration (closure)	High - negative	Local	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	Stockpile topsoil, controlled re-spread, avoid mixing horizons, progressive reinstatement, monitoring	Moderate - negative	Local	Short-term	Low - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure
soil	Site Remediation & Restoration (positive)	Soil cleanup, enrichment, revegetation (closure)	Moderate - positive	Local	Long-term	Moderate - positive	Moderate	Likely	Moderate	Moderate - positive	Soil improvement, organic enrichment, long-term monitoring and adaptive management.	High - positive	Local	Short-term	Moderate - positive	Moderate	Likely	Moderate	Moderate - positive	Decommissioning/ closure
soil	Vegetation Re-establishment (positive)	Replanting with natives and stabilisation (closure)	High - positive	Local	Long-term	Moderate - positive	High	Likely	High	High - positive	Well-designed revegetation program, native species, maintenance and monitoring	High - positive	Local	Short-term	Moderate - positive	High	Likely	High	High - positive	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
General Environment	General environmental pollution due to Waste Generation	Dismantling of structures, disposal of materials, residual waste, spills, or uncleaned materials.	Moderate - negative	Local	Short-term	Low - negative	High	Likely	High	Moderate - negative	• Reuse or recycle materials where feasible; • Dispose of remaining waste at approved sites; • Conduct site cleanup and remediation; • Restore disturbed land to natural or agreed condition; and • Conduct post-closure environmental monitoring.	Low - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	Decommissioning/ closure
Community Health, Safety, Security, and Human Rights	Road safety risks and traffic accidents	Transportation activities.	Moderate - negative	Regional	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Continue avoiding transportation of materials through busy trading centers and towns by using bypasses as appropriate; • Ensure regular maintenance of machinery, vehicles, and equipment as per the manufactur	Low - negative	Regional	Short-term	Moderate - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											er's recommendation. • Ensure regular maintenance of access roads to be used for transportation activities; • Continue implementing safety speed limits; and Post safety signage along the route where transportation activities will be undertaken to safeguard the safety of the surrounding community and other road users.									

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Community Health, Safety, Security, and Human Rights	Spread of communicable diseases	Decommissioning activities of the project may result in the spread of communicable and sexually transmitted diseases through continual interaction.	Moderate - negative	Regional	Short-term	Moderate - negative	Moderate	Possible	Moderate	Moderate - negative	• Continue providing training and awareness programs on communicable, infectious, and sexually transmitted diseases and provide them to workers and surrounding communities; • Ensure contractors continue to adhere to the NVCL Code of Conduct, providing a worker code of behavior including worker-worker interactions, worker-community interactions, and development of personal relationships with members of the local communities; • Continue providing workers with appropriate	Low - negative	Regional	Short-term	Moderate - negative	Low	Possible	Low	Low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											sanitary facilities, which are appropriately designed to prevent contamination; • Continue implementing a communicable and infectious disease management plan. The plan is to be explained and communicated clearly to the workforce and surrounding communities; • Continue providing appropriate PPE to workers; and • Continue to align awareness campaigns with those of other organizations in the area (i.e., NGOs, the Ministry of Health, etc.). These campaigns should use various common practice methodolog									

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											ies to ensure social and cultural sensitivity.									

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Community Health, Safety, Security, and Human Rights	Violation of human rights	Activity related to security (Continuous use of security forces)	Moderate - negative	Local	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	• Continue observing transparent communication about the role and responsibilities of security forces; • Clearly articulate the purpose of their presence and the measures being taken to safeguard the community and the project; • Continue providing comprehensive training to security personnel on human rights, cultural sensitivity, and community engagement; • Ensure that security forces operate in line with local and international laws and adhere to ethical standards; • Continue to implement	Low - negative	Local	Short-term	Low - negative	Very low	Unlikely	Very low	Very low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											accountability measures for any misconduct or human rights violations; and • Continue building positive relationships between security personnel and community members to foster trust.									

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
Labour and Working Condition	Occupational Health and Safety Risks	Workers to be exposed in various occupational hazards (ergonomic, biological, chemical, mechanical, and physical hazards) due to decommissioning activities	Moderate - negative	Site-specific	Short-term	Low - negative	High	Likely	High	Moderate - negative	• Continue conducting Risk Assessment covering all activities associated with the project; • Undertake medical check-up, which includes periodic, as well as pre-existing medical check-up; • Continue providing appropriate PPE to all workers to safeguard their health; • Emphasize the application of the hazard control hierarchy when mitigating hazards; • Continue implementing the health and safety management plan associated with all activities at site; • Continue providing OHS training to workers;	Low - negative	Site-specific	Short-term	Low - negative	Moderate	Possible	Moderate	Low - negative	Decommissioning/ closure

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											• Conduct periodic site inspection to identify existing hazards at workplace; • Ensure compliance with the OSHA Act, 2003, and other OHS International Good Practices; • Ensure posting of the safety signage in different areas of the site to inform of the associated hazards present in the area; • Ensure provision of welfare facilities at each project working site; and • Ensure provision of facilities and other supporting safety material, such as SOPs, procedures, etc., for the protection of workers against various hazards to									

VEC	Impact	Activity	Pre-mitigation:								Mitigation	Post-mitigation:								Project phase
			Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance		Magnitude x type	Scale	Duration	Consequence	Exposure	Probability	Likelihood	Significance	
											which they are exposed.									

(Source: MTL Consulting, 2025)

8 CLIMATE CHANGE MITIGATION, CLIMATE CHANGE ADAPTATION, AND ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

This chapter outlines the Climate Change Mitigation, Climate Change Adaptation, and Environmental Management Plan (CCMCCA&EMP) developed to ensure effective management of the impacts identified in Chapter 7 throughout the full life cycle of the proposed project. The CCMCCA&EMP encompasses all project-related activities and details the associated climate, environmental, and social impacts, proposed mitigation measures, proposed implementation timelines, estimated costs, roles and responsibilities, and the commitments required to minimize both potential and actual adverse effects resulting from the project's operations, products, or services. The plan has been formulated based on an assessment of the project's potential risks and impacts. It further specifies the mitigation strategies to be adopted, the institutional responsibilities for implementation, and the monitoring activities to be conducted, including their frequency to ensure compliance and effectiveness.

Accordingly, WWSL will be responsible for developing and executing a site-specific CCMCCA&EMP to ensure that the project is implemented in an environmentally and socially responsible manners. This approach requires the active involvement and awareness of all stakeholders, including employees, contractors, subcontractors, suppliers, local communities, regulatory authorities, consultants, NGOs, and other interested parties, regarding the environmental and social risks, both potential and actual, associated with the proposed project.

Specifically, the plan will be designed with the following objectives:

- Ensuring that project implementation aligns with the design specifications by taking appropriate mitigation actions to minimize adverse environmental and social impacts throughout the project's life cycle;
- Ensuring regulatory compliance. Regulation 16(d) of the Environmental Impact Assessment and Audit Regulations, 2005 (as last amended in 2024), requires the project proponent to create a management plan that includes mechanisms for monitoring and evaluating compliance and environmental performance, as well as the cost of mitigation measures and the timeframe for implementing the measures;
- Providing a consolidated summary of environmental and social commitments relevant to the mine projects' planning and implementation;
- Assisting in the establishment of measures for mitigating, monitoring, and managing institutional aspects during project implementation and operation to reduce adverse environmental and social impacts to levels acceptable to regulators;
- Identifying both actual and potential impacts on environmental and social aspects, and recommending corrective actions where necessary; and
- Identifying the required resources and outlining the roles and responsibilities of the key personnel who are in-charged with the responsibility of managing the proposed project.

WWSL will develop individual monitoring programs and processes to assess the effectiveness of the CCMCCA&EMP. These programs will include, but are not limited to, the development of monitoring procedures, the collection and analysis of environmental samples, periodic environmental and social audits, and both planned and unplanned inspections.

The results from environmental monitoring will assess the performance of environmental and social measures and may necessitate adjustments or updates to the CCMCCA&EMP based on the findings. Continuous environmental monitoring is essential throughout both the implementation and operational phases to ensure the adequacy and efficiency of environmental controls.

As a minimum, this chapter will include but not be limited to:

- Community Management Plan;
- Flora, Fauna and Aquatic Management Plan;
- Water Resources Management Plan;
- Land and Soil Management Plan;
- General Environment and Waste Management Plan;
- Air Quality Management Plan;
- Noise and Vibration Management Plan;
- GHG Management Plan;
- Aesthetic and Visual Impact Management Plan;
- Community Health, Safety, Security, and Human Rights Management Plan, and ;
- Labor and Working Condition Management Plan;

8.2 Personnel Responsible for the Implementation of the CCMCCA&EMP

The overall accountability for implementing this CCMCCA&EMP lies with the General Manager. This role includes coordinating across departments to ensure effective collaboration between the Occupational Health and Safety (OHS) and Environmental teams. While the General Manager retains ultimate responsibility, certain duties may be delegated to the Environmental Manager and other relevant department heads, who will oversee the plan's implementation and ensure compliance with site-specific requirements. The Environmental Manager may further assign routine monitoring and reporting tasks to designated staff members.

To support effective implementation, WWSL will establish a clear organizational structure and define specific roles and responsibilities for personnel involved in CCMCCA&EMP execution during the soda ash project operational phase. These responsibilities will include monitoring and measuring surface and groundwater quality, air emissions, noise and vibration levels, and carrying out and facilitating community consultation and engagement activities. Furthermore, WWSL acknowledges its overarching responsibility for managing environmental and social impacts and is committed to involving all employees and contractors in the practical execution of the CCMCCA&EMP, fostering a shared culture of environmental and social accountability across the organization.

8.3 Consultation and Disclosure

Woswosi Soda Limited will maintain its routine meetings with the identified project stakeholders in accordance with the Stakeholder Engagement Plan for the overall Trona Extraction and Soda Ash Production project. These meetings will focus on sharing operational updates, addressing environmental matters, and agreeing on necessary follow-up or corrective actions.

8.4 Environmental Audit Procedures

Woswosi Soda Limited (WWSL) will be responsible for implementing and overseeing the environmental inspection and audit programme throughout the Project life cycle. This function is aimed at systematically evaluating the effectiveness of the Climate Change Mitigation, Climate Change Adaptation, and Environmental Management Plan (CCMCCA&EMP) in mitigating potential impacts and ensuring full compliance with statutory requirements, project permits, and relevant environmental obligations.

Comprehensive procedures and protocols will be developed to define the scope, methodology, frequency, and documentation requirements for environmental inspections, internal audits, and formal management reviews. In addition, a structured Environmental Risk Assessment Framework will be established to guide periodic assessments of project-level environmental risks, task-specific risks, and daily operational (field-level) risks. These risk assessments will be integrated into routine project planning and execution processes to ensure proactive identification and mitigation of potential environmental and social hazards.

All project personnel, including contractors and subcontractors, will be required to maintain continuous vigilance in identifying and reporting hazardous conditions or practices that may pose risks to the environment, health, safety, or surrounding communities. Any observed non-conformances or potential environmental and social impacts shall be promptly reported to supervisors and the Environmental Management Unit for review and corrective action.

WWSL will be responsible for documenting all inspection and audit findings, maintaining a centralized record of compliance performance, and coordinating management review sessions. Where deficiencies or non-compliances are identified, the Environmental Manager will prepare and implement Corrective Action Plans (CAPs) in accordance with ISO 14001:2015 principles. Each CAP will include:

- A detailed description of the finding or non-conformance;
- Root cause analysis;
- Recommended corrective and preventive measures;
- Defined roles and responsibilities; and
- Implementation timelines and follow-up verification requirements.

All significant findings particularly those involving material health, safety, or environmental risks, or instances of regulatory non-compliance will be given immediate attention and resolution. The Project will maintain full cooperation with competent regulatory authorities and facilitate any external inspections, compliance assessments, or audits initiated by government agencies. To ensure transparency and accountability, the Project will undertake regular environmental audits and prepare periodic compliance reports for submission to the relevant regulatory bodies in accordance with applicable permit conditions and national environmental regulations. These reports will include evaluations of the CCMCCA&EMP and Monitoring Plan , recommendations for updates or adaptive management measures, and records of any newly implemented mitigation actions.

Results of ongoing environmental and social monitoring will be communicated to affected communities, local authorities, and regulatory agencies through established reporting and stakeholder engagement mechanisms. Continuous public consultation will be integrated into the Project's environmental management framework to ensure that community feedback,

grievances, and recommendations are systematically captured and addressed throughout the Project life cycle.

8.5 Emergency Preparedness and Response Plan

WWSL will develop, implement, and maintain an Emergency Preparedness and Response Plan (EPRP) to outline procedures for anticipating, managing, and responding to potential health, safety, and environmental incidents across all phases of the project lifecycle. The EPRP will be treated as a living document and will be regularly reviewed and updated to reflect evolving project conditions, operational changes, and lessons learned during implementation. The objective(s) of the plan are to provide a comprehensive system to:

- Establish a process for identifying potential emergencies before occurrence;
- Take steps to prevent or minimize the impact of potential emergencies;
- Train personnel to appropriately identify, report, and respond to emergencies;
- Provide and maintain emergency response resources and equipment to mitigate potential emergencies;
- Define detailed procedural steps to respond to and manage various types of potential emergencies;
- Contain, where possible, any emergencies and their effects within the project site boundary;
- Provide information to and consult with the surrounding community regarding environmental risks and response measures;
- Co-operate with external emergency response organizations;
- Safely return to normal operations following an emergency; and
- Identify the cause(s) of the emergency event and the corrective and preventative measures to avoid a recurrence.

The Plant Manager will be responsible for the day-to-day implementation of the plan. The department will be responsible for the following:

- Preparing and maintaining the Emergence and Preparedness Response Plan;
- Ensuring that the plan is available and documented accordingly;
- Communicating and distributing the plan to all departments, contractors, and subcontractors for implementation;
- Training individuals with responsibilities for its implementation;
- Undertaking training for employees and contractors in general emergency notification and evacuation procedures at the time of induction and annually thereafter;
- Organizing and training an emergency response team following applicable legal requirements and as defined in the Plan;
- Conducting regular emergency response drills for potential emergencies; and
- Keeping emergency response equipment, materials, and supplies available and in good working condition.

The Emergency Preparedness and Response Plan (EPRP) will cover a range of potential emergencies and natural disasters that may pose a threat to human life, other living

organisms, the environment, or property, especially those beyond the scope of routine operational control. It will include response procedures for incidents such as on-site and off-site chemical spills, hydrocarbon releases (including diesel, oil, and grease), medical emergencies, security incidents, vehicle accidents, surface and groundwater-related events, and fire outbreaks. The plan will also define protocols for incident investigation and reporting to support effective response and continuous improvement.

a) Hazardous Chemical Spills

Procedure for managing highly hazardous materials, including chemicals and hydrocarbons, will be developed. “Hazardous chemicals” means any chemical that has the likelihood of causing adverse effects or injury to human health or the environment. “Chemical" means industrial or consumer chemical or chemical product, which is a substance in any form, whether by itself or in a mixture or preparation, whether manufactured or obtained naturally, but excludes medicines, pesticides, radioactive, food additives, and any other substance that has therapeutic effects (Industrial and Consumer Chemical Act, 2003).

This procedure outlines the measures for preventing, preparing for, responding to, and recovering from hazardous materials incidents, such as chemical spills (Sodium Carbonate and Sulphuric Acid), at the proposed project site. It is intended to guide effective management of risks to personnel, visitors, property, and the environment that may result from the handling of hazardous substances. The procedure ensures that all hazardous chemicals and associated wastes are managed responsibly throughout their lifecycle, including storage, transport, usage, and disposal. All practices will align with WWSL’s Environmental Policy, comply with applicable local regulations, and meet relevant international standards adopted by the company. Additional requirements will be specified as needed for the safe management of individual chemical substances. To prepare for and respond to a chemical or hydrocarbon spill event, WWSL will:

- Prepare an operating procedure for chemicals and hydrocarbon management;
- Conduct training for all employees, contractors, and subcontractors on the management of chemicals and hydrocarbons;
- Install secondary containments for the storage of chemicals and hydrocarbon product storage tanks and piping above ground or in an engineered double wall system;
- Store liquid chemicals, oil, and fuels in storage tanks that meet applicable regulations and standards;
- Ensuring that the secondary containments are equivalent to 110% of the capacity of the largest vessel within the containment basin;
- Train the emergency response team to attend and timely respond accordingly to spill events e.g., neutralizing agents;
- Investigate the causes of any incidents and develop and implement measures to prevent a recurrence;
- Ensure that the spill response equipment is adequate and in place at all times;
- Notify the applicable authorities and the surrounding community in the event of a spill that may impact the community or exceed a legal reporting requirement; and
- Implement appropriate remediation if a spill occurs, i.e., control, contain, and clean up.

b) Extreme Weather Event

To prepare for and respond to an extreme precipitation event, the Project will involve designing, constructing, operating, and maintaining all engineered water management facilities to contain a 1:50-year return period event.

c) Earthquakes

To respond to earthquake emergencies, the project will

- Prepare a specific earthquake emergency response plan outlining procedure to be followed;
- Provide earthquake preparedness and response training to designated individuals and managers; and
- Carry out inspection programs after major earthquakes.

d) Vehicle Accidents/Incidents

Vehicle accidents are identified as a Significant Environmental and Social Risk, particularly along the access road. This risk will be addressed as follows:

- Construction of the access road passing Wosiwosi village;

Undertaking a traffic risk assessment and implementing site-specific and appropriate traffic safety measures indicated as part of the assessment – such measures may include:

- Construction of paths for pedestrians and bicycles where numbers of people congregating suggest unacceptable traffic risks;
- Strictly enforce the Project's Drug and Alcohol policy;
- Monitoring Project driver performance and enforcing Project traffic safety requirements, including speed limits (40 km/h or less);
- Tracking of Project vehicles using GPS or similar equipment;
- Implementing public information and education programs on traffic-related hazards at least once in the local villages before construction starts and regularly thereafter;
- Consultation with villages on public events that may be affected by Project traffic;
- Investigating basic causes of vehicle accidents, and developing and implementing measures to minimize the possibility of recurrence; and
- Maintenance of vehicles to reduce risks.

e) Fire

To respond to fire emergencies, the Project will

- Maintain adequate supplies of water and other applicable fire suppressants on-site;
- Maintain fire-fighting equipment available and in good working order;
- Train emergency response personnel in appropriate firefighting measures, and provide recurrent training and practices;
- Periodically exercise emergency response and evacuation procedures;
- Develop and implement procedures to reduce the risks of fire within Project facilities and adjacent bushland; and
- Establish and maintain a 6 m-wide firebreak around perimeter fences

f) Incident Investigation and Reporting Procedure

The Project will investigate incidents with significant health, safety, or environmental and social impact, resulting in non-compliance with applicable regulations or permits. Near misses, which could have caused such an incident, will also be investigated. Investigations will be initiated as soon as practicable after an incident or near-miss occurrence, maintaining evidence as needed. A report will be prepared outlining the circumstances of the incident, including root cause analysis, and identifying corrective actions taken and recommended to prevent recurrence. WWSL will be responsible for conducting investigations, reporting, and implementing corrective measures. The Project will fully cooperate with government agencies that may conduct investigations of potential Project incidents.

g) Emergency Incident Classifications

The establishment, implementation, and maintenance of a comprehensive process for managing all types of incidents at the project site will be done by WWSL. This aims to reduce or prevent risks and impacts on human health, the community, equipment, company assets, and the environment. Incidents may include issues related to health, safety, environmental and social concerns, theft, property damage, or loss of company assets. The company will devise innovative strategies to mitigate risks and enhance processes to prevent recurrence. If incidents do occur, it is essential to develop a process to assess their nature and severity to avoid future occurrences, allocate adequate resources, and set up internal Incident Classification Criteria that align with legal requirements and international best practices. Internal and external reporting obligations will vary based on the severity of the incident, and it is crucial to ensure consistency in these reports. WWSL operations will need to report environmental incidents according to the Environmental Incident Criteria.

8.6 Monitoring Program

The Monitoring Program is well-designed to ensure the effectiveness and continuous improvement of emergency response measures across all project phases. It will involve regular monitoring of emergency drills, environmental quality during incidents, equipment functionality, worker safety, and community communication. The program will define clear parameters, responsibilities, and reporting mechanisms to track performance, identify gaps, and implement corrective actions. Monitoring results will be documented, reviewed, and used to update the EPRP annually or after major incidents, ensuring the plan remains responsive, compliant, and aligned with local and international best practices.

8.7 Climate Change Mitigation, Climate Change Adaptation, and Environmental Management Plan

8.7.1 Community Management Plan

The primary objectives of the management plan are to:

- Minimize the impacts on surrounding communities;
- Build strong relationships with stakeholders and ensure that all commitments are fulfilled;
- Support community development programs through Corporate Social Responsibility (CSR) initiatives; and
- Promote environmental awareness within the community.

Table 8.1: Community Management Plan During Construction Phase

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
Restriction of Access to Natural Resources	Construction of infrastructures.	• Provide access to the project areas for community members to harvest and collect the soda ash, medicinal plants and rootstock prior to construction • Develop a strategy to allow controlled access to specific areas. • Conduct environmental campaigns to raise awareness of conservation and biodiversity among employees and the local community. • Donate trees, species to be cleared and resources such as soda ash during construction to surrounding communities	WWSL	2 Months	13,000,000
Access to Grazing land	Construction of infrastructures	• Adjust project design to avoid or reduce taking key grazing areas and ensure only a minimal portion of land is affected. • Offer culturally appropriate compensation through replacement grazing areas or monetary payment agreed upon with Maasai elders. • Identify and improve new grazing zones with adequate pasture and water points to support livestock. • Introduce programs for livestock health, fodder production, and water harvesting to sustain pastoral livelihoods. • Continue consultation with Maasai leaders and respect traditional decision-making and cultural practices. • Establish a joint plan for sustainable grazing, regular monitoring, and grievance handling.	WWSL	1-6 Months	8,000,000
Increase in HIV/AIDS and STDs	Increase in Social Interaction	• Conduct regular HIV/AIDS and STD awareness sessions for workers and nearby communities. • Provide free and easy access to condoms at work sites and camps • Facilitate voluntary HIV counselling and testing (VCT) for project staff and willing community members • Partner with community leaders and youth groups to deliver HIV/STDs messages	WWSL	3-9 Months	18,000,000

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
Price Inflation	Population Influx	• Promote Local Supply and Production: Support local farmers, traders, and producers to increase supply of food and basic goods to meet project-related demand. • Work with local authorities to monitor commodity prices and discourage exploitation or unfair pricing in nearby markets. • Prioritize procurement of goods and services from local suppliers to stabilize the local economy and strengthen livelihoods. • Provide small business training and access to microfinance to help local entrepreneurs adapt to new market opportunities. • Where possible, employ local residents to reduce sudden population pressure and demand for limited goods. • Collaborate with district authorities to plan and monitor inflation trends and develop measures for market stabilization	WWSL	6-12 Months	15,000,000
Reduction in the Tourism and Ecological Value of Lake Natron Ramsar Site.	Construction activities	• Restrict project activities near sensitive zones, especially flamingo breeding and nesting areas, to preserve ecological and visual integrity. • Establish and enforce adequate buffer distances between the project footprint and the lake shoreline to protect scenic views and wetland ecosystems. • Control dust, noise, and wastewater discharge to prevent pollution and maintain the lake's natural appearance and habitat quality. • Collaborate with local authorities and tour operators to enhance sustainable tourism through conservation education and community-based tourism programs. • Restore any disturbed areas using native vegetation to retain the natural landscape and visual appeal important for tourism. • Work with the Ramsar Site Management Committee and TANAPA to monitor environmental conditions and ensure compliance with Ramsar conservation standard	WWSL	6-12 Months	17,000,000

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
Employment Opportunities	Construction activities	• Priorities in local employment. • Set targets and monitor the progress to reach targets. • Verify the resident status of applicants in consultation with community representatives. • Set a target for the employment of local women and youth. • Provide training for local recruits to enable them to apply for permanent positions during the operation phase	WWSL	3-6 Months	10,000,000
Increased Business Opportunities	Procurement of Construction materials	• Priorities sourcing of goods, materials, and services from local businesses. Set targets and monitor progress to reach the target. • Verify the local status of interested business.	WWSL	Immediately	20,000,000
Fiscal Benefits	Payment of taxes and levies	• Ensure all revenues are paid in compliance with legal requirements. This includes remitting employee taxes to the Tanzania Revenue Authority (TRA) and contributing to social security through the National Social Security Fund (NSSF). Additionally, encourages contractors to fulfil their tax obligations to the government and the Longido and Ngorongoro District Council. • Undertake compensation in accordance with applicable Tanzanian laws and international standards where economic losses occur	WWSL	Immediately	Budget to reflect compliance of TRA, NSSF and other legal Tax obligations
Foreign Direct Investment (FDI)	Project investments	• Ensure the project complies with both local and international requirements	WWSL	Immediately	10,000,000
Loss and destruction of Archaeological Artifacts	Vegetation clearance, land clearance	• Avoid disturbance of archaeological sites within the proposed project area and beyond the disturbance footprint where possible. • Demarcate and place a buffer of 50m around site to be avoided where practicable.	WWSL	2-6 Months	15,000,000

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
		• Follow procedure for preservation and protection of sites and artefacts of archaeological significance specified by the Antiquities Act. • Undertake clearing of sites within the project disturbance footprint in accordance with the requirement permits. • Develop and implement a cultural heritage Management Plan			
Impacts on Social Practices and Relationships	Interaction of people from diverse backgrounds and cultures	• Support initiatives that promote the preservation and revitalization of local traditions and cultural practices. Respect and Integration. • Provide cultural sensitivity training for project staff, contractors, and stakeholders. • Develop and implement a Cultural Heritage Management Plan.	WWSL	306 Months	15,000,000

(Source: MTL Consulting, 2025)

Table 8.2: Community Management Plan during the Operation Phase

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
Restriction of Access to Natural Resources	Project Activities	• Refer to enhancement measures for "Restriction of Access to Natural Resources" during the Construction phase	WWSL	2 Months before construction	13,000,000
Loss of Grazing Land	Project Activities	• Refer to enhancement measures for "Restriction of Access to Natural Resources" during the Construction phase	WWSL	2 Months before construction	
Improved Public Infrastructure and social services	Community Development initiatives support	• Develop and implement a Social program in close collaboration with beneficiaries and stakeholders to ensure the long-term sustainability of the initiatives. • Maintain traditional livestock access routes wherever feasible	WWSL	3-9 Months	15,000,000

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
		• Avoid unnecessary restriction of community access to grazing areas and salt collection zones • Ensure collaboration with beneficiaries and stakeholders to ensure the sustainability of initiatives. • Expand skills development and capacity building programs to non-employees			
Increased pressure on existing public infrastructures and Services	Increase of people in search of employment opportunities	• Focus on hiring locally, assist local government authorities through community development programs to strengthen their capacity to provide essential social services and • Provide health insurance for permanent employees, allowing them to access healthcare services beyond the district	WWSL	Immediately	12,000,000
Reduction in the Tourism and Ecological Value of Lake Natron Ramsar Site.	Operation Activities	• Restrict project activities near sensitive zones, especially flamingo breeding and nesting areas, to preserve ecological and visual integrity. • Establish and enforce adequate buffer distances between the project footprint and the lake shoreline to protect scenic views and wetland ecosystems. • Control dust, noise, and wastewater discharge to prevent pollution and maintain the lake's natural appearance and habitat quality. • Collaborate with local authorities and tour operators to enhance sustainable tourism through conservation education and community-based tourism programs.	WWSL	3-9 Months	16,000,000

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
		• Restore any disturbed areas using native vegetation to retain the natural landscape and visual appeal important for tourism. • Work with the Ramsar Site Management Committee and TANAPA to monitor environmental conditions and ensure compliance with Ramsar conservation standard			
Increase in HIV/AIDS and STDs	Increase in Social Interaction	• Refer to enhancement measures for "Increase in HIV/AIDS and STDs" during the Construction phase	WWSL	1-6 Months before construction	13,000,000
Cultural Interaction	Increase in Social Interaction	• Ensure all project staff and contractors are sensitized to Maasai customs, dress codes, and social etiquette through cultural awareness training. • Develop and implement a Livelihood Restoration Plan for economically affected households and user groups • Establish continuous stakeholder engagement mechanisms with affected villages, pastoral communities, conservation authorities, and other land users • Maintain continuous consultation with Maasai elders and cultural leaders in all decision-making and community engagement processes. • Establish a clear code of conduct for project workers to prevent cultural disrespect, harassment, or discrimination. • Support initiatives that foster positive interaction, such as cultural induction sessions or joint community events promoting understanding.	WWSL	Immediately	13,000,000

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
		• Identify, map, and avoid disturbance of areas with spiritual or cultural importance, ensuring access for traditional practices is not restricted. • Include culturally appropriate procedures for reporting and resolving issues arising from cultural misunderstandings or disrespect			
Price Inflation	Project Operation activities	• Refer to enhancement measures for “Price Inflation” during the Construction phase	WWSL	1 Month before construction	15,000,000
Employment Opportunities	Project Operation activities	• Refer to enhancement measures for “Employment Opportunities” during the Construction phase	WWSL	1 Month before construction	
Increase in Business Opportunities	Project Operation activities	• Refer to enhancement measures for “Increase Business Opportunities” during the Construction phase	WWSL	1 Month before construction	
Capacity Building and Skills Transfer	Project Operation activities	• Develop tailored training for Maasai youth and interested community members on plant operations, safety, and environmental management. • Offer apprenticeship or internship opportunities during the operation phase to enable practical skill transfer to local residents. • Partner with vocational training centers or NGOs to deliver technical and business-related capacity-building programs.	WWSL	6-9 Months	13,000,000

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
		• Adopt a local recruitment policy giving preference to qualified Maasai individuals for semi-skilled and unskilled positions. • Organize community workshops to explain plant operations, safety procedures, and environmental protection practices. • Create a structured plan with measurable targets for local employment, training participation, and progress monitoring.			
Fiscal Benefits	Statutory Payments (Taxes, NSSF, WCF, and levies	• Refer to enhancement measures for “Fiscal Benefits” during the Construction phase	WWSL	1 Month before construction	13,000,000

(Source: MTL Consulting, 2025)

Table 8.3:Community Management during the Decommission Phase

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
Loss of government revenue	Decommissioning activities of the Project	• Make sure to notify government agencies, including the Tanzania Revenue Authority (TRA), of the projected closure timelines well before the decommissioning and shutdown activities begin.	WWSL	12 Months before decommissioning and 1 Month before planned shut downs	5,000,000

Impact	Activity	Management Programs	Responsible	Timeframe	Budget (TZS)
Loss of Employment	Decommissioning activities of the Project	• Throughout the operation period, all employees will be provided with pension schemes. If possible, and if the Company has other operations in the country, skilled employees will be considered for positions at these locations. • Skills training programs will be established to improve employment prospects for employees following the closure. • Furthermore, the closure plan will address potential job losses and involve consultations with stakeholders to effectively manage these impacts.	WWSL	1 Month	Budget to be determined as per legal pension schemes
Decrease in Business Opportunities	Decommissioning activities of the Project	• Encourage people to invest in alternative sectors such as construction and agriculture.	WWSL	3 Months	3,000,000
Loss of Community Development Support	Decommissioning activities of the Project	• Collaborate with local government and community organizations to take over management of ongoing initiatives. • Create a sustainable fund to continue supporting priority community projects after decommissioning. • Train local leaders and committees to manage projects and resources independently. • Involve beneficiaries in planning the closure of programs to ensure needs are prioritized and expectations managed. • Track the effectiveness of program handover and adjust support measures as needed during the transition period."	WWSL	6 Months	15,000,000

(Source: MTL Consulting, 2025)

8.7.2 Flora, Fauna and Aquatic Management Plan

The Management Objectives: The objectives for the flora, fauna, and aquatic management program are as follows:

- Minimize impacts on terrestrial flora, fauna, and aquatic life in the Project site; and
- Minimize and mitigate the spread of alien invasive species.

Tables 8.4, 8.5 and 8.6 summarize the Flora and Fauna Management Plan for the construction and operational phases, respectively.

Table 8.4: Flora, Fauna, and Aquatic Management Plan during Construction Phase

Impacts	Activities	Management Programmes	Responsible	Proposed Timeframe	Annual Budget (TZS)
Impacts on Flora					
Loss of Vegetation Cover	Vegetation Clearance	• Limit vegetation clearance strictly to designated and approved project areas. • Clearly demarcate construction zones and enforce “no-go” boundaries to protect surrounding vegetation. • Restore disturbed areas progressively using native and locally adapted species once construction concludes. • Minimize the infrastructure footprint to the extent practicable and avoid ecologically or socially sensitive areas	WWSL	Throughout construction (6 months)	7,000,000
Dust Deposition	Earthworks and construction traffic may generate dust that can settle on surrounding vegetation	• Cover trucks transporting loose materials. • Avoid vegetation clearance and excavation during high wind conditions where possible. • See the mitigation measures for “*Deterioration of Air Quality and Exceedance of the Ambient Air Quality Standards and Regulation*” during the construction phase	WWSL	Throughout construction (6 months)	15,000,000
Risk of Invasive Species Introduction	Importation of construction materials and equipment could introduce non-native plant species	• Inspect and clean all machinery, vehicles, and equipment before entering the project site. • Conduct periodic inspection of disturbed and restored areas for early detection of invasive species. • Immediately remove and dispose of any invasive plants using manual or approved mechanical methods before establishment.	WWSL	Throughout construction (6 months)	
Impacts on Fauna					
Loss and Fragmentation of Fauna Habitats and Ecological Connectivity	Construction activities such as site clearing, establishment of processing facilities, road construction, and installation of utilities	• To avoid construction of the project facilities within sensitive zones used by lesser flamingo and a perfect project layout must be designed to minimize the project footprint. • Implement progressive rehabilitation and re-vegetation of disturbed sites using native plant species. • Prohibit off-road vehicle movement and unnecessary vegetation clearing. • Design project layout to minimize habitat disturbance and overall project footprint.	WWSL	Throughout construction (6 months)	10,000,000
Disturbance to Fauna from Noise, Light, and Human Activity	Construction activities such as Heavy machinery operations, vehicle movement, and lighting at night	• Restrict construction activities to daylight hours near sensitive fauna habitats. • Use of low-intensity bulbs to reduce light pollution, especially near flamingo breeding zones. • Enforce buffer zones and exclusion areas where human access is restricted during critical breeding seasons. • Provide awareness training to workers on wildlife sensitivity and behaviour near fauna habitats.	WWSL	Throughout construction (6 months)	
Impacts on Species of Conservation Concern	Disturbance from construction, hydrological change, and habitat degradation may result in reduced access to breeding and foraging areas, directly threatening Species of conservation survival. Ramsar designation of Lake Natron and its international ecological importance.	• Maintain buffer zones and avoid project activities near nesting and feeding areas of conservation species. • Schedule project works outside known breeding or migration seasons. • Monitor wildlife populations regularly, focusing on indicator and threatened species. • Collaborate with responsible authority including NEMC, TAWIRI, TAWA, WWF, IUCN, BirdLife International and Nature Tanzania for joint biodiversity monitoring and adaptive management. • Maintain wildlife corridors and connectivity between Lake Natron and surrounding ecosystems.	WWSL	Throughout construction (6 months)	7,800,000
Impacts on Aquatic biodiversity					
Water Pollution and Contamination	Activities such as dredging, excavation, handling of construction materials, and machinery operation	• To minimize water pollution and contamination, all fueling, mixing, and chemical handling must occur on impermeable, contained platforms to prevent spills. • Wastewater and saltwater effluent should be treated before discharge using sedimentation or neutralization ponds. • Natural vegetation buffers must be retained along shorelines to filter runoff. • Regular maintenance and spill response plans will reduce leak risks from machinery and storage areas. • Continuous water quality monitoring should detect early contamination.	WWSL	Throughout construction (6 months)	10,000,000
Alteration of water flow	Dredging and installation of trona extraction infrastructure may modify local flow patterns in inflowing streams and along the shoreline	• Construction designs should maintain natural drainage to avoid altering stream discharge or lake inflow. • Preserve riparian vegetation for bank stability and flow regulation. • Regularly monitor flow patterns and sediment movement. • Restore drainage and stabilize channels to recover natural flow regimes.	WWSL	Throughout construction (6 months)	8,000,000

Impacts	Activities	Management Programmes	Responsible	Proposed Timeframe	Annual Budget (TZS)
Sedimentation and Erosion	Site preparation and dredging activities associated with the establishment of access routes, construction platforms, and trona slurryy intake systems	• Minimize vegetation clearing to control runoff. Stockpiles and exposed soil should be covered or compacted. • Disturbed sites must be revegetated with native species immediately after construction. • Maintain embankments and drainage structures during operation to prevent erosion. • Limit vehicle movement near water bodies. • Grade and stabilize slopes using bioengineering methods to prevent renewed sedimentation.	WWSL	Throughout construction (6 months)	10,000,000
Noise Pollution	Noise generating activities will include dredging, pile driving, the operation of heavy machinery (such as excavators, bulldozers, and pumps), and vehicle traffic associated with material transport along the shoreline and inflowing stream zones	• Use modern, well-maintained machinery fitted with silencers to reduce noise. • Restrict noisy works like pile driving to daylight hours and low sensitivity periods like breeding season. • Employ vibratory techniques instead of impact hammers when feasible. • Establish buffer zones and noise barriers near aquatic habitats. • Monitor underwater noise levels during operation and control vessel speeds near the site. • Apply similar measures during decommissioning to limit disturbance.	WWSL	Throughout construction (6 months)	9,000,000
Loss, Disturbance, and Degradation of Aquatic Habitats	Construction activities such as site clearing, dredging, and installation of trona slurry intake systems	• Implement a comprehensive waste management plan covering collection, treatment, and safe disposal. • Treat sewage through constructed wetlands or oxidation ponds before discharge. • Solid waste must be segregated, covered, and sent to approved disposal sites. • Keep waste storage areas away from watercourses to prevent leachate. • Train workers on waste handling and emergency spill response. • Remove and rehabilitate all waste and sanitation facilities to restore site integrity.	WWSL	Throughout construction (6 months)	5,000,000
Wastewater and Solid Waste	Construction activities such as the establishment of access roads, plant foundations, trona extraction infrastructure, and workers' camps	• Restrict construction to already disturbed zones and mark sensitive habitats to avoid damage. • Limit dredging to defined areas and avoid breeding seasons. • Restore disturbed vegetation using native riparian species immediately after work. • Design embankments with gentle slopes to support recolonization. • Maintain environmental flows during operation. • Regrade and replant all disturbed shorelines to restore natural habitats and biodiversity.	WWSL	Throughout construction (6 months)	5,000,000

(Source: MTL Consulting, 2025)

Table 8.5: Flora, Fauna, and Aquatic Management Plan during Operation Phase

Impacts	Activities	Management Programme	Responsible	Proposed Timeframe	Annual Budget (TZS)
Impacts on Flora					
Alteration of Local Microhabitats	Operation Activities	• Maintain natural drainage pathways where possible and design engineered drainage systems to prevent waterlogging or erosion. • Inspect vegetation health and composition periodically in areas surrounding operational facilities.	WWSL	Continuous throughout operation (Annual)	10,000,000
Disruption and Loss of Ecosystem Services	Operation Activities	• *Refer the proposed mitigation measures for "Restriction of access to natural resources" impact during construction and operation phase* • *Refer the proposed mitigation measures for "Loss of grazing land" impact during construction and operation phase* • *Refer the proposed mitigation measures for "Reduction in the Tourism and Ecological Value of Lake Natron Ramsar Site" impact during construction and operation phase*	WWSL	Continuous throughout operation (Annual)	10,000,000
Continued Loss of Vegetation Cover	Continuous vehicular movement, maintenance works, and human activity during operation	• Restrict vehicle movement to designated routes within the site. • Implement biodiversity protection and environmental monitoring measures to safeguard sensitive habitats and ecological functions • Implement and periodically update a vegetation management and restoration plan. • Conduct regular inspection of ground cover and promptly restore degraded patches using native species.	WWSL	Continuous throughout operation (Annual)	5,000,000

Impacts	Activities	Management Programme	Responsible	Proposed Timeframe	Annual Budget (TZS)
Impacts on Fauna					
Hydrological Alteration and Pollution Impacts on Fauna Habitats	Operation activities such as extraction and processing of soda ash will require abstraction of freshwater from inflowing rivers and springs, which may alter the hydrological balance of Lake Natron	• Limit freshwater abstraction to sustainable levels approved by the water authorities. • Develop and implement a comprehensive Water Management Plan to monitor abstraction and inflow levels into Lake Natron. • Construct lined waste containment systems and install wastewater treatment prior to discharge. • Monitor surface and groundwater quality regularly for early detection of contamination. • Promote water recycling and reuse within processing and support facilities.	WWSL	Continuous throughout operation (Annual)	8,000,000
Continue Loss and Fragmentation of Fauna Habitats and Ecological Connectivity	Operational activities such as continuous use of developed areas and traffic movement along haul roads	• Refer to the mitigation measures of "Loss and Fragmentation of Fauna Habitats and Ecological Connectivity" during the construction phase	WWSL	Continuous throughout operation (Annual)	7,000,000
Disturbance to Fauna from Noise, Light, and Human Activity	Noise, light, and human activity from processing operations, vehicle movement, and 24-hour lighting at the plant site	• Refer to the mitigation measures of "*Disturbance to Fauna from Noise, Light, and Human Activity*" during the construction phase • Maintenance of adequate separation distances between dredging activities and identified breeding habitats; • Avoidance or minimization of high-disturbance activities during the peak breeding and chick-rearing season (September to December), where practicable; • Use of electrically powered dredgers to reduce operational noise and vibration; • Control of vessel movement, workforce access, lighting, and unnecessary activities within ecologically sensitive areas; • Adoption of adaptive management measures should monitoring indicate significant behavioural disturbance or ecological stress. • Implementation of flamingo behavioural and ecological monitoring programs during breeding seasons	WWSL	Continuous throughout operation (Annual)	9,000,000
Impacts on Species of Conservation Concern	Sustained disturbance and potential habitat degradation	• Refer to the mitigation measures of "*Impacts on Species of Conservation Concern*" during the construction phase	WWSL	Continuous throughout operation (Annual)	7,800,000
Impacts on Aquatic biodiversity					
Sedimentation, Erosion, and Habitat Degradation	Operation activities such as continuous vehicle movement, maintenance of abstraction channels, and trona slurry transportation	• Implement erosion and sediment control plans, including silt fences, sediment traps, and vegetative buffer zones. • Restrict vehicle movement to designated and stabilized access routes. • Regularly maintain drainage and containment structures to prevent sediment wash-off. • Re-vegetate disturbed areas with native grass or shrub species after maintenance activity • Install sediment retention ponds at discharge points to capture fine particulates before water returns to the natural system.	WWSL	Continuous throughout operation (Annual)	9,000,000
Noise Pollution and Disturbance to Aquatic Fauna	Operation of pumps, and other machinery will generate persistent low-frequency noise that may propagate through the trona extraction channels and shoreline areas	• Use low-noise equipment and ensure proper maintenance to minimize mechanical noise emissions. • Install acoustic dampeners or vibration isolators on pumps, and other stationary machinery. • Locate stationary noise-generating units away from sensitive inflowing streams or fish refuge areas. • Schedule high-noise activities during daytime hours to reduce cumulative disturbance. • Implement a noise monitoring program (both airborne and underwater) to ensure compliance with acceptable limits.	WWSL	Continuous throughout operation (Annual)	11,000,000
Solid Waste Mismanagement	Operational activities may generate various solid wastes including packaging materials, process residues, and maintenance debris	• Implement a comprehensive solid waste management plan emphasizing waste minimization, segregation, and recycling. • Designate impermeable waste storage areas with secondary containment and located far from drainage lines or water bodies. • Prohibit direct disposal of any solid waste into aquatic or shoreline zones. • Conduct regular clean-up and waste collection schedules for all operational sites. • Partner with licensed waste contractors for offsite disposal of non-recyclable materials.	WWSL	Continuous throughout operation (Annual)	15,000,000

Impacts	Activities	Management Programme	Responsible	Proposed Timeframe	Annual Budget (TZS)
		• Train all staff on waste handling and spill prevention protocols.			

(Source: MTL Consulting, 2025)

Table 8.6: Flora, Fauna, and Aquatic Management Plan during Decommissioning Phase

Impacts	Activities	Management Programme	Responsible	Proposed Timeframe	Annual Budget (TZS)
Temporary Disturbance from Demolition Activities	Decommissioning activities such as demolition of infrastructure and removal of materials	• Conduct demolition activities in a phased and controlled manner to limit the area of disturbance. • See the mitigation measures of “Dust Deposition” impact during the construction phase	WWSL	2–3 Months (during decommissioning) + 1-year post-closure monitoring	5,000,000
Opportunities for Habitat Recovery	Decommissioning activities	• Implement a detailed restoration and re-vegetation plan using native species typical of the Lake Natron basin. • Undertake post-rehabilitation monitoring to evaluate vegetation establishment success. • Prevent reintroduction of invasive or exotic species during the restoration process.	WWSL	2–3 Months (during decommissioning) + 1-year post-closure monitoring	5,000,000
Disturbance to Fauna from Noise, Light, and Human Activity	Decommissioning activities, including facility dismantling, site clearing, and restoration	• Refer to the mitigation measures of "Disturbance to Fauna from Noise, Light, and Human Activity" during the construction and operation phase	WWSL	2–3 Months (during decommissioning) + 1-year post-closure monitoring	5,000,000
Impacts on Species of Conservation Concern	Chance for population recovery through restoration and reduced human interference	• Habitat restoration and vegetation re-establishment: Rehabilitate disturbed areas by replanting native vegetation and restoring shoreline and wetland habitats to support species of conservation concern. • Post-decommissioning monitoring of key species: Regularly monitor indicator species, such as the Lesser Flamingo and other IUCN-listed threatened species, to track ecosystem recovery and guide adaptive management if needed.	WWSL	2–3 Months (during decommissioning) + 1-year post-closure monitoring	5,000,000
Water Pollution and Contamination	Decommissioning activities	• Drain, neutralize, and clean all tanks and pipelines before dismantling. • Collect and safely dispose of residual trona slurry and sludge through licensed facilities. • Implement emergency spill response procedures. • Conduct post-decommissioning water quality monitoring (pH, salinity, TDS, alkalinity).	WWSL	2–3 Months (during decommissioning) + 1-year post-closure monitoring	5,000,000
Sediment Disturbance and Increased Turbidity	Decommissioning activities	• Conduct decommissioning works during dry or low-flow seasons to minimize sediment dispersal. • Avoid dragging heavy equipment directly on sediment substrates. • Stabilize disturbed banks immediately using natural materials or vegetation.	WWSL	2–3 Months (during decommissioning) + 1-year post-closure monitoring	5,000,000
Habitat Disturbance and Recovery Potential	Decommissioning activities	• Implement a site restoration and rehabilitation plan targeting re-vegetation with native riparian species. • Regrade and stabilize disturbed soils to prevent erosion. • Monitor recovery of riparian vegetation and aquatic habitats post-decommissioning.	WWSL	2–3 Months (during decommissioning) + 1-year post-closure monitoring	5,000,000

(Source: MTL Consulting, 2025)

8.7.3 Water Resources Management Plan

The management of water resources within the Lake Natron Soda Ash Project area is critical due to the ecological sensitivity of the Lake Natron Basin and the reliance of surrounding communities and ecosystems on its hydrological systems. Both surface water and groundwater must therefore be managed in a manner that prevents degradation, avoids unnecessary abstraction, and ensures the long-term sustainability of water availability and quality.

This section presents the Surface Water Management Plan and Groundwater Management Plan to be implemented across the construction, operational, and decommissioning phases of the project. The Plans are designed to provide clear management actions, monitoring frameworks, and compliance requirements to minimize risks to water resources and maintain alignment with national legislation and relevant basin authority guidelines.

Management Objectives

The key objectives of the Surface Water and Groundwater Management Plans are to:

- Minimize adverse environmental impacts on rivers, streams, springs, wetlands, shallow aquifers, and other water bodies throughout all project phases.
- Ensure full compliance with applicable water resource regulations, licenses, and permit conditions issued by the relevant authorities.
- Protect and sustain local water resources to safeguard ecological integrity, local livelihoods, and groundwater-dependent ecosystems.

These objectives form the basis for identifying site-specific management actions, monitoring indicators, responsible parties, and reporting requirements.

Tables 8.7 to 8.9 present the Surface Water and Groundwater Management Plan measures for the construction, operation, and decommissioning phases.

Table 8.7: Surface Water and Groundwater Management Plan measures for the construction Phases.

Impact	Activity	Management Programs	Responsible	Timeframe	Annual Budget (TZS)
Sedimentation & turbidity increase	Site clearing, grading, road and foundation construction	• Schedule earthworks in dry months • Provide sediment traps & silt fences • Preserve drainage paths • Progressive re-vegetation	WWSL	Throughout construction (6 months)	30,000,000
Hydrocarbon & chemical contamination	Fuel storage, refueling, concrete batching	• Bunded, lined fuel storage • Dedicated maintenance area • Immediate spill response • Worker training	WWSL	Throughout construction (6 months)	
Contamination from temporary waste / sanitation systems	Workers' camps, septic pits, waste storage	• Lined septic tanks • Off-site sludge disposal • Groundwater quality monitoring (nitrates, EC, pH)	WWSL	Monthly during construction (6 months)	
Reduced recharge due to compaction	Heavy machinery traffic, foundation works	• Limit machinery movement • Restore infiltration capacity post-works • Maintain natural drainage corridors	WWSL	3–6 months	26,000,000

(Source: MTL Consulting, 2025)

Table 8.8: Surface Water and Groundwater Management Plan measures for the Operation Phases.

Impact	Activity	Management Programs	Responsible	Timeframe	Annual Budget (TZS)
Alteration of lake salinity & hydrodynamics	Continuous trona extraction through dredging	• Limit abstraction to sustainable yield • Install flow regulators • Maintain hydrological buffers • Continuous lake-level & salinity monitoring	WWSL	Continuous throughout operation (Annual)	42,000,000
Process effluent / runoff contamination	Settlement ponds, drainage from plant	• Zero-Liquid-Discharge system • Double-lined ponds • Segregated stormwater systems • Routine effluent quality checks	WWSL	Quarterly monitoring + continuous system operation	
Aquifer depletion	Industrial abstraction for process & domestic use	• Prioritize reuse / harvested water • Flow-metering & permit compliance • Annual water-balance audit	WWSL	Annual audit + monthly abstraction monitoring	40,000,000
Salinization through seepage	Leakage from ponds, pipelines, waste cells	• Double-lined ponds • Leak-detection systems • Monitoring boreholes (up/down-gradient) • Emergency containment plan	WWSL	Continuous + quarterly groundwater monitoring	

(Source: MTL Consulting, 2025)

Table 8.9: Surface Water and Groundwater Management Plan measures for the Decommissioning Phases.

Impact	Activity	Management Programs	Responsible	Timeframe	Annual Budget (TZS)
Mobilization of contaminants during closure	Demolition, waste removal, rainfall events	• Decommission in dry season • Neutralize & remove residues • Temporary runoff collection basins	WWSL	2 Months (dry season)	26,000,000
Erosion & sediment discharge	Site rehabilitation, backfilling, grading	• Stabilize slopes • Vegetate with native halophytes • Maintain diversion drains until stabilization	WWSL	3–6 Months (until vegetation establishes)	26,000,000
Residual leachate contamination	Unremoved liners, underground pipes, contaminated soils	• Pre-closure contamination survey • Excavate polluted soils • Seal boreholes • 5-year post-closure monitoring	WWSL	5 Years (monitoring)	26,000,000
Altered recharge after landform reshaping	Backfilling, grading during rehabilitation	• Design closure topography for natural drainage • Add infiltration trenches • Verify hydraulic conductivity	WWSL	3–4 Months	26,000,000

(Source: MTL Consulting, 2025)

8.7.4 Land and Soil Management Plan

Certain activities associated with the Lake Natron Soda Ash Project including site preparation, plant installation, and access road development will require selective land clearance and grading. The extent and severity of land disturbance will depend on local topography, soil characteristics, existing land use, and the presence of community or environmental assets such as grazing areas, cultural sites, and natural vegetation zones.

To mitigate soil degradation and promote long-term land stability, the project will implement best land and soil management practices throughout construction, operation, and decommissioning. These practices will focus on:

- Minimizing the footprint of cleared areas to what is strictly necessary for project infrastructure;
- Preserving and stockpiling topsoil for reuse during site rehabilitation;
- Promoting rapid re-vegetation of disturbed areas not required for traffic or operational use to reduce erosion, prevent washouts, and limit dust emissions; and
- Stabilizing cut and fill slopes through appropriate engineering and vegetative measures.

A detailed Land and Soil Management Plan will guide these activities, specifying site preparation methods, soil handling procedures, and post-construction restoration measures. Table 8.10 provides a summary of the environmental management actions related to land and soil conservation for the Lake Natron Soda Ash Project.

Table 8.10: Land and Soil Management Plan

Impact	Activity	Project phase	Management Programme	Responsible	Timeframe	Annual Budget (TZS
Soil compaction and loss of structure (physical degradation of soil)	Site clearing, and infrastructure construction, heavy machinery movement	Construction, Operation and decommissioning	• Restrict vehicle movement to designated routes and work zones. • Implement a “Permit to Clear” procedure and maintain a Disturbed Land Register. • Preserve natural landforms and restore degraded areas as per the Revegetation Plan. • Reuse topsoil for backfilling and site rehabilitation. • Maintain biological diversity and integrity of natural vegetation and wildlife habitats.	WWSL	Throughout all phases (Annual)	13,000,000
Soil erosion and sedimentation	Land clearance, grading, drainage construction, vehicle traffic	Construction, operation and decommissioning	• Implement erosion control measures such as silt fences, gabions, and vegetative buffers. • Apply adaptive management measures to address any emerging land use conflicts during project implementation and operation • Stabilize disturbed surfaces using brush matting, mulching, or re-vegetation with salt-tolerant native species • Design drainage systems to minimize scouring and sediment discharge into Lake Natron. • Monitor and rehabilitate eroded sites following rainfall events.	WWSL	Throughout all phases with quarterly inspections	39,000,000

Impact	Activity	Project phase	Management Programme	Responsible	Timeframe	Annual Budget (TZS
Soil contamination (chemical and hydrocarbon pollution)	Fuel and chemical handling, vehicle maintenance, waste disposal	Construction, Operation and decommissioning	• Store fuels, oils, and reagents in bunded areas with spill containment. • Conduct regular soil testing for hydrocarbons and salts. • Treat contaminated soils through bioremediation or removal to approved facilities. • Service machinery in dedicated maintenance bays with oil collection systems. • Dispose of used oils through licensed recycling contractors.	WWSL	Continuous + semi-annual soil testing	26,000,000
Loss of topsoil and organic matter	Excavation, pond construction, and site preparation	Construction and Operation	• Strip, stockpile, and preserve topsoil for reuse in rehabilitation. • Avoid mixing topsoil with subsoil. • Promote rapid re-vegetation of disturbed areas not required for operations. • Rehabilitate cleared areas as per Revegetation and Land Restoration Plan.	WWSL	Construction period + annual review during operation	26,000,000
Soil Subsidence	Ground disturbance due to trona extraction and pond construction	Operation	• Conduct geotechnical monitoring and soil stability assessments. • Ensure pond embankments and foundations are properly compacted and inspected regularly. • Undertake corrective actions if settlement or cracking is observed.	WWSL	Annual geotechnical inspections + continuous monitoring	20,800,000

(Source: MTL Consulting, 2025)

8.7.5 General Environment and Waste Management Plan

The General Environment and Waste Management Plan (GWMP) outlines the procedures for managing all solid and liquid waste, both hazardous and non-hazardous to be generated by the Trona Extraction and Soda Ash Production Project within the designated project area (Table 8.11 to 8.13). The GWMP applies across the construction, operational, and decommissioning phases. This section sets out the management programs that WWSL is responsible for implementing.

Overall Objective: The overall objective of this management plan is to provide guidelines on waste reduction, segregation, collection, and disposal practices in accordance with local and international best practices, to avoid deterioration of the natural environment (Soil, water, air, etc) and negative impacts on the health and safety of the communities' vicinity of the project area. WWSL is committed to applying the waste hierarchy for proper waste management. This plan is the primary tool to guide employees toward waste management.

Specific Objectives: The specific objectives are as follows:

- To use, store, transport, and dispose of hazardous materials in an environmentally responsible and safe way;
- Minimize the potential for accidental releases and ensure that those accidental releases that may occur are mitigated; and
- Minimize waste generation and maximize recycling and reuse of materials and waste to the extent that conventional prudence allows; and

Waste Management Options - Waste Hierarchy

The waste management technique (hierarchy) comprises five stages, commencing with the most preferable option to the least preferable option. Waste prevention is the most preferred option, followed by reuse, recycling, and recovery, including energy recovery, and the last option is safe disposal, as shown in Figure 8.1. The technique will preferably be used to enhance the proper and acceptable management of materials and wastes.

Figure 8.1: Waste Management Technique (Hierarchy)

(Source: MTL Consulting, 2025)

Table 8.11: General Environment and Waste Management Plan During Construction Phase

Impact	Activity	Management Programs	Responsibility	Timeframe	Proposed Annual Budget (TZS)
General environmental pollution due to Waste Generation	Generation of construction debris, packaging materials, and domestic waste.	• Prioritize the application of a waste management hierarchy i.e. prevention, re-use, recycling, recovery, and disposal at site; • Ensure waste minimization through measures such as using less material in design, reduction (e.g., keeping products for longer or designing to last longer), and reuse; • Encourage waste recycling, particularly used oils, containers, equipment, paper, and plastics; • Encourage on-site segregation of construction waste into categories such as metal, wood, concrete, and hazardous materials; • Ensure storage and treatment of waste undertaken in a manner that protects the environment; • Emphasize use of specific installations, authorization prior to burying waste, accreditation of specialized companies; • Traceability of hazardous waste, detailing the type of waste, quantity, and identification of both carrier and destination; • Regularly inspect and maintain vehicles and equipment to prevent leaks of oil or other fluids; • Provide training to responsible personnel on proper methods for transporting, transferring, and handling hazardous substances that have the potential to impact surface and groundwater resources; • Ensure proper management of wastewater from the kitchen and sanitary facility at the site and, where necessary, apply the recycling method of wastewater for other water use purposes; and • Where possible, substitute hazardous materials with safer alternatives; and • Use licensed waste collectors for disposal and recycling.	WWSL	Throughout construction (Monthly monitoring)	13,000,000

(Source: MTL Consulting, 2025)

Table 8.12: General Environment and Waste Management Plan During Operation Phase

Impact	Activity	Management Programs	Responsibility	Timeframe	Proposed Annual Budget (TZS)
General environmental pollution due to Waste Generation	Maintenance waste, packaging, sludge, and domestic refuse, soda ash processing, chemical reactions, and cooling systems	• Refer management program on *"General environmental pollution due to waste generation"* discussed in the construction phase; • Ensure regular monitoring of effluent quality; • Store and handle hazardous waste according to international standards.	WWSL	**Continuous during operation + quarterly audits**	18,200,000

(Source: MTL Consulting, 2025)

Table 8.13: General Environment and Waste Management Plan During Decommissioning Phase

Impact	Activity	Management Programs	Responsibility	Timeframe	Proposed Annual Budget (TZS)
General environmental pollution due to Waste Generation	Dismantling of structures, disposal of materials, residual waste, spills, or uncleaned materials.	• Reuse or recycle materials where feasible; • Dispose of remaining waste at approved sites; • Conduct site cleanup and remediation; • Restore disturbed land to natural or agreed condition; and • Conduct post-closure environmental monitoring.	WWSL	**2–3 Months (during decommissioning) + 1-year post-closure monitoring**	18,200,000

(Source: MTL Consulting, 2025)

8.7.6 Air Quality Management Plan

The deterioration of Air Quality can occur from various contributing factors during the early phases of the Project. Factors such as dust generation is one of most common factors since building materials need to be transported to and from the site during the construction phase of the Project

The Management Objectives: The main objective of the management plan is to:

- Minimise and mitigate the emissions of noxious gases, and particulate matter/dust that can have an impact on the ambient air.

Table 8.14: Air Quality Management Plan During Construction Phase

(Source: MTL Consulting, 2025)

Impact	Activity	Management Programs	Responsible Person	Timeframe	Annual Budget (TZS)
Deterioration of Air Quality and Exceedance of the Ambient Air Quality Standards and Regulation	Construction Activities such as Vegetation Clearance and Soil Stripping. (This includes removal of any structures and buildings)	• Impose speed limit on all vehicles in the construction site and on the main roads leading to construction site. • Implement dust suppressing techniques in the construction site. (Water or Chemical Binding agents.) • Cover loose trucks transport fine materials (soil, sand, etc) to prevent wind-blown dust. • Locate stockpiles away from sensitive receptors • Clear vegetation and strip topsoil only in areas required for immediate construction • Schedule clearance in phases to minimize the area of exposed soil at any one time. • Preserve natural vegetation buffers near watercourses and settlements.	WWSL	Throughout construction (Daily / continuous implementation)	26,000,000
Health Impacts Risks to Workers and surrounding Communities from Construction Activities	Generation of Pollutant Gases Fossil Fuel power equipment and Generation of Particulate Matter (Dust) from movement of vehicles during construction phase	• Conduct regular maintenance schedule for construction vehicles and equipment to minimize emissions. • Use low Sulphur fuels in machinery and vehicles. • Install catalytic converters on vehicles that still have long life of service and replace vehicles which are near the end of life. • Use fuel with low Sulphur content • Avoid unnecessary idling of engines in unused vehicles.	WWSL	Throughout construction (Monthly monitoring)	26,000,000

(Source: MTL Consulting, 2025)

Table 8.15: Air Quality Management Plan During Operation Phase

Impact	Activity	Management Programs	Responsible	Timeframe	Annual Budget (TZS)
Exceedance of the Ambient Air Quality standards and regulations resulting in air quality deterioration (Noxious Gasses, Particulate Matter)	Operation Activities on the TSF, Mining Pits, Waste Rock Dumps and Processing Plant	• Conduct regular maintenance on transportation vehicles and other machinery to reduce the amount Noxious Gas being released into the ambient air. • Regularly water haul roads, pit benches and loading areas to suppress dust. • Limit vehicle speeds and enforce dust control schedules during dry periods • Maintain a moist surface on active tailing areas to reduce the creation of dust from TSF area • Restrict dumping of materials during high windy days • Conduct regular visual inspection of all possible sources of emissions (Gas Pipes, etc) •	WWSL	Continuous durin operation quarterly inspections	26,000,000
Disturbances or Nuisance to sensitive receptors	Generation of particulate matter/dust from operation activities	• Refer to Management Programs from Impact (Exceedance of the Ambient Air Quality standards and regulations resulting in air quality deterioration (Noxious Gasses, Particulate Matter) in Table 8.9: Air Quality Management Plan During Operation Phase,	WWSL	Continuous durin operation	**18,200,000**

(Source: MTL Consulting, 2025)

Table 8.16: Air Quality Management Plan During Decommissioning Stage

Impact	Activity	Management Programs	Responsible Person	Timeframe	Annual Budget (TZS)
Disturbances or Nuisance to sensitive receptors	Generation of particulate matter/dust from Decommissioning Activities (Dismantling of Infrastructure, Transportation of dismantled infrastructure away from project site, etc)	• Apply dust suppressants or dust control products on surfaces with the potential to release dust particles.	WWSL	2–3 Months (during decommissioning)	26,000,000

(Source: MTL Consulting, 2025)

8.7.7 Noise and Vibration Management Plan

Heavy Machinery, movement of light/heavy vehicles, and on-site equipment during the construction and operation phases of the Project can have an impact on the noise and vibration levels of the Project area and its surrounding sensitive receptors. By utilizing a careful plan and minimizing unnecessary movement, these effects can be mitigated.

Overall Objective:

The main objective of the management plan is to minimize noise and vibration impact within the Project area and the sensitive receptors that are close to the Project boundary

Table 8.17: Noise and Vibration Management Plan During Construction Phase

Impact	Activity	Management Programs	Responsible	Time Frame	Annual Budget (TZS)
Disturbances and Nuisances to sensitive receptors	Generation of Noise Machinery and Vehicle during the construction stage	• Utilize noise suppression techniques or equipment such as silencers on the exhaust of vehicles on site • Restrict operation of high noise equipment to daytime hours (06:00 - 18:00). Develop a noise criteria document that relates to relevant work practices and nearby receptors. • Schedule noisy activities to avoid simultaneous operation of multiple high-noise sources near sensitive receptors. • Maintain proper balancing of moving equipment and machinery to minimize vibrations.	WWSL	Throughout constructi (Daily implementation weekly monitoring)	52,000,000

(Source: MTL Consulting, 2025)

Table 8.18: Noise and Vibration Management Plan During Operation Phase

Impact	Activity	Management Programs	Responsible	Time Frame	Annual Budget (TZS)
Nuisance/Deterioration of ambient noise levels to sensitive receptors outside the boundary of project site	Operation activities (Movement of heavy-duty vehicles & light vehicles)	• Utilize noise suppression techniques or equipment such as silencers on the exhaust of vehicles or acoustic barriers around sources of noise. • Maintain the noise levels of alarms to be contained within the boundary of the Project site by locating alarms in a direction away from sensitive receptors • Develop a noise criteria document that relates to relevant work practices and nearby receptors. The document is to be placed on a noticeboard so that all site workers can quickly reference noise information	WWSL	Continuous during operati + quarterly noise monitorir	52,000,000
Hearing loss to workers due to prolong exposure to high noise levels	Operation Activities (Driving Heavy Loud Vehicles, Operation Heavy Machinery, etc)	• Provide and enforce the use of PPE such as, ear plugs and muffs in areas of exposure to high noise levels to workers. • Implement appropriate health and safety procedures that comply with OSHA Act No.5 of 2003 as well as TZS 932: 2017: Acoustic — General tolerance limits for environmental and occupational noise • Limit the working time on specific equipment that produces high levels on noise Incorporate sound proofing techniques on machines	WWSL	Continuous during operati + annual worker audiomet tests	39,000,000

(Source: MTL Consulting, 2025)

Table 8.19: Noise and Vibration Management Plan During Decommissioning Phase

Impact	Activity	Management Programs	Responsible	Time Frame	Annual Budget (TZS)
Nuisance/Deterioration of ambient noise levels to sensitive receptors outside the boundary of project site	Decommissioning phase activities (Dismantling Facilities and Equipment, etc)	• Utilize noise suppression techniques such as silencers on the exhaust of transportation vehicles. • Use acoustic barriers around the decommission project site.	WWSL	2–3 Months (duri decommissioning period)	52,000,000

(Source: MTL Consulting, 2025)

8.7.8 GHG Management Plan

The emission of GHGs can occur from several factors during the construction and operation of the Facility. The use and operation of on-site machinery and transportation vehicles is the most common factors since building materials need to be transported to and from the site during the construction phase of the Project.

Overall Objective:

The main objective is to:

- Minimise and mitigate the emissions of GHGs that can cause climate change

Table 8.20: GHG Management Plan During Construction Phase

Impact	Activity	Management Programs	Responsible Person	Proposed Timefram	Annual Budget (TZS)
Climate Change	Energy Consumption (Use of onsite power panels for backup power) Transportation of Goods and Materials to and from site	• All work schedules and journey logistics to be done effectively to reduce unnecessary usage of fuel for vehicles and onsite equipment • Undertake regular service of all machinery to reduce the amount of GHG's released into the atmosphere. • Utilize vehicles that are compliant with the most recent emissions standards. • Conduct regular energy audits to assess the power needs and use of the infrastructure. • Implement a fuel management plan to monitor and optimize fuel usage on-site • Optimize transportation routes and schedules to minimize fuel consumption	WWSL	Throughout construction (Monthl monitoring continuous implementation)	32,000,000

(Source: MTL Consulting, 2025)

Table 8.21: GHG Management Plan During Decommissioning Phase

Impact	Activity	Management Programs	Responsible	Proposed Timeframe	Annual Budget (TZS)
Climate Change	Energy Consumption (Use of onsite power panels for backup power) Transportation of Goods and Materials to and from site	• Refer to Table 8.11: GHG Management Plan During Construction Phase, Management Programs	WWSL	2–3 Months (fu decommissioning period)	52,000,000

(Source: MTL Consulting, 2025)

8.7.9 Aesthetic and Visual Impact Management Plan

Objectives: The objectives for the Aesthetic and Visual Impact Management Plan are:

- Minimize the impact on Aesthetic and Visual Amenity.
- Minimize the impact from the night lights emitting from the Project site on nearby sensitive receptor.

Table 8.22: Visual Amenities Impact Management Plan During Operation Phase

Impact	Activity	Management Programs	Responsible	Proposed Timeframe	Annual Budget (TZS)
Lighting from the Processing Plant, Vehicles and other equipment	Operation Activities	• Introduce trees, bushes, and grass to the landscape at strategic locations to break full exposure of the Project site. • Avoid up-lighting of structures. • Direct the main bean angle of lights directed towards any potential observer to not be more that 70 degrees • Glare to be kept to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70%.	WWSL	Continuous during operation + annual review of lighting systems	13,000,000

(Source: MTL Consulting, 2025)

8.7.10 Community Health, Safety, Security, and Human Rights Management Plan

This section addresses the management plan relating to health and safety risks, which are the potential to occur during the execution of the Trona Extraction and Soda Ash Production Project (Table 8.23 to 8.25), the risks associated with impact on human health, violation of human rights, spread of communicable diseases, as well as road safety risks and transport accidents.

Overall Objective: The main objective of the plan is to ensure that significant community health and safety risks arising from the Trona Extraction and Soda Ash Production Project's related activities (source of hazards) are adequately controlled or eliminated to safeguard the health, safety, and environment of workers at the Project site and the nearby surrounding communities.

Specific Objectives: The specific objectives of the community, health, safety, security, and human rights management plan are as follows:

- Minimize the potential for incidents and potential injuries to the surrounding community members;
- Avoid violation of human rights;
- Protecting surrounding communities against the health and safety risks arising from the Project activities;
- Identify and control all sources of hazards that are potentially related to the Project; and
- Minimize and control the Project activities that are likely to impact the physical environment (water bodies, air, soil, etc) as well as health and safety.

Table 8.23: Community, Health, Safety and Human Rights During the Construction Phase

Impact	Activity	Management Programs	Responsibility	Timeframe	Proposed Annual Budget (TZS)
Road safety risks and traffic accidents	Transportation of materials in and out during construction activities.	• Avoid transportation of project equipment and materials through busy trading centers and towns by using bypasses as appropriate; • Ensure regular maintenance of machinery, vehicles, and equipment as per the manufacturer's recommendation. • Ensure regular maintenance of access roads to be used for transportation activities; • Ensure establishment and implementation of safety speed limits; and • Post safety signage along the route where transportation activities will be undertaken to safeguard the safety of the surrounding community and other road users.	WWSL	Throughout construction (daily monitoring + monthly reporting)	13,000,000
Spread of communicable diseases	Construction activities of the project may result in population influx, which makes it easy to spread communicable and sexually related diseases.	• Develop training and awareness programs on communicable, infectious, and sexually transmitted diseases and provide them to workers and surrounding communities; • In the event of a new disease, increased transmission, or outbreak compared to the baseline, interact with local health care facilities and workers to ensure there is an appropriate response in place to make workers aware and to ensure proper precautionary measures are implemented; • Ensure contractors adhere to the WWSL Code of Conduct, providing a worker code of behavior including worker-worker interactions, worker-community interactions, and development of personal relationships with members of the local communities; • Providing workers with appropriate sanitary facilities, which are appropriately designed to prevent contamination; • Developing a robust waste handling system to avoid the creation of new vector breeding grounds or attracting rodents to the area; • Ensuring appropriate food preparation and monitoring measures are in place; • Ensure workers are provided with access to selected treatment at health facilities at or near the Project Site as deemed necessary for this Project. The requirements for these health facilities should be based on a risk assessment considering access to existing health facilities and travel time to facilities that offer international standards of care. Access to health care should include direct employees and subcontractors working on-site; • Prepare and implement a communicable and infectious disease management plan. This plan is to be explained and communicated clearly to the workforce and surrounding communities; • Ensure the provision of appropriate PPE to workers; and • Align awareness campaigns with those of other organizations in the area (i.e., NGOs, the Ministry of Health, etc.). These campaigns should use various common practice methodologies to ensure social and cultural sensitivity.	WWSL	Throughout construction (continuous monitoring and awareness campaigns)	
Violation of human rights	Activity related to security (Use of security forces)	• Ensure transparent communication about the role and responsibilities of security forces; • Clearly articulate the purpose of their presence and the measures being taken to safeguard the community and the project; • Where necessary, provide comprehensive training to security personnel on human rights, cultural sensitivity, and community engagement; • Sensitize security forces to the local culture and customs to avoid unintentional offenses; • Ensure that security forces operate in line with local and international laws and adhere to ethical standards; • Implement accountability measures for any misconduct or human rights violations; • Adopt a community policing approach, where security forces work collaboratively with the community to address security concerns; and • Build positive relationships between security personnel and community members to foster trust.	WWSL	Throughout construction (continuous + annual review)	

(Source: MTL Consulting, 2025)

Table 8.24: Community Health and Safety Management Plan During Operational Phase

Impact	Activity	Management Programs	Responsibility	Proposed Timeframe	Proposed Annual Budget (TZS)
Road safety risks and traffic accidents	Transportation of materials or products in and out of the project during the operation phase	• Refer management program on "*Road safety risks and traffic accidents"* discussed in the construction phase.	WWSL	Continuous during operation + quarterly monitoring	18,200,000
Spread of communicable diseases	Operation of the project may result in a continual population influx, which makes it easy to spread communicable and sexually transmitted diseases.	• Refer to management programs on *"Spread of communicable diseases"* discussed in the construction phase; and • Pre-employment screening protocols to be put in place within the framework of equal opportunities and non-discrimination. This includes pre-employment medicals and follow-up medicals as appropriate. The screening protocols to consider health conditions related to the nature of the work undertaken, employee residential details, and legal requirements.	WWSL	Continuous during operation	18,200,000
Violation of human rights	Activity related to security (Use of security forces)	• Refer management program on "*Violation of human rights*" discussed in the construction phase.	WWSL	Continuous during operation + annual review	18,200,000

(Source: MTL Consulting,2025)

Table 8.25: Community Health and Safety Management Plan During Decommissioning/Closure Phase

Impact	Activity	Management Programs	Responsibility	Proposed Time Frame	Proposed Annual Budget (USD)
Road safety risks and traffic accidents	Transportation activities.	• Refer management program on "*Road safety risks and traffic accidents*" discussed in the construction phase	WWSL	2–3 Months (decommissioning period)	15,000
Spread of communicable diseases	Decommissioning activities of the project may result in the spread of communicable and sexually transmitted diseases through continual interaction.	• Refer to management programs on "*Spread of communicable diseases*," discussed in the construction phase.	WWSL	**2–3 Months (decommissioning period)**	
Violation of human rights	Activity related to security (Use of security forces)	• Refer management program on "*Violation of human rights*," discussed during the construction phase.	WWSL	2–3 Months (decommissioning period)	

(Source: MTL Consulting; 2025)

8.7.11 Archaeology and Cultural Heritage Management Plan

The objective of the Archaeology and Cultural Resources Management Plan is

- Identify and protect cultural and archaeological resources.
- Manage chance finds during project activities.
- Train staff and contractors on heritage procedures.
- Engage local communities and heritage authorities.
- Monitor and report on heritage protection measures

Table 8.26: Archaeology and Cultural Heritage Management Plan During the Construction Phase

Impacts	Activity	Management Programme	Responsible	Timeframe	Annual Budget (TZS)
Loss and destruction of Archaeological Artifacts, Cultural Interference	Site clearance, Mobilization and Construction activities,	• Undertake an archaeological survey and shovel test pit to the defined Project area before Project commences	WWSL	Throughout construction	15,000,000
		• Basic training for the field supervisor and staff on possible findings, artefact identification, action plan steps for mitigation measures, surface collections, excavations and communication routes to follow in the case of discovery of cultural heritage resources	WWSL	Throughout construction	3,000,000
		• Implement Chance Find Procedures- In the event that any cultural remains or artefacts are accidentally uncovered during site clearance, mobilisation and construction, all works in the immediate vicinity must cease and the Antiquities Division or Archaeologist notified. Work will only resume when the conservation specialist (archaeologist) has completed the work	WWSL	Throughout construction	5,000,000
		• Follow all procedures for preservation and protection of sites and artefacts (paleontological, archaeological, and historical) specified by the Antiquities Act (No.10 of 1964) and its amendment Act No.22 of 1979.	WWSL	Throughout construction	5,000,000
		• Establish a procedure for salvage in consultation with the Antiquities Division and ensure this procedure is detailed in Contractor's Site-Specific Cultural Heritage Management Plans. The procedure is to cover the salvage of known sites prior to the commencement of works where required and the salvage of unknown sites, where required as part of the Cultural Heritage Chance Finds Procedure	WWSL	Throughout construction	13,000,000
		• Engage appropriately qualified archaeologists and cultural heritage specialists to coordinate and direct salvage of know sites prior to Project activities commence. • Employ an archaeologist who will be at the project area as a brief watcher and provide advice in case chance find materials observed during the site clearance, mobilization and construction	WWSL	Throughout construction	13,000,000
		• Ensure that significant cultural heritage findings are interpreted, documented and reported to the Antiquities Division	WWSL	Throughout construction	6,000,000
		• Establish a Community Liaison Committee with representation from Maasai elders (laigwanan), Sonjo traditional leaders, women, youth, and project management.		Throughout construction	2,000,000
		• Conduct ongoing culturally sensitive consultations in the local language, ensuring that decisions affecting cultural heritage are made with free, prior, and informed consent (FPIC) of the affected communities.	WWSL	Throughout construction	13,000,000
		• Develop and enforce a Workforce Code of Conduct that includes provisions on respect for local culture, prohibition of encroachment on sacred sites, and rules against discrimination and harassment	WWSL	Throughout construction	13,000,000
		• Engage local leaders and custodians before and during the project.	WWSL	Throughout construction	3,000,000
		• Provide cultural orientation training for all project employees and contractors, covering Maasai and Sonjo customs, protocols for interacting with elders, and awareness of cultural sensitivities (e.g., gender roles, ceremonial periods).	WWSL	Throughout construction	4,500,000
		• Assign heritage monitors during construction and decommissioning.	WWSL	Throughout construction	6,000,000
		• Apply a "chance finds" procedure for unexpected discoveries.	WWSL	Throughout construction	5,00,000
		• Restore any disturbed sites in consultation with the community.	WWSL	Throughout construction	13,000,000
		• Locate worker accommodation camps away from culturally sensitive areas and ensure they are designed to minimize social disruption (e.g., family accommodation where appropriate, separation from local settlements	WWSL	Throughout construction	10,000,000
		• Implement camp management protocols that regulate visitors, alcohol, and behaviour to prevent negative spillover into host communities	WWSL	Throughout construction	4,000,000
		• Establish a culturally accessible grievance mechanism that allows community members to raise concerns related to cultural interference anonymously and without fear of retaliation	WWSL	Throughout construction	13,000,000

Impacts	Activity	Management Programme	Responsible	Timeframe	Annual Budget (TZS)
		• Prioritize local employment and skills development to reduce the need for large-scale external in-migration. Where external recruitment is necessary, ensure a balance that does not overwhelm host communities.	WWSL	Throughout construction	15,000,000
		• Support local enterprises (e.g., catering, transport, construction) through a local procurement policy, allowing the community to benefit economically without losing cultural autonomy	WWSL	Throughout construction	13,000,000

Table 8.27: Archaeology and Cultural Heritage Management Plan During the Operation Phase

Impacts	Activity	Management Programme	Responsible	Timeframe	Annual Budget (TZS)
Loss and destruction of Archaeological Artifacts, Cultural Interference	Operation Activities	• Refer management program on "Loss and destruction of Archaeological Artifacts, Cultural Interference" described in construction phase	WWSL	Throughout Operation	15,000,000

Table 8.28: Archaeology and Cultural Heritage Management Plan During the Operation Phase

Impacts	Activity	Management Programme	Responsible	Timeframe	Annual Budget (TZS)
Loss and destruction of Archaeological Artifacts, Cultural Interference	Decommissioning Activities	• Refer management program on "Loss and destruction of Archaeological Artifacts, Cultural Interference" described in the construction phase	WWSL	During the decommissioning	7,800,000

8.7.12 Labor and Working Condition Management Plan

This plan promotes social responsibility, respect for human rights, and sustainable development by addressing labor-related issues to ensure positive social and economic development through respecting the rights and well-being of workers. The objectives of this plan focus to;

- Ensure that workers are treated with dignity and respect;
- Safeguard the rights of workers, including freedom of association and the right to collective bargaining;
- Prohibit discrimination and child labor, and promote principles of equality in the workplace;
- Establish and maintain a safe and healthy working environment;
- Identify and mitigate potential occupational health and safety hazards;
- Provide workers with access to appropriate welfare facilities, including sanitation and clean drinking water; and
- Promote fair employment practices, including reasonable working hours and limitations on overtime.

Tables 8.26 to 8.28 describe the Labor and Working Condition Management Plans in various project phases.

Table 8.29: Labor and Working Condition Management Plan During Construction Phase

Impact	Activity	Management Programs	Responsibility	Time Frame	Proposed Annual Budget (TZS)
Occupational Health and Safety Risks	Workers to be exposed to various occupational hazards (ergonomic, biological, chemical, mechanical, and physical hazards) due to Site clearing, excavation, heavy equipment operation, and handling of materials	• Conduct Risk Assessment covering all activities associated with the project; • Undertake medical check-up, which includes pre-entry, periodic, as well as pre-existing medical check-up; • Ensure providing appropriate PPE to all workers to safeguard their health; • Emphasize the application of the hazard control hierarchy when mitigating hazards; • Develop and implement the health and safety management plan associated with all activities at site; • Ensure provision of OHS training to workers; • Conduct periodic site inspection to identify existing hazards at workplace; • Ensure compliance with the OSHA Act, 2003, and other OHS International Good Practices; • Ensure posting of the safety signage in different areas of the site to inform of the associated hazards present in the area; • Ensure provision of welfare facilities at each project working site; and • Ensure provision of facilities and other supporting safety material, such as SOPs, procedures, etc., for the protection of workers against various hazards to which they are exposed.	WWSL	Throughout construction (daily monitoring + monthly reporting)	15,000,000
Labor Disputes and Rights Violations	Unfair working conditions, such as discrimination, unfair treatment, prevention of freedom of association, use of child/forced labor, and poor working conditions (i.e. provision of breaks, access to sanitary facilities, working hours, terms of payment, lack of contracts in place etc.).	• Establish and implement GRM procedures for workers; • Ensure provision of clear and understandable information regarding rights under national labor and employment law, and any applicable collective agreements, including those related to hours of work, wages, overtime, compensation, etc. • Ensure provision of reasonable working conditions and terms of employment; • Ensure provision of employment, compensation/remuneration, and working conditions, including working hours, based on equal opportunity and fair treatment, avoiding discrimination on any aspects; • Ensure provision of adequate welfare facilities on site; • Ensure the adoption and implementation of a sexual harassment policy in all sections and • Ensure adoption of an open attitude towards freedom of association.	WWSL	Throughout construction (continuous + quarterly review)	13,000,000

(Source: MTL Consulting, 2024)

Table 8.30: Labor and Working Condition Management Plan During the Operational Phase

Impact	Activity	Management Programs	Responsibility	Proposed Time Frame	Proposed Annual Budget (TZS)
Occupational Health and Safety Risks	Workers are to be exposed to various occupational hazards (ergonomic, biological, chemical, mechanical, and physical hazards) due to operational activities	• Refer management programs on "*Occupational Health and Safety Risks*" described in the construction phase.	WWSL	Continuous during operation + annual review	18,200,000
Labor Disputes and Rights Violations	Operation activities - Unfair working conditions, such as discrimination, unfair treatment, prevention of freedom of association, use of child/forced labor, and poor working conditions (i.e., provision of breaks, access to sanitary facilities, working hours, terms of payment, lack of contracts in place etc.	• Refer to the management programs on "*Labor Disputes and Right Violation*" described in the construction phase.	WWSL	Continuous during operation + annual review	13,000,000

(Source: MTL Consulting, 2025)

Table 8.31: Labor and Working Condition Management Plan During the Decommissioning Phase

Impact	Activity	Management Programs	Responsibility	Proposed Time Frame	Proposed Annual Budget (TZS)
Occupational Health and Safety Risks	Workers to be exposed in various occupational hazards (ergonomic, biological, chemical, mechanical, and physical hazards) due to decommissioning activities	• Ensure undertaking of medical check-ups, which include post-existing medical check-ups; and • Refer management program on “Occupational Health and Safety Risks” described in the construction phase.	WWSL	During decommissioning period (2–3 months)	13,000,000
Labor Disputes and Rights Violations	Unfair working conditions, such as discrimination, unfair treatment, prevention of freedom of association, use of child/forced labor, and poor working conditions (i.e., provision of breaks, access to sanitary facilities, working hours, terms of payment, lack of contracts in place, etc.).	• Refer management programs on “Labor Disputes and Right Violation” described in the construction phase.	WWSL	During decommissioning period (2–3 months)	13,000,000

(Source: MTL Consulting, 2025)

9 CLIMATE CHANGE MITIGATION, CLIMATE CHANGE ADAPTATION, AND ENVIRONMENTAL MONITORING PLAN

9.1 Introduction

This section presents the monitoring and reporting framework that will be applied throughout the construction, operation, and post-decommissioning phases of the project. The primary goal of the environmental and social monitoring programme is to ensure that all management measures identified in the ESIA are effectively implemented and that compliance with the CCMCCA&EMP is consistently achieved. Construction activities will be closely monitored on site, with regular inspections and audits conducted in accordance with the CCMCCA&EMP and the Environmental and Social Management System (ESMS). The overall objective is to attain full (100%) compliance with the CCMCCA&EMP requirements to safeguard environmental and social performance standards.

Monitoring will encompass key environmental and social aspects, including soils and land use, biodiversity, water quality and quantity, materials, waste and effluent, air quality, noise and vibration, community health and safety, as well as labour conditions, socio-economic factors, and quality assurance. The specific parameters for each aspect were identified during the ESIA process and serve as indicators to assess the project's performance without necessitating a full audit. Depending on the nature of the parameter, monitoring responsibilities will be shared between the contractor and the project proponent, with the proponent holding overall accountability for implementation. To ensure effective delivery, both parties will establish clear organisational structures and assign dedicated personnel responsible for monitoring and reporting activities.

At a minimum, the personnel responsible for monitoring the CCMCCA&EMP must ensure that proper procedures are in place to maintain effective implementation and compliance. This includes verifying that the most up-to-date version of the CCMCCA&EMP is being used, ensuring that any variations, non-compliances, and corresponding corrective actions are properly documented, and confirming that emergency response procedures are established and clearly communicated to all relevant personnel to support prompt and coordinated action when required

The monitoring programme will cover key environmental and social receptors, including but not limited to:

- Soil Quality Monitoring Plan;
- Biodiversity and Habitat Integrity;
- Surface and Groundwater Quality & Availability;
- Material Sourcing and Utilization;
- Waste and Effluent Management;
- Air Quality and GHG Monitoring Plan
- Noise and Vibration Monitoring Plan
- Aesthetic and Visual Monitoring Plan
- Community Health, Safety, and Security;
- Occupational Health and Safety; and

- Socio - Economic conditions.

Each monitoring activity outlined in the monitoring plan will specify the following details:

- **Monitoring Measure** – a clear description of the specific monitoring activity or action to be carried out.
- **Monitoring Location** – identification of the exact sites, both on and off the RSF and associated facilities, where monitoring will take place.
- **Responsibility** – designation of the party or entity accountable for conducting and managing the monitoring activity.
- **Timing and Frequency** – indication of when the monitoring will occur within the project lifecycle and how often it will be conducted (e.g., daily, weekly, monthly, or annually).
- **Performance Indicator** – definition of measurable criteria or outcomes that will be used to assess the effectiveness and success of each monitoring activity.

9.2 Environmental and Social Monitoring

9.2.1 Water Resource Monitoring Plan

Effective water resource monitoring is critical due to the hydrological sensitivity of the Lake Natron Basin and the dependence of local communities, ecosystems, and groundwater-dependent habitats on available water resources. The monitoring program addresses both water quality and water quantity in surface water and groundwater systems to ensure that project activities do not adversely affect water availability, aquatic ecology, or public health.

Monitoring of water quality enables early detection of contamination and long-term evaluation of trends in key physicochemical and biological parameters. Monitoring of water quantity provides information on changes in surface water flows and groundwater levels, allowing for the assessment of potential project-related impacts on hydrological systems. Together, these measures support sustainable water management, regulatory compliance, and proactive mitigation.

a) Applicable Water Quality Guidelines and Standards

Water quality monitoring and assessment will be guided by the following standards and reference documents:

- TZS 789:2018 – Drinking Water Quality (Natural Potable Water) Standard
- TZS 789:2018 – Drinking Water Quality (Treated Potable Water) Standard

Where national standards do not provide specific guidance for certain parameters, the following will be used as supplementary references:

- World Health Organization (WHO, 2008) – Guidelines for Drinking Water Quality
- International Finance Corporation (IFC, 2007) – Environmental, Health, and Safety (EHS) Guidelines for Effluent Discharge and Water Resources

Compliance with these standards ensures that monitored water resources meet acceptable thresholds for environmental protection and human use.

b) Monitoring Objectives

The water resource monitoring program is designed with the following key objectives:

- Baseline Characterization: To establish a comprehensive dataset of surface and groundwater flow, level and quality, reflecting the natural hydrological and hydrogeology as well as water quality conditions before the intensification of project activities;
- Impact Assessment: To monitor and assess changes in flow, level, and water quality for both surface and groundwater attributable to project activities, particularly from infrastructure such as waste rock dumps and tailings storage facilities;
- Regulatory Compliance: To ensure all discharges comply with local Environmental Standards and International Standards regarding effluent quality;
- Risk Management: To identify and mitigate risks related to both surface and groundwater contamination or hydrological and hydrogeological disruptions that could impact downstream communities and ecosystems; and
- Data Support for Decision-Making: To provide reliable and continuous data that supports environmental management decisions, ensuring timely responses to potential environmental impacts.

c) Proposed Monitoring locations

Table 9.1 present a proposed practical, GIS-ready list of monitoring points that can adopted but the project proponent for surface water and groundwater monitoring.

Table 9.1: Proposed Surface Water and Groundwater Monitoring Locations

ID	Location / Description	Purpose	Sample Type / Method	Monitoring Frequency
Surface Water Monitoring Points (SW)				
SW-R1	Upstream reference point on main inflow river/stream (Ewaso Ng'iro)	Establish natural baseline; control for seasonal variability	Grab sample at mid-channel (~0.5 m depth)	Quarterly routine; Event-based after incidents
SW-R2	Downstream point near process drainage / settlement pond outfall	Detect influence of plant runoff or effluent	Grab sample near-surface and mid-depth	Monthly during operation; Weekly during commissioning or suspected releases
SW-L1	Lake nearshore – northern shore (adjacent to site runoff influence)	Monitor ecological receptor conditions (e.g., flamingo habitat)	Surface grab; Vertical profile if stratification suspected	Quarterly
SW-L2	Lake nearshore – southern/receptor side	Compare spatial trends and detect ecosystem responses	Surface grab	Quarterly
SW-W1	Wetland or spring margin supplying local use or habitat	Track groundwater–surface water interaction and	Grab sample	Monthly

ID	Location / Description	Purpose	Sample Type / Method	Monitoring Frequency
		biodiversity sensitivity		
SW-S1	Stormwater sump / sediment pond outlet	Assess sediment load (TSS), turbidity, and metal mobilization during runoff	Grab sample, especially after rainfall	Monthly + Event-based (rainfall-triggered)
SW-E1	Final treated effluent discharge point	Demonstrate compliance with effluent discharge standards	24-hour composite preferred; otherwise grab sample + flow measurement	Weekly during commissioning; Monthly thereafter (or per permit)
Groundwater Monitoring Points (GW)				
GW-B1	Upgradient background monitoring borehole	Establish natural groundwater baseline (quality + levels)	Purged well sample following standard protocols	Quarterly routine
GW-B2	Downgradient borehole near processing plant	Early detection of potential salt/chemical plume	Purged groundwater sample	Monthly
GW-B3	Borehole near waste rock or tailings storage area	Detect potential metals/salts mobilization from waste zones	Purged groundwater sample	Monthly; **Increased frequency in wet season**
GW-B4	Community borehole / water supply well	Protect public health and local water security	Microbiological: monthly; Metals/chemistry: quarterly	Monthly (microbiology); Quarterly (full analysis)
GW-P1	Nested piezometer cluster (shallow + deep) near critical infrastructure	Determine vertical gradients, migration pathways, and hydraulic direction	Water level measurement + periodic quality sampling	Monthly (water level); Quarterly (water quality)
GW-B5	Regional background well beyond influence zone	Long-term reference for basin-scale trend comparison	Purged groundwater sample	Quarterly

(Source: MTL Consulting, 2025)

d) Water Monitoring Network

The monitoring network consists of strategically located sampling points designed to capture spatial variability and detect project-related changes (Table 9.2).

Table 9.2: Water Monitoring Network Components

Monitoring Component	Description
Surface Water Quality Monitoring Locations	Selected along streams, springs, wetland margins, and drainage pathways potentially influenced by project activities. Upstream reference/control stations will be included to differentiate natural variation from project effects.
Groundwater Quality Monitoring Locations	Monitoring boreholes will be established around the project area, including both shallow and deep aquifer systems, and near key abstraction points. Existing community wells may also be included where permission is granted.
Monitoring Frequency	Water sampling and level measurement will be conducted at regular intervals (e.g., monthly, quarterly, or as required), with event-based monitoring during extreme rainfall or process incidents. Recommended frequencies will be detailed in the Monitoring Schedule.
Water Sampling Procedures	Sampling will follow standard field protocols for collection, handling, preservation, chain of custody, and laboratory analysis to ensure data accuracy, repeatability, and traceability. Accredited laboratories will be used for analysis of key parameters.

(Source: MTL Consulting, 2025)

e) Surface and Groundwater Monitoring Determinants

The specific determinants to be monitored in surface and groundwater include physical, chemical, and biological parameters, as outlined in Table 9.3.

Table 9.3: Surface and Groundwater Monitoring Determinants

Category	Parameter	Unit	Purpose / Rationale
Physical / Field Parameters	Temperature	°C	Understand thermal regime; detect thermal or discharge influence
	pH	-	Assess acidity/alkalinity; key for soda-ash chemistry
	Electrical Conductivity (EC)	µS/cm	Indicator of salinity and dissolved ions
	Total Dissolved Solids (TDS)	mg/L	Measure salinity concentration, lake-water character
	Turbidity	NTU	Detect sediment runoff and erosion effects
	Dissolved Oxygen (DO)	mg/L	Assess suitability for aquatic life in surface water
	Salinity	ppt / PSU	Track brine influence in lake margin systems
	Water Level / Stage / Groundwater Depth	m	Track hydrological and hydrogeological changes
	Total Suspended Solids (TSS)	mg/L	Assess sediment load from runoff and discharge

Category	Parameter	Unit	Purpose / Rationale
General Chemical Parameters	Total Hardness (as $CaCO_3$)	mg/L	Characterize baseline hydrochemistry
	Alkalinity (as $CaCO_3$)	mg/L	Critical in alkaline lake/soda-ash equilibrium
	Chemical Oxygen Demand (COD)	mg/L	Assess overall organic/industrial load
	Biochemical Oxygen Demand (BOD_5)	mg/L	Evaluate biodegradable organic pollution
	Oil and Grease	mg/L	Detect hydrocarbon contamination from machinery/process
Major Ions	Sodium (Na^+)	mg/L	Key soda-ash constituent; indicator of brine interaction
	Potassium (K^+)	mg/L	Brine and mineral deposition indicator
	Calcium (Ca^{2+})	mg/L	Water hardness and ion balance indicator
	Magnesium (Mg^{2+})	mg/L	Indicator of hydrochemical evolution
	Chloride (Cl^-)	mg/L	Salinity tracer; track groundwater flow direction
	Sulphate (SO_4^{2-})	mg/L	Indicator of geochemical weathering and processing effects
	Carbonate / Bicarbonate (CO_3^{2-} / HCO_3^-)	mg/L	Key in soda-ash equilibria and buffering capacity
Nutrients	Nitrate (NO_3^-)	mg/L	Detects wastewater or fertilizer influence
	Nitrite (NO_2^-)	mg/L	Early indicator of organic/nitrogen pollution
	Ammonia / Ammonium (NH_3 / NH_4^+)	mg/L	Indicator of decomposition or effluent leakage
	Total Phosphorus (TP)	mg/L	Eutrophication potential in local wetlands
	Ortho-Phosphate (PO_4^{3-})	mg/L	Measures biologically available phosphorus
Microbiological Parameters	Total Coliforms	MPN/100 mL	Indicator of general sanitation contamination
	Escherichia coli (E. coli)	MPN/100 mL	Key indicator of faecal contamination impacting community health
	Enterococci (optional, if human contact risk)	CFU/100 mL	Strong faecal contamination indicator in saline water
	Algal Productivity	Cells/mL	Monitor the primary food source for Lesser Flamingos
	Cyanobacterial Abundance	µChlorophyll-a/L	
Metals (Total / Dissolved)	Iron (Fe)	mg/L	General water quality and mineral dissolution indicator
	Manganese (Mn)	mg/L	Can mobilize under reducing groundwater conditions

Category	Parameter	Unit	Purpose / Rationale
	Zinc (Zn)	mg/L	Often linked to equipment corrosion/residue
	Copper (Cu)	mg/L	Potential contaminant from process piping
	Lead (Pb)	mg/L	Toxic trace metal; human and ecosystem risk
	Cadmium (Cd)	mg/L	High toxicity; must be tracked if industrial inputs occur
	Chromium (Cr total & Cr(VI))	mg/L	Critical where alkaline chemistry can mobilize Cr(VI)
	Nickel (Ni)	mg/L	Indicator of industrial water-rock interaction
	Mercury (Hg)	µg/L	Ultra-trace toxicity monitoring
	Arsenic (As)	µg/L	Can increase in evaporative/saline groundwater systems
	Selenium (Se)	µg/L	May accumulate in evaporation ponds; ecological sensitivity
Project-Specific (Optional Based on Brine Chemistry)	Boron (B)	mg/L	Brine tracer in soda-rich hydrogeology
	Lithium (Li)	mg/L	Indicator of evaporite concentration processes
	Fluoride (F^-)	mg/L	Naturally elevated in volcanic terrains; drinking water concern

(Source: MTL Consulting, 2025)

9.2.2 Soil Monitoring Plan

Monitoring will be undertaken as follows:

- Visual inspection of erosion and sediment control structures on a monthly basis, and after heavy rain events to ensure that these are not silted up.

9.2.3 General Environment and Waste Monitoring

A waste monitoring plan plays a vital role in assessing and controlling the potential impacts of a project's waste generation and management practices. It includes systematic tracking and evaluation of waste quantities, types, and disposal methods to ensure that project activities do not negatively impact the environment or nearby communities. The plan details the potential impacts, specific parameters to monitor, monitoring locations, frequency, key performance indicators (KPIs), targets, and the responsible individuals, as outlined in Table 9.4.

Table 9.4: General Environment and Waste Monitoring Plan

VEC	Description of Impact	Parameter	Location	Frequency	Responsible	KPI	Targets	Cost (TZS)
General Environment	Land pollution, soil and water contamination are due to waste generation.	Tons/Kg or liters of waste	Collection, Storage, and Discharge Points.	Monthly during construction, operation and decommissioning	WWSL	• Comply with TZS 860: Municipal and Industrial Wastewater Standard; and • Comply with Environmental Management (Solid Waste Management) Regulations, 2009 as Amended, 2018.	Minimal Waste generation	13,000,000

(Source: MTL Consulting, 2025)

9.2.4 Community Monitoring Plan

The Community Monitoring Plan (CMP) is designed to ensure that local communities, particularly the Maasai who reside around the Lake Natron area, actively participate in monitoring the environmental and social performance of the Soda Ash Project. This participatory approach aims to promote transparency, accountability, and shared ownership of environmental protection and community wellbeing. The plan seeks to empower local people to understand and monitor the project's impacts, build their capacity in environmental and social observation, strengthen communication between the project and the community, and ensure that any emerging issues are identified and resolved promptly.

Implementation of the CMP will follow a participatory framework where community representatives, village leaders, and local government officials jointly observe project performance. Project Liaison Officers will receive training in key areas such as environmental observation, health and safety, and data recording to enable informed participation. Monitoring will focus on critical parameters such as dust and noise levels, grazing land conditions, employment and training opportunities, and community health and safety. Regular monitoring conducted quarterly and during high-impact project phases will be complemented by community-friendly reporting formats and quarterly meetings to discuss findings and follow-up actions. The Community Monitoring Plan will be reviewed annually to assess its effectiveness and incorporate feedback from both the community and regulatory bodies, ensuring continuous improvement and relevance throughout the project lifecycle.

Table 9.5: Community Monitoring Indicators

Monitoring Parameter	Indicator	Frequency	Responsible Party	Reporting Mechanism
Dust and Air Quality	Visible dust along access roads and settlements	Monthly (during dry season)	Project Liaison Officer & Contractor	Community meeting feedback sessions
Noise Levels	Disturbance reported by nearby households or herders	Quarterly	Project Liaison Officer & EHS Team	Community meeting feedback sessions
Livelihood and Grazing Land Condition	Access to grazing routes, water points, and livestock pastures	Quarterly	Village Livestock Committee & Project Liaison Officer	Livelihood monitoring reports submitted to project and local government
Employment and Training Opportunities	Number of local Maasai employed and trained	Quarterly	HR Department & Project Liaison Officer	Employment progress presented in stakeholder meetings
Community Health and Safety	Cases of accidents, communicable diseases, or unsafe practices	Quarterly	Local Health Officer & Community Committee	Health status summary shared with project and health authorities
Implementation of CSR Commitments	Progress of community support programs and infrastructure initiatives	Bi-annually	CSR Team & Community Representatives	Reports presented during stakeholder review forums
Grievance Resolution	Number and type of grievances raised and resolved	Continuous	Community Liaison Officer & Grievance Committee	Grievance register reviewed monthly

(Source: MTL Consulting, 2025)

9.2.5 Biodiversity Monitoring

a) Vegetation Monitoring

Vegetation monitoring will be undertaken throughout the project lifecycle to evaluate the effectiveness of implemented mitigation measures, detect any unanticipated impacts on vegetation, and ensure progressive rehabilitation and ecological stability within the project footprint and its surroundings. Given the ecological sensitivity of the Lake Natron Basin, monitoring will focus on changes in vegetation composition, ground cover, and the presence of invasive species in both terrestrial and riparian habitats.

The main objectives of the vegetation monitoring program are to:

- Assess the effectiveness of mitigation and rehabilitation measures implemented during construction, operation, and decommissioning phases.
- Detect and quantify changes in vegetation cover, species diversity, and composition over time.
- Identify the presence and spread of invasive or exotic plant species introduced through project activities.
- Evaluate the recovery of native vegetation and the success of post-disturbance restoration efforts.
- Provide scientific data to support adaptive management and compliance with NEMC and other regulatory requirements.

Table 9.6: Flora Monitoring Plan

Project Phase	Monitoring Indicator	Description / Parameter to Measure	Monitoring Method / Approach	Frequency / Timing	Responsible Party	Expected Outcome Purpose	Annual Budget (TZS)
Construction	Vegetation cover and clearance extent	Area of vegetation cleared compared to approved site plan; evidence of off-limit area disturbance	Field verification using GPS mapping, transect surveys, and photo records	Monthly during construction	WWSL	Ensure vegetation loss is restricted to approved footprint	8,500,000
	Dust deposition on vegetation	Visual assessment of dust accumulation on leaves, reduction in Vigor near construction routes	Visual inspections and vegetation health assessment within 50 m of haul roads and plant sites	Quarterly	WWSL	Assess effectiveness of dust suppression measures	5,000,000
	Presence of invasive species	Observation of alien or exotic plants near disturbed or imported material areas	Transect walk surveys and species identification	Quarterly	WWSL	Early detection and control of invasive species	4,500,000
Operation	Vegetation health and cover stability	Regeneration and persistence of native vegetation around operational areas	Permanent transects and photographic monitoring	Bi-annually (wet & dry seasons)	WWSL	Evaluate long-term vegetation stability	7,000,000

Project Phase	Monitoring Indicator	Description / Parameter to Measure	Monitoring Method / Approach	Frequency / Timing	Responsible Party	Expected Outcome Purpose	Annual Budget (TZS)
	Species diversity and abundance	Changes in native species composition compared to baseline	Quadrat sampling and floristic inventory	Bi-annually	WWSL	Maintain or improve baseline vegetation diversity	5,500,000
	Presence and spread of invasive species	Monitoring of disturbed and access road areas for invasive plant spread	Visual survey and GPS mapping	Bi-annually	WWSL	Prevent ecological degradation from invasive flora	5,000,000
Decommissioning	Vegetation recovery on rehabilitated areas	Extent and success of revegetation on disturbed sites	Transect and quadrat surveys, photo documentation	Annually for 3 years post-closure	WWSL	Confirm recovery towards pre-project condition	7,000,000
	Soil condition and erosion status	Visual signs of erosion, compaction, or instability affecting revegetation	Field inspection and soil surface assessment	Annually	WWSL	Support effective habitat restoration	4,500,000
	Invasive species re-introduction	Post-closure monitoring for exotic or opportunistic species colonization	Field verification and species identification	Annually	WWSL	Maintain ecological integrity of restored areas	4,000,000

(Source: MTL Consulting, 2025)

) Fauna Monitoring

WWSL should establish, implement and maintain the terrestrial ecology monitoring plan for the project to ensure proper implementation and effectiveness of mitigation measures. More specifically monitoring will aim at:

i. Ensuring that the magnitude of impacts and sensitivity of receptors are verified regularly in order to rapidly adapt the management plan;

ii. Determining if the environmental, social and community health changes that are observed to be occurring are attributable to project activities or are the result of other activities or natural variation; and

iii. Adopting a continual review and improvement in Project design and execution.

i. Indicators, Measurements, and Monitoring Extent

The indicators presented in the terrestrial ecology monitoring approach should be used to monitor the project effects on biodiversity. Applying indicators is an approach to offset budgets and outcomes, and such indicators need to be selected very smart. Biodiversity indicators in this report are also sufficiently sensitive to provide an indication of changes prior to irreversible damage happening. These indicators serve to indicate/signify where no significant change is occurring, and also where the threshold between insignificant and significant change lies.

Three types of indicators and Guidelines on Biodiversity Monitoring have been suggested to monitor effectiveness of mitigation measures (Table 9.7)

Table 9.7: Types of Indicators and measurements for monitoring

Monitoring Component	Key Indicators	Measurement / Method	Monitoring frequency	Responsible
Avifauna (Birds)	Population trends of Lesser Flamingo and other key bird species	Ground and aerial counts Photographic surveys Observation of breeding colonies	Monthly during breeding season Entire lake margin and adjacent wetlands	Biodiversity Specialist
Terrestrial Mammals	Species presence and abundance Movement corridors	Transect surveys Incident reporting via community liaison	Quarterly	Biodiversity Specialist / Project Environmental Officer
Herpetofauna (Reptiles & Amphibians)	Species diversity and abundance	Visual encounter surveys Pitfall traps and night searches	Biannual (wet and dry seasons)	Biodiversity Specialist / Project Environmental Officer
Noise and Light Disturbance	Noise level (dB) and artificial light intensity	Portable sound meters and lux meters Night-time observation of fauna response	Weekly (during construction), Quarterly (during operation)	Biodiversity Specialist / Project Environmental Officer
Rehabilitation and Restoration	Fauna recolonization	Field surveys	Biannually (post-construction and decommissioning phase)	Biodiversity Specialist / Project Environmental Officer

(Source: MTL Consulting, 2025)

ii. Monitoring Frequency

The evaluation and reporting of the monitoring programme will be on-going as follows:

- Daily: General fauna monitoring, and reporting of incidents impacting biodiversity and emergency response;
- Monthly: Compilation of monitoring progress, environmental training delivered, details on any major incidents/events, general progress of the monitoring program;
- Quarterly: Summary report on quarterly biodiversity monitoring programs, review quarterly performance and apply adaptive management if required; and
- Annual: Review annual biodiversity monitoring program, prepare annual report to include evaluation results for the year against targets and biodiversity objectives.

The baseline data collected as part of biodiversity surveys will serve to assess Project impacts and efficiency of mitigation measures, as well as biodiversity gain and loss.

iii. Proposed fauna monitoring locations

Fauna monitoring for the Lake Natron Soda Ash Project aims to track changes in wildlife populations, habitat condition and ecosystem health across the project footprint and surrounding landscapes. Monitoring locations have been strategically selected to represent the diversity of habitats found in the area, including the lake's saline flats, freshwater inflows and human settlement zones.

Suggested key monitoring sites include Lake Natron shoreline in Wosiwosi village, Engaresero wetlands and Ngarenyuki stream (Ewasongiro) which is the main river that flows in Lake Natron. These areas will be closely monitored for population trends, nesting success, hydrological changes, and vegetation cover to ensure that critical habitats remain functional.

Additional monitoring locations can be in project processing site and nearby villages such as Engaresero and Pinyinyi which can experience fauna displacement, noise impacts and pollution risks from project operations. A five-kilometre buffer zone will serve as a reference area for comparison with impacted sites.

a) Aquatic Monitoring

Aquatic bio-monitoring indicators will be used to measure the health condition of watercourses as a habitat for aquatic flora and fauna. Sensitive and endemic fish species will be used as bio-indicator species. A monitoring program will be developed to identify the changes in the abundance, composition, or condition of conservation-significant fish species.

A program to monitor the ecological state of Lake Natron ecosystems is recommended throughout the preparation, construction operation, and closure phases of the Project. The same methods that were used during the baseline survey are recommended for long-term monitoring of aquatic habitat quality, habitat integrity, and fish (Table 9.8).

Table 9.8: Types of Indicators and Measurements for Monitoring

Indicator Type	Measurement	Monitoring Tools / Equipment	Monitoring Frequency	Performance Indicator
Condition / Habitat Indicators	• Species richness and composition of fish and benthic macroinvertebrates in inflowing streams and shoreline habitats. • Relative abundance of endemic tilapia species. • Physical habitat quality: substrate condition, aquatic vegetation cover, and shoreline stability.	Seine net, gill net, hand/dip net, underwater camera, GPS mapping tools	Baseline before construction, then quarterly during construction and biannually during operation.	• Stable or improved species composition and richness. • No significant loss of spawning or nursery habitats. • Shoreline and streambank vegetation maintained or recovering.
Water Quality Indicators	• Turbidity, suspended sediment, dissolved oxygen, pH, temperature, electrical conductivity, nutrient levels (nitrate, phosphate), hydrocarbon residues	Multi-parameter water quality meter, turbidity meter, sediment traps, and laboratory chemical analysis.	Monthly during construction, then quarterly during operation.	• Turbidity and sediment within acceptable limits. • DO sufficient for aquatic fauna health. • No detectable hydrocarbon contamination in inflows or lake.
Noise and Vibration Indicators	• Underwater and nearshore noise levels during construction and heavy machinery operations	Underwater hydrophones, vibration meters.	Daily during high impact construction as needed for operational activities	• Noise maintained below disturbance thresholds for fish and macroinvertebrates. • Sensitive spawning or juvenile habitats remain unaffected.
Response Indicators	• Signs of ecosystem recovery or deterioration, including habitat condition and fauna abundance. • Changes in juvenile fish or macroinvertebrate recruitment.	Seine net, gill net, dip net and visual habitat surveys	Biannually post-construction and during operation.	• Stabilization or recovery of fish and macroinvertebrate populations compared to baseline. • Juvenile recruitment maintained in inflowing streams and shoreline habitats.

Indicator Type	Measurement	Monitoring Tools / Equipment	Monitoring Frequency	Performance Indicator
Community/Stakeholder Indicators	• Community reporting of unusual water conditions, livestock impacts, or habitat disturbance. • Level of participation in monitoring	Structured interviews, participatory shoreline surveys, and mobile reporting apps.	Ongoing, with monthly community review meetings.	• High community engagement and reporting. • Rapid response to incidents within 24–48 hours of detection.

(Source: MTL Consulting, 2025)

i. Proposed Aquatic Monitoring Site Locations

Monitoring of aquatic fauna and habitats will focus on areas most likely to be affected by soda ash extraction, plant and township construction, trona slurry pipelines, and access roads. Sampling will target both shoreline zones and inflowing streams to capture the main ecological gradients and habitat types.

To support robust assessment and long-term ecological monitoring, the program should focus on:

- Impact Zones: Areas directly influenced by construction and operational activities, including inflowing streams entering Lake Natron, shoreline areas adjacent to the plant and township, and stream segments upstream and downstream of intake or discharge points. These zones will be regularly monitored to track changes in fish populations, macroinvertebrate communities, substrate condition, and vegetation cover.
- Near Field Reference Zones: Upstream or lateral areas outside immediate construction influence, representing baseline conditions within similar habitats. These zones will provide comparative data to help distinguish project related impacts from natural variations.
- Far Field Reference Zones: Remote areas several kilometers away from the project footprint, representing regional background conditions unaffected by the project. These zones will help detect cumulative or widespread environmental changes and ensure regional context is incorporated into monitoring.

9.2.6 Air Quality and GHG Monitoring

a) Applicable Air Quality Guidelines and Standards

The regulatory guidelines and standards relevant to air quality include:

- Tanzania Bureau of Standards – TZS 845:2019, Air Quality – Specification.
- Tanzania Bureau of Standards – EMDC 2 (1758), Air Quality – Vehicular Exhaust Emission Limits.
- Environmental Management (Air Quality Standards) Regulations, 2007:
- First Schedule, Permissible Weight Concentration of Emission Limits from the Atmosphere to a Receptor and Respective Test Methods.
- Second Schedule, Highest Permissible Quantity of Emission and Test Methods.
- Fourth Schedule, Emission Limits for Motor Vehicles.

In addition to the standards above the following guidelines may be used as reference where the above standards do not prescribe guideline limits or values for air quality parameters.

b) Air Quality Monitoring Locations

Table 9.9 indicates the Air Quality Monitoring locations established during surveys of baseline conditions. Locations were chosen based on their unique locations and their proximity to project sites.

Table 9.9: Air Quality Monitoring Locations

Sampling Locations	Sample CODE		Coordinates (Zone 36L UTM 1960)		
	Particulate Matter	Noxious Gases	Easting	Northing	Elevation
Proposed Processing Plant Site 1	SDASH AQSP 1	SDASH NGSP 1	0178881	9735342	1424
Proposed Processing Plant Site 2	SDASH AQSP 2	SDASH NGSP 2	0180336	9737956	1400
Wosi Wosi Village	SDASH AQSP 3	SDASH NGSP 3	0182823	9731359	1411
Residential House	SDASH AQSP 4	SDASH NGSP 4	0181903	9735694	1450

(Source: MTL Consulting, 2025)

c) Air Quality Monitoring Frequency

The monitoring of PM_{10} and $PM_{2.5}$ will be done in the identified four (4) sampling points using an appropriate mobile monitor e.g., Micro-Dust Pro Cell 712. The following parameters: NO_X, NO_2 and SO_2 will be monitored within the production wells, other facilities and the surrounding communities on a quarterly basis.

All Air Quality monitoring data will be analysed by an appropriately qualified professional, and the results will be reported on a regular basis, as determined by management. Data from the closest weather station, recorded continuously, will be purchased and summarized in quarterly routine reports, unless more frequent data is required by operational needs.

d) Air Quality Parameters and Guideline Values/Limits

Air Quality monitoring parameters have been selected based on legislative requirements and international standards relevant to the Project. Table 9.10 lists the Air Quality monitoring parameters and guideline values/limits for the Project. Compliance criteria have been adopted from several guidelines and standards as no single guideline/standard contains limit concentrations for all parameters.

Table 9.10: Air Quality Parameters and Guideline Values

Parameter	Units of Measure	Tanzania Bureau of Standards TZS 845: 2005, Air Quality – Specification First Schedule, Permissible Weight Concentration of Emission Limits from the Atmosphere to a Receptor	Second Schedule, Highest Permissible Quantity of Emission	WHO – Air Quality Guidelines, 2021
Inhalable particulate matter (PM_{10})	µg/m³	Emission Limit 60 - 90	Annual mean – 250	Annual mean – 15 24 hours mean – 45
Inhalable particulate matter ($PM_{2.5}$)	µg/m³			Annual mean – 5 24 hours mean – 15

Parameter	Units of Measure	Tanzania Bureau of Standards TZS 845: 2005, Air Quality – Specification First Schedule, Permissible Weight Concentration of Emission Limits from the Atmosphere to a Receptor	Second Schedule, Highest Permissible Quantity of Emission	WHO – Air Quality Guidelines, 2021
Sulphur dioxide (SO_2)	µg/m³	24 hours mean – 20 10-minute mean – 500	Not applicable	24 hours mean – 40 10-minute mean – 500
Lead (Pb)	µg/m³	Annual mean – 0.5 24 hours mean – 1.5	Not to exceed 5 tonnes/year of lead or lead compounds by a stationary source.	
Nitrogen oxides (NO_X)	µg/m³	Annual mean – 0.1 24 hours mean – 150	Not applicable	Annual mean – 40 1 hour mean – 200
Carbon monoxide (CO)	mg/m³	Time-weighted exposures at the following levels: 00mg/Nm³ for 15 minutes 60mg/Nm³ for 30 minutes 30mg/Nm³ for 60 minutes 10mg/Nm³ for 8 hours Daily average of hourly vales shall not exceed 10 mg/kg and average of hourly values in eight consecutive hours shall not exceed 20 mg/kg.	Not to exceed 175 at diesel generators.	
Ozone	µg/m³	8 hours mean – 120	–	8 hours mean – 60

(Source: MTL Consulting, 2025)

Results from monitoring will be compared to the Tanzanian Air Quality Specification. The aim of the air quality analysis is to determine any changes in concentration of parameters which may be because of project activities. Exceedance of guideline criteria at any of the monitoring points will be identified, reported to management and relevant regulatory authorities, and corrective actions taken where required.

9.2.7 Noise and Vibration Monitoring

Noise and Vibration emissions will be monitored by WWSL during all phases of the project. Regular monitoring is required to provide necessary information to determine the impacts of these emissions in relation to the activities of the project.

The monitoring program for noise and vibration will ensure that:

- The objectives of the Noise and Vibrations Management Plan are being met.
- Ambient noise does not exceed applicable noise criteria at sensitive receptors outside of the Project Area.
- Vibration levels do not exceed the applicable criteria and does not cause damage to structures.
- To gather data such that any potential noise and vibration impacts are identified, and appropriate mitigation measures are put in place.

a) Applicable Noise and Vibration Guidelines and Standards

Regulatory guidelines and standards relevant to noise and vibration include:

- Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2015.
- Tanzania Bureau of Standards – EMDC 6 (1733) P2: Acoustics - General Tolerance Limits for Environmental Noise.

In addition, other international guidelines may be used as reference where the above standards do not prescribe adequate guide limits or values for noise and vibration. These are:

- World Health Organisation Guidelines for Community Noise, 1999.

b) Noise and Vibration Monitoring Locations

Noise and Vibration monitoring locations are indicated in Table 9.11. Further locations, if necessary, will be established as project activities commence. These other vibration points will be selected based on their proximity to the project sites.

Table 9.11: Noise and Vibration Sampling Locations

Sampling Locations	Sample ID		Coordinates (Zone 36L UTM 1960)		
			Easting	Northing	Elevation
Proposed Processing Plant Site 1	SDASH NSP 1	SDASH VSP 1	0178881	9735342	1424
Proposed Processing Plant Site 2	SDASH NSP 2	SDASH VSP 2	0180336	9737956	1400
Wosi Wosi Village	SDASH NSP 3	SDASH VSP 3	0182823	9731359	1411
Residential House	SDASH NSP 4	SDASH VSP 4	0181903	9735694	1450

(Source: MTL Consulting, 2025)

c) Noise and Vibration Guideline Value/Limits

Noise and Vibration monitoring parameters have been selected based on legislative requirements and international standards relevant to the Project. Table 9.12 lists the Noise guideline values/limits applicable to the Project. Compliance criteria have been adopted from several guidelines and standards as no single guideline/standard contains limit concentrations for all parameters.

Results from monitoring will be compared to the baseline data previously collected from the sampling locations and evaluated against the Tanzanian General Tolerance Limits for Environmental Noise. The aim of the noise monitoring is to determine any significant changes in ambient noise at sensitive receptors, which may be because of project activities.

Exceedance of guideline criteria at any of the monitoring points will be identified, reported to management and relevant regulatory authorities, and corrective actions taken where required.

Table 9.12: Noise Monitoring Guideline Criteria

Area	WHO Guidelines for Community Noise		Tanzania General Tolerance Limits for Environmental Noise	
	Daytime (dBA)	Nighttime (dBA)	Daytime (dBA)	Nighttime (dBA)
Residential	55	45	55	45
Industrial	70	70	70	60

Source: MTL Consulting, 2025

The Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2015 classifies excessive vibration as that which exceeds 5 mm/s beyond any source property boundary. This tolerance limit applies to sensitive sites, which has been classified as land within 10 meters of a residence, hospital, school, or other premises in which people could reasonably expect to be free from undue annoyance and nuisance caused by vibration. The 10 meters will be measured from the boundaries of the property.

The limit stipulated in the Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2015 for air over pressure (sub-sonic vibration) is always 120 dBL at sensitive sites. Exceedance of guideline values/limits at any vibration monitoring point will be identified and reported to management and relevant regulatory authorities

d) Noise and Vibration Monitoring Frequency

Noise and vibration monitoring will be conducted in accordance with the noise and vibration management plan. A quarterly monitoring analysis will be conducted at strategic points within the project area and the sensitive receptors to ensure levels are within the stipulated local and international standards respectively.

e) Noise and Vibration Monitoring Data Analysis

Data analysis will be overseen by a qualified professional, and the results will be reported on a regular basis as determined by management.

9.2.8 Community Health, Safety, Security, and Human Rights Monitoring Plan

This monitoring program is designed to safeguard the well-being of local communities in the vicinity of the trona extraction and soda ash production project. It ensures that project activities do not adversely affect community health and safety, while also addressing potential security concerns to prevent any increase in crime or social unrest linked to the project. The monitoring methods detailed in Table 9.13 will be implemented to maintain and, where possible, enhance community health, safety, and security both within the project site and in surrounding areas.

Table 9.13: Community Health, Safety, Security and Human Rights Monitoring

VEC	Description of Impact	Parameter	Location/Area	Frequency	Responsible	KPI	Targets	Reference	Cost (TZS)
Community Health, Safety and Security	Road safety risks and traffic accidents	Number of accidents and injuries reported	Project area and surrounding local communities along access roads	Monthly during the construction, operation, and decommissioning phases	WWSL	Zero accidents and injuries	Achieve a reduction of 10-20% of accidents and injuries reported annually.	Incidence report	51,800,000
	Spread of communicable diseases	Number of infected people	The project area and the surrounding local communities	Monthly during the construction, operation, and decommissioning phases	WWSL	No increase in people infected.	Low % of new people infected	Baseline data from Health Center Facilities	
	Violation of human rights	Number of human rights violations reported.	The project area and the surrounding local communities	Monthly during the construction, operation, and decommissioning phases.	WWSL	No human rights violation.	Achieve a reduction of 10-20% of human rights infringements annually.	-	

(Source: MTL Consulting, 2025)

9.2.9 Labor and Working Conditions Monitoring Plan

The Labor and Working Condition Monitoring Plan is intended to safeguard employee well-being by identifying potential workplace hazards, enforcing safety protocols, and ensuring access to proper training and personal protective equipment (PPE), workers' rights, maintenance of equal job opportunities, avoiding discrimination and harassment. Its primary goal is to reduce violations of workers' rights, the risk of accidents, injuries, and occupational illnesses through continuous risk assessment, regulatory compliance, and the promotion of a proactive safety culture. The strategies

and methodologies WWSL will adopt to monitor labor and working condition performance at the trona extraction and soda ash production project site are presented in Table 9.14.

Table 9.14: Labour and Work Condition (OHS) Monitoring Plan

VEC	Description of Impact	Parameter	Location/Area	Frequency	Responsible	KPI	Targets	Cost (TZS)
Project Employees	Violation of labour rights	The number of people affected due to the deterioration of human rights	All working areas at the project site.	Monthly during the construction, operation, and decommissioning phases.	WWSL	Zero deterioration of human rights	Achieve a reduction of 10-20% of human rights deterioration reported annually.	14,750,000
Project Employee	Occupational Health and Safety Risks (ergonomic, biological, chemical, mechanical, and physical hazards)	Number of accidents and injuries reported	All working areas at the project site.	Monthly during the construction, operation, and decommissioning phases.	WWSL	Zero accidents and injuries occurred	Achieve a reduction of 10-20% of accidents and injuries reported annually.	14,750,000
		Number of hazards identified and assessed				Updated risk assessment	Updated risk assessment	
		• Number of training sessions held; and • Attendance rate.				100% training sessions held, and the attendance rate	At least 90% of training sessions are done	
		Number of health check-ups conducted				100% health check-ups conducted	At least 90% of health check-ups are done	
		• Number of incidents reported; and				Zero incidents reported	Achieve a reduction of 10-20% of incidents reported annually.	

VEC	Description of Impact	Parameter	Location/Area	Frequency	Responsible	KPI	Targets	Cost (TZS)
		• Investigation completion time.						
		• Number of drills conducted; and • Response time.				100% drill is conducted regularly	At least 90% drill was conducted	
		• Number of inspections conducted; and • Compliance rate with safety standards.				100% inspections are conducted on a regular basis	At least 90% inspections were conducted	

(Source: MTL Consulting, 2025)

9.2.10 Archaeology and Cultural Heritage Monitoring Plan

Monitoring archaeology and cultural heritage will involves regularly inspecting and assessing areas of archaeological and cultural significance to ensure they are protected from potential damage caused by project activities. This will include conducting field surveys and site inspections, documenting the condition of heritage sites, and ensuring that any discoveries are reported and handled according to established protocols. Engaging with local communities, cultural experts, and regulatory authorities will be essential to ensure that heritage management plans are effectively implemented and culturally sensitive. Monitoring reports will be prepared periodically to record any changes, interventions, or required corrective actions.

Monitoring Objectives include:

- Ensure compliance with cultural heritage laws and regulations;
- Protect and conserve identified archaeological and cultural heritage sites;
- Document and assess the condition of cultural heritage assets regularly;
- Prevent unauthorized access and mitigate potential damage from project activities;
- Facilitate stakeholder engagement to address any cultural heritage concerns; and

- Record and manage discoveries according to established procedures

Table 9.15: Archaeology and Cultural Heritage Monitoring Plan

Aspect	Indicator / Parameter	Monitoring Method	Frequency	Responsible Party
Chance Finds (Archaeological & Paleontological)	Number of chance finds reported; time between discovery and notification; compliance with stop-work protocol	Site inspections; review of incident reports; worker interviews; verification by qualified archaeologist	Continuous (daily during ground-disturbing activities); monthly summary report	WWSL
Condition of Avoided Archaeological Sites	Physical integrity of sites (e.g., artifact scatters, fossil localities) located outside project footprint but within PAI	Visual inspection; photographic record; GPS mapping; comparison with baseline documentation	Quarterly (or after major disturbance events)	WWSL
Sacred Sites (Ereto, Graves, Salt Licks)	Accessibility and condition of sacred sites; community reports of interference; unauthorized access	Community consultations; key informant interviews with elders; participatory mapping; site visits (where culturally appropriate)	Biannual; additionally upon community request	WWSL
Cultural Orientation & Worker Compliance	Percentage of workers (including contractors) trained; number of cultural incidents reported; adherence to Workforce Code of Conduct	Training attendance records; spot checks; anonymous grievance reports; workforce surveys	Monthly (training records); quarterly (compliance review)	WWSL
Community Engagement & Grievances	Number and type of cultural heritage-related grievances; time to resolution; community satisfaction	Grievance log analysis; community meetings; focus group discussions; satisfaction surveys	Quarterly, or as grievances arise	WWSL

Aspect	Indicator / Parameter	Monitoring Method	Frequency	Responsible Party
Intangible Cultural Heritage (e.g., traditional practices, language use)	Perceived impact on cultural practices (e.g., ceremonies, traditional governance); youth engagement with heritage	Ethnographic interviews; participant observation (with consent); annual cultural mapping update	Annually	WWSL
In-migration & Cultural Interference	Population changes in host villages; incidence of social tensions; resource conflicts	Census data (village records); key informant interviews; conflict incident logs; stakeholder meetings	Biannually	WWSL
Archaeological & Cultural Heritage Reporting	Timely submission of monitoring reports to Division of Antiquities and NEMC; completeness of data	Internal audit; authority feedback	Quarterly (internal); annual (regulatory submission)	WWSL

10 COST BENEFIT ANALYSIS

10.1 Introduction

The Cost-Benefit Analysis (CBA) for the proposed Trona Extraction and Soda Ash Production Project is expected to commence in 2026, with operations anticipated to start in the fourth quarter of 2026. Regulation 18(2) (xii) of the Environmental Impact Assessment and Audit Regulations, 2005 (as last amended in 2024), requires that the contents of the ESMP should include, among others, the cost-benefit analysis (CBA) of the Project. CBA is a procedure for evaluating the desirability of the Project by weighing benefits against costs. CBA is used for efficiency assessment of a Project, which refers to an analysis made for the purpose of identifying how to use scarce resources to obtain the greatest benefits from them.

The intervention can be in the form of new investment in infrastructure, new developments, the adoption of new policies, or the provision of new services. Economic impacts can be classified as follows:

a) Positive impacts include job creation, increased business sales and value-added, enhanced quality of life, higher disposable income, and growth in government revenue from taxes and royalties.

b) Negative impacts encompass the loss of alternative livelihoods or business activities and adverse social and environmental externalities.

Economic Impact Assessment in mining activities involves evaluating how a specific project will affect the economic environment of the host area. This involves analysing potential changes in production output, Gross Value Added (GVA), and employment throughout the project's lifecycle. To assess these impacts, it is crucial to understand both the construction expenditures and operating costs once operations commence.

This chapter details the potential benefits and costs of the project by examining its proposed operations, community impacts, and environmental effects, in accordance with established policies and guidelines. Through a systematic evaluation of both costs and benefits, the CBA aims to determine whether the project represents a sound investment opportunity, considering its environmental and social impacts

10.2 Adopted Methods

Currently, Tanzania does not have a formal CBA framework for ESIA. As such, the CBA Guidelines provided by the Queensland Government – Department of Infrastructure and Planning - “Project Assurance Framework – Cost-benefit Analysis” (QG-DIP, 2011), have been adopted for this report.

The premise of the Project Assurance Framework is that, if the costs and benefits of a Project can be reasonably measured (including those that can be thought of as social and environmental), it is possible to gauge the impact of a Project on the economic welfare of a community (QG-DIP, 2011).

The Framework identifies the steps in the decision-making process of a CBA. These have been adapted for this report and include:

- Outcome identification;

i. Project viability evaluation through calculation of costs and benefits of the Project, including:

o Financial evaluation;

- Identification of stakeholders and determining the relative benefits and costs to various stakeholder groupings (stakeholder identification for this Project is provided in Chapter 5, and
- Analysis of the costs and benefits of the Project considering the social environment (e.g., education and health), ecological environment (e.g., habitats, flora, fauna, aquatic, air and water quality), and financial (i.e., if revenues will cover costs (on a cash basis) and if there will be a return on capital invested).

ii. Assessment of costs and benefits.

Aspects about the social environment, such as employment opportunities and social impacts of operation, have been incorporated into this analysis using a qualitative approach, due to the difficulty in quantifying all of the costs and benefits of this Project on the environment in monetary terms.

10.3 Desired Project Outcome

The desired outcome of the project is to develop a sustainable, safe, and cost-effective Soda Ash Production that supports Trona Extraction and Soda Ash Production Project while complying with national environmental regulations and international best practices. The facility aims to provide an alternative transport route that reduces reliance on road networks, thereby lowering environmental impacts, improving community safety, and minimizing infrastructure degradation. At the same time, the project seeks to generate socio-economic benefits through job creation, local procurement, and regional economic growth, while safeguarding Lake Natron's ecological integrity and aligning with Tanzania's development priorities.

10.4 Economic Overview

10.4.1 Brief Economic Overview of Tanzania

a) Real Gross Domestic Product (GDP)

Tanzania's GDP growth accelerated to 5.6% in 2024, up from 5.1% in 2023, driven by strong performance in key sectors such as services, tourism, and telecommunications, along with sustained expansion in the industry and construction sectors, supported by ongoing infrastructure investments.

The economy is projected to grow further by 6.0% in 2025, underpinned by continued government investment in infrastructure and improved performance in the tourism sector. Between 2025 and 2029, Tanzania's GDP growth is forecast to average 6.3% annually, reaching 6.5% in 2029. This robust outlook is supported by growth in intra-regional trade, rising Foreign Direct Investment (FDI), continued momentum in key sectors such as tourism and mining, and persistent government-led infrastructure development. (Figure 10.1)

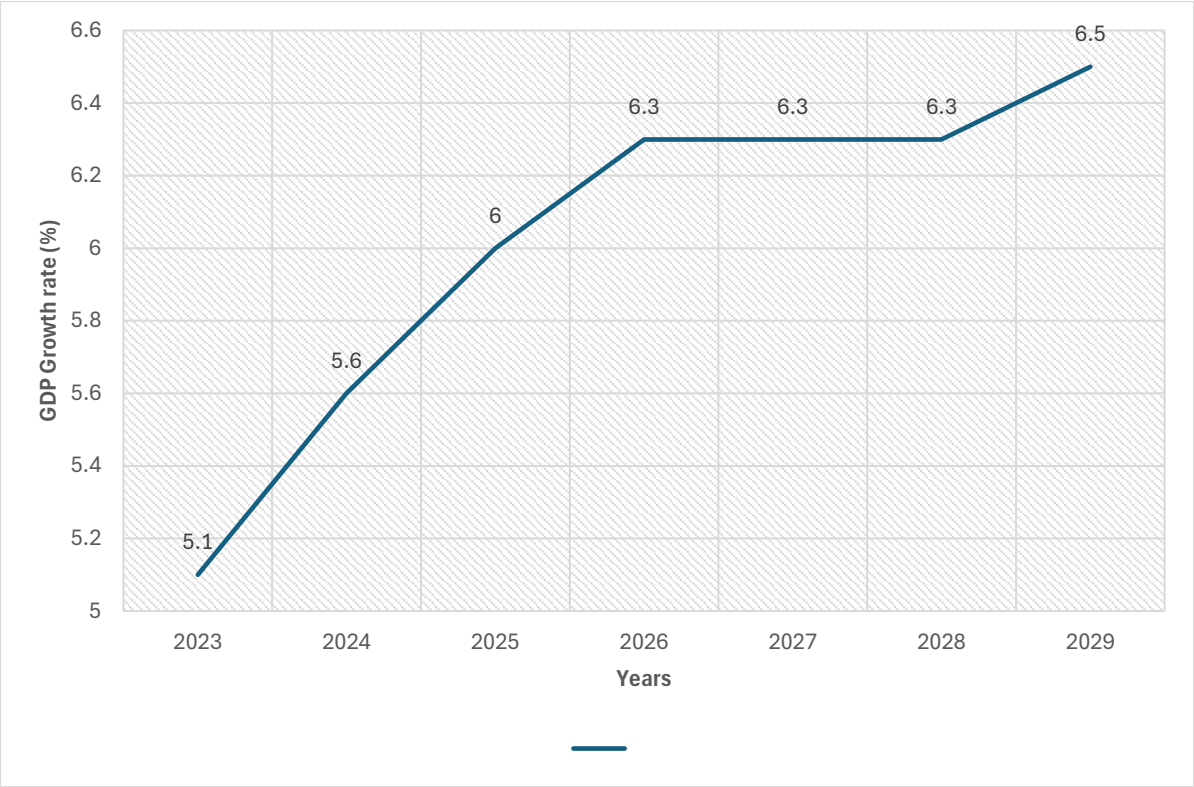

Figure 10.1: Tanzania Real GDP Growth Forecast, 2023-2029

(Source: Deloitte Budget Analysis Report, 2025)

b) Sector Growth

In 2025, the agriculture sector is projected to grow by 3.6%, slightly down from 3.9% in 2024. This decline is attributed to rising production costs and anticipated climate variability. However, the government is expected to continue supporting agricultural productivity through fertilizer subsidies, the provision of certified seeds, and the expansion of irrigation infrastructure.

The industry sector is expected to grow by 5.1% in 2025, a slight decline from 5.2% in 2024, supported by ongoing investments in strategic infrastructure projects.

Meanwhile, the services sector is forecast to expand by 7.9% in 2025, up from 6.9% in 2024, driven by robust growth in finance and insurance, information and communication technology (ICT), trade, and tourism. (Figure 10.2).

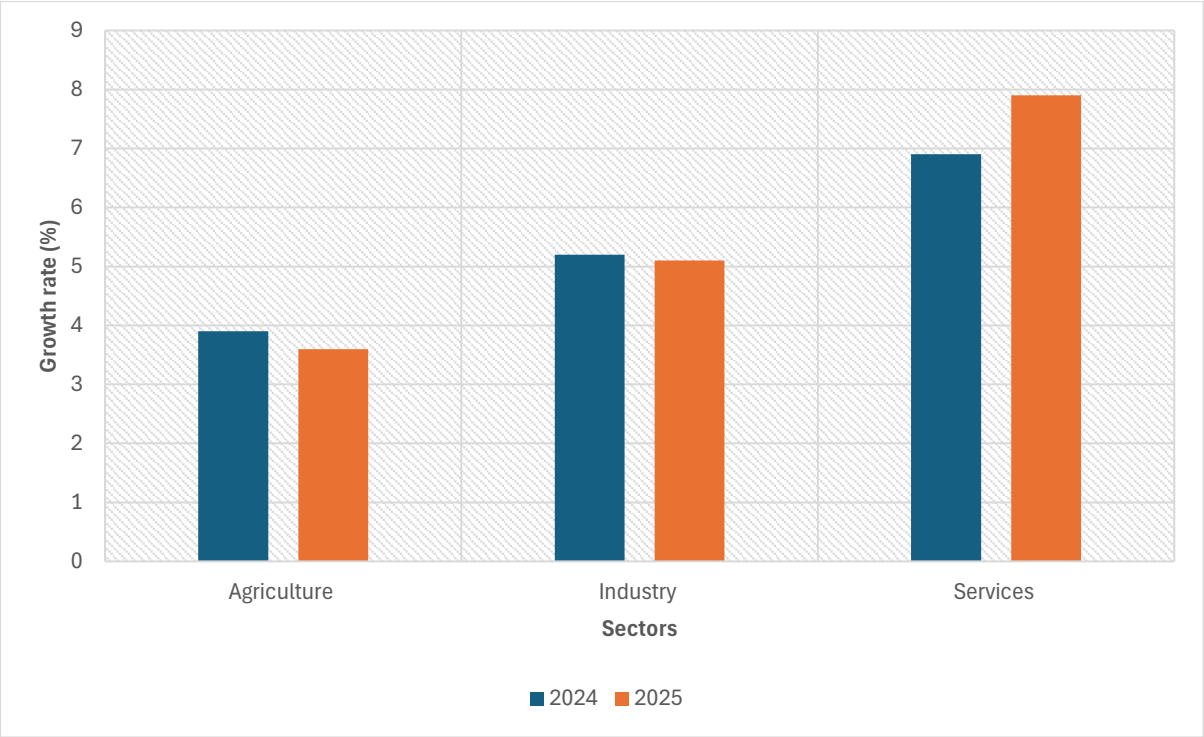

Figure 10.2: Sector Growth Forecast 2024 vs 2025

(Source: European Intelligent unit, Delloite Budget Analysis Report 2025)

c) Inflation and Interest Rates

Tanzania's inflation rate is projected to rise slightly to 3.4% in 2025, up from 3.1% in 2024, largely as a result of the sharp 9.0% depreciation of the Tanzanian Shilling (TZS) against the US dollar in 2024. This currency depreciation is expected to exert upward pressure on consumer prices, given the country's heavy reliance on imported goods, particularly oil.

To manage inflationary pressures arising from higher import costs, the Bank of Tanzania (BoT) is expected to maintain the policy rate at 6.0% throughout most of 2025. However, declining global commodity prices, including those of crude and refined oil, could ease inflationary pressures and create room for the BoT to implement a rate cut to 5.5% by the fourth quarter of 2025. (Figure 10.3).

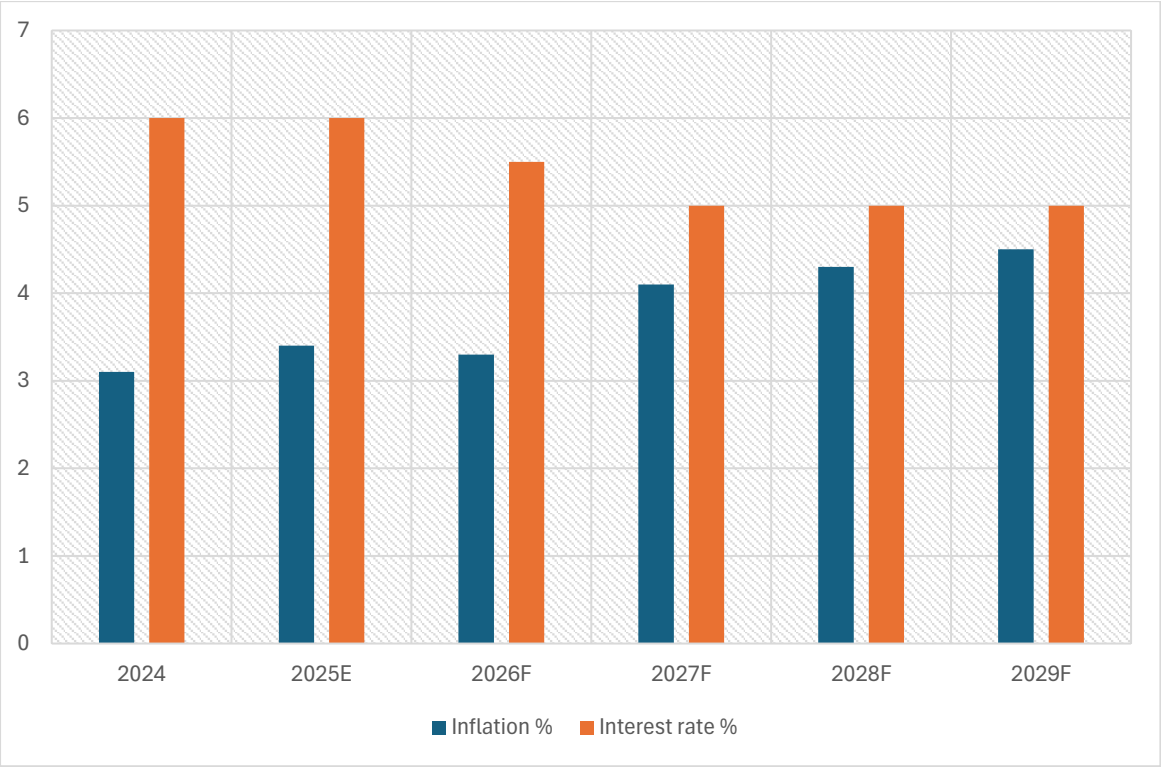

Figure 10.3: Inflation and Interest Rates

(Source: BoT, 2025)

d) Foreign Exchange and Foreign Reserves

In 2024, the Tanzanian Shilling (TZS) depreciated by 9.0% against the US dollar, the steepest annual decline since 2016. This sharp depreciation occurred primarily in the first half of the year, driven by unprecedented demand for US dollars due to increased imports outpacing exports, which widened the current account deficit.

However, the Shilling regained relative stability in the second half of 2024, following a combination of government interventions and notable improvements in the current account balance.

Looking ahead to 2025, the Shilling is expected to depreciate at a slower rate of 3.7%, supported by continued efforts to stabilize the external sector. This moderate depreciation will be influenced by the projected current account deficit of 3.2% of GDP and election-related speculative volatility. Nevertheless, Tanzania is anticipated to maintain adequate foreign exchange reserves, sufficient to cover approximately four months of imports in 2025 (Figure 10.4).

Figure 10.4: Tanzania Foreign Exchange and Foreign Reserves

(Source: European Intelligent unit, Delloite Budget Analysis Report 2025)

e) Debt Sustainability and Performance

As of April 2025, Tanzania's total public debt stood at TSh 107.70 trillion, comprising TSh 72.94 trillion (68%) in external debt and TSh 34.76 trillion (32%) in domestic debt. According to the Debt Sustainability Analysis (DSA) conducted in October 2024, the debt remains sustainable across the short, medium, and long term. The present value (PV) of total public debt to GDP was 40.3%, well below the international threshold of 55%. Similarly, the PV of external debt to GDP was 23.6%, while the PV of external debt to exports stood at 123.8%, both within acceptable limits. Credit rating agencies have reaffirmed Tanzania's fiscal credibility, with Moody's maintaining a B1 rating and Fitch assigning a B+ rating, both with stable outlooks. These ratings reflect strong macroeconomic management, robust economic growth, and prudent fiscal policies. The government remains committed to strengthening domestic revenue collection, improving the efficiency of public investment, and allocating commercial loans to projects with high economic returns. Projections indicate a gradual decline in the PV of debt-to-GDP ratio from 40.3% in 2024/25 to around 36-37% by 2028/29. Additionally, the current account deficit narrowed to 2.7% of GDP in 2024, supported by increased tourism earnings and commodity exports, while foreign reserves remain sufficient to cover about four months of imports. Overall, Tanzania's debt position is considered sustainable and well-managed.

f) Budget Overview

Tanzania's 2025/26 budget amounts to TSh 56.49 trillion (approximately USD 22 billion), representing a 12–13% increase from the previous year. Revenue mobilization is a key focus, with TSh 40.47 trillion expected from domestic sources including TSh 32.3 trillion in tax revenue, TSh 6.5 trillion in non-tax revenue, and TSh 1.7 trillion from local government authorities equivalent to 16.7% of GDP. The budget also anticipates TSh 14.95 trillion from borrowing, split between TSh 6.27 trillion in domestic borrowing and TSh 8.68 trillion in external loans, alongside TSh 1.07 trillion in grants.

On the expenditure side, 69% is allocated to recurrent spending, including TSh 9.17 trillion for salaries and pensions, TSh 5.58 trillion for goods and services, and TSh 6.49 trillion for interest payments. Development spending accounts for 31% of the budget (approximately TSh 17.5 trillion), with significant allocations to major infrastructure projects such as the Standard Gauge

Railway, the Julius Nyerere Hydropower Project, rural electrification, and preparations for AFCON 2027. Key sectors such as energy, agriculture, and water are also prioritized.

Macroeconomic targets underpinning the budget include a projected real GDP growth rate of 6.0%, single-digit inflation (3–5%), domestic revenue rising to 16.7% of GDP, and a budget deficit of 3.0% of GDP. Foreign exchange reserves are expected to cover at least four months of imports.

Reforms in the budget include tax exemptions (e.g., fertilizers, cooking gas, and textiles), digitalization of tax systems, and implementation of the Second Blueprint for Regulatory Reforms. These measures aim to promote inclusive economic transformation, enhance transparency, and maintain fiscal discipline ahead of the general elections.

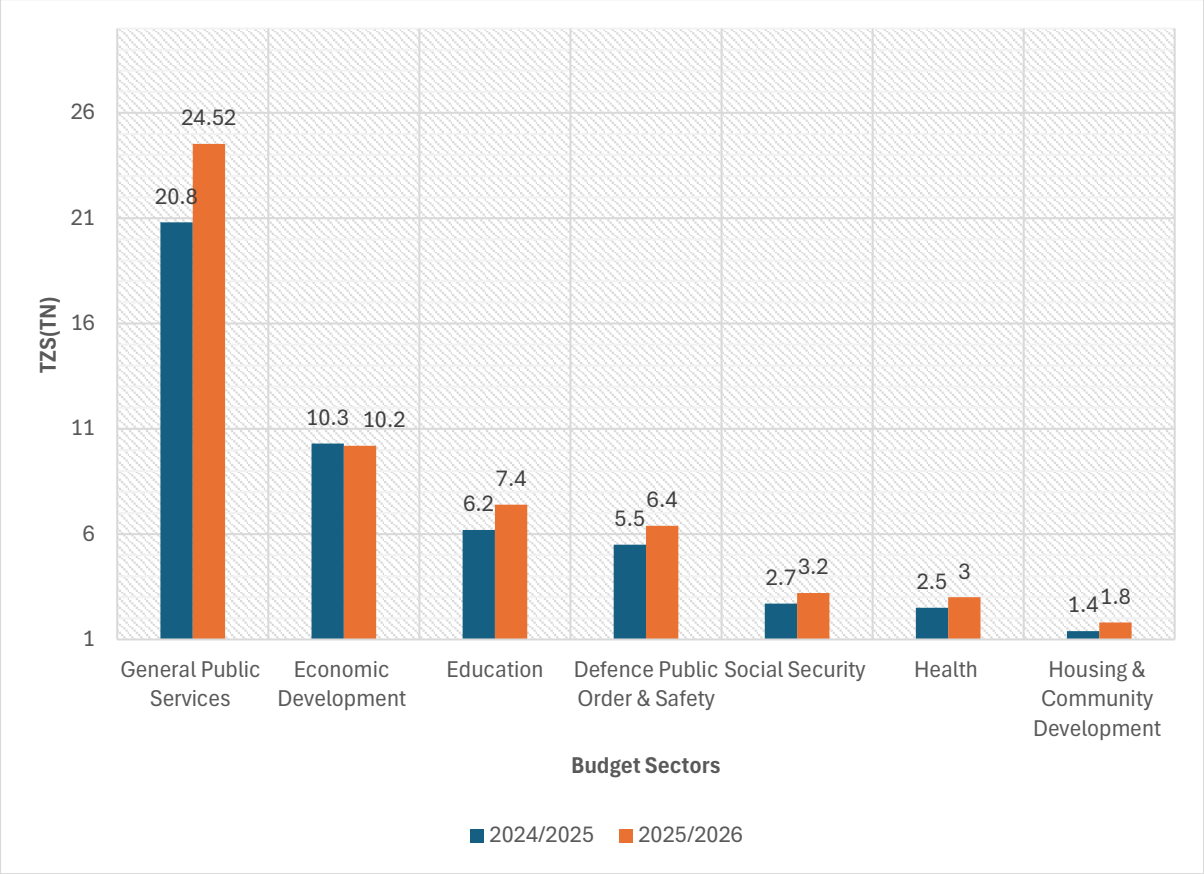

Figure 10.5: Budget allocation by Sector (TZS Millions)

(*Source: Tanzania Ministry of Finance & Planning - Budget Books 2024/2025 and 2025/2026)*

g) Revenue Collection

Between 2020/21 and 2023/24, Tanzania significantly enhanced its domestic revenue mobilization. Monthly average collections rose from TSh 1.72 trillion (TSh 20.59 trillion annually) in 2020/21 to TSh 2.49 trillion (TSh 29.83 trillion annually) in 2023/24. Continuing this upward momentum, in the 2024/25 fiscal year (July–May), the government collected TSh 45.07 trillion, equivalent to 89.6% of the TSh 50.29 trillion annual revenue target. This achievement was driven by the Tanzania Revenue Authority (TRA) which achieved TSh 26.86 trillion, or 91.3% of its target along with strong performance in non-tax and local government revenues (Figure 10.6).

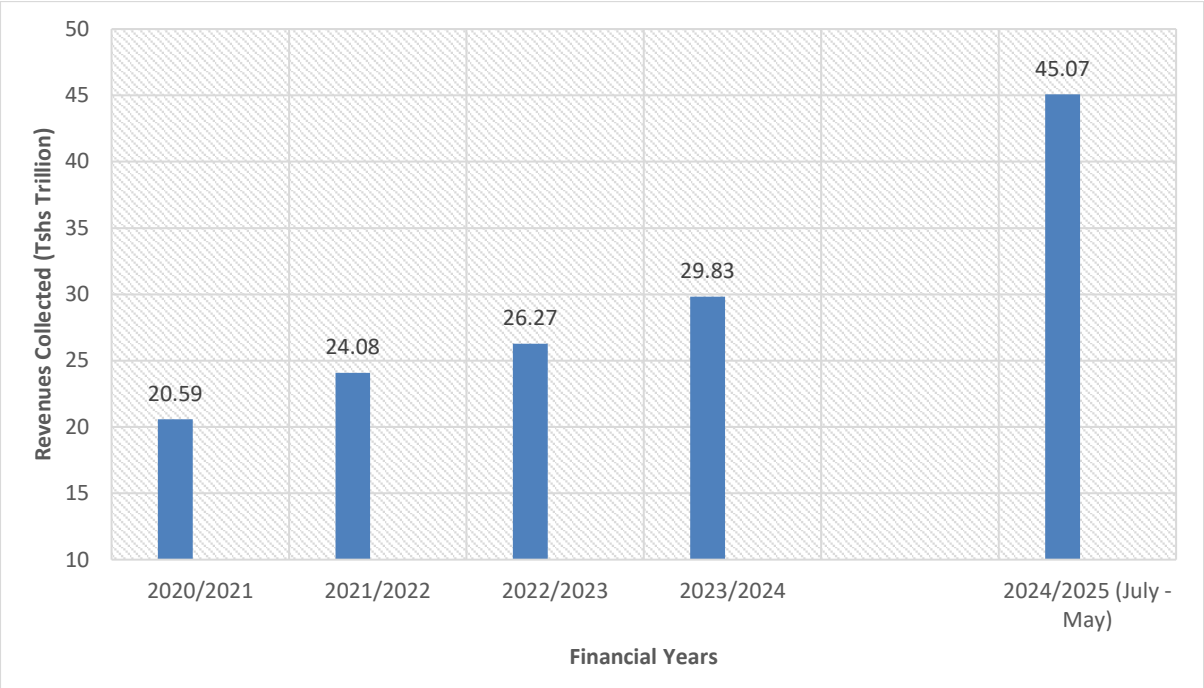

Figure 10.6: Trend in actual revenue Collections in Tanzania (2020/2021 – 2024/2025)

(Source: Tanzania Revenue Authority tax collection statistics, 2025)

10.4.2 Brief Economic Overview of Arusha Region

Arusha Region, located in northern Tanzania, is among the country's most economically vibrant regions and serves as a gateway to major tourist destinations such as the Serengeti National Park, Ngorongoro Conservation Area, Lake Manyara, Tarangire National Park, and Mount Meru. It is also close to Mount Kilimanjaro, further strengthening its status as a major tourism and commercial hub. The region benefits from its strategic location within the East African Community (EAC), facilitating cross-border trade with Kenya and positioning Arusha as a regional centre for business, diplomacy, and conferences.

Agriculture is the backbone of Arusha's economy, employing the majority of the population in both rural and peri-urban areas. Major crops include maize, beans, coffee, bananas, potatoes, wheat, and horticultural crops such as vegetables and flowers. The region is one of the leading horticultural producers in Tanzania, with large-scale flower farms exporting to Europe and other international markets. Irrigated farming is practiced in some parts, particularly in Arumeru, Monduli, and Karatu districts, which boosts productivity. However, smallholder farmers still face challenges such as limited access to credit, modern technology, and reliable markets.

Livestock keeping is another key economic activity, especially among pastoralist communities such as the Maasai, Barbaig, and Waarusha. Cattle, goats, and sheep are the main livestock types reared, contributing to household income and food security through the sale of milk, meat, and hides. The region has great potential for livestock-based industries such as meat processing, dairy production, and leather manufacturing. However, periodic droughts and conflicts over grazing land between pastoralists and farmers remain significant challenges.

Tourism is one of the largest sources of income in Arusha Region, making it a central pillar of the local economy. The region serves as Tanzania's "Safari Capital," hosting numerous international tour operators, hotels, and travel agencies. Visitors use Arusha as the starting point for northern circuit safaris, which include world-renowned attractions like Serengeti

National Park, Ngorongoro Crater, and Lake Manyara. In addition to wildlife tourism, cultural tourism is gaining popularity, with visitors engaging in Maasai cultural experiences, local crafts, and traditional dances. Arusha also attracts significant conference and business tourism due to facilities like the Arusha International Conference Centre (AICC), and the presence of international institutions such as the East African Community (EAC) Secretariat and the African Court on Human and Peoples' Rights. The tourism industry provides employment to thousands of residents in hotels, transport, guiding, handicrafts, and other related services.

Employment in Arusha Region is primarily concentrated in the agricultural sector, followed by tourism, trade, and public services. The private sector, particularly in tourism, horticulture, and trade, provides substantial job opportunities, though many of them are seasonal or informal. The hospitality and tour industries employ large numbers of youth, while others are engaged in small-scale enterprises such as tailoring, carpentry, and food vending. The public sector, on the other hand, employs people in education, health, local government, and administration. Despite the diverse economic activities, unemployment and underemployment remain challenges, especially among young people and recent graduates. Skill mismatches between education and market demands also limit employment opportunities in both sectors.

Overall, Arusha Region's economy remains dynamic and continues to grow, driven by agriculture, livestock, tourism, and cross-border trade. Continued investment in infrastructure, education, and market linkages will further strengthen its economic resilience and employment base.

10.4.3 Brief Economic Overview of Longido and Ngorongoro District

a) Longido District

Longido District, located in the northern part of Arusha Region along the Tanzania-Kenya border, is strategically positioned along the Arusha-Namanga highway an important corridor for trade, tourism, and regional integration within the East African Community (EAC). The district's economy is broad and diverse, driven mainly by livestock keeping, small-scale farming, tourism, mining, and cross-border trade. Despite its semi-arid climate, Longido continues to demonstrate significant economic potential due to its natural resources, cultural heritage, and proximity to major transport and tourism networks.

Livestock keeping forms the backbone of Longido's economy and is deeply rooted in the lifestyle of the Maasai community, who constitute the majority of the population. Cattle, goats, and sheep are reared for both subsistence and commercial purposes, providing income through the sale of animals and livestock products such as meat, milk, and hides. Donkeys are also widely used for fetching water and transporting goods such as crops and food, especially in rural areas where other means of transport are limited. Livestock markets in Longido and Namanga towns serve as key trading hubs for both local and cross-border sales, contributing significantly to household livelihoods and the district's overall economy.

Farming, though practiced on a smaller scale, provides supplementary income and food for households. Crops such as maize, beans, and pigeon peas are commonly grown, especially in areas with relatively favourable and water availability. Due to the region's arid nature, irrigation farming and the use of drought-tolerant crop varieties are being promoted to enhance food security and productivity.

Tourism is one of the fastest-growing sectors in Longido District, supported by its unique blend of natural, cultural, and wildlife attractions. The district is home to Lake Natron, one of the most spectacular and ecologically important soda lakes in East Africa. The lake's striking reddish-

pink hue, created by mineral-rich alkaline waters, makes it a natural wonder and the primary breeding site for lesser flamingos. The surrounding landscape dominated by the active volcano Oldonyo Lengai ("Mountain of God") offers breathtaking scenery that attracts adventure seekers, nature lovers, and geologists from around the world. Mount Longido, another prominent feature, provides opportunities for eco-tourism and hiking. Climbers can ascend its slopes for panoramic views of Mount Kilimanjaro, the Great Rift Valley, and Amboseli National Park in neighbouring Kenya. Beyond natural attractions, Longido also offers rich cultural tourism, particularly through Maasai cultural experiences such as homestays, traditional dances, and handicraft exhibitions. Community-based tourism initiatives have been established to ensure that local people directly benefit from visitors through guiding services, accommodation, and local enterprises. Additionally, Longido District hosts several wildlife hunting blocks, which contribute to both the local and national economy through regulated trophy hunting and conservation fees. These hunting blocks are primarily located in remote areas with significant wildlife populations, including species such as buffalo, zebra, eland, and various antelope species. The government licenses these blocks to private operators under strict conservation guidelines, ensuring that hunting remains sustainable and supports wildlife management. Revenues generated from hunting blocks contribute to district development funds and community projects, such as education and water infrastructure.

Mining also plays a significant role in Longido's local economy. The district is endowed with gemstones, including rubies and other semi-precious stones found in the Longido hills and surrounding areas. Mining is mostly artisanal and small-scale, providing alternative livelihoods for many youth and low-income households. Despite its potential, the sector faces challenges such as limited technology, poor safety conditions, and environmental degradation. The government continues to encourage formalization and sustainable practices within the small-scale mining industry to enhance revenue collection and community benefits.

Employment in Longido District is largely informal, with the majority of residents engaged in pastoralism, small-scale agriculture, trade, mining, and tourism-related services. The private sector is steadily expanding, particularly in areas such as hospitality, gemstone trading, and cross-border commerce. The public sector, meanwhile, provides employment in education, health, and administrative roles. Despite these opportunities, unemployment remains high, particularly among youth, due to limited vocational training and access to capital. Expanding training programs and promoting entrepreneurship could help bridge this gap and enhance local employment.

The Arusha- Namanga highway and Namanga border post make Longido an important trade corridor between Tanzania and Kenya. Livestock, food crops, textiles, and household goods are commonly traded commodities. This cross-border commerce supports many small traders and contributes significantly to local revenue collection. Infrastructure improvements in roads, markets, and communication networks have enhanced mobility and economic integration.

Generally, Longido District's economy is driven by livestock keeping, tourism, mining, and cross-border trade. The district's natural attractions particularly Lake Natron, Oldonyo Lengai, and the wildlife hunting blocks position it as a unique and growing tourism destination.

b) Ngorongoro District

Ngorongoro District, located in the northern part of Arusha Region, is one of Tanzania's most unique and economically significant districts due to its combination of rich wildlife resources, cultural heritage, and pastoralist traditions. The district forms part of the larger Ngorongoro Conservation Area (NCA), a UNESCO World Heritage Site renowned globally for its

biodiversity and archaeological importance. The district borders Kenya to the north and is characterized by diverse landscapes, including highlands, savannahs, and semi-arid plains. Its economy is largely based on livestock keeping, tourism, small-scale farming, and cross-border trade

Livestock keeping is the dominant economic activity in Ngorongoro District and forms the foundation of the Maasai community's livelihood, which constitutes the majority of the population. Cattle, goats, and sheep are reared for both household consumption and commercial purposes. Livestock serves as a source of income, food, and social status among the Maasai. Donkeys play a vital role in daily life, being used for fetching water and transporting goods such as crops and food across long distances in the dry and rugged terrain. Major livestock markets are found in Wasso, Loliondo, and Sale, where animals are traded locally and across the border with Kenya.

Farming is practiced on a small scale due to the district's fragile ecosystem and conservation restrictions. Crops grown include maize, beans, wheat, and vegetables, mainly in areas outside the conservation zone such as Loliondo and Sale divisions. Irrigation is limited, and most agriculture depends on seasonal rainfall. Soil erosion and human-wildlife conflicts also pose challenges to farming activities. Nonetheless, small-scale farming remains an important supplementary source of food and income for households.

Tourism is the leading source of revenue in Ngorongoro District and a major contributor to the national economy. The district is home to the Ngorongoro Conservation Area (NCA), which encompasses the world-famous Ngorongoro Crater-a natural wonder and one of Africa's most visited wildlife destinations. The crater hosts an incredible variety of wildlife, including elephants, lions, rhinos, and numerous bird species. Beyond the crater, the conservation area includes other iconic sites such as Olduvai Gorge, known as the "Cradle of Mankind" for its archaeological discoveries of early human fossils by Dr. Louis and Mary Leakey. Tourism in Ngorongoro also extends to Lake Natron, located on the eastern edge of the district. The lake is a vital breeding ground for lesser flamingos and a striking natural attraction for eco-tourists. Visitors are also drawn to the active volcano Ol Doinyo Lengai, revered by the Maasai as the "Mountain of God." In addition to wildlife and nature-based tourism, cultural tourism plays a significant role, offering visitors opportunities to interact with Maasai communities, learn about traditional pastoral lifestyles, and purchase handmade crafts. Ngorongoro District also contains several hunting blocks, particularly in the Loliondo Game Controlled Area. These areas are designated for regulated trophy hunting under strict government supervision, contributing to conservation funding and community development initiatives. Revenues from hunting blocks and photographic tourism support local infrastructure, education, and health services

Employment in Ngorongoro District is predominantly informal, with most residents depending on pastoralism, small-scale farming, and tourism-related services. The private sector provides employment in hotels, lodges, tour operations, and guiding services, especially in and around the Ngorongoro Conservation Area. The public sector employs people in education, health, and local government administration.

Ngorongoro's proximity to Kenya facilitates active cross-border trade, particularly in livestock and consumer goods. The Wasso and Loliondo areas serve as major trading centers for both Tanzanian and Kenyan traders.

Overall, Ngorongoro District's economy is anchored in livestock, tourism, and cross-border trade, with significant potential for further growth in cultural and eco-tourism. The district's

global reputation as a conservation and heritage site offers vast opportunities for sustainable development.

10.5 Stakeholders to the Project

Chapter 5 of this report identified the stakeholders relevant to the proposed Project and outlined their perspectives. This section presents an analysis of the anticipated costs and benefits of the Project for each stakeholder group

10.5.1 National Level Stakeholders

At the national level, the key stakeholders primarily consist of government institutions, including the Ministry of Minerals; Vice President's Office (Department of Environment and NEMC); Ministry of Finance and Planning; Ministry of Health, Community Development, Gender, Elderly and Children; Occupational Safety and Health Authority (OSHA); Ministry of Community Development, Women and Children Affairs; and others. Some of these institutions play a direct regulatory role in relation to the Project for instance, the vice president office, division of Environment and NEMC, others such as the Ministry of Finance and Planning (through the Tanzania Revenue Authority), are primarily responsible for collecting revenue and benefits accruing from the Project.

The Ministry of Minerals serves a dual role, both regulating mining resource management and overseeing the collection of revenue generated from those resources, such as royalties. Additionally, the Forestry and Beekeeping Division within the Ministry of Natural Resources and Tourism is tasked with ensuring that appropriate fees are collected for vegetation clearance during construction. The Tanzania National Parks Authority (TANAPA) oversees the management and development of all national parks in the country, ensuring the conservation of biodiversity and the promotion of sustainable tourism. The Ngorongoro Conservation Area Authority (NCAA) manages and conserves the Ngorongoro Conservation Area, ensuring the sustainable use of its natural and cultural resources while guiding development initiatives to prevent negative impacts on wildlife, ecosystems, and cultural heritage. Similarly, the Tanzania Wildlife Research Institute (TAWIRI) conducts wildlife research, monitors biodiversity, and provides scientific advice to support conservation efforts and ensure that development projects align with environmental sustainability objectives.

Other national institutions including the Ministry of Health, Community Development, Gender, Elderly and Children; Ministry of Water and Irrigation (via the Lake Victoria Basin Water Board); Government Chemist Laboratory Authority; Tanzania Bureau of Standards; and OSHA are responsible for regulating and monitoring Project activities to ensure they do not adversely affect the health and safety of workers and surrounding communities. These institutions play a critical role in minimizing the social costs associated with the Project. Similarly, NEMC, through the enforcement of the Environmental Management Act, CAP 191 (R.E: 2023), plays a key role in mitigating the Project's environmental impacts and ensuring compliance with national environmental standards.

10.5.2 District Level Stakeholders

At the district level, stakeholders include institutions responsible for managing and monitoring the environmental and social impacts associated with the Project. The District Commissioner (DC) is tasked with ensuring that the implementation of the Project does not compromise public safety, peace, or social cohesion. The District Executive Director (DED) of Longido and Ngorongoro District plays a critical oversight role. The council host technical experts in key areas such as forestry, environment, community development, and water, who are responsible

for ensuring that the Project is implemented in accordance with applicable standards, regulations, and local by-laws.

Furthermore, the Environmental Management Act, CAP 191 (R.E: 2023), mandates District Environmental Officers to monitor and enforce environmental compliance at the local level, thereby safeguarding the environment from potential adverse impacts.

Community development initiatives to be undertaken by the Project proponent, in line with its future Corporate Social Responsibility (CSR) commitments, will be developed and implemented in collaboration with the offices of DC and DED. This collaborative approach is intended to maximize the benefits to local communities directly or indirectly affected by Project activities. Active participation in both the design and management of these programmes will help ensure that the Project contributes meaningfully to the sustainable development of the respective districts.

10.5.3 Local Level Stakeholders

The proposed Project is located on the peripheries of Wosiwosi, Matale B, Magadini, Pinyinyi, Ngaresero and Alailai villages, all situated within Gelai Lumbwa and Pinyinyi Wards. Within the Project area, the villages of Wosiwosi and Matale B fall under the Mining License boundary, with the majority of the Project site situated in Wosiwosi village. Given this, it is appropriate that residents of these communities particularly those from Wosiwosi are prioritized to benefit from the Project, including through Corporate Social Responsibility (CSR) programs and other community development initiatives.

10.6 Project Viability Evaluation

10.6.1 Financial Analysis

a) Ecosystem Services

Assessing the Financial and Economic implications of the Trona Extraction and Soda Production project is a crucial component for the Cost–Benefit Analysis (CBA). This evaluation considers both the internal viewpoint of the project proponent and the wider perspective encompassing the community, government, and national economy.

The financial costs and benefits of the Project are presented in Table 10.1.

Table 10.1: Summary of Financial Cost and Benefits

Parameter	Total (US$)
Capital Expenditure	
Capital expenditure (US$ M) – ((US$ M) (including Contingency)	172,458,948.50
1. Direct Site Costs (US $ M)	93,019,131.00
2. Indirect Costs (US $ M)	68,175,683.00
3. Contingency (US $ M)	11,321,096.00
Operating Costs	
1. Operating cost (USD M/year)	10,056,962.00
2. General & Administration Costs (US$ M/year)	1,911,520.00

(Source: WWSL, 2025)

The Financial Analysis indicates that the proposed project is anticipated to be a sound and viable investment. Beyond the direct financial returns, the project is anticipated to deliver substantial socio-economic benefits through job creation, local procurement opportunities, and increased government revenue from taxes and royalties. In summary, the long-term economic,

social, and operational advantages outweigh the associated costs, affirming that the proposed project constitutes a vital and sustainable infrastructure investment.

10.6.2 Environmental Analysis

While financial costs and benefits determine a project's profitability, they often fail to account for the broader impacts on local communities and the environment. Recognizing the intrinsic value of natural ecosystems is vital for informed decision-making that integrates both environmental and social considerations. Ecosystems are dynamic systems composed of interactions among plants, animals, microorganisms, and their physical surroundings, with humans forming an essential component of these interconnected systems.

Ecosystem services represent the diverse benefits that people obtain from nature. These include direct services such as the provision of food, water, fuelwood, and medicinal resources, as well as cultural services encompassing spiritual, recreational, and heritage values. In addition, ecosystems provide indirect benefits through regulating services—such as flood control, climate regulation, and disease mitigation—and supporting services like nutrient cycling, which underpin all forms of life on Earth.

Valuing ecosystem services can be achieved by using two complementary frameworks. These are:

- **Millennium Ecosystem Assessment (MEA) 2007**: widely accepted framework for categorizing all ecosystem services. Table 11.2 provides examples of the different types of ecosystem services within the four broad categories of ecosystem services.
- **Total economic value framework (TEV) (Brander et al., 2010):** methodology used to value changes in ecosystem services. Determine the use and non-use values that individuals or society gains or losses from marginal changes in ecosystem services.

Table 10.2: Millennium Assessment Ecosystem Service Categories

Category	Description	Examples of ecosystem services provided
Provisioning services	Products obtained from ecosystems	• Food (e.g., crops, fruit, fish) • Fuel and fiber (e.g., timber, rope, and firewood). • Biochemical, natural medicines, and pharmaceuticals.
Regulating services	Benefits obtained from the regulation of ecosystem processes	• Climate regulation: e.g., land cover can affect local temperature and precipitation globally; ecosystems affect greenhouse gas sequestration and emissions. • Water regulation: ecosystems can affect the timing and magnitude of runoff, flooding, etc. • Erosion control: vegetative cover plays an important role in soil retention/prevention of land/asset erosion. • Water purification/detoxification: ecosystems can be a source of water impurities but can also help to filter out/ decompose organic waste. • Natural hazard protection: e.g., from storms, floods, landslides. • Bioremediation of waste: i.e., removal of pollutants through storage, dilution, transformation, and burial.
Cultural services	Non-material benefits that people obtain through spiritual enrichment, cognitive development, recreation, etc.	• Spiritual and religious values: many religions attach spiritual and religious values to ecosystems. • Inspiration for art, folklore, architecture etc. • Social relations: ecosystems affect the types of social relations that are established e.g., fishing societies. • Aesthetic values: many people find beauty in various aspects of ecosystems. • Cultural heritage values: many societies place high value on the maintenance of important landscapes or species. • Recreation and ecotourism.
Supporting services	Necessary to produce all other ecosystem services	• Soil formation and retention. • Nutrient cycling. • Primary production. • Water cycling. • Production of atmospheric oxygen. • Provision of habitat.

(Source: Millennium Ecosystem Assessment 2007)

a) Total Economic Value Framework

Total Economic Value (TEV) is a concept in cost-benefit analysis that refers to the value derived by people from a natural resource, a man-made heritage resource or an infrastructure system, compared to not having it. The framework is summarized in Figure 10.7 and Table 10.3 gives a typology of those values (Brander et al., 2010).

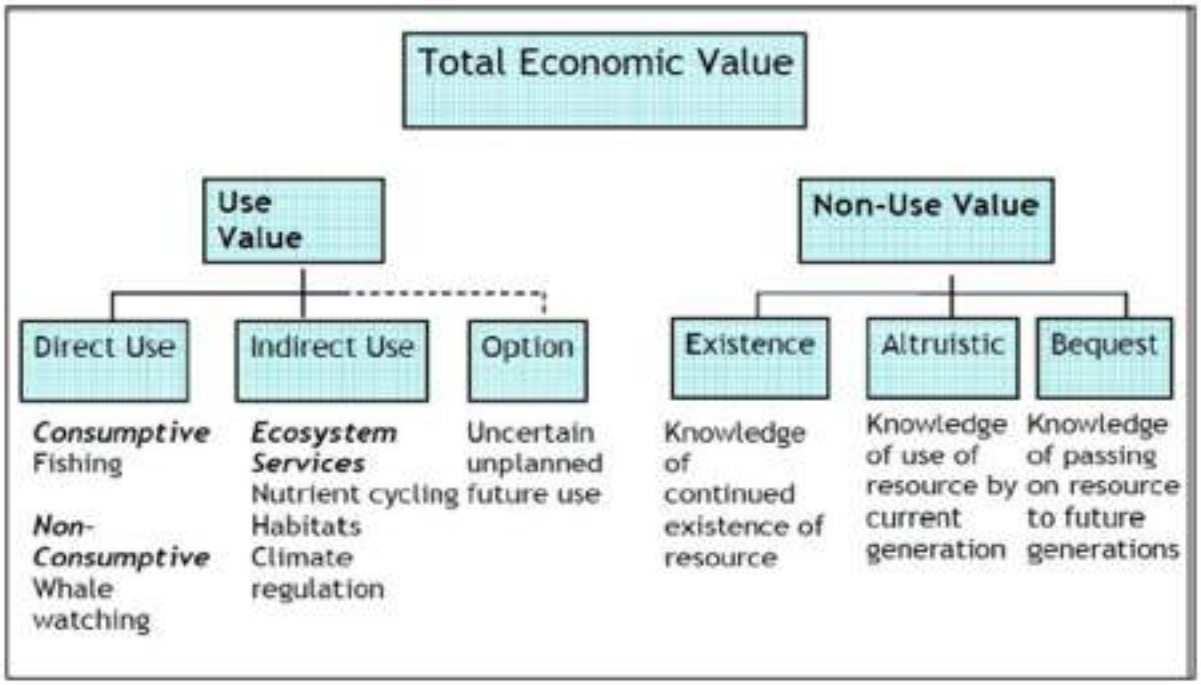

Figure 10.7: Total Economic Value Framework

(Source: Potts & Hastings, 2012)

Table 10.3: A Typology of Values

Value type	Value sub-type	Meaning
Use values	Direct use value	Results from direct human use of biodiversity (consumptive or non-consumptive).
Indirect use value	Derived from the regulation services provided by species and ecosystems	
Option value	This relates to the importance that people give to the future availability of ecosystem services for personal benefit (option value in a strict sense).	
Non-use values	Bequest value	Value is attached by individuals to the fact that future generations will also have access to the benefits of species and ecosystems (intergenerational equity concerns).
Altruist value	Value is attached by individuals to the fact that other people of the present generation have access to the benefits provided by species and ecosystems (intra-generational equity concerns).	
Existence value	Value is related to the satisfaction that individuals derive from the mere knowledge that species and ecosystems continue to exist.	

(Source: Brander et al., 2010)

The Millennium Ecosystem Assessment (MEA) and Total Economic Value (TEV) are complementary, and Table 10.4 shows how these two approaches can be combined to value ecosystem services.

Table 10.4: Valuing Ecosystem Services using the MA and TEV Frameworks

MA Framework		TEV Framework			
MA Group	**Service**	**Direct Use (D)**	**Indirect Use (I)**	**Option Value (O)**	**Non-use Value (N)**
Provisioning	• Food • Fibre • Fresh water supply • Land Use	P			
Regulating	• Air Quality • Climate • Water • Natural Hazard		P		
Cultural	• Cultural Heritage • Recreation • Tourism • Aesthetic	P			
Supporting	• Primary production • Nutrient cycling	Valued through the other ecosystem services categories			

(Source: Millennium Ecosystem Assessment 2007; Brander et al., 2010)

i. Ecotourism value of Lake Natron

Lake Natron has exceptional global ecological and tourism value. It is the only major breeding site in East Africa for the Lesser Flamingo, attracting birdwatchers, researchers, and eco-tourists from around the world. Its dramatic volcanic landscapes, cultural experiences with Maasai communities, and remote wilderness setting make it a niche but growing eco-tourism destination. Although current tourism revenues are relatively modest compared to mass tourism sites, its long-term potential is high, especially if conservation-based tourism is strengthened. Importantly, this value is non-replaceable, as the ecosystem supporting flamingo breeding is globally unique and highly sensitive.

10.7 Prediction of Costs and Benefits

10.7.1 Environmental Project Costs

The qualitative predictions of the Project's environmental costs related to ecosystem services, including both internal and external services within the Project area, are detailed in Table 10.5 below.

Table 10.5: Qualitative Cost Analysis on Key Ecosystems Services

Ecosystem Service Category	Ecosystem Service Role	Nature of Value				Predicted Cost Effect/ Value	Description
		D	I	O	N		
Regulating	Air Quality Maintenance	✓	✓	✓	✓	-	Dust emissions from excavation, material handling, and haulage, along with exhaust from processing plant operations, may degrade air quality, affecting nearby settlements, fauna, and vegetation. Air quality controls

Ecosystem Service Category	Ecosystem Service Role	Nature of Value				Predicted Cost Effect/ Value	Description
		D	I	O	N		
							and regular monitoring are required to minimize impacts.
	Water regulation (e.g., Groundwater & Hydrogeology)	✓		✓		-	Groundwater abstraction for processing and domestic use may alter local hydrogeological balance. Potential contamination risks exist from trona slurry leakage, process effluents, or chemical storage areas if not well managed.
	Water regulation (e.g., Surface water & Hydrology)		✓	✓		-	Alterations to surface runoff and drainage patterns may occur due to construction of evaporation ponds, roads, and processing facilities. Sediment and chemical runoff could affect nearby streams and the saline lake margin.
	Soil Regulation (e.g., Soil Quality and Topography)	✓	✓	✓		-	Site clearing, pond construction, and vehicle movement may cause soil erosion, compaction, and salinization. Loss of productive soils and reduced infiltration capacity are possible without adequate soil management.
	Terrestrial Biodiversity & Habitats		✓		✓	-	Vegetation clearance, habitat disturbance, and transportation along access roads may affect local terrestrial fauna and flora, altering species distribution and ecological functions. However, the impacts are expected to be localized.
	Aquatic Biodiversity & Habitats	✓	✓	✓	✓	-	Lake Natron is a critical ecosystem supporting flamingos, invertebrates, and aquatic plants. Water abstraction and altered water chemistry may affect ecological balance and nesting grounds, requiring strict ecological flow and salinity management.
Provisioning	Salt and Trona Resources	✓	✓	✓	✓	+	The Project will enhance national industrial mineral output through large-scale trona extraction, supporting local and national economies.
	Freshwater Resources	✓			✓	-	Abstraction of groundwater for processing may reduce water availability for community use and livestock if not sustainably managed.

Ecosystem Service Category	Ecosystem Service Role	Nature of Value				Predicted Cost Effect/ Value	Description
		D	I	O	N		
	Livestock Grazing Land	✓			✓	-	Project infrastructure may occupy or restrict access to grazing areas used by pastoral communities, potentially affecting livelihoods.
	Fisheries and Food Resources					0	The saline nature of Lake Natron limits fishing potential; thus, direct impacts on fisheries are negligible.
	Local Economic Opportunities					+	Employment generation, local procurement, and service opportunities will contribute to community income and local economic development.
Cultural	Aesthetic Value (e.g., Landscape and visual)		✓		✓	-	Industrial infrastructure and evaporation ponds may alter the visual landscape of the lake area, affecting its natural beauty and tourism appeal. Visual screening and aesthetic design can reduce this effect.
	Social Relations	✓			✓	0	Project-induced employment and infrastructure development may improve living standards but could also alter traditional social dynamics. Community engagement is essential.
	Tourism and Recreation		✓		✓	-	The Lake Natron ecosystem is a key tourism site. Landscape alteration and reduced wildlife visibility could affect tourism, though improved access roads may enhance visitation in some areas.
	Spiritual and Religious value	✓			✓	0	No significant interference with cultural or spiritual sites is anticipated; consultation with local communities will ensure protection of valued sites.
Supporting	Nutrient Cycling	Valued through the other categories					
	Soil Preservation						
	Water Cycling						
	Production of Atmospheric Oxygen						
	Provision of Habitat						
	Primary Production						

D – Direct Use
I – Indirect Use

O – Optional Value
N – Non-Use Value
+ Likely Positive Effect
- Likely Negative Effect
0 Likely no effect or insignificant
? Uncertain Effect

(Source: MTL Consulting, 2025)

The qualitative cost analysis of the Trona Extraction and Soda Ash Production Project reveals a spectrum of ecosystem service values, ranging from moderate adverse impacts to significant socio-economic benefits. Applying the combined Millennium Ecosystem Assessment (MA) and Total Economic Value (TEV) frameworks, the assessment indicates that while certain negative effects are anticipated, particularly on Air Quality, Water Regulation, Soil Stability, and Local Biodiversity, these impacts are largely localized and can be effectively mitigated through the implementation of robust environmental management and monitoring measures.

At the same time, the project is expected to generate substantial positive socio-economic outcomes, including employment creation, local business engagement, and increased government revenues through taxes and royalties. When managed sustainably, the long-term economic and social gains are likely to outweigh the short-term environmental costs. (Refer to Chapter 8 for details on mitigation measures.)

10.7.2 Assessment of the Costs and Benefits

This section presents the results of the cost-benefit analysis and incorporates the financial costs and benefits, and the environmental Project costs and benefits that will remain post-mitigation. The qualitative results are displayed in Table 10.6.

Table 10.6: Qualitative Cost and Benefits of the Trona Extraction and Soda Ash Production Project

Cost / Benefit	Cost / Benefit Bearer			Justification
	Prop[1]	Com[2]	Env[3]	
Capital and operating costs to implement the Project	–	+		**Tangible costs to the proponent:** • The total capital expenditure (US$ 172 million) will be required for Trona extraction development, processing plant construction, and supporting infrastructure (roads, evaporation ponds, housing). Operating costs are estimated at US$ 10 million annually.
Fiscal Revenues (Taxes, Royalties, and Fees)		+		• Tangible benefit to the government: Annual contributions from corporate tax, royalties, and fees are expected to generate significant fiscal revenue and enhance local and national economic growth.
Increased resource pressure due to in-migration		–	–	• **Tangible cost** to the community and environment: Project inducted immigration may strain local water, sanitation, education, and health services, as well as increase pressure on land and natural resources.

Cost / Benefit	Cost / Benefit Bearer			Justification
	Prop[1]	Com[2]	Env[3]	
Air Quality Deterioration and Emissions		–	–	• **Intangible cost** to the environment and community: Processing and transportation activities may lead to Dust, SO_2, and NO_x emissions, affecting local air quality and human health. Proper dust suppression, emission controls, and monitoring will minimize these impacts.
Loss of habitat		–	–	• **Intangible environmental cost**: Land clearing, and infrastructure may cause loss of terrestrial and aquatic habitats. Mitigation measures, including habitat restoration and buffer zones, will help maintain ecosystem integrity.
Water Resource Use and Potential Contamination		-	-	• **Tangible cost** to the community and environment: Groundwater abstraction and potential contamination from trona slurry leakage or effluents could impact water availability and quality for local users and ecosystems. Sustainable water management will be essential.
Decrease in visual amenity		-		• **Intangible social cost:** The industrial development may alter the scenic value of the Lake Natron area, affecting its aesthetic and tourism appeal. Landscape design and restoration can help minimize this impact.
Benefits to local stakeholders: • Employment of nationals and locals. • Increased training opportunities. • Increased local expenditure.		+		• **Tangible and intangible benefits to the community:** The project will generate direct and indirect employment opportunities during both construction and operation phases and enhance workforce skills through training programs.
Increased business linkages		+		• **Intangible benefit to the community:** Increased local demand for goods and services will stimulate business growth, strengthen supply chains, and promote local enterprise development.
Improved Infrastructure and Social Services		+		• **Tangible and intangible benefit:** Investment in roads, power, water, and social facilities will improve accessibility and service delivery, benefit both the project and surrounding communities.
Benefits to local, regional, and national stakeholders		+		• **Intangible benefit:** The project will promote industrial diversification in Tanzania's mineral sector, attract ancillary industries, and enhance the economic profile of the Lake Natron area.
Increased community identity.		+		• **Intangible benefit:** Project operations are expected to boost local markets and create

Cost / Benefit	Cost / Benefit Bearer			Justification
	Prop[1]	Com[2]	Env[3]	
				secondary employment in sectors such as transport, hospitality, and trade.
Corporate Social Responsibility (CSR) Contributions		+		• **Intangible benefit to the community:** The proponent's CSR initiatives will support education, health, and community development programs, enhancing local welfare and social cohesion.
Long-Term Environmental Stewardship			+	• **Intangible environmental benefit:** Implementation of rehabilitation and restoration programs post-closure will enhance ecosystem resilience and maintain natural resource productivity.

1. Proponent.
2. Community, which includes the community at the national and local scales, and the government and economy, because benefits to these will be filtered down to the community level.
3. Environment.
– Cost
+ Benefit

(Source: MTL Consulting, 2025)

10.7.3 Comparative Assessment of Long-Term Tourism Benefits versus Short-Term Mining Benefits

In addition to the direct financial and socio-economic benefits associated with the proposed Trona Extraction and Soda Ash Production Project, an independent comparative assessment was undertaken to evaluate the long-term sustainable economic value of tourism against the immediate high-impact revenues expected from mining activities within the Lake Natron ecosystem and the wider northern tourism circuit of Tanzania.

Northern Tanzania hosts some of the world's most significant tourism and conservation destinations, including Lake Manyara National Park, Arusha National Park, and the Ngorongoro Conservation Area. These protected areas collectively support Tanzania's tourism industry through wildlife-based tourism, cultural tourism, employment creation, foreign exchange earnings, ecosystem conservation financing, and associated business activities within the hospitality and transport sectors. The tourism sector contributes significantly to the national economy and provides long-term renewable income streams due to the continued ecological and cultural attractiveness of these conservation landscapes.

Lake Natron itself possesses substantial ecological and tourism value. The lake is internationally recognized as the primary breeding site for Lesser Flamingos in East Africa and forms part of a sensitive ecological system supporting migratory bird populations, wildlife habitats, and unique volcanic landscapes associated with Oldonyo Lengai. In addition to ecological tourism, the area supports cultural tourism through Maasai cultural heritage, traditional pastoralism, and community-based tourism initiatives. These tourism-related activities provide long-term livelihood opportunities for local communities and contribute to sustainable economic development within Longido and Ngorongoro Districts.

The proposed Trona Extraction and Soda Ash Production Project is anticipated to generate considerable short- to medium-term economic benefits through capital investment, taxes, royalties, employment opportunities, infrastructure development, and increased industrial

mineral production. The Project is expected to contribute positively to national economic growth and government revenue generation. However, unlike tourism and ecosystem services, mineral resources are finite and non-renewable in nature, meaning that the direct economic benefits associated with extraction activities are expected to decline following resource depletion and eventual mine closure.

From an environmental perspective, the Project may introduce risks to ecosystem integrity through habitat disturbance, alteration of hydrological systems, visual landscape changes, increased human activity, dust emissions, and potential impacts on aquatic ecology within the Lake Natron basin. Although mitigation measures have been proposed to minimize impacts, any significant ecological degradation affecting flamingo breeding habitats, wildlife movement, or landscape quality could reduce the long-term tourism attractiveness of the area and negatively affect conservation-dependent livelihoods and businesses.

The assessment further recognizes the transboundary significance of the Lake Natron ecosystem and the wider northern conservation landscape. Wildlife movements and regional tourism circuits extend beyond Tanzania into neighbouring Kenya, particularly through ecological linkages associated with the Serengeti–Maasai Mara ecosystem and cross-border tourism activities. Tourists visiting northern Tanzania frequently combine destinations within both countries, generating shared economic benefits through accommodation, transport services, tour operations, and conservation tourism. Consequently, ecological disturbance within the Lake Natron area has the potential to affect not only Tanzania's tourism economy but also regional tourism dynamics and biodiversity conservation efforts within Kenya.

A comparison between tourism and mining indicates that tourism provides long-term, renewable, and environmentally sustainable economic benefits when ecosystems are effectively protected and managed. These benefits include continuous employment opportunities, preservation of biodiversity, foreign exchange earnings, cultural heritage conservation, and sustained ecosystem services. In contrast, mining activities provide immediate and high-value economic returns but are associated with finite resource extraction and potential environmental externalities that may undermine long-term ecological sustainability if not carefully managed.

Overall, the comparative assessment concludes that while the proposed mining project offers important economic and industrial development benefits, the long-term sustainability of the Lake Natron ecosystem and the broader northern tourism circuit remains critical to maintaining renewable economic value, biodiversity conservation, cultural heritage, and transboundary tourism benefits. Therefore, strict environmental management, ecological monitoring, stakeholder engagement, and implementation of robust mitigation measures will be essential to ensure that mining activities do not compromise the long-term tourism and conservation value of the area.

10.8 Summary and Conclusions

The Cost-Benefit Analysis of the Trona Extraction and Soda Ash Production project indicates that the long-term economic, social, and operational benefits outweigh the potential costs and environmental impacts. Socio-economic benefits include direct and indirect employment opportunities, stimulation of local businesses, and contributions to government revenue through taxes and royalties. Environmental impacts, such as minor disturbance to aquatic habitats, temporary dust emissions, and localized visual changes, are expected to be manageable through mitigation measures. Overall, the analysis demonstrates that the

proposed project represents a sustainable and viable infrastructure investment that balances economic efficiency, social benefits, and environmental protection.

11 DECOMMISSIONING

11.1 Decommissioning Context

Decommissioning refers to the systematic process of ceasing operations, removing infrastructure, and restoring the environment to a condition that is safe, stable, and compatible with surrounding land uses. For the Lake Natron Soda Ash Project, decommissioning will be undertaken once mining, processing, or associated industrial activities become economically or environmentally unsustainable.

In line with Tanzanian and international standards, the project is required to undertake continuous site rehabilitation throughput its lifecycle and before the cessation of operation activities. A framework for decommissioning will be developed and submitted to the National Environmental Management Council (NEMC) under the Environmental Management Act, CAP 191 R.E 2023 section 102, and the EIA and Audit Regulations of 2005 and its last amendments of 2024, specific sections, including:

- Regulation 6, sub-section (c)
- Regulation 18, sub-section 2 (a)
- Amendment of 2018, regulation 8, sub-section 1 (c)

These regulations mandate the preparation of a decommissioning plan as part of the Environmental Impact Assessment Report.

11.2 Tanzania Legal Framework

11.2.1 Relevant Tanzanian Legislation

a) Environmental Management Act, CAP 191 R.E 2023

Section 102 requires that safe decommissioning, site revegetation and ecosystem restoration is undertaken before the decommissioning of the Project. Furthermore, revegetation and restoration of degraded ecosystems must be undertaken through the development and implementation of plans or other management strategies.

b) Environmental Impact Assessment and Audit Regulations of 2005 as amended in 2018

Regulation 6 sub-regulation (c) states that “A developer or proponent shall, depending on the nature of the project or undertaking, register in accordance with Form No. 1 specified in the Third Schedule to these Regulations and prepare a project brief stating c) the activities that shall be undertaken during the project construction, operation and decommissioning phases; and

Regulation 18 sub-regulation 2 (a) states that “A developer or proponent shall submit to the Council, an environmental impact statement incorporating but not limited to the Decommissioning Plan”.

11.3 Decommissioning Framework

11.3.1 Decommissioning Objectives

The purpose of the Decommissioning Plan for the Lake Natron Soda Ash Project is to provide a clear framework of processes, standards, and responsibilities to ensure that project closure and rehabilitation are undertaken in a safe, environmentally responsible, and socially acceptable manner. The project closure activities will need to:

a) Be implemented in accordance with Lake Natron Soda Ash Project's environmental and social management policies and aligned with recognized international best practices for industrial plant decommissioning and mine closure;
b) Comply with all requirements set out by the Ministry of Minerals, the National Environment Management Council (NEMC), and the conditions stipulated in the Environmental Impact Assessment (EIA) Certificate and other relevant permits and licenses issued for the Project;
c) Adhere fully to all applicable Tanzanian laws and regulations, including those related to environmental protection, occupational safety, and land management;
d) Align with international environmental and social standards, such as the IFC Performance Standards, World Bank Environmental, Health and Safety (EHS) Guidelines, and ICMM Mine Closure Framework;
e) Take into account the biophysical, socio-economic, and cultural context of the Lake Natron area, ensuring that closure activities respect the sensitivity of the local ecosystem and community interests;
f) Identify and manage internal and external risks to the health and safety of workers, contractors, and surrounding communities during decommissioning operations;
g) Implement appropriate mitigation measures to address potential adverse environmental, health, and socio-economic impacts resulting from decommissioning and site restoration;
h) Incorporate considerations for social, environmental, health, safety, legal, governance, and human resources (HR) aspects to ensure integrated and transparent management; and
i) Promote continuous stakeholder engagement and consultation with local communities, government institutions, and other stakeholders throughout the decommissioning process.

The environmental and social components that will potentially be affected by the decommissioning activities will be identified, and specific objectives and intended outcomes will be stated in the Decommissioning Plan.

11.3.2 Decommissioning Processes

The decommissioning processes will include the following:

a) Removal of Infrastructure;
b) Remediation of Contaminated Soils;
c) Restoration of impacted Project areas; and
d) Stakeholder engagement for grievances and Project legacies identification.

11.3.3 Relinquishment

To achieve successful decommissioning and closure, the Lake Natron Soda Ash Project must meet agreed completion criteria that demonstrate compliance with regulatory, environmental, and social obligations. Relinquishment will only be approved upon verification that the site has been rehabilitated to a safe, stable, and sustainable condition, acceptable to both regulators and local stakeholders, including surrounding communities.

The relinquishment of the soda ash production and associated infrastructure will require formal approval from the National Environment Management Council (NEMC) and the Mining Commission, contingent upon adherence to the following criteria:

a) All landforms and watercourses are left in a stable and non-eroding condition, capable of sustaining natural drainage and vegetation;

b) All equipment, machinery, and pipelines have been dismantled and removed, except where infrastructure is designated for post-closure community or government use;

c) All concrete foundations have been removed, covered and re-vegetated;

d) Access roads are restored as before or as agreed;

e) All scrap and demolition waste have been safely collected and disposed of or recycled in accordance with NEMC-approved waste management standards; and

f) Watercourses and drainage channels have been reclaimed to ensure that:

- Long-term water quality is maintained to a standard specified in the Environmental Management (Water Quality Standards) Regulations, 2007; and
- Drainage is restored either to original watercourses or to new watercourses which will sustain themselves without maintenance.

Alongside the legal requirements for decommissioning, it is considered good practice to meet the completion criteria to the satisfaction of relevant stakeholders, such as local communities. The decommissioning objectives outlined are preliminary and conceptual, needing further refinement as planning advances. Specific performance indicators for the project's components are detailed in the subsequent sections. It is important to note that the completion objectives in this report are based on current understanding of the local environment's resilience and the revegetation techniques commonly employed in similar situations.

11.4 Decommissioning Activities

11.4.1 Audit for Structures Integrity

To ensure safe and effective decommissioning of the Lake Natron Soda Ash Project, a comprehensive structural integrity audit will be conducted on all major facilities prior to dismantling or reuse. The audit will evaluate the physical stability, safety, and environmental suitability of each structure to determine whether it should be demolished, rehabilitated, or retained for alternative use following project closure. The auditing the structural integrity will involve a systematic assessment of various components to ensure the building is safe and meets the required standards. This will include:

- Initial Assessment: This includes review of the available documents (review engineering drawings, maintenance records, and prior inspection reports to understand original specifications and structural performance) and visual inspection (conduct a preliminary field assessment to identify visible defects such as cracks, corrosion, settlement, deformation, or chemical damage to concrete and steel components).
- Detailed Inspection: This includes inspections of foundations to check for cracks, settlement, water intrusion, or any other signs of foundation issues. Inspection of structural Elements (inspection of beams, columns, load-bearing walls, and other critical structural components for signs of stress, cracks, corrosion, or deformation). Inspection of material condition including assessing condition of construction materials like concrete, steel, wood, and masonry for deterioration or damage.
- Environmental and Site Conditions: This comprises of assessment of environmental factors such as soil stability, and water drainage that could affect the building’s integrity and inspect for signs of environmental wear and tear, such as corrosion from exposure to chemicals or saltwater.

11.4.2 Removal of Infrastructure

Decommissioning activities will commence once soda ash production and related operations have ceased. The process will involve the systematic dismantling and removal of all plants, pipelines, evaporation ponds, workshops, storage tanks, offices, and associated utilities,

unless otherwise agreed upon with NEMC, the Mining Commission, or other relevant authorities.

Reusable and recyclable materials such as steel structures, pipes, pumps, and electrical components will be salvaged for recycling or repurposing. Where appropriate, functional equipment and materials of community value may be donated to local institutions or councils for post-closure use.

Items with no residual or reuse value will be disposed of safely in accordance with approved waste management standards and environmental best practices, ensuring no risk to human health or the surrounding environment. The final demolition decisions will be guided by recommendations from the National Mining Closure Committee (NMCC) and approved by relevant authorities.

11.4.3 Contaminated Soils and site Clean-up

To mitigate potential environmental impacts from contamination associated with industrial operations and trona slurry management, specific remediation and cleanup measures will be implemented. These will include:

- On-site Remediation: Identification and treatment of soils contaminated with hydrocarbons, trona slurry residues, or chemical reagents used during soda ash production. Techniques may include bioremediation, soil replacement, or stabilization using clean fill.
- Detailed Site Investigation: Comprehensive assessment of potentially contaminated zones, including fuel storage areas, process plants, and evaporation ponds, to determine the extent and severity of contamination and define appropriate remediation actions.
- Complete Site Cleanup: Removal of all introduced materials, construction debris, and residual waste generated during operations. All contaminated soils, sediments, and process residues will be managed and disposed of in accordance with NEMC and international Environmental, Health and Safety (EHS) standards to restore the site to a safe, stable, and environmentally acceptable condition.

11.5 General Restoration

11.5.1 Soil Management

Throughout the construction, operation, and decommissioning phases, the Lake Natron Soda Ash Project will strictly adhere to the approved Environmental and Land Management Plans, with particular focus on soil conservation and rehabilitation. Soil handling will aim to preserve topsoil quality, prevent contamination, and facilitate successful revegetation during and after decommissioning. During site closure, stored topsoil will be reapplied to disturbed areas to promote natural regrowth and restore ecosystem productivity.

11.5.2 Erosion and Sediment Control

oils in the Lake Natron project area originate from volcanic and evaporitic materials, forming saline-alkaline clays and silts near the lake and sandy to clay loams on the surrounding plains. These soils are poorly structured, weakly permeable, and highly erodible when disturbed, particularly under the region’s semi-arid climate and sporadic intense rainfall.

Erosion control during decommissioning will focus on:

- Stabilizing sodic and dispersive soils near the lake through mulching, brush matting, and organic cover;
- Installing drainage controls such as bunds, silt traps, and check dams to capture runoff and sediments;
- Implementing progressive re-profiling and revegetation using native, salt-tolerant species; and
- Reducing wind erosion through surface roughening and vegetative barriers.

These measures will maintain soil stability, protect water quality, and prevent sedimentation into Lake Natron, ensuring sustainable post-closure landform recovery.

11.5.3 Landform Design

Landform design during decommissioning will aim to recreate natural terrain patterns consistent with the surrounding rift valley landscape and maintain hydrological stability.

Activities will include:

a) Re-profiling disturbed areas to stable, erosion-resistant slopes and drainage lines;
b) Scarifying compacted surfaces, particularly those within haul roads and plant sites, to improve infiltration and root penetration;
c) Applying mulching or organic compost where necessary to enhance soil moisture retention; and
d) Designing landforms to withstand occasional intense rainfall events typical of the Lake Natron catchment.

All reshaped areas will be designed to blend with the natural topography, minimize erosion, and promote long-term vegetation establishment.

11.5.4 Re-vegetation

Revegetation will focus on restoring native semi-arid vegetation typical of the Lake Natron ecosystem. Locally adapted grasses, shrubs, and trees such as Acacia tortilis, Salvadora persica, and Chloris gayana will be used to re-establish ecological stability and minimize erosion.

Revegetation will rely on stored topsoil, seed banks, and community-based nurseries to supply indigenous species. The project will collaborate with local communities to provide training in seed collection, nursery management, and planting techniques, fostering both ecological restoration and local livelihood opportunities

11.6 Decommission Strategy

Decommission strategy for the key infrastructure components of the Project will include the following.

11.6.1 Watercourses

Decommissioning objectives for watercourses include ensuring that:

- Restored to either join the original watercourses or to new watercourses which are to be free draining.
- Left in a condition so as not to accelerate erosion and would sustain themselves without maintenance; and
- Long-term water quality is maintained within the prescribed standards under the Water Resources Management Act, CAP 331 R.E 2023.

To achieve these objectives, the impacted watercourses will be reinstated to follow their natural patterns unless impracticable.

11.6.2 Soda Ash Production Facilities

Decommissioning of the soda ash production system is aimed at being safe and effectively, minimizing environmental impact and ensuring compliance with regulatory standards as well as international good practices. The decommissioning strategy will include the following:

- **Stakeholder Engagement**: Inform and involve stakeholders, including local communities, regulatory bodies, and other relevant parties.
- **Site Assessment**: Conduct a comprehensive review of operational areas to identify contamination, hazards, and environmental concerns.
- **Regulatory Compliance**: All dismantling will adhere to the approved Decommissioning Plan and permits.
- **Plant Shutdown**: Safe shutdown of crystallizers, evaporators, and mechanical systems to ensure all units are depressurized, drained, and isolated.
- **Equipment Removal**: Salvage and recycling of reusable machinery and components; hazardous materials will be handled and disposed of per regulatory standards.
- **Site Restoration**: Demolished structures will be backfilled, compacted, and re-vegetated. Final grading will restore surface drainage to stable, natural conditions.

11.6.3 Roads, Open Spaces and Access Routes

Decommissioning measures for roads, open spaces and access routes will include:

- Levelling to re-establish the natural drainage pattern.
- Relinquishment of the access roads to the community for use by local residents (as will be agreed by the stakeholders).
- Rehabilitate the access roads which will be deemed not required by the community (as will be agreed by the stakeholders)
- Revegetation of the approved access roads for revegetation to pre-mining conditions, where practicable.
- Cross ripping to loosen soil and encourage self-regeneration of vegetation.
- Direct seeding of tree and shrub species at densities similar to adjacent land.

11.6.4 Buildings, and Other Infrastructure

The objectives of Decommissioning these facilities are as follows:

- To ensure the safety of the community (internal and external community) accessing the facilities.
- Return the areas occupied to a land capability that will sustain native vegetation.
- Ensure resulting waste is handled so as not to potentially to cause any contamination.

The measures to achieve these include:

- Salvage reusable and recyclable items from buildings and infrastructure e.g., air conditioners, kitchen utensils, furniture, pipelines, doors, steel bars, housing blocks, windows, etc. for provision to other similar operations, recycling facilities, or the community.
- All machinery and equipment and other scrap will be salvaged and provided to other similar operations or communities, unless impractical then they will be disposed of in an acceptable manner.

- The areas will be revegetated to establish open woodland or shrub vegetation.

11.6.5 Soda Ash Production Plant

a) **Site Assessment**: Detailed inspection to identify hazards, contamination, and structural risks before dismantling.

b) **Preparation and Isolation**: Controlled shutdown of processing systems, isolation from pipelines and utilities.

c) **Decontamination**: Removal and safe disposal of chemical residues, trona slurry sludge, and waste products.

d) **Dismantling**: Sequential removal of tanks, crystallizers, and structures, prioritizing high-risk components.

e) **Site Remediation**: Remediate contaminated soils and restore the site using regrading, revegetation, and drainage stabilization.

11.6.6 Waste Management Facility

Any sites used for disposal of general waste and sewage will be appropriately closed upon decommissioning of the project. The Decommission measures will include:

- Cap the surface of the site with low permeability material followed by topsoil and revegetate with shallow-rooted vegetation.
- Divert stormwater upstream of the sites away from the facilities.
- Demolish and dismantle all surface waste management infrastructures if present.
- Cleanup of waste generated during operation and those generated during the implementation of closure.

11.7 Decommissioning Audit Protocol

The Project will undertake an audit assessment after the decommissioning phase to demonstrate that decommissioning objectives have been achieved. The parameters and frequency of the audit will be determined by additional information gathered during operations and the post-decommissioning monitoring period will be agreed upon with the relevant stakeholders and regulators.

11.8 Decommissioning Reporting and Data Management

The Project recognizes the importance of decommissioning reporting and data management for the decommissioning planning process. Information to be maintained may include GIS data, monitoring records, chemical records, and physical properties (such as ground and surface water, air quality (dust), vibrations, erosion, and safety), structures integrity and numbers, contamination issues, and revegetation status.

11.9 Decommissioning Timeline

The full decommissioning program is projected to span 12–24 months following cessation of soda ash operations. However, post-decommissioning monitoring will continue until closure objectives are achieved and verified by NEMC and the Mining Commission, after which final relinquishment may be approved.

12 CONCLUSION AND RECOMMENDATIONS

12.1 CONCLUSION

This Environmental and Social Impact Assessment (ESIA) has conducted a comprehensive, systematic, and science-based analysis of the potential positive and negative impacts associated with the proposed Trona Extraction and Soda Ash Production Project, to be located at Wosiwosi Village, Gelai Lumbwa Ward, Longido District in the Arusha Region.

The assessment confirms that the project presents a significant, strategic opportunity for the United Republic of Tanzania. The economic benefits including substantial contributions to GDP, foreign currency earnings, the creation of hundreds of direct and indirect jobs, substantial tax revenues, and opportunities for local social development are clear and compelling. The project aligns with national development goals by promoting industrialization and adding value to natural resources.

Simultaneously, the ESIA has identified and characterized substantial, significant, and potentially irreversible environmental and social risks. These risks are almost entirely attributable to the project's proposed location within the Lake Natron basin. This area is an internationally recognized Ramsar Site (a wetland of international importance) and, most critically, is the sole and critical breeding ground for the global population of the Lesser Flamingo (*Phoeniconaias minor*).

The principal adverse impacts identified, should mitigation measures not be applied, include:

a) Ecological Damage: The potential for irreversible alteration of the lake's unique and delicate hypersaline brine chemistry due to water extraction or effluent discharge.

b) Biodiversity Loss: The disruption of the micro-organism (cyanobacteria) food source for flamingos, and the physical or chemical disturbance of their breeding habitats, which could lead to a catastrophic decline in the global population.

c) Hydrological Disruption: Potential impacts on the lake's sensitive water balance from industrial extraction.

d) Socio-Economic Impacts: Potential for economic displacement of traditional pastoralist livelihoods, in-migration leading to pressure on limited local social services (health, water), and potential cultural conflicts.

e) Amenity Impacts: Generation of dust, noise, and visual intrusion in a pristine and ecologically sensitive landscape.

The core finding of this ESIA is that these two realities, significant opportunity and significant risk are not mutually exclusive. The assessment has demonstrated that a viable, albeit narrow, pathway exists for the project to proceed. This pathway is entirely contingent on the proponent's commitment to implementing the proposed mitigation measures not just as recommendations, but as foundational, non-negotiable components of the project's design and operation.

The project's design, particularly its commitment to a Zero-Liquid Discharge (ZLD) system, is identified as the central, non-negotiable cornerstone of this mitigation strategy. This, combined with the comprehensive Environmental and Social Management Plan (ESMP) and the detailed Environmental and Social Monitoring Plan (ESMoP) developed herein, forms the basis for managing the identified risks.

In summary, this ESIA concludes that the project's adverse impacts are manageable, but only if the unprecedented environmental sensitivity of the site is met with an equally unprecedented and non-negotiable commitment to mitigation, monitoring, and adaptive management. The project's viability is fundamentally linked to its ability to operate as a closed-loop system, posing no threat to the hydrological and chemical integrity of the Lake Natron ecosystem.

12.2 RECOMMENDATIONS

Based on the findings and conclusion of this ESIA, the following recommendations are made to the National Environment Management Council (NEMC) and the Project Proponent:

a) Recommendation for Conditional Approval

It is recommended that the National Environment Management Council (NEMC) grant Environmental Approval for the proposed Soda Ash Project, subject to the proponent's binding acceptance and full, verifiable implementation of all conditions, mitigation measures, and management plans detailed in this ESIA report and its annexes.

b) Adoption of Management Plans as Binding Conditions

The Environmental and Social Management Plan (ESMP) and the Environmental and Social Monitoring Plan (ESMoP) must be adopted in their entirety as legally binding conditions of the Environmental Certificate. The proponent must allocate and commit the full financial budget as detailed in the ESMP to ensure its complete implementation.

c) Non-Negotiable Technical Conditions

Zero-Liquid Discharge (ZLD) System: The project's approval must be fundamentally conditional on the successful engineering, construction, and operation of the ZLD system as described. Any unplanned discharge of process effluent treated or untreated, into the Lake Natron catchment shall constitute a major non-compliance, resulting in immediate penalties and potential suspension of operations.

Buffer Zones and Site Selection: The proponent must adhere to the finalized plant and infrastructure locations, which have been selected to maximize distance from sensitive flamingo breeding sites. A non-intrusion buffer zone, as defined in this report, must be demarcated and enforced.

d) Pre-Construction Requirements

Baseline Monitoring: The proponent must implement the full ESMoP, particularly the components related to hydrological monitoring and flamingo population/breeding surveillance, for a period of no less than one (1) full year prior to the commencement of any construction. This is to establish a definitive, multi-season baseline against which all future monitoring data will be compared.

Operationalize Grievance Mechanism: The proponent must fully establish and operationalize the formal Grievance Redress Mechanism (GRM) before construction begins. This includes hiring and training a dedicated Community Liaison Officer (CLO) and disseminating information to all local communities.

Financial Assurance: The proponent shall be required to post an Environmental Bond or similar financial assurance with NEMC prior to construction, to cover the costs of potential environmental remediation and final decommissioning.

e) Social and Community Recommendations

Local Content: The proponent must adhere to the Livelihood Restoration Plan (LRP) and develop a Local Content Plan, prioritizing local communities (Wosiwosi Village, Gelai Lumbwa Ward) for non-skilled and semi-skilled employment and procurement opportunities.

Stakeholder Engagement: The Stakeholder Engagement Plan (SEP) must be maintained as a "living document," with regular, transparent consultations with local communities and other stakeholders throughout the project's life.

f) Oversight and Reporting

Establishment of an Independent Monitoring Committee (IMC): It is recommended that an IMC be established, funded by the proponent but reporting directly to NEMC. This committee should include representatives from NEMC, the proponent, local government, and at least one independent, third-party expert on East African avian ecology or soda lake hydrology. The IMC shall meet quarterly to review all monitoring data and compliance reports.

Adaptive Management: The proponent must commit to an adaptive management framework. If monitoring (per the ESMP) reveals any significant, unpredicted adverse impacts (e.g., changes in lake chemistry, disturbance to breeding flamingos), the proponent shall be required to immediately halt the specific activity causing the impact and propose corrective actions for NEMC approval before resuming.

Regular Reporting: The proponent shall submit quarterly monitoring reports to NEMC and the IMC and make a summary of these reports publicly available.

g) Decommissioning and Closure

The proponent must, within three (3) years of operational launch, submit a detailed Decommissioning and Site Rehabilitation Plan, complete with a verified cost estimate. This plan must be updated every five years.

REFERENCES

Biggs, J., Bastow, I.D., Keir, D., & Lewi, E. (2009). Multiple inflation and deflation events at a nascent rift zone in East Africa. Geophysical Journal International, 179, 145–1rBrown, L. (1954). The Breeding of Lesser and Greater Flamingoes in East Africa. Https://Www.Biodiversitylibrary.Org/Content/Part/Eanhs/Xxii_N0.5_97__159_1955_Brown.Pdf

Calais, E., Ebinger, C., Hartnady, C., & Nocquet, J.M. (2008). Kinematics Of The East African Rift from GPS and Seismicity Data. Geological Society, London, Special Publications, 259, 9–22

Childress, B., Hughes, B., Harper, D., & Van Den Bossche, W. (2007). *East African Flyway And Key Site Network Of The Lesser Flamingo (Phoenicopterus Minor) Documented Through Satellite Tracking*. Ostrich, 78(2), 463–468. Https://Doi.Org/10.2989/Ostrich.2007.78.2.55.135

Chorowicz, J. (2005). The East African Rift System. Journal Of African Earth Sciences, 43, 379–410.

Dawson, J.B. (2008). The Gregory Rift Valley and Neogene–Recent Volcanoes Of Northern Tanzania. Geological Society, London.

Deino, A.L., Et Al. (2006). Chronology of the Peninj Group, Lake Natron Basin, Tanzania. Journal Of Human Evolution.

Ebinger, C.J., Deino, A.L., Drake, R.E., & Tesha, A.L. (1997). Chronology Of Volcanism and Rift Basin Propagation: Rungwe Volcanic Province, East Africa. Journal of Geophysical Research, 102(B5), 10293–10311.

Foster, A., Ebinger, C., Mbede, E., & Rex, D. (1997). Tectonic Development of the Northern Tanzanian Sector of the East African Rift System. Journal of the Geological Society, London, 154, 689–700.

Hay, R.L. (1976). Geology of the Olduvai Gorge. University Of California Press.

Isaac, G.L. (1967). The Stratigraphy of the Peninj Group, Lake Natron Basin. Quaternaria.

Macdonald, R., & Dawson, J.B. (1978). Geological Evolution of the Gregory Rift Valley. Geological Society Of London Special Publication.

National Biodiversity Strategy and Action Plan (2015-2020). (2014). Vice President's Office, Division Of Environment, United Republic of Tanzania (Urt)

Pálmai, T., Szabó, B., Lengyel, E., Kotut, K., Krienitz, L., & Padisák, J. (2024). *Growth Response* of the *Picoplanktic Picocystis Salinarum and the Microplanktic Limnospira (Arthrospira) Fusiformis Strains from Lake Nakuru (Kenya) To Rapidly Changing Environmental Conditions*. Hydrobiologia, 851(8), 1873–1889. Https://Doi.Org/10.1007/S10750-023-05397-Y

Shackleton, R.M. (1993). The East African Orogenic Belt. Geological Society Special Publications

Tawa | Attraction Details. (N.D.). Retrieved October 21, 2025, From Https://Www.Tawa.Go.Tz/Attraction-Details/Lake-Natron

Tiercelin, J.J., & Lezzar, K.E. (2002). A 300 million years history of rift lakes in Central and East Africa. Earth-Science Reviews, 57, 41–83.

UNEP-WCMC and IUCN (2025), Protected Planet: The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM) [Online], October 2025, Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION IN LAKE NATRON AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD AND LONGIDO DISTRICT IN ARUSHA REGION-TANZANIA

VOLUME 2: APPENDICES

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Submission Date: 14th May 2026

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APPENDIX 1: CERTIFICATE OF INCORPORATION

TANZANIA

BRELA

Certificate of Incorporation of a Company

Section 15

No: 157942433

I HEREBY CERTIFY THAT

NGARESERO VALLEY COMPANY LIMITED

is this day incorporated under the Companies Act, 2002 and that the Company is Limited.

GIVEN under my hand at Dar es Salaam this 22nd day of **SEPTEMBER TWO THOUSAND AND TWENT**

REGISTRAR OF COMPANIES * TANZANIA *

PRINC ASST. REGISTRAR OF COMPANIES

APPENDIX 2: CONSULTATION FORMS

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, OLAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA- NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: DISTRICT COMMISSIONER'S OFFICE — Date: 26/09/2025

S/N	Name (Use)	Position (Client)	Phone (Client)	Signature (Safety)
1	Ngoitiko Saibulu	M/KOO	0787345611	
2	[illegible] Kaaya	Ranger Officer	0787 / 152394	

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, OLAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA- NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: DISTRICT COMMISSIONER'S — Date: 26/09/2025

S/N	Name (Use)	Position (Client)	Phone (Client)	Signature (Safety)
1	SAILUM H.A KAILI	DC - LONGIDO	0715 240062	

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, OLAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA- NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: WOSWOSI VILLAGE — Date: 02/10/2025

S/N	Name (Use)	Position (Client)	Phone (Client)	Signature (Safety)
1.	Ngoitiko Naibiji	M/KOO	0787345611	
2.	Mary s. Kaaya	VEO	0786 240095	
3.	Daniel Tawon	Mjumbe	0747775838	
4.	Moses Nakuiya	Mjumbe	0789220859	
5.	Ngoitiko Longoton	—"—	0697510247	
6.	Kone Mbororo	—"—		
7.	Ngoitoit Oltiyetu	—"—	0782 903871	
8.	Lukungen Mwariya	—"—		
9.	Kimirit Alaisoi	—"—		

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, OLAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA- NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: LOSIRWA VILLAGE — Date: 05/10/2025

S/N	Name (Use)	Position (Client)	Phone (Client)	Signature (Safety)
10	Lyka Sarakwa	Mjumbe		
11	Sirdiana Kaliwo	Mjumbe		
12	Meshi Lekanet	Mjumbe	0762997777	
13	Meshi Marbala	Mjumbe		
14	Ngulay Sabala	—"—		
15	Sabo Mesheti	—"—		
16	Laun Alaisoi	—"—		
17	Mayo Kedenga	—"—	0784975532	
18	Olelen Lateno	—"—		
19	Lasoo Kimeli	—"—	0785188416	

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, OLAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA- NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: MSAKESH VILLAGE — Date: 03/10/2025

S/N	Name (Use)	Position (Client)	Phone (Client)	Signature (Safety)
01	JOHN ALOYCIUS MKUL	ALOYCIUS JOHN KAOU	0713 CS / 19 5	
02	OSCAR FELIX KIBWANA	VEO MSAKESH	0743504823	
03	JOSEPH N MBILEL	MKUTUNGA COM TEAM	0743344774	
04	LOMBEREK LEMOMU	MJUMBE	0620 [illegible]27	
05	ROMYEN TIMBENE	MJUMBE	0741927799	
06	SAQUNI LOITUDE	MJUMBE	0686738	
07	SHONGON LOSHIMU			
08	KASIAYA LAUMET	—"— —"— —"—	0746980806	
09	JOSHUA SAQUNI		0755 [illegible]	

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, OLAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA- NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: MSAKESH VILLAGE — Date: 03/10/2025

S/N	Name (Use)	Position (Client)	Phone (Client)	Signature (Safety)
10	NAINA NAIYANGOSH			
11	EMANUEL SUBENGE			
12	LOMASHUT KUUYO			
13	MARDEO NKOITA			
14	LARMASAY LEKERAI			
15	MULA NANYAMBOK			
16	NAINGUNA NKOITA			
17	JACOB NAIYANGOSH			
18	NGILIARA NGULA			

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA-NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: ARASHI VILLAGE Date: 05/9/2025

SN	Name (Jina)	Position (Cheo)	Phone (Simu)	Signature (Saini)
19	LENKINE SHIALO			
20	MENGILA MOHAMED			
21	SAKAMBA MBULA			
22	MUMBO LEMBULA		0743067355	
23	JEMIS SABAYA		0769279552	
24	SALAMA LEMAIYAN			
25	TETO SHIMOH	0766699553	0756693363	
26	LESI OSIRINGETI			
27	MOPPO MUKWANA			

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA- NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: NKARU VILLAGE Date: 05/9/2025

SN	Name (Jina)	Position (Cheo)	Phone (Simu)	Signature (Saini)
28	OLODO NAMHANBOK		0784679345	
29	LENGAKUI PENETI	BOMBI		
30	SAITORI TARENE	MWANAKE	0666699559	
31	RAPHEL MAROKO	MEMBE	0747701978	
32	SANINGE METEYAN	ASUMBI	0769734530	
33	LESINGI PENETI	MWANE	0769598335	
34	MOHA LOMBOMA		0698788734	
35	LABASHI SIOMBO			
36	NDILASHI KUYA		0746605460	
37	SAINTI KIRUCHIA		0749683245	
38	LUNVA SHIMSHA		0740704401	

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA-NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: ANTHEL VILLAGE Date: 05/9/2025

SN	Name (Jina)	Position (Cheo)	Phone (Simu)	Signature (Saini)
1	LAILY LUMBWA	V/E/O	0686630601	
2				
3	ZAKAYO MALELI	MJUMBE	0698605516	
4	AZIZ A.	MJUMBE	0756605616	

KUMBI CHA MWANZA CHA KIJIJI CHA ARUSHA

LEO TARENE 05/9/2025

WALIOHUDHURIA

NA	JINA KAMILI	CHEO	SAHIHI
1.	Solomon Mosses	MJUMBE KITUONI	
2	LAILY LIMBWA	VEO	
3	YUSUFU KAMWENA	NGARESERO CO. LTD Consultant	
4	MOHAMED MOHAMED	MTL Ongoing to LTD Environmental consultant	
5	ZAKAYO MOSSES	DMO	
6	JOSEPH NYAMBEKA	MWENYEKITI	
7	JOSEPH SAMWEL	MJUMBE KITUONI	
8	JOHN LINALI	MJUMBE	
9	NGOITIKE SAIDIMOI	MJUMBE	
10	EMANUEL KIBURIERI	MJUMBE	
11	SENDEKA MOSES	MJUMBE	
12	ZABRON MASSEE	MJUMBE	
13	PETER ALAIS	MJUMBE	
14	ELIZABETH MIRAMBO	MJUMBE	
15	JOHN MESEDO	MJUMBE	
16	OMARI ROMAN	MJUMBE	
17	MATAYO SOMBA	MJUMBE	
18	DANIELI LEMAIYA	MJUMBE	
19	TOMAS LEMTENJI	MJUMBE	
20			
21			
22			
23			
24			
25			

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA-NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: MTAMEE B VILLAGE Date: 05/9/2025

SN	Name (Jina)	Position (Cheo)	Phone (Simu)	Signature (Saini)
1.	VOLETA RAPHAEL	MJUMBE	0766755550	
2.	JOEL G MBUYA	VEO	0623215334	
3.	LEMAI SIRIKA	MJUMBE	0683467629	
4.	SIMON NDEIP	MJUMBE	0694281681	
5.	VOSIYAN REUBEN	MJUMBE	0693065[illegible]	
6.	SAMUEL MOSES	MJUMBE	0781[illegible]2098	
7.	SIMON KILEPOO	—"—	0733114694	
8.	NGOLOKWEI NAMIS	—"—	0693502367	
9.	NAISEKEN MARU	—"—	0688SLC818	

ENVIRONMENTAL AND

SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA-NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: MTAMEE B VILLAGE Date: 05/9/2025

SN	Name (Jina)	Position (Cheo)	Phone (Simu)	Signature (Saini)
10	[illegible]	MJUMBE	0693798017	
11.	[illegible]	MJUMBE	0682287968	
12	[illegible]	MJUMBE	0696395096	
13.	[illegible] KAREI	MJUMBE	0696795096	
14	[illegible]	MJUMBE	0693519887	
15.	[illegible]	MJUMBE	0693107628	
16.	[illegible]	MJUMBE	0695705612	
17	[illegible]	MJUMBE	0786396385	
18	[illegible]	—"—		

ENVIRONMENTAL AND

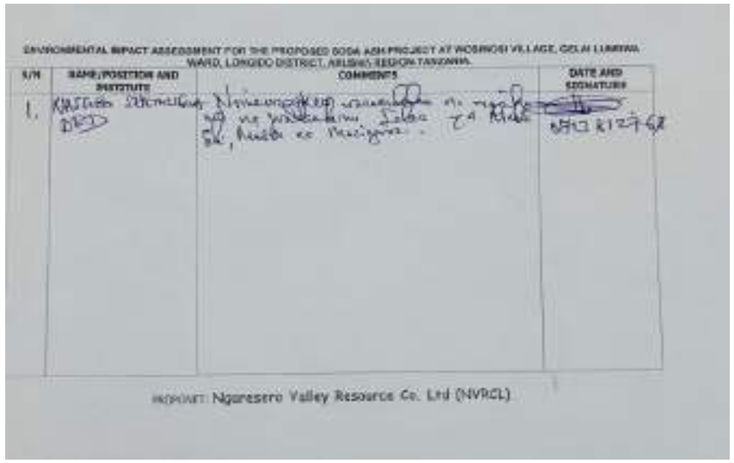
SOCIAL IMPACT ASSESSMENT (ESIA) FOR A PROPOSED FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON, WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION, TANZANIA- NGARESERO VALLEY COMPANY LIMITED (NVCL)

SEPTEMBER - 2025

STAKEHOLDER CONSULTATION FORM

Institution: BARTHE E VILLAGE Date: 15/11/2025

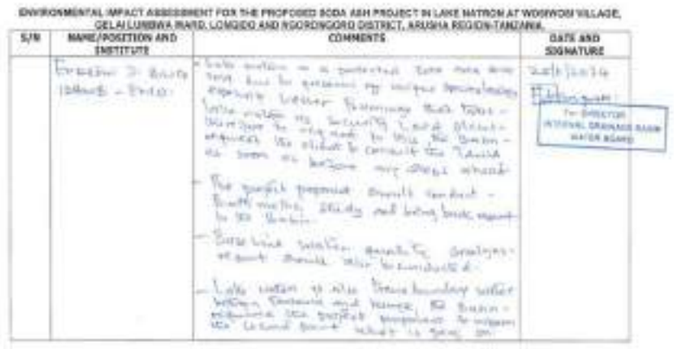
SN	Name (ANA)	Position (Cheo)	Phone (Simu)	Signature (Saini)
19	ANGELI [illegible]	[illegible]	0656279711	[illegible]
22	[illegible] SANTAU	ALA-QUMANI	0789518480	[illegible]
2	[illegible]	[illegible]	0658807363	[illegible]
23	[illegible]	[illegible]	0739311[illegible]	[illegible]
25	[illegible] Peter	Mfumbe	0658627825	[illegible]
24	[illegible] PETER	MJUMAE	0658726215	[illegible]
25	[illegible]	MJUMAE	0658726444	[illegible]
26	NGHMASIRWA [illegible]	MJUMBER	0694895902	[illegible]
27	[illegible]	—11—		



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
1.	[illegible] DED	[illegible]	[illegible]

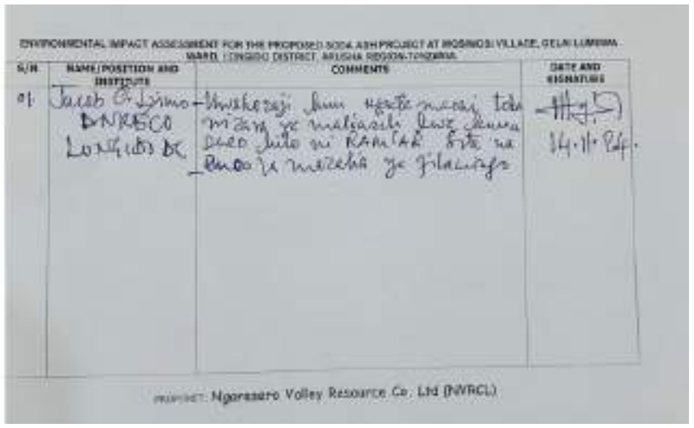
PROPONENT: Ngoresero Valley Resource Co. Ltd (NVRCL)



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT IN LAKE NATRON AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO AND NGORONGORO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
	[illegible]	[illegible]	[illegible]

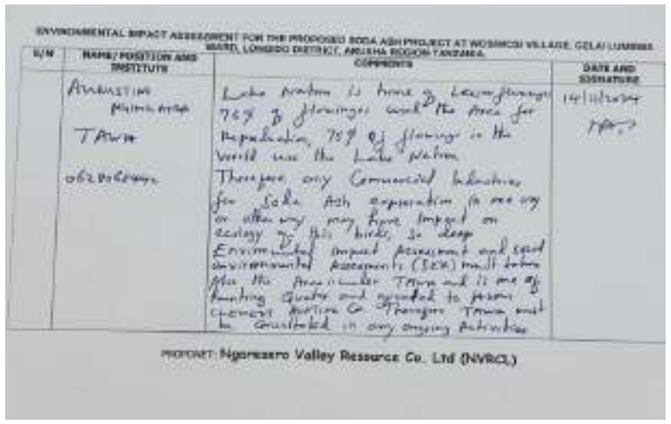
PROPONENT: Ngoresero Valley Co. Ltd (NVCL)



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
01	Jacob Ng'imo DNRO&C Longido DC	Mwakenji Jambo, Hapa tumeona tofa mizuri ya malisanki kwa sababu DED Juto ni RAMLAH bila ya Ruhusa ya mkezeka ya Gilalinga	14.11.Pdf.

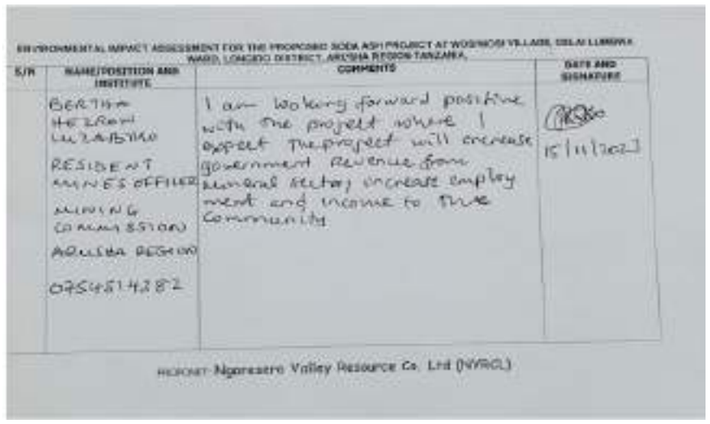
PROPONENT: Ngoresero Valley Resource Co. Ltd (NVRCL)



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
	ANNASTIN [illegible] TAWA 0628[illegible]	Lake natron is home to Lesserflamingo 76% of flamingo walk the Area for Reproduction, 75% of flamingo in the world use the Lake natron Therefore any Commercial Industries for Soda Ash exploration in the city or otherwise may have Impact on ecology of the birds, so deep Environmental impact Assessment and Strategic environmental Assessments (SEA) must be done also the Annual under Tawa and it one of hunting Quota and agreed to person Cleaner Activity Co Therefore Tawa must be Considered in any ongoing Activities	14/11/2025

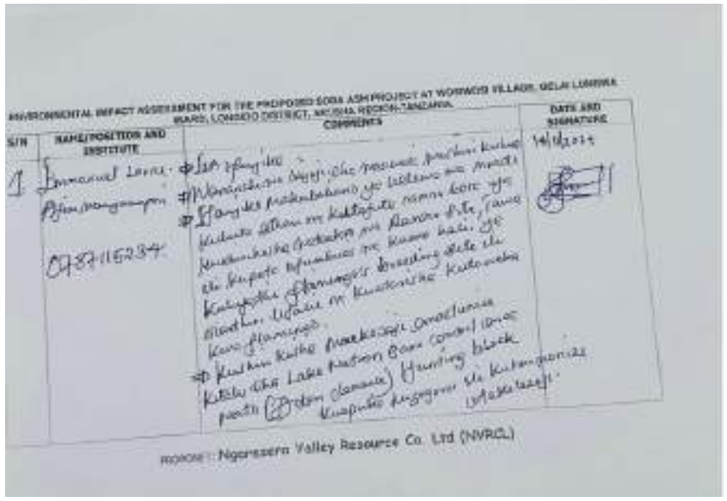
PROPONENT: Ngoresero Valley Resource Co. Ltd (NVRCL)



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
	BERTHA HEZRON LUKABANO RESIDENT MINES OFFICER MINING COMMISSION ARUSHA REGION 0754514282	I am Working forward positive with the project where I expect the project will increase government Revenue from mineral sector, increase employment and income to the Community	15/11/2025

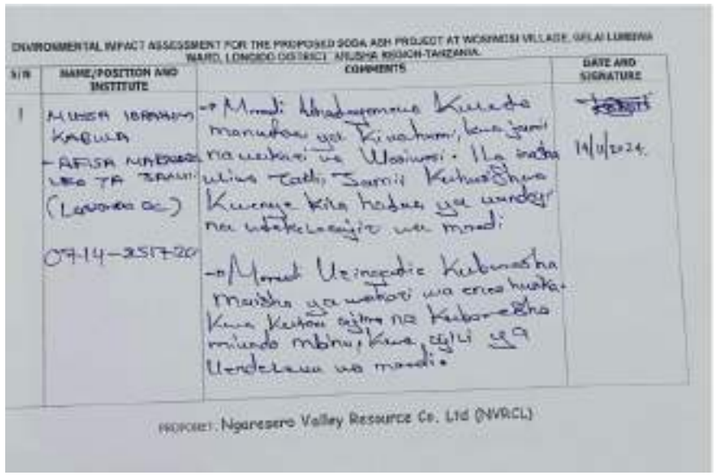
PROPONENT: Ngoresero Valley Resource Co. Ltd (NVRCL)



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
1	Emmanuel Laiza - Afisa mazingira	#Sijapinga ile #Mwinuchaya Sayansi che mawasiliano kuhusu kuhusu athari za mradi kuhusu athari za mradi kwenye mazingira ili kuepuka athari hasi kwa jamii #Elimu ya kuhifadhi mazingira kwa wafanyakazi wa kiwanda ili kuepuka athari hasi kwa mazingira. #Kuwa na kituo cha huduma ya kwanza kwa wafanyakazi wa kiwanda. #Kuwa na kituo maalumu cha kuhifadhi taka zitokanazo na kiwanda (Waste management facility)	14/1/2024

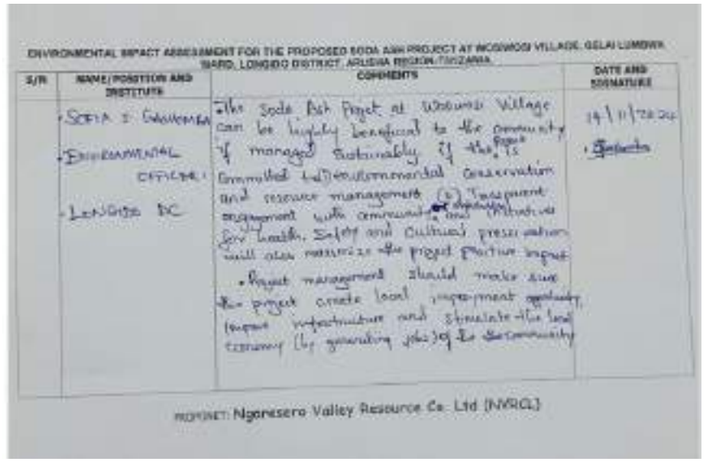
PROPONET: Ngoresero Valley Resource Co. Ltd (NVRCL)



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
1	MUSSA IBRAHIM KABURA - AFISA MAZINGIRA LEO TA TAWIL (Longido DC) 0714-351720	-Mradi Uhakiwemwa Kuleta manufaa ya Kiuchumi, kwa jamii na wakazi wa Wosiwosi. Ila watu wa tahadhari Jamii Kuhusiana Kuepuka kuharibu mazingira wakati wa uendeshaji wa mradi. -Mradi Uzingatie Kuhusisha Maisha ya wakazi wa eneo husika. Kwa Kuitoa ajira na Kuboresha miundo mbinu, Kwa ujirani mwema Uendelezaji wa mradi.	14/1/2024

PROPONET: Ngoresero Valley Resource Co. Ltd (NVRCL)



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
	• SOFIA S. GAKUMBA • ENVIRONMENTAL OFFICER I • LONGIDO DC	-The Soda Ash Project at Wosiwosi Village can be highly beneficial to the community if managed sustainably by the project committed to environmental conservation and resource management (b) Transparent engagement with community and authorities Env. health, Safety and Cultural preservation will also maximize the project positive impact • Project management should make sure the project create local employment opportunity improve infrastructure and stimulate the local economy by generating jobs for the community	14/11/2024

PROPONET: Ngoresero Valley Resource Co. Ltd (NVRCL)

Environmental Statement for the proposed Trona Extraction and Soda Ash Production in Lake Natron at Wosiwosi Village, Gelai Lumbwa Ward, Longido District in Arusha Region.

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
1	ELIZABETH C. MTIRE – OCCUPATIONAL HYGIENE INSPECTOR (OSHA)	✓ Registration of the project (during construction and during operations) - sect 16 of OHS ACT ✓ Prepare OHS POLICY statement – sect 96 ✓ Prepare OHS policy implementation guidelines – sect 96 ✓ Conduct OHS Risk Assessment report – sect 60 ✓ Provide proper first aid program i.e. first aid facilities, train first aider from OSHA, and develop proper emergency evacuation plan in case, keep records of all cases (minor/major) - sect 58 of OHS ACT & OSH First aid and welfare facilities rules 2015 ✓ Train safety and health representatives – sect 11 ✓ Compose OHS committee – sect 13 ✓ Conduct OHS committee and keep the minutes discussed - sect 13 &14 ✓ Health and welfare provisions should adhere OHS standards i.e. supply of clean, safe and wholesome drinking water (sect 54), proper sanitary convenience (55), washing facilities (56), Accommodation for clothing (sect 57) and proper facilities for sitting when needed for resting (sect 59) ✓ Proper provision of appropriate personal protective equipment's to all workers (sect 63).	03/01/2025

PROPONET: Ngoresero Valley Co. Ltd (NVRCL)

STAKEHOLDER CONSULTATION DURING ENVIRONMENTAL IMPACTS ASSESSMENT STUDY FOR THE PROPOSED ESTABLISHMENT OF TRONA/BRINE EXTRACTION WITHIN LAKE NATRON AND SODA ASH PRODUCTION PLANT AT WOSIWOSI VILLAGE IN GELAI LUMBWA WARD AND LONGIDO DISTRICT.

NAME ESTHER J. ABRAHAM

TITLE WEIGHTS PHYSICIST

DATE 01/05/2025

S/N	COMMENTS	PHONE NO.	SIGNATURE
	INVESTOR SHOULD INTRODUCE HIMSELF TO THE VILLAGE OFFICE - ALSO HE/SHE MUST PROVIDE EMPLOYMENT OPPORTUNITY TO THE VILLAGERS.	0686307737	

Environmental Statement for the proposed Trona Extraction and Soda Ash Production in Lake Natron at Wosiwosi Village, Gelai Lumbwa Ward, Longido District in Arusha Region.

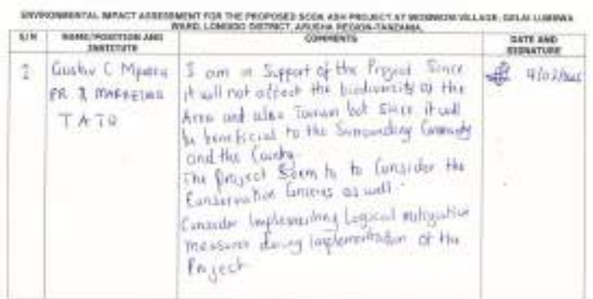
STAKEHOLDER CONSULTATION DURING ENVIRONMENTAL IMPACTS ASSESSMENT STUDY FOR THE PROPOSED ESTABLISHMENT OF TRONA/BRINE EXTRACTION WITHIN LAKE NATRON AND SODA ASH PRODUCTION PLANT AT WOSIWOSI VILLAGE IN GELAI LUMBWA WARD AND LONGIDO DISTRICT.

NAME IZUMAR KIRENGA

TITLE INCHARGE – Tanzania Meteorological Authority (Arusha)

DATE 6th May 2025

S/N	COMMENTS	PHONE NO.	SIGNATURE
	On implementing the project you should take weather report especially on rainfall winds and relative humidity from -TMA	0787477956	



ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
2	Gushu C Mpoki FR & MARKETING TATO	I am in Support of the Project Since it will not affect the biodiversity of the Area and also Tourism but since it will be beneficial to the Surrounding Community and the Country. The Project Seem to be Consider the Conservation Concerns as well. Consider Implementing Logical mitigation measures during implementation of the Project	4/2/2025

PROPONET: Ngoresero Valley Co. Ltd (NVRCL)

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
1	ELIZABETH C. MTIRE – OCCUPATIONAL HYGIENE INSPECTOR (OSHA)	✓ Registration of the project (during construction and during operations) - sect 16 of OHS ACT ✓ Prepare OHS POLICY statement – sect 96 ✓ Prepare OHS policy implementation guidelines – sect 96 ✓ Conduct OHS Risk Assessment report – sect 60 ✓ Provide proper first aid program i.e. first aid facilities, train first aider from OSHA, and develop proper emergency evacuation plan in case, keep records of all cases (minor/major) - sect 58 of OHS ACT & OSH First aid and welfare facilities rules 2015 ✓ Train safety and health representatives – sect 11 ✓ Compose OHS committee – sect 13 ✓ Conduct OHS committee and keep the minutes discussed - sect 13 &14 ✓ Health and welfare provisions should adhere OHS standards i.e. supply of clean, safe and wholesome drinking water (sect 54), proper sanitary convenience (55), washing facilities (56), Accommodation for clothing (sect 57) and proper facilities for sitting when needed for resting (sect 59) ✓ Proper provision of appropriate personal protective equipment's to all workers (sect 63).	03/01/2025

PROPONET: Ngoresero Valley Co. Ltd (NVRCL)

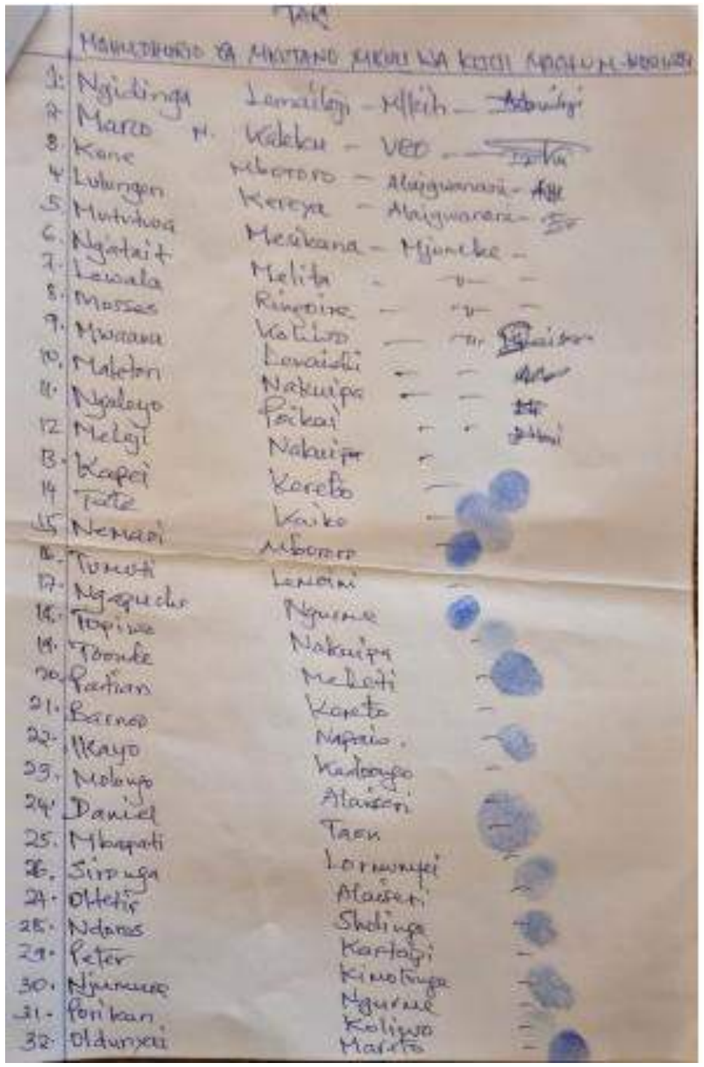
STAKEHOLDER CONSULTATION DURING ENVIRONMENTAL IMPACTS ASSESSMENT STUDY FOR THE PROPOSED ESTABLISHMENT OF TRONA/BRINE EXTRACTION WITHIN LAKE NATRON AND SODA ASH PRODUCTION PLANT AT WOSIWOSI VILLAGE IN GELAI LUMBWA WARD AND LONGIDO DISTRICT.

NAME IZUMAR KIRENGA

TITLE INCHARGE – Tanzania Meteorological Authority (Arusha)

DATE 6th May 2025

S/N	COMMENTS	PHONE NO.	SIGNATURE
	On implementing the project you should take weather report especially on rainfall winds and relative humidity from -TMA	0787477956	



1.	Ngidinga	Lemailoja – Kilish – Adunigi
2.	Marco N.	Kakeku – VEO – Isiaka
3.	Kone	Mbororo – Alaigwanasi – Ale
4.	Lubungen	Kereya – Alaigwarera – Sir
5.	Mutuhoa	Meikana – Mjuncke –
6.	Ngatait	Melita – " –
7.	Lewala	Rinoine – " –
8.	Moses	Katiwo – " – Ilaiser
9.	Maraua	Lenaishi – – Alm
10.	Makelon	Nakuipa – – 14
11.	Ngaleyo	Poikai – . – Ilkai
12	Melgi	Nakuipa –
13.	Kapei	Kereko –
14	Tate	Kaiko –
15	Nenaoi	Mbororo
16.	Tunesh	Lenoni
17.	Ngaguche	Nguene
18.	Topine	Nakuipa
19.	Tooke	Meketi
20.	Partian	Kereto
21.	Barnes	Napaio .
22.	Ikayo	Kadonyo
23.	Mokuyo	Alaiseri
24	Daniel	Taeu
25.	Mbappati	Lorwunpei
26.	Sironga	Alaiseri
27.	Ottetir	Shelinga
28.	Ndanes	Kartagi
29.	Peter	Kinotinga
30.	Njanuae	Ngurue
31.	Poikan	Koliwo
32	Oldunyeli	Mareto

33	Loipotari	Kiambu
34	Ngutecry	Poikai
35	Ikonet	Alaiseri
36.	Lengai	Nakuipa
37.	Sindina	koliwo.
38.	Nasiti	Poikai
39.	Ole Lawai	Letena
40.	Nooretet	Lekibi.
41.	Seroyo	Kereto
42.	Kisoi	Ngulua.
43.	Pain	Nukenyi
44	Nagolayi	Napaio.
45.	Naanpaikuo	Losuudi.
46.	Nooruqeta	Oltus.
47.	Sipapei	Tate
48	Nanuuu	Tate
49.	Noorkisongo	Alaiseri
50.	Lesanta	Kereto
51.	Saindai	Ole Sainde.
52.	Muino	Lenanet
53.	Meaoki	Martinda.
54.	Nooseke	Lengarua
55.	Nolosiyo	Ikonet
56.	Lepaekyo	Poikai
57	Morondi	Lewale.
58.	Pelo	Lewalo.
59.	Ngoiyo	Kadonyo.
60.	Loini	Lewalo.
61.	Loolwukwa	Lengolini.
62.	Parmuya	Martinda.
63.	Sengerwa	Mbororo.
64.	Leonoré	Losuudi.
65.	Lesya	Lukimeti

66	Sawingo	Kalesi
67	Ngingoi	Sengitaia
68.	Sepere	Tunuti
69.	Kikose	Lenupi
70.	Nashuan	Lengai
71	Ndarngaeka	Mbororo
72	Noorolonen	Ngokiak
73.	Nalepo	Sikar
74	Naropil	Seupi
75.	Nasoro	Kone
76.	Neena	Arkasuai
77	Noorkuseng	Lewala
78	Noorkiumpak	Kadonyo
79.	Siangiki	Poikai
80.	Nanuelin	Kone

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Executive Director,
0785402085

Dear Elisikimu Dominick and Yesaya Kaoneka,

COMMENTS ON THE PROPOSED ESTABLISHMENT OF TRONA/BRINE EXTRACTION WITHIN LAKE NATRON AND SODA ASH PRODUCTION PLANT AT WOSIWOSI VILLAGE.

Please refer to your letter to us dated 23rd May 2025. Our general comment for now is that the soda ash mining at Lake Natron will significantly impact the ecological balance of the lake's ecosystem and the socio-economics of the local Maasai people. Even with the best technology, soda ash mining at Natron is not a feasible idea.

Regarding your letter, it lacks clarity on the proposed project, making it difficult for us to provide detailed comments. For example,

i. It is unclear what the proponent wants to do at Wosiwosi. The letter states that this consultation aims to help sustainably **operate** and develop an **existing project**; Which is the "existing" project, and where is it being implemented? Is the consultancy for a new Environmental and Social Impact Assessment (ESIA) or an approved ESIA?
ii. What technology do you propose to use (Is it trona mining as in the case of Lake Magadi in Kenya, or the extraction of brine (concentrated salty water?)

Furthermore, previous studies and research have documented that mining soda ash at Lake Natron cannot overcome the fundamental ecological and social sensitivities of the site. The unique biophysical conditions required for the Lesser Flamingo breeding and the traditional livelihoods of the Maasai people are intrinsically linked to the current, undisturbed state of the lake and its environment.

However, we would appreciate receiving detailed information about the project and its setup to determine whether the planned mining process will mitigate the significant negative impact on the lake and the socio-economic well-being of the people. While we await detailed information from your side, we kindly request that you refer to TATA's previous soda ash mining project and extract the facts regarding the environmental and socio-economic challenges associated with implementing such a project in Lake Natron, as well as the reasons why it was dropped.

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Below, I present notes on why soda ash mining at Lake Natron would be detrimental to the lake's ecosystems, specifically the Lesser Flamingo breeding grounds, and to the socioeconomics of the local Maasai.

Yours in sustainable development,

Signed by:
EMMANUEL MGIMWA
DIRECTOR

Emmanuel Mgimwa
Executive Director – Nature Tanzania

NatureTanzania BirdLife INTERNATIONAL We belong to BirdLife International, the global Partnership of nature conservation organisations

UNITED REPUBLIC OF TANZANIA
VICE PRESIDENT'S OFFICE

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In reply, please quote

Government City,
Mtumba Area,
Vice President's Office Building,
P. O. Box 2502,
DODOMA.

2nd September 2025.

Ref No: BA. 78/136/04/A

Mr. Yesaya Kaoneka
Environmental Expert
Ngorongoro Valley Company Limited (NVCL)
P.O. Box 77910
Dar es Salaam

REF: STAKEHOLDER ENGAGEMENT ON THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION PROJECT AT LAKE NATRON.

2. The Office of the Vice President, in its capacity as Tanzania's **Ramsar Site Management Authority**, acknowledges receipt of your letter dated 10th July 2025 regarding Ngorongoro Valley Company Limited (NVCL) proposed Trona extraction and Soda Ash production project at Lake Natron.

3. To thoroughly evaluate your project proposal, we conducted a three-stage review: (1) detailed analysis of project documents and the Draft EIA Report; (2) on-site assessment of the proposed location; and (3) extensive consultations with key stakeholders, including government officials and local communities. This comprehensive approach ensured a complete understanding of both the technical aspects and potential impacts of your proposed development.

4. We reaffirm Lake Natron's critical status as a Ramsar Wetland of International Importance (Site No. 1050), the primary breeding site for 75% of the world's Lesser Flamingo population, and a hydrologically sensitive ecosystem requiring stringent protection. Given its ecological significance, any proposed development must adhere to the highest environmental standards to prevent irreversible harm. The VPO hereby directs NVCL to conduct rigorous scientific studies demonstrating full compliance with international sustainability and accountability standards, ***ensuring no adverse impact on Lake Natron's ecosystem, flamingo populations, or hydrological balance.***

5. Additionally, NVCL must exclusively **employ verified clean technologies** that safeguard biodiversity, maintain water quality, and protect critical flamingo habitats. Tanzania supports sustainable industrial growth but not at the expense of irreplaceable ecosystems.

6. We trust NVCL will uphold global best practices in environmental stewardship, setting a benchmark for responsible resource extraction.

7. Thank you for your continued cooperation.

Abdallah H. Mitawi
For. PERMANENT SECRETARY

WWF *for a living planet*®

Safeguarding biodiversity and ecosystem integrity amid Soda Ash mining in the Engaruka–Lake Natron Area

Executive Summary

WWF Tanzania acknowledges the strategic importance of industrialization but urges that the proposed soda ash development in the Engaruka – Lake Natro ecosystem be approached with scientific rigor, inclusive planning, and environmental caution. This ecologically sensitive area forms part of the transboundary ecosystem and is globally recognized as the only regular breeding ground for the lesser flamingo (*Phoenicopterus minor*), which relies on the saline wetlands of Lake Natron. Tanzania hosts over 75% of the world's lesser flamingo population, and disruptions in this habitat would have irreversible global consequences for the species.

The area also plays a vital role in the regional hydrological cycle, supports over 150 species of birds, and is a key corridor for migratory wildlife between Serengeti, Ngorongoro, Amboseli, and Masa Mara. Any industrial activity that disrupts these functions may compromise decades of conservation investments, climate resilience programming, and the cultural survival of pastoralist communities.

WWF recommends integrating community-led monitoring systems, applying a precautionary approach, and aligning the project with international standards (e.g., IFC Performance Standards, Ramsar Convention obligations, and the Kunming-Montreal Global Biodiversity Framework).

Background

Tanzania holds substantial soda ash reserves, with the Engaruka – Lake Natron ecosystem alone estimated to contain 4.68 billion cubic meters of soda ash. Following the cancellation of a controversial plan to extract soda ash from Lake Natron in 2008 due

to global conservation opposition, attention has now shifted to Engaruka, located approximately 50 km away.

In January 2025, the Government of Tanzania launched a new industrial initiative through the National Development Corporation (NDC) to establish a large-scale soda ash extraction plant in Engaruka. The project has commenced initial compensation processes for residents in affected villages with the aim of promoting import substitution and local economic development.

However, the Engaruka–Lake Natron ecosystem is a transboundary ecosystem; a globally significant ecological corridor supporting the largest breeding site of the lesser flamingo and hosting over 75% of its global population. It is a critical wildlife migratory corridor between Serengeti, Ngorongoro, and Kenya's Amboseli and Mara ecosystems, and a culturally and ecologically vital wetland with springs and grazing areas used by Maasai and other pastoralist communities.

WWF is concerned that large-scale industrial development in this ecosystem, if not governed with strong environmental oversight, may disrupt hydrological systems and wildlife migration corridors, introduce chemical and air pollution risks, trigger land use conflicts and community displacement, and undermine decades of conservation and climate resilience investments.

Expanded justification and additional information

- A previous soda ash proposal at Lake Natron in 2007 was rejected after global outcry from conservationists led by BirdLife International and Wetlands International. Studies by the Wildfowl & Wetlands Trust (WWT) estimated that such development could lead to the loss of up to 500,000 flamingos across East Africa due to breeding disruption.
- Lake Natron and Engaruka form part of a Ramsar-designated wetland of international importance, obligating Tanzania under the Ramsar Convention (1971) to "maintain the ecological character" of the site.

- The 2014 BirdLife International Assessment warned that hydrological disturbances in this area could cause a 95% decline in flamingo nesting success. Any upstream extraction or groundwater diversion in Engaruka could therefore have ecosystem-wide cascading effects.
- The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) warns that over one million species face extinction, and large-scale habitat degradation from projects like this contributes significantly.

Recommendations

1. **Conduct a Strategic Environmental Assessment (SEA) at the Ecosystem Scale:** A basin-wide SEA must be undertaken covering Engaruka, Lake Natron, and cross-border systems, including cumulative impacts of water abstraction, infrastructure, and climate variability, aligned with EAC protocols.
2. **Ensure high-standard Environmental Impact Assessment (EIA) with Independent Review :** WWF recommends use of independent ecological reviewers and inclusion of transboundary water and migratory species data. EIA reports should be published publicly and subjected to peer review.
3. **Designate No-Go Zones and Critical Ecological Buffers:** Specific hydrological recharge zones, flamingo breeding sites, and wildlife corridors should be legally protected. Buffer zones of 3–5 km should be maintained from key wetland habitats.
4. **Apply Free, Prior, and Informed Consent (FPIC):** The project should incorporate community consultations with clear documentation, benefit-sharing models, and livelihood co-development plans to ensure cultural and land tenure protections.
5. **Establish a Regional Environmental and Social Monitoring Platform:** Co-managed by local communities, conservation institutions, and government bodies to track impacts on groundwater, air quality, bird nesting success, and pastoralist grazing access.
6. **Strengthen Regional and Transboundary Governance:** Engage the East African Community (EAC) and Lake Natron-Magadi Basin stakeholders to co-

develop water governance protocols, early warning systems, and disaster risk reduction plans.

7. **Adopt Clean Technologies and Circular Production Systems:** Developers should commit to zero-liquid discharge, renewable energy integration, and use of low-carbon soda ash production technologies aligned with climate-smart industrialization goals.

Conclusion

The Engaruka–Lake Natron area is not only a national asset but a global ecological treasure. While Tanzania has the sovereign right to pursue development, this must be balanced against international environmental commitments and the risk of irreversible ecological loss. WWF urges the Government of Tanzania and project stakeholders to adopt a precautionary, inclusive, and science-led approach—demonstrating that nature-positive development is not only possible, but essential.

Prof Noah Sitati

SOKNOT Tanzania Lead

WWF Tanzania

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

UNESCO NATIONAL COMMISSION

Our Ref.
UNESCO/NC/CLT/WHC/25/I/ 80 Date: 8th September, 2025

Director General,
Ngaresero Valley Company Limited (NC),
P. O. Box 77910,
DAR ES SALAAM.

RE: SUBMISSION OF FIELD OBSERVATION REPORT OF AN AREA PROPOSED FOR TRONA EXTRACTION AND SODA ASH PRODUCTION IN LAKE NATRON AT WOSIWOSI VILLAGE, LONGIDO DISTRICT COUNCIL IN ARUSHA REGION IN COMPARISON TO LAKE MAGADI IN KENYA

The heading above refers.

2. The National Commission for UNESCO of the United Republic of Tanzania received a request from Ngaresero Company Limited on 15th July 2025, concerning the field visit for comparative study to an area of the proposed project of trona extraction and soda ash production in Lake Natron at Wosiwosi village in comparison to the area where production had been taking place since 1911 at Lake Magadi in Kenya. The main goal of the company's invitation to UNESCO National Commission was to let the Commission to compare and recommend with informed knowledge on the proposed project.

3. The National Commission for UNESCO of the United Republic of Tanzania (URT) is mandated to oversee UNESCO activities in the country including the implementation of the UNESCO 1971 Convention for Ramsar Sites and the UNESCO 1972 Convention for the World Heritage Sites, which the United Republic of Tanzania is a signatory. The Commission cooperates well with different stakeholders to ensure that, all World Heritage Sites in Tanzania including the Ngorongoro Conservation Area, Lake Manyara Man and Biosphere Reserve (MAB) and Ramsar Sites are well preserved and protected for the present and future generations.

4. Therefore, to ensure that the Ngorongoro Conservation Area maintains its Outstanding Universal Values (OUVs) to which they were inscribed and that, the Lake Manyara Biosphere Reserve maintains its credibility of a MAB, the Commission accepted the invitation and appointed three staff, basing on their areas of expertise, these were (1) Chotimbao Tinda-Community based issues expert, (2) Godfrey Munuo-Environmental expert and (3) Noel Yocta

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- Biodiversity and marine science expert. The team of three experts undertook a visit for field study to an area of the proposed project and to the area with existing similar project in Kenya and how they address and mitigate on environmental issues.

5. The Commission recommends and advises the Ngaresero Company Limited to fully abide to all stakeholders opinions and recommendations for the proposed project so as to comply with the rules and procedures for the establishment, construction and production in the World Heritage Site.

6. It is our expectation that, our recommendation and those of other stakeholders will help you in making the correct decision on this matter and lead to protecting, conserving and creating sustainable development to the beautiful Ramsar site and natural Heritage sites for our present and future generations.

7. Herewith, please find the attached field report based on our observation and comparative study we had undertaken during the site visit.

8. Thank you for your continued cooperation.

Prof. Hamisi M. Malebo
EXECUTIVE SECRETARY

Copy:

Director General,
National Environmental Management Council (NEMC),
P.O. Box 63154 ,
DAR ES SALAAM.

JAMHURI YA MUUNGANO WA TANZANIA
WIZARA YA MALIASILI NA UTALII
MAMLAKA YA HIFADHI YA NGORONGORO

Unapojibu tafadhali taja:

Kumb. Na. CD.389/540/01-H/20 08 Julai, 2025

Ngaresero Valley Company Limited (NVCL),
Ukwamani, Nearby Kawe Mosques Kinondoni,
S.L.P. 77910,
DAR ES SALAAM.

Barua pepe: khalid@ngareserosoda.com

Simu: 0767 080 734

Yah: **KUWASILISHA MAONI JUU YA UJENZI MRADI WA MAGADI SODA KATIKA ZIWA NATRON – MONDULI**

Tafadhali husika na mada tajwa hapo juu.

2. Kama utakavyokumbuka, kupitia barua yako ya tarehe 08 Mei, 2025, uliomba kupatiwa maoni kuhusu ujenzi wa Mradi wa Magadi Soda katika Ziwa Natron. Kufuatia maombi hayo, kilifanyika kikao tarehe 30 Juni, 2025 katika ukumbi wa Hema uliopo Makao Makuu ya Mamlaka ya Hifadhi ya Ngorongoro (NCAA). Kikao hicho kilihusisha wataalam wa Mamlaka ya Hifadhi ya Ngorongoro na Mwekezaji aliyeambatana na Mtaalam wa Mazingira wa Mradi.

3. Katika kikao hicho, pamoja na mambo mengine yaliyojadiliwa, Wataalam wa NCAA walitoa maoni kuhusu utekelezaji wa Mradi huo. Kwa barua hii nawasilisha rasmi maoni ya Mamlaka kuhusu Mradi wa Magadi Soda katika Ziwa Natron kwa utekelezaji wako.

4. Ninashukuru kwa ushirikiano wako.

Aidan P. Makalla
Kny: **KAMISHNA WA UHIFADHI**

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Barua zote zielekezwe kwa Kamishna wa Uhifadhi

RECOMMENDATION OF LAKE NATRON

In response to the correspondence dated 8th May 2025 regarding the proposed Trona Extraction and Soda Ash Production at Wesiwasi Village, Lake Natron, the NCAA acknowledges its role as a key stakeholder in safeguarding the ecological integrity of this region.

It is recognized that Lake Natron and Ngorongoro Conservation Area (NCA) are ecologically interconnected, sharing important geological, hydrological, and biological linkages that support the survival of migratory birds-especially flamingos-and local communities through sustainable pastoralism. This co-dependence reinforces the need for responsible development that ensures conservation and economic progress can coexist.

General Observation

i. The proposed project has the potential to impact the environment through; Disturbance, and disappearance of the lesser flamingo (Near Threatened) and Greater flamingos (Least Concern) in Lake Natron and Environmental pollution in terms of water, air, waste generation and its contribution to climate change impacts.

ii. Ecologically, Lake Natron is one of the important bird areas IBAs, and a breeding site for the lesser and greater flamingoes, of which NCA specifically flamingoes from Lake Magadi, Lake Empakai, Lake Eyasi, and Lake Manyara have a connective ecological correlation with the flamingoes' breeding sites and food, algae. Lake Natron as a Ramsar Site stand for wetland with international significance are important for over 300 bird's species sharing resources of the alkaline lakes including the lake Magadi, lake Empakai, Lake Eyasi in NCA, and lake Manyara in the Manyara Region.

iii. The flamingoes, and Pelican are well known as migratory birds that utilize the lake natron as a breeding site, that have ecological correlation with the alkaline lakes, such as those found in the Ngorongoro Conservation Area (Lake Magadi, Lake Empakai, Lake Eyasi, and Lake Manyara in the Manyara Region).

iv. NCA as a protected area, stands affected if the project does not confer the detailed EIA to rectify the possible environmental impact due to the ecological connectivity of the Important Bird Areas, which flamingoes depend on for breeding site, habitat, cover, and escape site.

Recommendation

For the proposed project to be sustainable a great deal on the conservation aspect should be a number one priority, the following are NCA recommendations as part of the ongoing Environmental and Social Impact Assessment.

i. The Environmental and Social Impact Assessment (ESIA) must thoroughly address every aspect of the proposed project—from baseline conditions and potential environmental and social impacts (including cumulative effects) to detailed mitigation measures, monitoring plans, and compliance with legal and regulatory frameworks.

ii. Thorough and meaningful engagement with all stakeholders is crucial for any development at Lake Natron, and must be conducted comprehensively and with sensitivity to local and environmental interests.

iii. Although local communities around Lake Natron don't rely directly on the lake for fishing or water supply, it is essential that they are fully engaged so their interests are integrated into all stages of proposed project planning and implementation.

iv. To prevent irreversible environmental and social impacts from the proposed project, it is highly recommended to implement rigorous, multi-component monitoring—at defined intervals—for avifauna adaptation, lake-water chemistry, air quality (including deposition of nitrogen and phosphorus), and wildlife populations. The monitoring program should establish baseline conditions, set action-and-limit thresholds, enable stakeholder participation, and trigger adaptive management when thresholds are breached.

v. The project is encouraged to integrate sustainability into its operations by adopting eco-industrial tourism models, which will showcase conservation practices alongside mineral production, providing educational and economic value.

Conclusion

NCAA has no objection to the proposed project, considering the project planning is aware of the ecological nature of Lake Natron. Therefore, the proposed industrial project in the area must undergo a thorough Environmental and Social Impact Assessment (ESIA). This process should actively involve all stakeholders, including local communities, to identify and mitigate potential environmental risks, ensuring the preservation of biodiversity and the promotion of sustainable development. Additionally, continuous monitoring and evaluation are essential to assess the long-term impacts and effectiveness of conservation efforts.

International Union for Conservation of Nature (IUCN)

TECHNICAL REVIEW OF THE ES AND RISK MANAGEMENT PLAN FOR THE PROPOSED SODA ASH MINING IN LAKE NATRON RAMSAR SITE BY NATURE TANZANIA

1. **Background**

Ngaresero Valley Company Ltd asked Nature Tanzania to review their Environmental Statement (ES) and risk management plan for their proposed soda ash mining project at Lake Natron Ramsar Site. The following are observations from our review so far.

2. **Introduction**

Lake Natron is a Ramsar-designated wetland and the only breeding site for East Africa's Lesser Flamingos, a near-threatened species. Like all closed-basin lakes of the East African Rift, it has experienced fluctuations in both level and extent over the past twenty years. Unlike Lake Magadi, which is bounded by steep faults, Lake Natron has relatively shallow, low-angled margins. As a result, flooding can spread across vast, broad mudflats during exceptionally wet years. The proposed industrial activities—dredging, chemical processing, and infrastructure development—pose a direct threat to the lake's fragile ecosystem, potentially altering its chemical composition and disrupting the food chain that supports flamingos and other endemic species.

Lesser Flamingos breed in Lake Natron intermittently and in massive synchronous events when site conditions (water depth, salinity, island substrate, absence of predators) are suitable. Their breeding success depends on a very narrow range of hydrological and chemical conditions that produce exposed nesting islands protected by shallow caustic waters and high salinity (this deters terrestrial predators). Any sustained change in water level, influx of fresh water, dredging, or shoreline modification can eliminate or flood nesting islands or, conversely, remove the saline moat that protects nests. Thus, alterations to hydrology or direct shoreline works would likely prevent successful breeding.

The proposed extraction of 1,000,000 metric tons of soda ash annually, regardless of the mining method or technology used, would be overwhelming and could disrupt the balance between development and conservation of the lake and its inhabitants. This large quantity alone could be a major concern for environmental and ecological aspects. Given its environmental and ecological sensitivity, the project's implementation will undoubtedly threaten the lake's hydrology and, consequently, the survival of Lake Natron and its inhabitants. The degradation or loss of lacustrine habitats linked to the project could severely impact waterbirds. Therefore, establishing the soda ash extraction and processing plant, along with all supporting infrastructure, will cause considerable ecological and environmental damage within the fragile Lake Natron ecosystem.

Furthermore, based on the overall analysis of the provided environmental statement and risk management plan, serious concerns are raised by the significant misunderstandings and internal contradictions for a proposed project of this scale and sensitivity. Important parts of the documents demonstrate a fundamental ignorance of the biological, ecological, and hydrological realities and complexities of Lake Natron Ramsar Sites.

3. **General comments**

3.1 The proposed project to extract 1,000,000 metric tonnes per year is alarming, and given its duration, it poses a significant threat to the environmental and ecological aspects of a wetland of international importance like Lake Natron.

3.2 We note **insufficient baseline data.** Without proper, detailed, and independent supporting studies and a baseline by qualified experts, the entire ES is no more than a scoping exercise that cannot quantify impacts.

3.3 There have not been adequate ecological and hydrological surveys by professional and qualified experts, and therefore, the ES is inadequate for making decisions with such far-reaching consequences. Without proper, detailed, and systematic quantification of impacts, it is impossible to develop effective mitigation measures.

3.4 The ES draft report lacks details on the current state of Lake Natron's hydrogeology, water chemistry, and sedimentology. Due to weather variability, it remains uncertain whether the minimum water volume requirements will consistently sustain the hydrological system while maintaining social demands in Tanzania and Kenya (Ewaso Ng'iro River).

3.5 The ES does not specify the extent of current major threats, such as climate change and human activities. This is because implementing the proposed project is likely to exacerbate these existing threats.

3.6 Repeated comparisons of Lake Magadi to argue that flamingos are unaffected by soda ash mining are factually wrong and reveal a serious ecological misunderstanding. The presence or absence of birds is not a sufficient measure of impact, and the hydrogeology of Lake Natron is more complex than that of Lake Magadi.

3.7 The substantial water requirements pose a critical threat, risking the depletion of fresh groundwater, contaminating aquifers, and compromising the delicate lacustrine habitat. This would lead to water scarcity and disastrous consequences for the entire ecosystem.

3.8 Given the duration of the proposed project, the ES lacks a comprehensive hydrological modelling study to assess the full impact of the proposed developments, including the dam, river abstractions, and soda extraction, on Lake Natron's water levels and chemistry. Current assessments rely on a single flow measurement from the Ewaso Ng'iro River, which fails to capture seasonal and interannual variability. Furthermore, the proposed dam on Ewaso Ng'iro flood/rain flows is not well supported by hydrology, storage yield, spillway design, or downstream impact analysis.

3.9 No ecological flow requirements are defined for key perennial lagoons, springs, and river deltas that support flamingo nesting/juveniles and other biota. This critical information is required before any decision-making towards the project approval process.

3.10 We note insufficient water supply details. Further details are required regarding the water supply, both on the surface and underground. Without a reliable supply, even the proposed project cannot succeed; most importantly, it will lead to the collapse of the entire ecosystem, given the project's duration.

3.11 The ES fails to account for how declining river flow caused by climate change and increased social pressure for water diversion could significantly impact Lake Natron and any soda plant.

3.12 The documents indicate a lack of understanding of hydrogeology, especially concerning the reuse and reinjection of water from the plant.

3.13 Despite acknowledging chemistry sensitivities, there is no explicit link between operations and cyanobacterial productivity.

3.14 The ES states that factory construction and soda ash extraction will pose less environmental risks, but the criteria used to reach this conclusion are not substantiated.

3.15 Lake Natron is a global breeding site for Lesser Flamingos. The report is weak on the review of the impact on other habitats, such as Lakes Manyara, Ngorongoro Crater, Mommela Lakes, Magadi, Bogoria, Nakuru, and many smaller ones. Furthermore, the Lake Natron ecosystem has a wide variety of wildlife. There is a strong reason to have a comprehensive review of human-wildlife interactions.

3.16 The proponent does not provide data or scientific evidence to justify the site selection, i.e., Wosiwosi.

3.17 The list of consulted institutions omits important stakeholders with a strong interest in Lake Natron. This includes eight other villages around the lake, Monduli and Ngorongoro district councils, NGOs, academia and researchers, tour operators, and relevant Kenyan authorities (as required by the Transboundary Ecosystems Management Bill of 2010). Some of these stakeholders possess critical knowledge and data about the site, which will inform any decision-making process regarding this project.

3.18 Consultations with the existing technical contributors to the Lake Natron Consultative Group are missing. Many of the individuals and institutions mentioned in the report are still active. The report does not appreciate summaries. We would have expected a deeper consultation with institutions with interests in Lake Natron to be more in-depth.

3.19 The report should have considered why the TATA Chemicals Ltd proposal was halted and why this particular time was chosen. Since the 2008 decision to stop soda ash mining in Lake Natron, the government has moved all soda ash mining prospects to the Engaruka Basin. A tender was announced in December 2024.

3.20 Lake Natron has global interest—a Ramsar site. We need to be careful to maintain compliance before drafting the proposed project, addressing all provisions. This 300-page-plus document has serious gaps.

4. **Specific comments on the ES**

4.1 The statement that "The project and Lesser Flamingo can co-exist as in Magadi, Kenya" is a serious misunderstanding that confirms serious ecological ignorance. Flamingos in Lake Magadi do not co-exist with the soda ash plant, and Lake Magadi is not comparable to Lake Natron. Lesser Flamingos have only attempted to breed at Lake Magadi once in over 70 years of recording, and this effort was unsuccessful. In fact, there is evidence that flamingo species decline in abundance at lakes pressured by mining activities.

4.2 The proposal claims that the "Wosiwosi location is far removed from ecologically sensitive areas, such as flamingo nesting sites and ecotourism hubs." This is fundamentally incorrect and further demonstrates the ecological misunderstanding. Gelai lagoons, including the Wosiwosi area, are also one of the important sites for Lesser Flamingo breeding ecology. Therefore, industrial development on the shoreline of Wosiwosi will significantly affect chick feeding in the Southern and Gelai lagoons during breeding years.

4.3 The ES document states that "Soda ash processing requires significant amounts of water for various production processes." This already will already seriously damage one or more chick feeding lagoons, which is highly likely to negatively impact the lesser

flamingo populations in East Africa and globally, since Natron is the largest global breeding site.

4.4 The fresh groundwater needed is 192 cubic meters per hour is significant, but no attempt has been made to explain and quantify how the competition for this already scarce resource by the factory, local communities, livestock, and wildlife and how it will be addressed.

4.5 According to the ES, the project site at Wosiwosi Village is strategically located away from sensitive springs and eco-tourism zones. This demonstrates further ecological ignorance of the writers. The consultants overlook the fact that the entire Lake Natron is fragile and ecologically sensitive, where everything interacts as a functioning unit. Any activity in the northern lake zone will have a domino effect on the southern end, and vice versa.

4.6 The statement that "Village members raised the issue of Flamingo birds at Lake Natron and said that the implementation of the Soda Ash project will not pose any significant impact on flamingos since on the other side (Kenya side) at Magadi Lake there is the same Soda Ash project and flamingo birds still survive well" is not factual and further demonstrates the ecological ignorance.

4.7 The Wastewater Discharge Management section is generic and appears to be a **"cut and paste" job**, failing to address specific and critical issues.

4.8 The ESIA documents say that "The project's operations must align with the principles of the Ramsar Convention." Still, there is no evidence throughout the documents to show that this will be the case.

4.9 All anticipated impacts are based on opinion and not quantified by evidence. A full Environmental Impact Assessment (EIA) for this site **IS REQUIRED**, which includes ecological data and impact assessments conducted by qualified avifaunal experts, before any decision-making towards the project approval process.

5. **What should be done**

5.1 Because Lake Natron is a Ramsar site and supports globally important flamingo breeding, the precautionary principle should be observed.

5.2 Qualified experts must redo comprehensive biodiversity assessments and cumulative impact analyses to identify and quantify impacts systematically.

5.3 The possibility of short-term climate changes should be addressed in all plans.

5.4 Given the proposed project duration, comprehensive sedimentological and palaeolimnological studies, including coring of lake sediments, are urgently required. These analyses are vital for understanding the lake's history, palaeohydrology, and how its ecosystem has evolved over recent decades. The data derived from these studies should be systematically used to identify and quantify the potential impacts of the proposed project.

5.5 The impact of sourcing materials locally, such as sand, stones, and timber, should be systematically identified, assessed, and quantified.

5.6 A detailed hydrological modelling study is essential to systematically identify, assess, and quantify. Furthermore, the impact of water abstraction from the Ewaso Ng'iro River on biodiversity and communities should be systematically identified, assessed, and quantified.

5.7 The discharge of industrial brine into the lake is unjustified and will cause irreversible harm. The claim that it will have "no adverse impact" is vague and incorrect. Further systematic analysis is required.

5.8 The hot springs have not been thoroughly studied, and the assumption of their consistent flow remains unproven. Independent, detailed research is needed to identify, evaluate, and measure impacts systematically.

5.9 A detailed hydrogeological survey of the basin must be conducted before any planning or decision is made.

5.10 Regarding the proposed dam on Ewaso Ngiro flood and rain flows, conduct hydrology, storage yield, spillway design, or downstream impact analysis.

5.11 All stakeholders interested in Lake Natron, including the eight villages around the lake that have not been consulted, Ngorongoro and Monduli district councils, tour operators, Engaresero Eramatare Community Development Initiative (EECDI), a CBO based in Magadi village, NGOs, and researchers, among others, must be formally consulted.

5.12 Furthermore, under the Transboundary Ecosystems Management Bill of 2010, relevant Kenyan authorities must be consulted to avoid regional disputes and conflicts over shared resources.

6. **Conclusion**

Because Lake Natron is a Ramsar site and supports globally important flamingo breeding, the precautionary principle should be observed. Any proposal that would reduce or alter inflows requires a basin-scale Strategic Environmental Assessment (SEA), transboundary consultation, and a formal Ramsar Advisory Mission. Existing evidence indicates a high risk of irreversible harm; therefore, proposals should not proceed until independent studies by qualified experts are conducted, and impacts are systematically identified and quantified.

We also comment that, regardless of how well the project design is developed or how technologically advanced the methods used are, the extremely sensitive nature of the current proposed project site cannot accommodate any further pressure beyond what currently exists. Given the above significant shortcomings, it is evident that the proposed soda ash mining project at Lake Natron Ramsar Site should not proceed, as even the best mitigation measures would be inadequate to prevent irreversible long-term damage.

The Environmental Statement recognises alternative development models such as community-based ecotourism. In Lake Natron, ecological costs outweigh the proposed economic benefits. The government has already proposed soda ash mining at Engaruka Basin, and significant progress has been made, indicating that an alternative for soda ash mining is already available away from the sensitive ecosystem of Lake Natron.

We appreciate your understanding of the above matters. We will continue to review these documents thoroughly and will share additional and detailed concerns during the next phases of the EIA process. Thank you very much.

Yours truly,

Emmanuel Mpinzile

Executive Director – Nature Tanzania

Eastern and southern Africa Coordinator for the IUCN-SSC Flamingo Specialist Group

5

TECHNICAL REVIEW OF THE ES AND RISK MANAGEMENT PLAN FOR THE PROPOSED SODA ASH MINING IN LAKE NATRON RAMSAR SITE BY NATURE TANZANIA

1. **Background**

Ngaresero Valley Company Ltd asked Nature Tanzania to review their Environmental Statement (ES) and risk management plan for their proposed soda ash mining project at Lake Natron Ramsar Site. The following are observations from our review so far.

2. **Introduction**

Lake Natron is a Ramsar-designated wetland and the only breeding site for East Africa's Lesser Flamingos, a near-threatened species. Like all closed-basin lakes of the East African Rift, it has experienced fluctuations in both level and extent over the past twenty years. Unlike Lake Magadi, which is bounded by steep faults, Lake Natron has relatively shallow, low-angled margins. As a result, flooding can spread across vast, broad mudflats during exceptionally wet years. The proposed industrial activities—dredging, chemical processing, and infrastructure development—pose a direct threat to the lake's fragile ecosystem, potentially altering its chemical composition and disrupting the food chain that supports flamingos and other endemic species.

Lesser Flamingos breed in Lake Natron intermittently and in massive synchronous events when site conditions (water depth, salinity, island substrate, absence of predators) are suitable. Their breeding success depends on a very narrow range of hydrological and chemical conditions that produce exposed nesting islands protected by shallow caustic waters and high salinity (this deters terrestrial predators). Any sustained change in water level, influx of fresh water, dredging, or shoreline modification can eliminate or flood nesting islands or, conversely, remove the saline moat that protects nests. Thus, alterations to hydrology or direct shoreline works would likely prevent successful breeding.

The proposed extraction of 1,000,000 metric tons of soda ash annually, regardless of the mining method or technology used, would be overwhelming and could disrupt the balance between development and conservation of the lake and its inhabitants. This large quantity alone could be a major concern for environmental and ecological aspects. Given its environmental and ecological sensitivity, the project's implementation will undoubtedly threaten the lake's hydrology and, consequently, the survival of Lake Natron and its inhabitants. The degradation or loss of lacustrine habitats linked to the project could severely impact waterbirds. Therefore, establishing the soda ash extraction and processing plant, along with all supporting infrastructure, will causes considerable ecological and environmental damage within the fragile Lake Natron ecosystem.

Furthermore, based on the overall analysis of the provided environmental statement and risk management plan, serious concerns are raised by the significant misunderstandings and internal contradictions for a proposed project of this scale and sensitivity. Important parts of the documents demonstrate a fundamental ignorance of the biological, ecological, and hydrological realities and complexities of Lake Natron Ramsar Sites.

Yours truly,

Emmanuel Mpinzile

Executive Director – Nature Tanzania

Eastern and southern Africa Coordinator for the IUCN-SSC Flamingo Specialist Group

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

STAKEHOLDER CONSULTATION FORM

Institution: Ngorongoro Conservation Area Authority **Date:** 18th March, 2025

S/N	Name/Position	Comments	Phone/Signature
	Dr. Agness Gidna; **Coordinator for the Ngorongoro Lengai UNESCO Global Geopark & Head of Ngorongoro Geopark Museum**	Although the proposed extraction of the Trona will be conducted in Lake Natron which is outside the Ngorongoro Lengai UGGp boundary, it seems the project permanent facilities and other logistics will be conducted in Gelai Lumbwa found within the geopark territory. As indicated in the geopark boundary map. According to UNESCO Global Geoparks operational guidelines, **article** 3 (vii), it is illegal for any geopark to be involved in extractions of minerals, fossils or rocks products business within UNESCO Global Geopark territory. **Option:** Shift project facilities on the other side of the Lake/outside the geopark boundary (Gwasa, Hamahi, Mfomalaga)	0784790747 gidnaagness@gmail.com

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

S/N	NAME/POSITION AND INSTITUTE	COMMENTS	DATE AND SIGNATURE
1.	Geers w Sumay, Regional Environmental Officer, Arusha	I am positive about the project since it is going to be beneficial to the Community adjacent and country at large. I am also supporting the project because the Community concerns were considered and in case of negative impacts mitigation measures will be taken.	2/7/2025
2.	Samuel Nasson Tarimo	- Community views has been received & the Project at whole will not further has positive economic input to the community and also contribution to the country GDP	Signature
3.	Sayla F. Chuma, Conservation Officer F, Tanapa	- Based on the comments brought by the project I positively support the project with the understanding that all negative impact & the project should be well addressed and practical mitigation measures are put in place.	02/07/2025

PROPONENT: **Ngaresero Valley Resource Co. Ltd (NVRCL)**

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

STAKEHOLDER CONSULTATION FORM

Institution: National Development Corporation **Date:** 2/8/2025

S/N	Name/Position	Comments	Phone/Signature
1	Godfrey Nahunda Senior Engineer	Soda Ash Project at Lake Natron can be implemented Considering the lesser Flamingo is not disturbed to the extent that can limit their breeding	0754787497

JAMHURI YA MUUNGANO WA TANZANIA
WIZARA YA MALIASILI NA UTALII

Telegram: "MALIASILI"
Simu:255 026 2321566/2321567
Email: ps@maliasili.go.tz

Unapojibu tafadhali taja:

Mji wa Serikali Mtumba,
Mtaa wa Ardhi,
Barabara ya Waziri Mkuu,
S.L.P. 1351,
DODOMA.

Kumb. Na. BA. 388/389/01

07 Oktoba, 2025

Ngaresero Valley Company Limited (NVC),
P. O. Box 77910,
DAR ES SALAAM.

Yah: **MAONI KUHUSU TATHMINI YA ATHARI KWA MAZINGIRA (EIA) KWA MRADI PENDEKEZWA WA UCHIMBAJI WA TRONA/BRINE NDANI YA ZIWA NATRON**

Wizara inakiri kupokea barua yako ya tarehe 12 Julai, 2025 kuhusu nia ya kujenga kiwanda cha uchimbaji wa madini soda Trona/Brine katika Ziwa Natron hususan katika kijiji cha Wosiwosi, Kata ya Gelai lumbwa, Wilaya ya Longido.

2. Baada ya kupitia barua hiyo, Wizara imebaini kwamba pamoja na maoni ya wadau mbalimbali juu ya mradi tajwa wapo wadau muhimu kama TAWA na wananchi wa vijiji husika hawajafikiwa kwa ajili ya kupata maoni yao. Sambamba na hilo, imebainika kuwa zipo athari za kikolojia, kimazingira, kiuchumi na kijamii zinazoweza kusababishwa na Mradi wa Uchimbaji wa Madini Soda na hivyo kuhatarisha viumbe adimu kama heroe wadogo, kuathiri shughuli za utalii, kuathiri mfumo haidrolojia, athari kwa jamii ya watu wanaoishi na kutumia eneo husika, migogoro kati ya wananchi na mamlaka za serikali pamoja na athari za kiutalii (Maoni ya Wizara yameambatishwa).

3. Kwa kuzingatia hayo Wizara inashauri yafuatayo:-

i. Ifanyike Tathmini ya Mazingira Kimkakati (Strategic Environmental Assessment - SEA) ili kuisaidia Serikali kuona namna bora ya kuendelea na kazi hii. Hatua hii itasaidia pia kupima faida zitakazotokana na Mradi pamoja na madhara ya Mradi husika,

ii. Jamii na mamlaka zote zinazohusiana na eneo husika ikiwemo TAWA na wananchi wanaozunguka eneo hili zishirikishwe kikamilifu kwa kufanya mikutano ya wananchi na kupata maoni yao kwa lengo la kuondoa hofu inayoweza kutanda kwa jamii, na

iii. Wizara ya Maliasili na Utalii ishirikishwe kikamilifu katika hatua zote za SEA.

4. Ninakushukuru kwa ushirikiano wako.

Dkt. Hassan Abbasi
KATIBU MKUU

ORODHA YA MAONI YA WIZARA JUU YA MRADI PENDEKEZWA WA UCHIMBAJI WA TRONA/BRINE NDANI YA ZIWA NATRON

i. Eneo la Ziwa Natron linatambulika kwa Mkataba wa Ramsar kuwa ardhioevu muhimu kimataifa na hivyo uanzishwaji wa shughuli za viwanda katika eneo husika utaharibu hadhi ya eneo eneo hili kimataifa na kuzalisha sintofahamu kati ya Jamhuri ya Muungano wa Tanzania na Ramsar Convention hali ambayo haitakuwa na mwisho mzuri.

ii. Mradi wa Uchimbaji madini soda utaleta athari hasi za kimazingira ikiwemo kuathiri mazalia ya ndege aina ya Heroe wadogo (Lesser flamingo) milioni 1.5 hadi 2.5 sawa na asilimia 75-80% duniani ambao huzaliana katika eneo la Ziwa Natron. Aidha uchimbaji huu utaleta athari kwa viumbe wengine adimu wakiwemo samaki ambao wanapatikana katika Ziwa hilo pekee (Endemic fish): *Alcolapia ndalalani* na *Alcolapia latirabris*.

iii. Uchimbaji wa magadi soda utavuruga uwiano uliopo wa kihaidrolojia na kikolojia ya ziwa ikiwemo algae muhimu ambao ni chakula cha Heroe na hivyo kufanya uwezekano wa idadi ya ndege hao kupungua au kuisha kabisa. Hii pia italeta mabadiliko katika viwango vya maji na Magadi hivyo kuathiri ukuaji wa algae.

iv. **Ujenzi wa kiwanda hiki utaathiri ushoroba wa wanyamapori wahamao kutoka hifadhi moja hadi nyingine mfano Ngorongoro, Ziwa Manyara na Tarangire.**

v. Mradi huo utasababisha uhaba wa maji kwa kuzingatia kwamba eneo hilo ni mojawapo ya maeneo makame na linapata mvua chache huku jua na joto kali zaidi ya nyuzi 40 zikiondoa maji kwa mvuke. Hali hii, italeta migogoro kati ya jamii na wanyamapori.

vi. Uchafuzi wa hewa kutokana na vumbi na kemikali utaongeza jotoridi katika eneo la Ziwa Natron na moshi wenye kemikali kutoka kiwandani, hivyo kuhatarisha uhai wa bioanuai.

vii. Taarifa za kitafiti za Kikanda kutoka Ziwa Magadi nchini Kenya zinathibitisha madhara makubwa ya mradi kama huo kwa jamii. Hata baada ya miaka 100 ya uchimbaji wa magadi soda nchini Kenya, jamii haijafaidika zaidi ya kusababisha uharibifu wa mazingira, uhaba wa maji safi, kupunguza umri wa kuishi na kupunguza malisho.

viii. **Mandhari ya kipekee ya Ziwa Natron na makundi makubwa ya Heroe ni vivutio muhimu vya watalii, vinavyochangia uchumi wa eneo hilo pamoja na serikali kupitia hoteli, safari na biashara. Uharibifu wa mazingira kutokana na kiwanda cha magadi soda utadhuru sekta ya utalii na maisha ya jamii yanayotegemea sekta hiyo. Mfano Kijiji cha Engaresero ambacho ni kitovu cha Utalii katika eneo hili kitapoteza tunu hii na shughuli zote yakiwemo makambi ya utalii na shughuli za kibiashara za wananchi kuathirika**

ix. Uanzishaji wa kiwanda hiki utalazimu kuhamishwa kwa wananchi wanaotegemeza maisha yao katika ufugaji na utalii katika eneo husika

x. **Ziwa Natron na maeneo yanayoilzunguka yana umuhimu wa kiutamaduni na imani kwa jamii za eneo hilo. Maendeleo ya viwanda yataathiri maeneo haya ya urithi wa kitamaduni na desturi za muda mrefu**

xi. Eneo pendekezwa ni eneo la mwekezaji wa kitalu cha uwindaji wa kitalii Adam Clemence safari Ltd. chini ya usimamizi wa TAWA na hivyo upo uwezekano wa kuingia katika mgogoro wa kisheria na hata kusababisha Serikali kushitakiwa hasa kwa kuzingatia kuwa wadau hawa muhimu hawajashirikishwa mpaka sasa.

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

STAKEHOLDER CONSULTATION FORM

Institution: TARURA Date: 02/04/2026

S/N	Name/Position	Comments	Phone/Signature
	LAWRENCE GAMALIEL MSEMO DISTRICT MANAGER	The proposed roads and their conditions to be improved from Longido to Wosiwosi are as follow:- 1. THE MATALE-WOSWOSI(6 km) is in POOR CONDITION 2. THE GELAI-LUMBWA-MAGADENI ROAD(45.8 km) is in POOR CONDITION	0764323810 / 0655223616

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

STAKEHOLDER CONSULTATION FORM

Institution: NGORONGORO DC Date: 07/04/2026

S/N	Name/Position	Comments	Phone/Signature
	JULIUS K. NKOBO DEMO NGORONGORO DC	- The project can lead to impacts on water resources (i) High water demand for soda ash extraction (ii) Reduction of fresh water availability for local communities, wildlife and livestock - Water Pollution and Soil contamination (i) Discharge of alkaline waste (ii) Chemical residues - Impacts on Biodiversity i) Globally important ecosystem ii) Breeding site for lesser flamingos - Land degradation and Habitat destruction. The project should be under standard EIA framework so as to come with solutions for expected impacts.	0787243249

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

STAKEHOLDER CONSULTATION FORM

Institution: Ngorongoro District (Council) Date: 07.04.2026

S/N	Name/Position	Comments	Phone/Signature
1.	Joseph L. Mengoro Tourism Officer	The Project should consider and look at the following natural values of lake natron: ① Lake Natron is a breeding site/ground for lesser flamingos - 75% of the flamingo population build at Lake Natron. ② Lake Natron is very important and vital for Tourism (Ngare Sero gate) and also government provide tourism revenue in Kenya ③ Lake Natron is an International recognized area as a Ramsar Site, Wetland of International importance Ngorongoro Conservation Area Authority ④ The lake receive limited water supply due to siltation of two major rivers (Engaresero and Pinyinyi River) ⑤ The area is very important for biodiversity of both aquatic and terrestrial animals ⑥ Sustainability of lake water resource is very crucial ⑦ The government (District Council, local communities depend tourism revenue from Engaresero Lake water gate, therefore the project should not interfere / disturb the opportunity of the revenue collections ⑧ The Project should involves all relevant stakeholders particularly the local communities surrounding the lake natron ⑨ The Project brief should be clarified and briefly shared to relevant stakeholders especially local communities ⑩ Site validation is very important and should be done in participatory manner. ⑪ The final EPIT report regarding this project should be shared to the relevant key stakeholders	0755252700

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

STAKEHOLDER CONSULTATION FORM

Institution: TPDC Date: 13/04/2026

S/N	Name/Position	Comments	Phone/Signature
01	Jamila J. Lawen STAKEHOLDERS OFFICER	Even project activities via the website - have e- online application system. Name is TPDC 960 TPDC 895	Jamila

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

STAKEHOLDER CONSULTATION FORM

Institution: TANROADS - MA Date: 17/04/2026

S/N	Name/Position	Comments	Phone/Signature
1	Magreth M.Mlay (Env. Officer)	Uporaba wa barabara ya Soda Ash kimpwa changamoto inapotokea wakati kuna kupaka lami barabara za vumbi (TARS) ili muweze kupaka vizuri ni vizuri ya kupeak mchanga kwanza kabla kuchanganya mashine	0659 [illegible]

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED SODA ASH PROJECT AT WOSWOSI VILLAGE, OLELAI LUMBWA WARD, LONGIDO DISTRICT, ARUSHA REGION-TANZANIA.

STAKEHOLDER CONSULTATION FORM

Institution: TAWA DAS

Date: 19/1/2026

S/N	Name/Position	Comments	Phone/Signature
1.	MAGESHENI WA ZIWA (Engineer)	The transportation of the ash has to adhere to all the required standards of road load management so as not to deteriorate our roads which maintenance is very costly (expensive).	0744685 901

MINUTES OF THE ENVIRONMENTAL CONSULTATIVE MEETING BETWEEN NEMC (TANZANIA) AND NEMA (KENYA) ON THE PROPOSED SODA ASH PROJECT AT LAKE NATRON

Date: 19th January, 2026
Venue: Kajiado County, Kenya
Convened by: National Environment Management Authority (NEMA), Kenya at the request of WosWosi Soda Company and National Environment Management Committee (NEMC), Tanzania
Purpose: Consultative meeting to obtain experience and lessons from the soda ash extraction project at Lake Magadi to inform the proposed Soda Ash Project at Lake Natron, Tanzania.

1. Attendance

List of Participants and Affiliations

i. **Mr. Elibariki Bajuta** – Director of Compliance, NEMC
ii. **Mrs. Luhuvilo Mwamila** – Manager (Headquarters), NEMC
iii. **Mr. Peres Ntinginya** – Officer (Headquarters), NEMC
iv. **Mr. Ramadhani Rashidi** – Legal Officer (Headquarters), NEMC
v. **Mr. Benjamin Dotto** – Manager (Northern Zone), NEMC
vi. **Mr. Albert Loth** – Officer (Northern Zone), NEMC
vii. **Mr. Elimeleki Ukwai** – District Environmental Management Officer (DEMO), Longido, Tanzania
viii. **Mr. John Sule** – Tanzania Wildlife Authority (TAWA), Longido, Tanzania
ix. **Mr. Yesaya Kaoneka** – Woswosi Soda Company, Tanzania
x. **Mr. Mark Ondieki** – Director, Kajiado County, NEMA – Kenya
xi. **Mr. Dennis Ngonela** – Woswosi Soda Company, Tanzania

2. Meeting Agenda

1. Opening and introductions
2. Overview of the Soda Ash Project at Lake Magadi, Kenya
3. Discussion on environmental management and regulatory compliance of Soda Ash in Magadi, kenya
4. Community and environmental challenges associated with soda ash extraction in Kenya
5. Lessons learned and recommendations for the proposed Lake Natron project
6. Way forward and closing remarks

3. Proceedings and Discussions

3.1 Opening and Introductions

The meeting was opened by **Mr. Elibariki Bajuta**, Director of Compliance, National Environment Management Council (NEMC) of Tanzania. Participants introduced themselves and outlined the objective of consultative engagement.

The delegation from the National Environment Management Council (NEMC) of Tanzania, led by **Mr. Elibariki Bajuta**, expressed appreciation to NEMA for hosting the meeting and facilitating knowledge exchange regarding soda ash extraction and environmental management.

3.2 Presentation on the Lake Magadi Soda Ash Project

Mr. Ondieki provided an overview of the soda ash extraction project at Lake Magadi operated by Tata Chemicals Magadi.

Key points highlighted included:

- The soda ash project at Lake Magadi has been operational since **1913**, long before Kenya's independence and prior to the establishment of the current environmental regulatory framework.
- The project is **privately owned and operated** and occupies a large land area.
- The facility is connected to Kajiado through a **100 km railway line and a tarmac road**, both developed by the company.
- Environmental monitoring is conducted regularly by the company, with **compliance reports submitted to NEMA**.
- NEMA undertakes **quarterly inspection visits** to monitor compliance with environmental regulations.
- There are **no NEMA officers permanently stationed** at the project site.
- The company maintains **tree nurseries** as part of its environmental conservation and sustainability initiatives.
- No significant complaints related to **vibration or noise pollution** have been reported.
- It was also noted that **Lake Natron supports significant algae growth**, which serves as the primary food source for **Lesser Flamingos**.
- The Lake Magadi soda ash operations have coexisted with flamingo populations for over a century, demonstrating that properly managed extraction activities can align with wildlife conservation.

- Soda ash extraction is an established industrial activity within the East African Rift Valley, as evidenced by the long-standing operations at Lake Magadi.
- With appropriate environmental safeguards, effective monitoring systems, and active community engagement, the proposed Lake Natron soda ash project can support both economic development and ecological conservation.
- The importance of collaboration between environmental authorities in Kenya and Tanzania was emphasized, particularly in managing shared ecosystem concerns within the Rift Valley.
- The Magadi project demonstrates the value of community-focused initiatives, including employment opportunities, infrastructure development, and provision of social services.
- Adoption of modern soda ash extraction technologies would significantly help in minimizing adverse environmental impacts.

3.3 Environmental and Community Challenges Observed

During the discussions, Mr. Ondieki outlined several challenges associated with the Lake Magadi project.

a) Land Ownership and Compensation

Land ownership and compensation issues were highlighted as critical considerations in large-scale projects. It was emphasized that these matters must be addressed **early, transparently, and fairly** to avoid conflicts with surrounding communities.

b) Community Concerns

Some nearby communities have reported **damage to iron sheet roofing**, believed to be associated with emissions from the processing plant.

Participants emphasized the importance of:

- Careful **site selection for processing facilities**
- Maintaining adequate **distance between industrial facilities and residential settlements**
- Considering **prevailing wind direction** when locating industrial infrastructure.

4. Key Lessons and Recommendations for the Proposed Lake Natron Project

Based on the discussions and experience from the Lake Magadi project, the following recommendations were made:

1. **Protection of Flamingo Breeding Areas**
   Flamingo breeding sites should be clearly demarcated and protected from mining and development activities.
2. **Adequate Buffer Zones**
   Processing facilities, including the factory and related infrastructure, should be located **at least 500 meters away from residential areas**.
3. **Comprehensive Water Monitoring**
   Continuous monitoring of both **surface water and groundwater** should be conducted, focusing on water levels and chemical characteristics.
4. **Establishment of a Water Treatment Plant**
   Due to the environmental sensitivity of the area, a **water treatment plant should be established prior to any effluent discharge**.
5. **Adoption of Appropriate Technology**
   The use of advanced and environmentally responsible technologies was strongly emphasized. It was noted that appropriate technology can mitigate **up to 75% of potential environmental impacts**.

5. Action Points

Action Item	Responsible Institution	Timeline
Incorporate lessons learned from Lake Magadi into the planning of the Lake Natron Soda Ash Project	NEMC / Project Developers	During project planning
Ensure environmental protection measures for flamingo breeding habitats	Project Developers / Environmental Authorities	Prior to project implementation
Develop a comprehensive water monitoring program	Project Developers / Environmental Authorities	During EIA and operatio stages
Assess appropriate technology options for soda ash extraction	Project Developers	Prior to final project des
Ensure transparent land acquisition and compensation mechanisms	Government / Project Developers	Before project construct

6. Conclusion

The meeting provided an important platform for knowledge exchange between NEMA Kenya and NEMC Tanzania regarding the environmental and social considerations associated with soda ash extraction.

The Tanzanian delegation appreciated the insights shared by NEMA, which will help guide environmentally responsible planning and implementation of the **proposed Lake Natron Soda Ash Project**.

ATTENDANCE SCHEDULE

Environmental Consultative Meeting Held on 19th January 2026 Between NEMC (Tanzania), NEMA (Kenya), and Woswosi Soda Company on the Proposed Soda Ash Project at Lake Natron

Name	Position / Institution	Signature
Mr. Mark Ondieki	Director, Kajiado County – NEMA (Kenya)	
Mr. Yesaya Kaoneka	Woswosi Soda Company – Tanzania	
Mr. Dennis Ngonela	Woswosi Soda Company – Tanzania	

APPENDIX 3: MEETING MINUTES

HALMASHAURI YA WILAYA YA LONGIDO - ARUSHA, TANZANIA
MUHTASARI WA KIKAO CHA UTOAJI ELIMU JUU YA MRADI WA -
WAJUMBE WA HALMASHAURI YA SIKALI YA KIJIJI PAMOJA NA WA-ANALISHI WA KAMATA
CHA UCHIMBAJI MADINI - LEO TAREHE 03/10/2025

AGENDA ZA KIKAO:

01: KUFUNGUA KIKAO KWA SALA PAMOJA NA UTAMBULISHO WA WAGENI
02: TATHMINI ZA ATHARI ZA MAZINGIRA KWA MRADI WA UCHIMBAJI WA MADINI YA TRONA (UTAMBULISHO WA MRADI)
03: ATHARI CHANYA NA HASI
04: MASWALI, MAONI NA MAPENDEKEZO
05: KUFUNGA KIKAO.

01: KUFUNGUA KIKAO KWA SALA PAMOJA NA UTAMBULISHO:

Mdogo Mkiti wa kijiji alifungua kikao hicho kwa Sala fupi Mungu wa Sara Mbili na mwisho Amitabi (Asiomin) na kutambulisha kilejumbe wote pamoja na Viongozi wote walio wasili kwenye Kikao hicho.

Alitoa nafasi pia kwa wageni kujitambulisha Kila Mmoja na Cheo (nafasi) yake.

OFISA MTENDAJI KIJ... CHA MAGADINI / NATRON ... ARUSHA

02: UTAMBULISHO WA MRADI

Mdogo Mkiti alitoa nafasi kwa wageni waliofika kutoa elimu juu ya Mradi wanaotegemea kunufaika katika kijiji cha kitosiwosi.

Mmoja ya wanakikiti alisimama na kuanza kutambulisha Mradi huu wanaotegemea kuanzishwi karibuni.

Alianza kwa kueleza kuwa Mradi wanaotegemea (walipanga) ufanyike katika kijiji cha kitosiwosi, kata ya Gelai Lumbwa.

Kilanatengeja (kulenga) kufanya Uchimbaji wa Madini aina ya Trona kama Malighafi katika Utengenezaji wa Magadi kama bidhaa ya Mwisho.

Matarajio yote haya yalitokana na baada ya kuwa na hatua ya kuanza ya kufanya Utafiti yakini fursa ya upatikanaji wa madini hayo pia kwa kufuata taratibu Ulioelekezwa na Sheria zilizowekwa na sidi.

Walipanga kuyenga kilanda pamoja na makazi ya watanda kwa (wajitiwa na jamii), katika eneo la Hekari Mia nga na Hamsini (150) Sawa na 1.5 Km katika eneo la kijiji cha kitosiwosi. Ufafanuzi wa hekari kwa ni matumizi yake.

1:50 hekari → Ujenzi wa kilanda.

2:100 hekari → Ujenzi wa makazi ya watumishi ikijumuisha sehemu za Starehe, kanakana, Makanisa na misikiti Minara ya Mawasiliano, Shule, Hospital pamoja na Michezo.

OFISA MTENDAJI KIJIJI CHA MAGADINI / NATRON KARIBU

ATHARI CHANYA (FAIDA)

01: Ajira kwa jamii, alielezea uwepo wa Uzalishaji wa ajira katika nyanja kuu Mbili:

i) Ujenzi wa nafasi zaidi ya 100 (ikijumuisha na wenye utaalamu/kawaida na wasio na Taaluma).

ii) Uendeshaji wa Shughuli za Mradi, nafasi zaidi ya nafasi 300 (ikijumuisha wenye utaalamu na wasio na Taaluma).

02: Kuchangia Huduma za kijamii zinazozingatiwa na Mradi kwa kufuata Matakwa ya Sheria.

03: Uwepo wa Soko la Bidhaa za Vyakula, Agro na Malazi kutokana na Shughuli za Mradi.

04: Ulipaji wa kodi katika Serikali kuu, ili kuongeza Pato la Taifa.

05: Kuwepo kwa Mwingiliano wa Tamaduni katika jamii.

OFISA MTENDAJI KIJ... CHA MAGADINI / NATRON ... ARUSHA

ATHARI HASI (HASARA) NA UTATUZI

01: Uchafuzi wa hali ya Hewa kutokana na Vumbi wakati wa Shughuli za Uzalishaji.

02: Uwepo wa Kelele kutokana Shughuli za Uzalishaji

UTATUZI:

⇒ Kuna wataalamu wataweshauri njia Sahihi Zitakazotumika Kupunguza Vumbi na kadhalika Kuweka vile Utaalamu wa Mashine na Teknolojia Za kisasa.

08: Ukataji Miti na Mimea Eneo la Mradi.

04: Uwepo wa Uhaba wa eneo la Malisho kutokana na sehemu ya kuendesha shughuli za Mradi

05: Taarifa kupelekea Upungufu wa Uzalishaji Udega ama ya Flamingo kutika Ziwa Natron

UTATUZI:

Kalipendekeza kijiji cha kitosiwosi kutokana na ukifiti waliofanya kwani kuna Uparde kwa hakuna Viota vya ndege.

04: MASWALI, MAONI NA MAPENDEKEZO.

MASWALI: Kutoka kwa kilejumbe.

A: Jee ni yupi Muandaji wa Maoni haya, na je ni Utakika tipi tutakuwa nao kuwa Maoni Yanefika sehemu Sahihi na Husika.

MAJIBU:

MTL Consulting ndio watusika wakuu katika Utuaji wa Maoni haya kupitia Mihtasari ya Halmashauri ya Sikaliya kijiji na kuwasilisha barua la NEMC pia hata mo watapita kwa Ujiji kujiridhisha.

B: Jee Mkataba utaishia Wosiwosi tuu

MAJIBU:

Ndio Mkataba tuu utakihusiska kijiji cha kitosiwosi Tuu ila kwenye kunufaika ni pamoja na Vijiji/vya jirani yake.

OFISA MTENDAJI ... CHA MAGADINI / NATRON ... ARUSHA

...Kuona ipi ya Uhekezaji wata Hakikisha Kutokomoza au Kupunguza Athari Hasi Zilizotajwa.

MAJIBU:

Uhekezaji ata Hakikisha Utumiaji wa Mashine Zenye Teknolojia ya Juu Pamoja na Kutumia Wataalamu Waliobobea Ili Kupunguza na Athari Hizo

SWALI LA KUONGEZA KUTOKANA NA UHEKEZAJI

Ikiwa Ya Tanzania Ya Viwanda, Jee Tunakubaliana Nao au La.

MAJIBU: Kutoka kwa Kalajumbe.

⇒ Kwanza Elikuwa 50% kwa 50% ila kwa Sasani 0% Kabisa Kutokana na Kuona Hawana Fida za Viwanda Katika Jamii Yao.

MAONI NA MAPENDEKEZO YA WAJUMBE:

01: Inawezekana Kuwepo Kwa Uliggoro ya Uaneo ya Kijiji cha Uhekezaji Pamoja na Majirani zake.

02: Kupungua / Kupungua kwa eneo la Malisho na Chakula kwa Wanyama na Binadamu.

03: Uchafuzi wa Maringira upande wa Hewa na Maji, ambayo vitapunguza Chakula cha Ndege na Wanyama wa Majini.

04: Kupelekea Upungufu wa Shughuli za Kitalii.

05: Uharibifu wa Utamaduni wa Kimasai Kutokana na Uringiliano wa Jamii.

06: Inaweza Kupelekea Kupungua kwa ajira Kupitia Shughuli za Kitalii.

07: Utoaji wa elimu juu ya faida za Uhekezaji kwa Kwa jamii

08: Uhepo wa Joto Kali

09: Ajira Kaika Kuhepo ya Utakika Kwajamii Kiii ya wanasai Kutokana na Ukosefu wa Elimu.

10: Kupelekea (Overpopulation) Ongezeko la Watu.

11: Inaweza kupelekea Upungufu wa wanyamapori na Hata Viumbe hai wa majini.

12: Uharibifu wa Uanyani (Uaringira) Asilia Kutokana Na Shughuli hizi.

Kajumbe wa halmashauri ya Serikali ya Kijiji Pamoja na Viongozi wa Kila Hawajaperdea wa na Uhekezaji wa Kivanda Katika Uaeneo Haya Kutokana na Maoni Tajwa Hapojuu.

KUFUNGA KIKAO:

Uhuja Uliki aliglaimika Kikao Hiki Kwa Sala fupi Muda wa Saa Saba Uchana (7:00) na Kuruhusu Wajumbe Kutawanyika.

FAHAMISHA NA

OSCAR FELIX MURAMA

AFISA MTENDAJI KI-
CHA MAGADINI/NATSOD
-ARUSHA

KUTHIBITISHA NA

JOSHUA MURIA

MWENYEKITI WA
CHA MAGADINI
S.L.P 84 LONGIDO

AGENDA

1. KUFUNGUA KIKAO
2. UTAMBULISHO
3. TATHMINI ZA ATHARI ZA MAZINGIRA KWA MRADI WA UCHIMBAJI WA MADINI YA TRONA
4. ATHARI CHANYA NA HASI
5. MAJUKUMU, MAONI NA MAPENDEKEZO
6. KUFUNGA KIKAO.

1. AGENDA NAMBA 1: KUFUNGUA KIKAO

Mwenyekiti alifungua Kikao rasmi saa 6:00 mchana Kwa Kuwakaribisha wajumbe pamoja na wageni

2. AGENDA NAMBA 2: UTAMBULISHO

Mwenyekiti aliwaya rafasi wageni ya Kujitambulisha pamoja na Kuwa tambulisha wajumbe wa Sentali ya Kijiji.

AGENDA NAMBA 3: TATHMINI ZA ATHARI ZA MAZINGIRA KWA MRADI WA UCHIMBAJI WA MADINI YA TRONA

Mwezeshaji waliwaeleza wajumbe juu ya athari za mazingira yaa yoweza Kutokea Kutokana na mradi na majukumu pia yakitakwa Kama ni athari zipi za binadamu zitokanazo na mradi.

AGENDA NAMBA 4: ATHARI CHANYA NA HASI

Moja ya athari chanya ni wanachi wa pinyinyi Kupata ajira na Kupata asilimia ya mapato Kwa Kama pendekezo Lwalobuly za awali ya mradi; wajumbe pia waliuliza hoja ya huduma ya - Mradi Kuchukua maji Kutoka ziwa pinyinyi na watu Kuharibu Kazi za Kisasa pia. na Kuelezea Kuwa Kuna Kuhatiani na mradi endapo utahitaji Kufunga chazo cha maji cha pinyinyi pamoja na watu Kuharibiwa

AGENDA NAMBA 5: MAJUKUMU, MAONI NA MAPENDEKEZO.

Wajumbe waliibua mazuri mbalimbali, Kuwa ni pamoja na zipi athari zitakazo tokana mradi, hivo na ili chanzo cha maji Kipi Kidate - Chukuliwa na mradi na Uhekezaji a Lichukua Shala la ujuu Kwa - pata asilimia ya mapato Kama mapendekezo Kutoka Kwa - wananchi.

AGENDA NAMBA 6: KUFUNGA KIKAO

Mwenyekiti alahimisha Kikao rasmi saa 5:00 mchana Kwa Kuwa ashukuru wajumbe Kwa mahudhurio yao.

Namba Kuwasiliana

M/KU KIJIJI

Lucy Lithuga
KATIBU

AFISA MTENDAJI KIJIJI
WA PINYINYI

KIKAO CHA DHARURA CHA SERIKALI YA KIJIJI KILICHOFANYIKA LEO TAREHE 02/10/2025

WALIOHUDHURIA

S/N	JINA KAMILI	CHEO	SAHIHI
1.	Solomon Doiungoi	M/Kiti Kitongoji	
2	Lucy Lithonga	VEO	
3	Yesaya Kaoneka	NGARESERO CO. LTD Consultant	
4	Abdallah Abdallahi	MTL Consulting Co. LTD Environmental Consultant	
5	Zakaria Erasto	BM-02	
6	Joseph Kiyhanga	Kitongoji	
7	Joel Simayo	M/Kiti Kitongoji	
8	John Linais	Mjumbe	
9	Naimjire Solomon	Mjumbe	
10	Elizabet Kiburiki	Mjumbe	
11	Sendeka Kirio	Mjumbe	
12	Zakayo Molel	Mjumbe	
13	Peter Alais	Mjumbe	
14	Elizabeth Kiburiki	Mjumbe	
15	John Meseno	Mjumbe	
16	Thomas Pombo	Mjumbe	
17	Mariano Mosa	Mjumbe	
18	Sanjolu Lemanta	Mjumbe	
19	Joseph Lemeleie	Mjumbe	
20			
21			
22			
23			
24			
25			

AFISA MTENDAJI IJIJ CHA MTALE

MUHTASARI WA KIKAO CHA SERIKALI YA KIJIJI CHA MATALE 'B' LEO TAREHE 05/10/2025 TATHMINI ZA ATHARI ZA MAZINGIRA KWA MRADI WA UCHIMBAJI MADINI YA TRONA (UTAMBULISHO WA MRADI).

AGENDA

01. KUFUNGUA KIKAO
02. UTAMBULISHO
03. TATHMINI ZA ATHARI ZA MAZINGIRA KWA MRADI WA UCHIMBAJI WA MADINI YA TRONA (UTAMBULISHO WA MRADI).
04. ATHARI CHANYA NA HASI
05. MASWALI, MAONI NA MAPENDEKEZO
06. KUFUNGA KIKAO.

AGENDA NO1: KUFUNGUA KIKAO.

Mwenyekiti Ameifungua kikao Rasimi Mnamo saa 6:40 Kwa Kuwakaribisha Wajumbe Pia kwa Sala Fupi iliyo Fanywa Na Mjumbe.

AGENDA NO2: UTAMBULISHO.

Utambulisho Umefanyika kwa Wajumbe wote walio hudhuria kikao pia kwa wageni walio Fika.

AGENDA NO3: TATHMINI ZA ATHARI ZA MAZINGIRA KWA MRADI WA UCHIMBAJI WA MADINI YA TRONA (UTAMBULISHO MRADI)

Mradi wa Magadi Unetambulishwa kwa Wajumbe Mradi huu Unatekelezwa Wasiwasi Hiyo Kesesi cha Matale 'B' Patu pita Kipande cha Reli Panoja Na Barabara Hii pia Haturuhusiwa Magari yatakuwa yanatumia Mwekezaji Anaruhusiwa Asilimia kwa Jamii CSI Lakini

Pia Vijana Wengi Watapatea Ajira wakazi wa Karibu Watapewa Kipaumbele Lakini pia Athari Zinazo wezea Kutokea Zimeelezewa kwa kina.

ATHARI CHANYA NA HASI.

Athari Zinazo weza Kutokea Ni panoja Na ongezeko la Watumiaji wa Barabara Pia Vumbi kwa kiasi Kidogo Lakini pia Baadhi ya Utamaduni za kigeni kuweza kuingia Pia Athari chanya Ni panoja Na Ajira kwa Vijana Zitatolewa Ajira Na Karibu Watapewa kipaumbele Pia Mbinu za kupunguza Athari Hasi Zimejadiliwa.

AGENDA NO5: MASWALI, MAONI NA MAPENDEKEZO.

Wajumbe Wamepewa Nafasi ya Kuuliza Maswali kutoa Maoni na Mapendekezo Wajumbe Wameuliza Maswali Mbalimbali Na Kupewa Majibu Wajumbe Wamependekeza Afa Matale 'B' Pia Wapo Tayari kuingia Kwenye Mradi huu Kutaka Na Faida wakizalishiwa na kiziwa Nalo Jirani

AGENDA NO6: KUFUNGA KIKAO

Mwenyekiti Ameifunga kikao Rasmi kwa kuwashukuru Wajumbe pia kwa Sala Fupi iliyo Fanyika kikao Kimefungwa Mnamo Saa 8:50 Mchana.

Simayo

JOEL S. MBUNGO

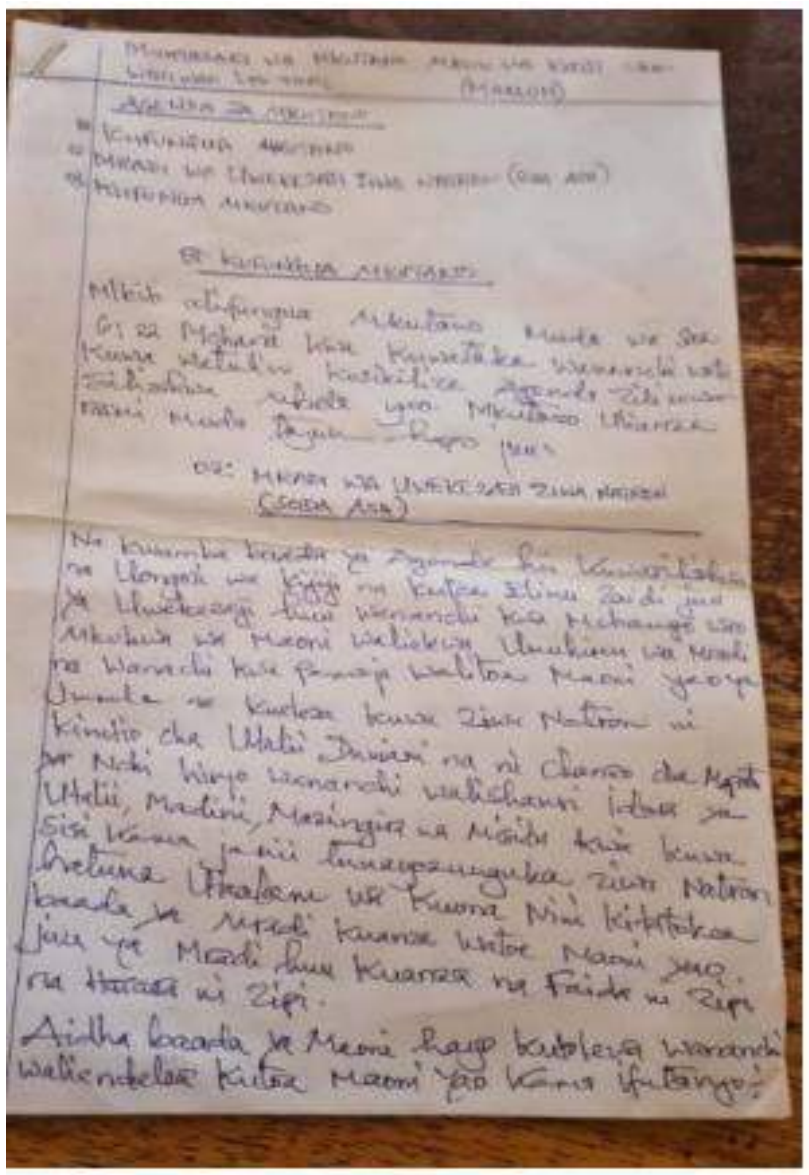
AFISA MTENDAJI,

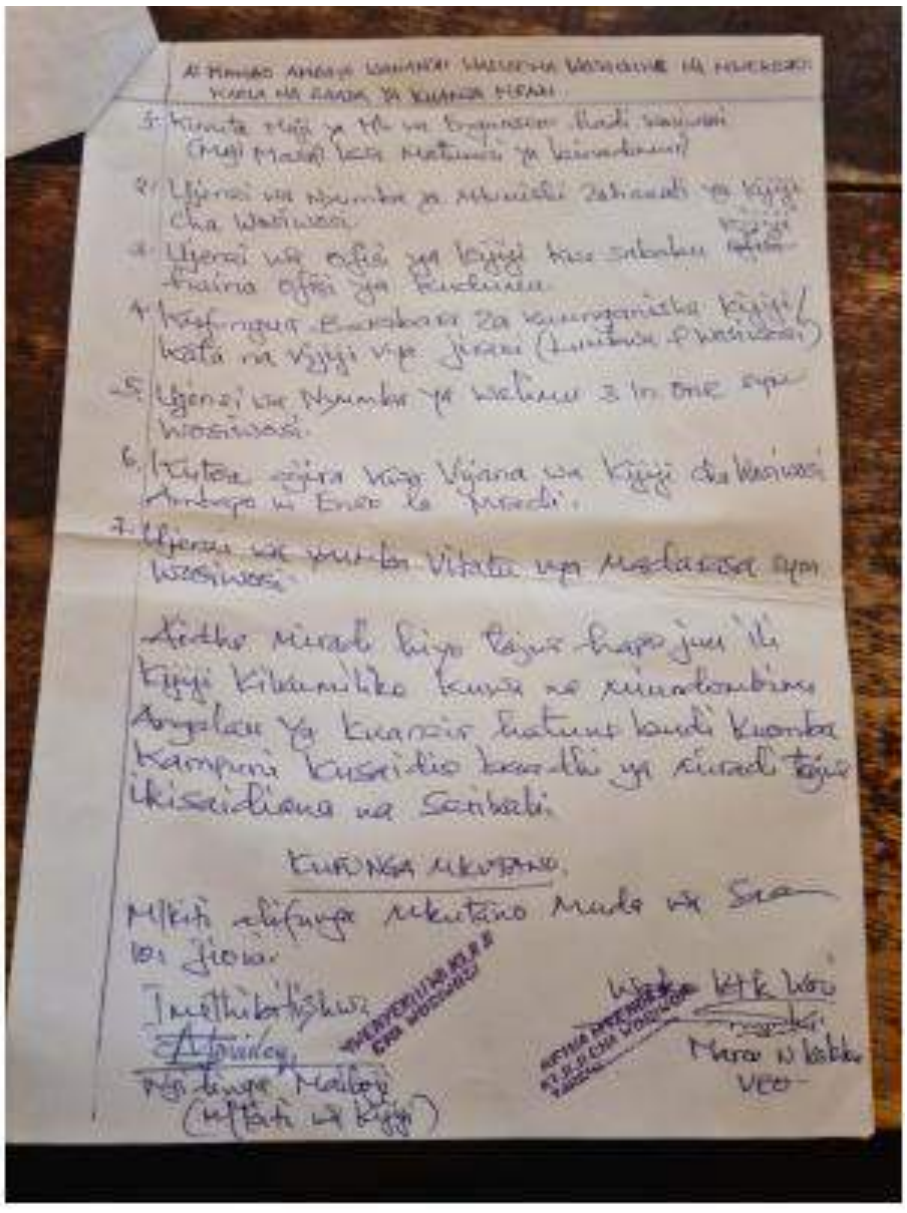
AFISA MTENDAJI IJIJ CHA MATALE

KELETO RAMBAIWA

MWENYEKITI WA KIJIJI

TAREHE 05/10/2025




Kiwanda cha Ng'ombe ya Maziwa
Ujenzi wa Nyumba ya Walinzi
Ujenzi wa Nyumba ya Watumishi 3 in One
Ujenzi wa ghala
Ujenzi wa Choo
Ujenzi wa Kibanda cha Kuhifadhia Maziwa
Ujenzi wa Kibanda cha Kuhifadhia Maziwa
KUFUNGA MKUTANO.
Mkutano ulifungwa saa Nane na Dakika Arobaini
Mwenyekiti
Katibu wa Kijiji

APPENDIX 4: BASELINE SUMMARY OF PROJECT AREA -VILLAGES

Indicator	Wosiwosi Village	Pinyinyi Village	Magadini Village	Matale Village
Sub-Villages	▪ Kipi, ▪ Lobili and ▪ Nepandi	▪ Embasi, ▪ Ndinyika, ▪ Masusu, ▪ Olorbilini and ▪ Pinyinyi	▪ Orpuraa, ▪ Armanii and ▪ Markii	▪ Emurutoto, ▪ Oltrotoibor and ▪ Emesera
Ethnic Groups Present	▪ Maasai	▪ Maasai ▪ Sonjo	▪ Maasai	▪ Maasai
Languages	▪ Masai ▪ Swahili ▪ English	▪ Masai ▪ Sonjo ▪ Swahili ▪ English	▪ Masai ▪ Swahili ▪ English	▪ Masai ▪ Swahili ▪ English
Housing Material	▪ Roof: thatch and iron roof ▪ Walls: mud or cement blocks ▪ Floor:	▪ Roof: thatch and iron roof ▪ Walls: mud or cement blocks ▪ Floor:	▪ Roof: thatch and iron roof ▪ Walls: mud or cement blocks ▪ Floor:	▪ Roof: thatch and iron roof ▪ Walls: mud or cement blocks ▪ Floor:
Religion	▪ Christian ▪ Pagans	▪ Christian ▪ Muslim ▪ Pagans	▪ Christian ▪ Pagans	▪ Christian ▪ Pagans
Places of Worship	▪ 5 Churches	▪ 1 Mosque ▪ 6 Churches	▪ 3 Churches	▪ 9 Churches
Population Size	▪ Total Population: 3672	▪ Total population: 3322	▪ Total Population: 2500	▪ Total Population: 6033 people ▪ Children: 4056
Population Gender Breakdown	▪ Not Available	▪ Male: 1800 ▪ Female: 1522	▪ Males: 1000 ▪ Female: 1500	▪ Males: 753 ▪ Females: 1224
Households	▪ 1110 Households	▪ Not Available	▪ 40 Households	▪ 1224 Households
Household Size	▪ 7 people per household	▪ Not Available	▪ 70 people per household	▪ 10 people per household
Female Headed Households	▪ 27 Households	▪ Not Available	▪ 7 Households	▪ 6 Households
Livelihood	▪ Livestock keeping- Cow-4663, Goat- 6056, Sheep-14366, Donkey- 1959 ▪ Trade (Credit Groups) ▪ Employment	▪ Farming Activities: cultivation of okra, maize, and fruits ▪ livestock Keeping - Cow, Goat, Sheep and Donkey ▪ Small-scale retail businesses	▪ Farming Activities: Food crops like maize and beans, ▪ Livestock keeping: Cow, Goat, Sheep and Donkey	▪ Livestock Keeping: Cows-17500 Sheep-24200 Goats-14300 and Donkeys-1060
Annual Village Revenue	▪ Not Available	▪ 6,000,000 Tshs per annual	▪ 23,000,000 Tshs per annual	▪ 2,000,000 Tshs per annual
Sources of Water	▪ Ponds	▪ One outside tap ▪ Constructed water drain (2)	▪ Hand Pump -1 ▪ Springs	▪ Hand pump -1 ▪ Borehole-1 ▪ Outside Tap-2
Primary Water Use	▪ Domestic ▪ Livestock	▪ Domestic ▪ Gardening ▪ Livestock	▪ Domestic ▪ Livestock	▪ Domestic ▪ Livestock ▪ Gardening
Sanitation Facilities	▪ Non-Ventilated Pit Latrines	▪ Non-Ventilated Pit Latrines	▪ Non-Ventilated Pit Latrines	▪ Non-Ventilated Pit Latrines
Electricity Access	▪ Electricity is available,	▪ Electricity is available, they also use Solar.	▪ Electricity is available	▪ Electricity is available
Status of Road network	▪ Moderate -seasonal accessible	▪ Moderate -seasonal accessible	▪ Moderate -seasonal accessible	▪ Moderate -seasonal accessible
Main sources of transport	▪ Motorcycles- which costs Tshs 150,000/= from the village to Longido district ▪ Village Executive Officer Car	▪ Motorcycles- which costs Tshs 60,000/= from the village to Ngorongoro district	▪ Bus- operate on the day of an auctions. ▪ Motorcycles- which costs Tzs 120,000/= from the village to Longido district	▪ Motorcycles- which costs Tshs 50,000/= from the village to Ngorongoro district
Security Management	▪ No Auxiliary Police	▪ Auxiliary Police	▪ No Auxiliary Police	▪ Auxiliary Police
Nongovernmental Organisations (NGOs)	▪ World Wildlife Fund (WWF)- Conservation of the flamingo breeding grounds ▪ Ujamaa Community Resource Team (UCRT)- land use plan	▪ TASAF – provide the support to the vulnerable families within the village	▪ Community Based Organization (CBO)- it is nonprofit organization aims at improving the social health and well-being of the community	▪ Convoy Hope- they offer borehole drilling services to support water supply for schools and the surrounding community

Indicator	Wosiwosi Village	Pinyinyi Village	Magadini Village	Matale Village
				▪ Ujamaa Community Resource Team (UCRT)- land use plan
Medical Facilities	▪ Not Available	▪ Pinyinyi dispensary ▪ Masusu dispensary	▪ Magadini health centre	▪ Emurutoto Dispensary
Educational Facilities	▪ Wosiwosi Primary School	▪ Pinyinyi Primary School ▪ Ambasi Primary School ▪ Ndinyika Primary School ▪ Masusu Primary School ▪ Njoruleni Primary School	▪ Magadini Primary School	▪ Emurutoto Primary School ▪ Emisera Primary School ▪ Oltrotobor Primary School
Community Development Needs	▪ Water supply ▪ Roads ▪ Health centre	▪ Electricity ▪ Road ▪ Health centre	▪ Village office ▪ Teacher's houses (Oltrotoibo Primary School) ▪ Dispensary	▪ Village office ▪ Water ▪ Health centres
Cultural Resources	▪ Mount Gelai which located near the village is used as a place of rituals ▪ There is no cemetery in the village, they bury their beloved one in their own plot	▪ There is sacred shrines which used for initiation rites is located at the mountain near Masusu sub village ▪ There is no cemetery in the village, they bury their beloved one in their own plot	▪ No sacred sites ▪ There is no cemetery in the village, they bury their beloved one in their own plot	▪ No sacred sites ▪ There is no cemetery in the village, they bury their beloved one in their own plot

APPENDIX 5: CONSULTATION PICTURES

APPENDIX 6: VIEWS RAISED BY STAKEHOLDERS AND RESPONSES

Sn	Stakeholder Name	Views Raised	Responses
1	Bird Life International and Nature Tanzania	The proposed Soda Ash mining at Lake Natron would critically disrupt the lake's fragile ecosystem, threatening the world's only regular breeding ground for the Lesser Flamingo and damaging the unique cyanobacteria-based food chain that sustains it;	Noted. A detailed feasibility study and several supporting assessments were conducted, which led to the recommendation to locate the project at Wosiwosi Village. This location was selected because it presents very minimal environmental impacts, most of which can be effectively mitigated or completely avoided through well-prepared management plans. The extraction technology to be used is environmentally friendly and does not involve the use of chemicals during the extraction process. Therefore, no pollution of water resources or disturbance to the breeding habitats of aquatic organisms, including the Lesser Flamingo, is expected.
		Mining operations would alter salinity and water levels, cause pollution, and fragment habitats leading to long-term biodiversity loss and degradation of surrounding freshwater sources;	Noted. Comprehensive environmental studies were undertaken to assess potential impacts on water salinity, levels, and biodiversity. The findings indicate that with the proposed project design and mitigation measures, these impacts will be minimal and manageable. The project will adopt a closed-loop water management system to prevent contamination or alteration of natural water sources. Additionally, continuous environmental monitoring will be implemented to ensure that salinity levels, water quality, and habitat integrity are maintained. No significant long-term biodiversity loss or degradation of surrounding freshwater sources is anticipated, as all activities will be conducted in accordance with national and international environmental standards
		The project would displace local Maasai communities, restrict access to grazing lands and water, erode cultural heritage, and potentially trigger resource-based conflicts and health risks from water contamination;	Noted. The project design has carefully considered the presence and livelihoods of the local Maasai communities. The selected site at Wosiwosi Village ensures that no physical displacement of communities will occur. Access to traditional grazing areas and water sources will be maintained, and alternative routes or shared-use arrangements will be developed where necessary through community agreements. A Cultural Heritage Management Plan will also be prepared to safeguard sites of cultural importance and uphold the traditions and values of the Maasai people. Furthermore, since no harmful chemicals will be used in the extraction process, the risk of water contamination and associated health impacts is not anticipated. Continuous engagement with the Maasai leaders (Laigwanani) and village councils will be maintained throughout the project cycle to prevent conflicts and ensure that community concerns are addressed promptly and transparently.
		Short-term industrial gains would undermine long-term economic opportunities such as ecotourism, which currently provides sustainable income and employment while preserving the area's ecological and cultural integrity;	Noted. The project has been designed to complement, not replace, existing sustainable economic activities such as ecotourism. The selected site at Wosiwosi Village is located away from key ecotourism zones, minimizing any interference with tourism operations. Moreover, the project is expected to stimulate local economic growth through job creation, infrastructure improvement, and service provision, while strict environmental management measures will ensure the preservation of the area's ecological and cultural integrity. Continuous coordination with tourism stakeholders will be maintained to promote coexistence and mutual benefits between the project and ongoing ecotourism activities.
		Similar soda ash mining at Lake Magadi, Kenya, and the previously rejected TATA proposal for Lake Natron demonstrate that such projects lead to environmental degradation, community grievances, and minimal socio-economic benefits underscoring the need to prioritize conservation and sustainable development alternatives;	Noted. The proposed project at Lake Natron has drawn important lessons from similar initiatives such as the Lake Magadi operation in Kenya and the earlier TATA proposal. These lessons have guided the current project design to ensure that past challenges are not repeated. The project at Wosiwosi Village has been planned with a strong focus on environmental protection, social inclusion, and sustainable development. Unlike the earlier proposals, this project employs environmentally friendly technology, excludes the use of harmful chemicals, and integrates Environmental and Social Management Plans (ESMPs) to prevent degradation and promote community benefits. Continuous stakeholder engagement and transparent monitoring will ensure that both environmental conservation and local socio-economic development are achieved in a balanced manner.
		Investors seeking soda ash extraction opportunities should focus on less ecologically sensitive sites, such as Lake Engaruka, or consider sustainable ventures like ecotourism that provide socio-economic benefits without compromising biodiversity and local livelihoods.	Noted. During the feasibility and site selection studies, several potential locations were assessed. However, the Wosiwosi Village site was identified as the most suitable due to its minimal ecological sensitivity and lower potential for adverse environmental and social impacts. The project has been carefully designed to align with principles of sustainable development, ensuring that biodiversity, local livelihoods, and cultural values are protected. Furthermore, the project will coexist with other sustainable economic activities, including ecotourism, by implementing strict environmental management and continuous monitoring throughout its implementation and operation phases.
2	International Union for Conservation of Nature and Natural Resources (IUCN)	Lake Natron, a Ramsar-designated wetland, is the only regular breeding site for East Africa's Lesser Flamingo. The proposed dredging, chemical processing, and infrastructure development threaten to alter its chemistry and disrupt the food chain that supports flamingos and other endemic species;	Noted. WWSL acknowledges the ecological significance of Lake Natron as a Ramsar-designated wetland and the only regular breeding site for the Lesser Flamingo in East Africa. While dredging will be part of the extraction process, it will be conducted under strict environmental controls and in designated areas that are far from the core flamingo breeding and nesting zones. The process will not involve the use of harmful chemicals, and modern, environmentally friendly dredging technology will be

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			applied to minimize disturbance to the lake's ecosystem. In addition, continuous environmental monitoring will be implemented to ensure that the lake's water chemistry and the food chain that supports flamingos and other endemic species are not disrupted. A comprehensive Environmental and Social Management Plan (ESMP) will guide all activities to ensure that the ecological integrity of Lake Natron is maintained throughout the project's implementation.
		The Lesser Flamingo's breeding success relies on a narrow range of hydrological and chemical conditions, including specific water depth, salinity, and predator-free nesting islands. Any alteration to water levels, salinity, or shoreline structure caused by the proposed project could eliminate or flood nesting areas, making successful breeding impossible;	Noted. The project fully recognizes the sensitivity of the Lesser Flamingo's breeding requirements and the importance of maintaining the lake's hydrological and chemical balance. Detailed hydrological and ecological assessments were undertaken during the feasibility stage to understand these conditions. The dredging activities will be carefully controlled and restricted to designated areas located away from known breeding and nesting zones. Continuous monitoring of water levels, salinity, and sediment movement will be implemented to ensure that the natural balance of the lake is not altered. In addition, adaptive management measures will be applied throughout the project's implementation to immediately address any potential changes that could affect the breeding success of the Lesser Flamingo or other dependent species.
		The proposed extraction of one million metric tons of soda ash annually, regardless of technology or method, represents a major ecological risk. The scale of this operation could severely disrupt the delicate balance between conservation and industrial development at Lake Natron;	Noted. The concern regarding the scale of production has been carefully considered during the feasibility and environmental studies. The proposed extraction of one million metric tons of soda ash annually will be implemented in phases to allow close monitoring and adaptive management of environmental conditions. The project design emphasizes minimizing ecological disturbance by applying environmentally friendly technology and enforcing strict compliance with national and international environmental standards. Continuous environmental monitoring and periodic independent audits will ensure that extraction activities do not compromise the ecological integrity of Lake Natron or disrupt the balance between conservation and sustainable industrial development.
		Habitat loss and degradation from construction, pollution, and hydrological disturbance would not only affect flamingos but also other waterbirds and aquatic biodiversity, leading to long-term ecosystem collapse;	Noted. The project recognizes the importance of protecting the broader aquatic ecosystem, including waterbirds and other biodiversity dependent on Lake Natron. All construction and operational activities will be conducted in carefully designated areas away from critical habitats to minimize disturbance. Environmentally friendly technologies and strict pollution controls will be applied to prevent contamination of water and surrounding habitats. Additionally, hydrological impacts will be continuously monitored, and adaptive management measures will be implemented to ensure that water levels, salinity, and habitat integrity are maintained.
		The project's large water demand poses severe risks to freshwater availability and groundwater integrity, potentially leading to aquifer depletion, pollution, and degradation of the lacustrine habitat;	Noted. The project's water requirements have been carefully assessed through hydrological studies to ensure sustainable use of freshwater resources. Water abstraction will be managed within safe limits to prevent depletion of aquifers and to maintain the integrity of lacustrine habitats. A closed-loop water management system will be implemented to recycle and minimize water use, while continuous monitoring will track water quality and levels. These measures, together with strict compliance with environmental management plans, will ensure that freshwater availability, groundwater integrity, and the ecological health of the lake are maintained throughout the project's operation.
		Assertions that the project can coexist with flamingo populations, as seen at Lake Magadi, are scientifically inaccurate. The hydrology and ecology of Lake Natron differ significantly, and evidence from Magadi shows that flamingo breeding attempts there have been unsuccessful. Any changes to salinity, water levels, or shoreline morphology will disrupt the delicate conditions necessary for flamingo nesting success;	Noted. The project recognizes that Lake Natron's hydrology and ecology are unique and distinct from other soda ash sites, such as Lake Magadi. The feasibility and environmental studies have taken these differences into account in the project design. Dredging and extraction activities will be carefully controlled and restricted to areas away from flamingo nesting zones. Continuous monitoring of salinity, water levels, and shoreline conditions will be implemented, and adaptive management measures will be applied to prevent any disruption to the delicate conditions required for flamingo breeding.
		Lake Natron's hydrology and ecology are interconnected with Kenya through the Ewaso Ng'iro River. The ESIA should assess cumulative and transboundary impacts, including potential conflicts over shared water resources, in line with the Transboundary Ecosystems Management Bill (2010);	Noted. The project acknowledges the transboundary nature of Lake Natron's hydrology and its connection with Kenya through the Ewaso Ng'iro River. A cumulative impact assessment has been conducted as part of the ESIA to evaluate potential effects on shared water resources and downstream ecosystems. All water use and extraction activities will be carefully managed to comply with national regulations and international best practices, including guidance from the Transboundary Ecosystems Management Bill (2010).
		All key stakeholders should be actively involved in all phases of the project to ensure their views, concerns, and insights inform the project's planning and decision-making process;	Noted. The project is committed to meaningful and continuous stakeholder engagement throughout all phases, from planning to implementation and operation. Consultations have been and will continue to be conducted with local communities, Maasai leaders (Laigwanani), village councils, government authorities, and other relevant stakeholders. Their views, concerns, and

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			insights are incorporated into project planning, decision-making, and the development of Environmental and Social Management Plans (ESMPs).
		The project threatens the livelihoods and cultural identity of local Maasai communities who rely on the surrounding landscape for grazing, water, and cultural practices. Industrialization in this sensitive area may lead to displacement, health risks, and social conflict over limited resources;	Noted. The project has been carefully designed to avoid displacement of local Maasai communities and to safeguard their livelihoods and cultural identity. The selected site at Wosiwosi Village ensures minimal interference with grazing areas, water sources, and culturally important sites. Community engagement, including consultations with Maasai leaders (Laigwanani) and village councils, will continue throughout the project to address concerns and prevent conflicts.
		IUCN emphasizes that a Strategic Environmental Assessment (SEA) at the basin level is required before any project approval. Independent studies by qualified experts must reassess ecological, hydrological, and socio-economic impacts using updated, peer-reviewed scientific data;	Noted. The project acknowledges the importance of basin-level Strategic Environmental Assessment (SEA) as emphasized by IUCN. While the project-specific ESIA has been conducted using updated and peer-reviewed scientific data, findings from broader regional and transboundary assessments were also considered during project planning. Independent expert reviews were carried out to evaluate potential ecological, hydrological, and socio-economic impacts. The project remains committed to transparency and will continue to engage qualified experts to reassess impacts as needed, ensuring that decision-making is informed by the best available scientific evidence and aligned with national and international environmental standards.
		Given the environmental sensitivity of Lake Natron, industrial soda ash mining is not a viable option. The government's initiative to develop soda ash extraction at Engaruka Basin offers a more suitable alternative that avoids critical ecological zones.	Noted. The project acknowledges the environmental sensitivity of Lake Natron and has carefully considered alternative sites, including the Engaruka Basin. After a thorough feasibility and environmental assessment, Wosiwosi Village was selected as the project site due to its lower ecological sensitivity and minimal potential impacts. The project design incorporates environmentally friendly extraction technologies, strict environmental management plans, and continuous monitoring to ensure that critical habitats, biodiversity, and community resources are protected.
3	United Nations Educational, Scientific and Cultural Organization (UNESCO)	Lake Natron's protection is a global responsibility, as it is a Ramsar and transboundary ecosystem shared by Tanzania, Kenya, and Uganda. Its degradation would disrupt the regional tourism circuit and risk diplomatic tensions over shared natural resources;	Noted. The project recognizes Lake Natron's global ecological significance as a Ramsar-designated wetland and its status as a transboundary ecosystem shared by Tanzania and Kenya. All project activities will comply with national and international environmental regulations, including transboundary ecosystem management guidelines. Continuous monitoring and coordination with relevant authorities will ensure that water resources, biodiversity, and habitats are protected, preventing degradation that could affect regional tourism or trigger disputes over shared resources.
		The Commission notes that sustainable soda ash extraction can be compatible with conservation if development integrates environmental protection, poverty reduction, and economic growth;	Noted. The project acknowledges the Commission's view that sustainable soda ash extraction can coexist with conservation when environmental protection, poverty reduction, and economic growth are integrated into development planning. Accordingly, the project design incorporates environmentally friendly extraction technologies, strict Environmental and Social Management Plans (ESMPs), and measures to support local livelihoods and socio-economic development. Continuous monitoring, stakeholder engagement, and adaptive management will ensure that the project contributes to sustainable economic growth while safeguarding biodiversity, ecosystem integrity, and community well-being.
		Mining should be restricted to areas outside critical breeding zones of the Lesser Flamingo. The shallow salt flats and inner lake areas must remain undisturbed, while peripheral zones may be considered for controlled extraction;	Noted. The project fully acknowledges the need to protect critical breeding zones of the Lesser Flamingo. Mining and dredging activities will be strictly restricted to designated peripheral areas that are away from shallow salt flats and core nesting sites. Environmentally friendly extraction technologies, combined with strict Environmental and Social Management Plans (ESMPs) and continuous monitoring, will ensure that critical habitats remain undisturbed.
		Solution mining should be prioritized as it minimizes surface disturbance, reduces ecological impact, and enhances miner safety compared to conventional methods;	Noted. The project recognizes the benefits of solution mining in minimizing surface disturbance, reducing ecological impacts, and enhancing worker safety. Accordingly, environmentally friendly extraction technologies will be employed. These methods, combined with strict Environmental and Social Management Plans (ESMPs) and continuous monitoring, will ensure that ecological integrity, critical habitats, and local livelihoods are preserved while maintaining safe and efficient operations.
		WWSL should enforce all proposed mitigation plans protecting breeding habitats, maintaining water quality and flow, and preventing disturbance or predation at nesting sites to ensure long-term conservation of flamingos;	Noted. The project is committed to full implementation of all proposed mitigation measures to protect flamingo breeding habitats, maintain water quality and natural flow, and prevent disturbance or predation at nesting sites. Strict Environmental and Social Management Plans (ESMPs) will guide all activities, and continuous environmental monitoring will be conducted to ensure compliance. Adaptive management measures will be applied as needed to safeguard the long-term conservation of flamingos and the ecological integrity of Lake Natron.
		Regular Environmental Monitoring and Environmental Audits (EA) should be conducted to assess air and water quality impacts. The	Noted.

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		project should comply fully with national and international environmental standards, including Ramsar obligations.; and	The project will implement regular environmental monitoring and periodic Environmental Audits (EAs) to assess potential impacts on air and water quality. All project activities will fully comply with national environmental regulations, international best practices, and Ramsar obligations. Monitoring results will inform adaptive management measures to promptly address any deviations, ensuring that ecological integrity, water quality, and overall environmental standards are maintained throughout the project lifecycle.
		The Commission advises adopting sustainable extraction practices modelled on successful approaches at Lake Magadi, ensuring environmental integrity and socioeconomic benefits coexist.	Noted. The project acknowledges the Commission's recommendation to adopt sustainable extraction practices. Lessons from successful approaches, including Lake Magadi, have been considered and adapted to Lake Natron's unique ecological and socio-economic context. The project will employ environmentally friendly technologies, strict Environmental and Social Management Plans (ESMPs), and continuous monitoring to ensure that environmental integrity is maintained while generating socio-economic benefits for local communities. Adaptive management will be applied to address any unforeseen impacts and ensure a balance between conservation and sustainable development.
4	Worldwide Fund for Nature (WWF)	WWSL should conduct a Strategic Environmental Assessment (SEA) at the ecosystem level, covering Engaruka, Lake Natron, and cross-border systems, including cumulative impacts of water use, infrastructure, and climate variability, in line with EAC protocols;	Noted. The project recognizes the importance of a Strategic Environmental Assessment (SEA) at the ecosystem level, including Engaruka, Lake Natron, and connected cross-border systems. Cumulative impacts related to water use, infrastructure development, and climate variability have been considered in the project-specific ESIA, and relevant EAC protocols were reviewed to guide planning. Continuous monitoring and coordination with regional and transboundary authorities will ensure that ecosystem integrity, water resources, and biodiversity are maintained, while potential cumulative impacts are identified and mitigated through adaptive management measures.
		WWSL should conduct a high-standard Environmental Impact Assessment (EIA) with independent ecological reviewers, including data on transboundary water systems and migratory species, and make the EIA publicly available for peer review;	Noted. The project has conducted a comprehensive Environmental Impact Assessment (EIA) in line with national and international standards, incorporating independent ecological reviews. The assessment includes data on transboundary water systems, migratory species, and other critical ecological factors. WWSL is committed to transparency, and the EIA will be made available for public and peer review
		WWSL should identify and legally protect no-go zones such as hydrological recharge areas, flamingo breeding sites, and wildlife corridors, maintaining 3–5 km buffer zones around key wetlands;	Noted. The project fully recognizes the importance of protecting critical ecological areas. WWSL will identify and legally safeguard no-go zones, including hydrological recharge areas, flamingo breeding sites, and wildlife corridors. A buffer zone of 3–5 km around key wetlands will be maintained to prevent disturbance. All project activities will comply with environmental management plans and national regulations, and continuous monitoring will ensure that these protected zones remain intact, preserving biodiversity and ecological integrity.
		WWSL should apply the Free, Prior, and Informed Consent (FPIC) principle through genuine community consultations, ensuring benefit-sharing, livelihood co-development, and land tenure protection;	Noted. The project is committed to applying the Free, Prior, and Informed Consent (FPIC) principle through genuine and ongoing consultations with affected communities. Engagement includes Maasai leaders (Laigwanani), village councils, and other stakeholders to ensure their views are incorporated into decision-making. Mechanisms for benefit-sharing, co-development of livelihoods, and protection of land tenure will be implemented to safeguard community rights and promote equitable socio-economic outcomes. Continuous monitoring and adaptive management will ensure that FPIC principles are upheld throughout the project lifecycle.
		WWSL should establish a Regional Environmental and Social Monitoring Platform, jointly managed by communities, conservation groups, and government, to monitor groundwater, air quality, bird nesting, and grazing access;	Noted. The project supports the establishment of a Regional Environmental and Social Monitoring Platform, jointly managed by local communities, conservation organizations, and government authorities.
		WWSL should strengthen regional and transboundary governance by working with the EAC and Lake Natron-Magadi Basin stakeholders to co-develop water governance, early warning systems, and disaster risk reduction plans; and	Noted. The project is committed to strengthening regional and transboundary governance by actively collaborating with the East African Community (EAC) and stakeholders within the Lake Natron-Magadi Basin.
		WWSL should adopt clean technologies and circular production systems, committing to zero-liquid discharge, renewable energy, and low-carbon soda ash production aligned with climate-smart industrial goals.	Noted. The project is committed to adopting clean and environmentally sustainable technologies
5	Tanzania Association of Tour Operators (TATO)	The project is not expected to negatively affect biodiversity or tourism activities in the area;	Noted.

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			The project has been carefully designed to minimize impacts on biodiversity and tourism activities. Site selection, environmentally friendly extraction technologies, and strict Environmental and Social Management Plans (ESMPs) ensure that critical habitats, wildlife, and tourism operations remain unaffected. Continuous monitoring and adaptive management measures will be implemented to maintain ecological integrity and support sustainable socio-economic activities in the area.
		The project will bring economic and social benefits to the surrounding communities if implemented responsibly;	Noted. The project is designed to generate sustainable economic and social benefits for surrounding communities through job creation, infrastructure development, and support for local livelihoods. Responsible implementation, guided by strict Environmental and Social Management Plans (ESMPs) and ongoing stakeholder engagement, will ensure that these benefits are realized while protecting ecological integrity, cultural values, and community well-being.
		TATO acknowledges that the project appears to consider both conservation concerns and national development goals; and	Noted. The project integrates conservation priorities with national development objectives.
		WWSL is encouraged to implement logical and effective mitigation measures during project implementation to ensure environmental and social sustainability.	Noted. The project is committed to implementing well-planned and effective mitigation measures throughout its lifecycle. Environmental and Social Management Plans (ESMPs) will guide all activities, ensuring that potential environmental and social impacts are minimized.
6	Tanzania Wildlife Authority (TAWA)	Lake Natron hosts about 75% of the world's Lesser Flamingo population, making it a globally significant breeding site. Any industrial activity, including soda ash extraction, could adversely affect the ecology of this species. Therefore, a comprehensive Environmental and Social Impact Assessment (ESIA) should be conducted before project implementation; and	Noted. The project acknowledges Lake Natron's global significance as a breeding site for approximately 75% of the world's Lesser Flamingo population. A comprehensive Environmental and Social Impact Assessment (ESIA) has been conducted prior to project implementation, incorporating ecological, hydrological, and socio-economic considerations.
		The proposed project area falls under TAWA's jurisdiction and is part of a licensed tourist hunting block managed by Adam Clement Hunting Company. Hence, TAWA should be fully consulted and involved throughout the project planning and implementation stages.	Noted. The project recognizes that the proposed area falls under TAWA's jurisdiction and includes a licensed tourist hunting block managed by Adam Clement Hunting Company. TAWA will be fully consulted and actively involved throughout all stages of project planning and implementation. Continuous collaboration will ensure compliance with regulatory requirements, protection of wildlife and habitat, and alignment with conservation and sustainable tourism objectives.
7	Ngorongoro Conservation Area Authority (NCAA)	The ESIA should be comprehensively address all aspects of the proposed project from baseline conditions and potential environmental and social impacts (including cumulative effects) to detailed mitigation measures, monitoring plans, and compliance with relevant legal and regulatory frameworks;	Noted. The project has conducted a comprehensive Environmental and Social Impact Assessment (ESIA) that addresses baseline conditions, potential environmental and social impacts including cumulative effects and detailed mitigation and monitoring measures. All activities are designed to comply with relevant national laws, regulations, and international best practices.
		All stakeholders, especially local communities and conservation entities, must be fully involved throughout the project planning and implementation stages to ensure their concerns and interests are properly integrated;	The project is committed to meaningful and continuous stakeholder engagement, ensuring that local communities, conservation organizations, and other relevant entities are fully involved throughout planning and implementation
		Although local communities around Lake Natron do not depend directly on the lake for fishing or water supply, they should still be actively engaged to ensure their social and economic interests are respected and incorporated into project decisions;	Noted. The local communities around Lake Natron do not rely directly on the lake for fishing or water supply, however, the project is committed to actively engaging them throughout all phases. Their social and economic interests will be carefully considered and incorporated into project planning and decision-making.
		To prevent irreversible environmental and social impacts, a rigorous, multi-component monitoring program should be implemented. This should include regular monitoring of avifauna adaptation, lake-water chemistry, air quality (especially nitrogen and phosphorus deposition), and wildlife populations. The program should set baselines, establish thresholds, enable stakeholder participation, and include adaptive management mechanisms;	Noted. The project will implement a rigorous, multi-component environmental and social monitoring program to prevent irreversible impacts. This program will include regular monitoring of avifauna adaptation, lake-water chemistry, air quality (including nitrogen and phosphorus deposition), and wildlife population
		The project should integrate sustainability into its operations by adopting eco-industrial tourism models, combining mineral production with conservation education to promote both ecological protection and economic development; and	Noted. The project is committed to integrating sustainability into its operations by exploring eco-industrial tourism models. This approach combines mineral production with conservation education, promoting ecological protection while generating economic opportunities for local communities

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		NCAA has no objection to the proposed project, provided that the ESIA is conducted thoroughly and that the project incorporates strong environmental safeguards, community engagement, and continuous monitoring to ensure long-term conservation and sustainable development.	Noted. The project acknowledges NCAA's position and is committed to conducting a thorough Environmental and Social Impact Assessment (ESIA). Strong environmental safeguards, continuous stakeholder engagement, and monitoring programs will be implemented to ensure the long-term conservation of Lake Natron and promote sustainable development
8	Tanzania Meteorological Authority (TMA)	The project should obtain weather data, including rainfall, wind patterns, and relative humidity, from the Authority throughout the project implementation period to support effective environmental monitoring and management	Noted. The project will coordinate with the Tanzania Meteorological Authority (TMA) to obtain weather data, including rainfall, wind patterns, and relative humidity, throughout the project lifecycle.
9	Tanzania Wildlife Research Institute (TAWIRI).	The project should implement bird collision prevention measures to protect migratory and resident bird species;	Noted. The project will implement bird collision prevention measures to protect both migratory and resident bird species. These measures will include careful planning of infrastructure placement, use of bird-safe design features, and ongoing monitoring of bird movements.
		The project should manage water quality to sustain the ecological conditions necessary for flamingo conservation;	Noted. The project will implement strict water quality management measures to sustain the ecological conditions essential for flamingo conservation. Continuous monitoring of water chemistry, salinity, and flow will be conducted, and adaptive management measures will be applied to address any changes that could affect the lake's habitat.
		The project should monitor brine and recycled water regularly for potential heavy metal contamination;	Noted. The project will implement regular monitoring of brine and recycled water for potential heavy metal contamination. Water quality testing will be conducted in accordance with national and international standards, and adaptive management measures will be applied immediately if any contamination is detected
		The project should conduct continuous monitoring of flamingo populations and their habitats to detect and address ecological changes;	Noted. The project will conduct continuous monitoring of flamingo populations and their habitats to detect any ecological changes. This program will include population surveys, nesting site observations, and habitat quality assessments.
		The project should enforce air pollution control measures and adopt emission reduction strategies in all project operations;	Noted. The project will implement strict air pollution control measures and adopt emission reduction strategies across all operations. This includes the use of clean and efficient technologies, regular monitoring of air quality, and compliance with national and international standards
		The project should ensure compliance with national regulations and international environmental agreements relevant to wildlife and habitat protection;	Noted. The project will ensure full compliance with all relevant national regulations and international environmental agreements pertaining to wildlife and habitat protection.
		The project should prevent land-use conflicts with investors by prioritizing community engagement and ensuring socio-economic benefits for local residents;	Noted. The project will prioritize community engagement to prevent potential land-use conflicts with investors. Mechanisms for benefit-sharing, livelihood support, and inclusive development will ensure that local residents gain socio-economic benefits from the project.
		The project should support government revenue generation through transparent and effective resource management;	Noted. The project will support government revenue generation through transparent and accountable resource management. All financial, operational, and environmental activities will comply with national regulations, fiscal policies, and reporting requirements.
		The project should designate and regulate trona extraction points to minimize environmental and social impacts; and	Noted. The project will designate and regulate all trona extraction points to minimize environmental and social impacts. Site selection will be informed by ESIA to avoid sensitive habitats and community areas. Extraction activities will follow strict ESMPs and monitoring protocols to ensure sustainable resource use while safeguarding biodiversity, water quality, and community livelihoods.
		The project should organize public hearings to enhance transparency and promote stakeholder participation in decision-making processes.	Noted. The project has conducted and will continue to conduct public hearings and stakeholder engagement sessions to enhance transparency and ensure that community and stakeholders input informs decision-making processes. Feedback from these

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			sessions will be integrated into project planning, Environmental and Social Management Plans (ESMPs), and operational activities
10	Occupational Safety and Health Authority (OSHA)	The Project should be registered with OSHA during both the construction and operation phases in accordance with Section 16 of the Occupational Safety and Health (OHS) Act;	Noted The project will be registered with OSHA during both the construction and operational phases, in full compliance with Section 16 of the Occupational Safety and Health (OHS) Act.
		An Occupational Health and Safety (OHS) Policy Statement should be prepared as required under Section 96 of the OHS Act;	Noted The project will prepare and implement an Occupational Health and Safety (OHS) Policy Statement in accordance with Section 96 of the OHS Act.
		Detailed OHS Policy Implementation Guidelines should also be developed in compliance with Section 96 of the OHS Act;	Noted The project will develop detailed Occupational Health and Safety (OHS) Policy Implementation Guidelines in compliance with Section 96 of the OHS Act.
		An OHS Risk Assessment Report should be conducted in line with Section 60 of the OHS Act;	Noted The project will conduct a comprehensive Occupational Health and Safety (OHS) Risk Assessment in accordance with Section 60 of the OHS Act.
		A comprehensive First Aid Program should be established, including the provision of first aid facilities, training of first aiders certified by OSHA, and preparation of an emergency evacuation plan. All cases (minor or major) must be recorded in compliance with Section 58 of the OHS Act and the OSH First Aid and Welfare Facilities Rules, 2015;	Noted The project will establish a comprehensive First Aid Program in compliance with Section 58 of the OHS Act and the OSH First Aid and Welfare Facilities Rules, 2015. This program will include provision of fully equipped first aid facilities, training of OSHA-certified first aiders, and preparation of an emergency evacuation plan. All incidents, whether minor or major, will be properly recorded and managed to ensure prompt response and continuous improvement in occupational health and safety practices.
		Safety and Health Representatives should be trained in accordance with Section 11 of the OHS Act;	Noted The project will ensure that Safety and Health Representatives are trained in accordance with Section 11 of the OHS Act.
		An OHS Committee should be formed as required under Section 13 of the OHS Act;	Noted The project will establish an Occupational Health and Safety (OHS) Committee in compliance with Section 13 of the OHS Act.
		The OHS Committee should hold regular meetings and maintain records of discussions and resolutions in compliance with Sections 13 and 14 of the OHS Act;	Noted The project will ensure that the Occupational Health and Safety (OHS) Committee holds regular meetings and maintains comprehensive records of discussions and resolutions, in compliance with Sections 13 and 14 of the OHS Act
		Health and welfare provisions must adhere to OHS standards, including the supply of clean and safe drinking water (Section 54), proper sanitary conveniences (Section 55), adequate washing facilities (Section 56), accommodation for clothing (Section 57), and appropriate facilities for resting (Section 59); and	Noted The project will ensure that all health and welfare provisions comply fully with OHS standards. This includes the supply of clean and safe drinking water (Section 54), proper sanitary conveniences (Section 55), adequate washing facilities (Section 56), accommodation for clothing (Section 57), and appropriate resting facilities (Section 59).
		Appropriate Personal Protective Equipment (PPE) should be provided to all workers in compliance with Section 62 of the OHS Act.	Noted The project will provide appropriate Personal Protective Equipment (PPE) to all workers in full compliance with Section 62 of the OHS Act
11	Ministry of Natural Resource and Tourism	A Strategic Environmental Assessment (SEA) should be conducted to assist the Government in determining the most appropriate way forward for this initiative. This process will also help evaluate both the potential benefits and the possible adverse impacts of the proposed project;	Noted. The project acknowledges the Ministry of Natural Resources and Tourism's comments. A comprehensive Environmental and Social Impact Assessment (ESIA) has been conducted, and its findings will support informed decision-making regarding the proposed project.
		All communities and relevant authorities within and around the project area including the Tanzania Wildlife Authority (TAWA) and local residents should be fully involved through public meetings to gather their views and address any concerns that may arise within the community;	Noted. The project is committed to fully involving all communities and relevant authorities within and around the project area, including the Tanzania Wildlife Authority (TAWA) and local residents. Public meetings and consultations will be conducted to gather stakeholder views, address concerns, and ensure that community input is integrated into project planning, decision-making, and implementation.
		The Ministry of Natural Resources and Tourism should be fully engaged in all stages of the SEA process to ensure proper	Noted

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		coordination and consideration of tourism and conservation interests.	The project acknowledges the Ministry of Natural Resources and Tourism's recommendation. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted, and the Ministry will be engaged throughout the process to ensure that tourism, conservation, and sustainable development interests are properly considered in project planning and decision-making.
		Lake Natron is protected under the Ramsar Convention. Establishing industries in this area would damage its international reputation and create diplomatic tension with the Ramsar Secretariat;	Noted The project acknowledges that Lake Natron is protected under the Ramsar Convention. Site selection and project planning will consider the lake's ecological sensitivity, and all activities will be designed to minimize environmental impacts. The findings of the Environmental and Social Impact Assessment (ESIA) will guide decision-making to ensure compliance with national and international environmental obligations, safeguarding both biodiversity and Tanzania's international environmental reputation.
		The project endangers the breeding grounds of 1.5–2.5 million Lesser Flamingos (about 75-80% of the global population) and rare fish species found only in Lake Natron;	Noted The project acknowledges the ecological importance of Lake Natron as a critical breeding site for 1.5–2.5 million Lesser Flamingos and habitat for rare, endemic fish species. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted to ensure that the project minimizes impacts on flamingo populations, rare species, and their habitats while supporting informed decision-making.
		Mining will disrupt the lake's hydrology and the algae that feed flamingos, leading to a decline or loss of the species;	Noted The project acknowledges concerns regarding potential impacts on Lake Natron's hydrology and the algae that sustain flamingo populations. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted to evaluate these risks and inform the development of mitigation measures aimed at protecting hydrological balance, preserving the lake's food chain, and minimizing impacts on flamingo populations.
		The project area forms part of a vital wildlife corridor linking Ngorongoro, Lake Manyara, and Tarangire ecosystems. Industrial development would obstruct migratory routes, threatening wildlife movement and genetic diversity;	Noted The project acknowledges that the proposed area forms part of a vital wildlife corridor linking Ngorongoro, Lake Manyara, and Tarangire ecosystems. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted to evaluate potential impacts on wildlife movement and genetic diversity. Mitigation measures will aim to avoid or minimize disruption to migratory routes and maintain ecosystem connectivity.
		Given that the area is semi-arid, with limited rainfall and extreme temperatures exceeding 40°C, the project would intensify water shortages. This scarcity is likely to trigger conflicts among communities, livestock keepers, and wildlife competing for the same limited water sources;	Noted The project acknowledges the semi-arid nature of the area, characterized by limited rainfall and extreme temperatures exceeding 40°C. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted to assess water demand and potential impacts on water availability. Mitigation measures, including efficient water use, recycling, and stakeholder engagement, will be implemented to minimize water scarcity and reduce the risk of conflicts among communities, livestock, and wildlife.
		Dust and chemical emissions from industrial activities would increase local temperatures and release pollutants harmful to biodiversity, human health, and air quality around Lake Natron;	Noted The project acknowledges concerns regarding dust and potential chemical emissions. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted to evaluate air quality risks. Mitigation measures, including the use of environmentally friendly extraction technologies, dust suppression systems, and continuous air quality monitoring, will be implemented to minimize impacts on biodiversity, human health, and surrounding air quality.
		Regional research from Lake Magadi, Kenya, demonstrates that similar soda ash mining projects have led to environmental degradation, water scarcity, poor public health, and minimal community benefits even after 100 years of operation;	Noted The project acknowledges lessons from regional experiences, including Lake Magadi, Kenya. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted to evaluate potential environmental, social, and economic impacts. The project will incorporate mitigation measures, community engagement, and sustainable management practices to minimize negative outcomes and maximize benefits for local communities while safeguarding the environment.
		Lake Natron's unique landscape and large flamingo colonies are major tourist attractions that contribute significantly to the local and national economy. Environmental degradation would harm the tourism industry, particularly in Engaresero Village a key tourism hub leading to the closure of lodges, campsites, and loss of community income;	Noted The project acknowledges that Lake Natron's unique landscape and flamingo colonies are key tourist attractions supporting local and national economies, including Engaresero Village. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted to evaluate potential impacts on tourism. Mitigation measures will be implemented to protect the lake's ecological and aesthetic values, ensuring that tourism activities and community incomes are safeguarded while supporting sustainable development
		Establishing the factory would likely result in the displacement of pastoralist and tourism-dependent communities, disrupting their livelihoods, culture, and socio-economic stability; and	Noted The project acknowledges that establishing the factory may affect pastoralist and tourism-dependent communities. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted to evaluate potential social impacts,

Sn	Stakeholder Name	Views Raised	Responses
			including displacement risks. Mitigation measures, community consultations, and livelihood support programs will be implemented to minimize disruptions to culture, livelihoods, and socio-economic stability, ensuring that community well-being is prioritized throughout the project lifecycle.
		The proposed site overlaps with a licensed tourist hunting block operated by Adam Clemence Safari Ltd under TAWA's management. Proceeding without involving these key stakeholders could lead to legal disputes and potential litigation against the Government.	Noted The project acknowledges that the proposed site overlaps with a licensed tourist hunting block managed by Adam Clemence Safari Ltd under TAWA's jurisdiction. A comprehensive Environmental and Social Impact Assessment (ESIA) will be conducted, and all relevant stakeholders, including TAWA and the license holder, will be fully engaged throughout the project planning and implementation process
12	Ministry of Water- Internal Drainage Basin Water Board (IDBWB)	Lake Natron has been designated as a protected zone since 2019 due to its unique ecological features, particularly as a breeding and nesting site for the Lesser Flamingo. In this regard, the Basin Authority advised that the project proponent should consult the Tanzania Wildlife Authority (TAWA) before proceeding with the project.	Noted The project acknowledges that Lake Natron has been designated as a protected zone since 2019 due to its unique ecological features, including its importance as a breeding and nesting site for the Lesser Flamingo. The project will consult and collaborate closely with the Tanzania Wildlife Authority (TAWA) and other relevant authorities during the Environmental and Social Impact Assessment (ESIA) process to ensure that project planning and implementation comply with protection requirements and safeguard the lake's ecological integrity.
		The project proponent should conduct a bathymetric study of Lake Natron and submit the results to the Basin Authority for review.	Noted The project acknowledges the recommendation to conduct a bathymetric study of Lake Natron. A comprehensive bathymetric survey will be carried out, and the results will be submitted to the Internal Drainage Basin Water Board (IDBWB) for review
		A baseline water quality analysis report should be conducted and submitted to the Basin Authority.	Noted The project acknowledges the recommendation to conduct a baseline water quality analysis. A comprehensive water quality assessment will be carried out, and the results will be submitted to the Internal Drainage Basin Water Board (IDBWB) for review
		As Lake Natron is a transboundary water body shared between Tanzania and Kenya, the Basin Authority requires the project proponent to notify the Kenyan authorities of the proposed activities.	Noted The project acknowledges that Lake Natron is a transboundary water body shared between Tanzania and Kenya. The project proponent will notify and engage the relevant Kenyan authorities regarding the proposed activities. This engagement will ensure that transboundary water management, ecological protection, and stakeholder coordination are properly considered throughout the project planning processes
13	Ministry of Mineral - Resident Mine Office (RMO) Arusha Region	The proposed project is expected to create employment opportunities for residents of Wosiwosi Village and neighbouring communities;	Noted. The project acknowledges the potential for employment creation for residents of Wosiwosi Village and neighbouring communities. During the construction phase, approximately 100 local residents, including both skilled and unskilled workers, are expected to be employed. During the operational phase, around 300 positions will be available, also comprising skilled and unskilled roles. The Environmental and Social Impact Assessment (ESIA) will further identify opportunities for skills development, training, and equitable recruitment to ensure meaningful socio-economic benefits for surrounding communities.
		The project will contribute to increased income generation for both the local community and the nation at large; and	Noted The project acknowledges that it will contribute to increased income generation for both the local community and the nation. Through employment opportunities, local procurement, and responsible resource management, the project aims to support economic growth, enhance livelihoods, and provide sustainable socio-economic benefits while ensuring environmental and social safeguards are implemented.
		The RMO expressed willingness to collaborate closely with the project proponent throughout all phases of the project	Noted The project acknowledges the Resident Mine Office's (RMO) willingness to collaborate closely throughout all phases of the project. The project proponent will maintain continuous engagement with the RMO to ensure coordination, effective implementation of ESIA recommendations.
14	Vice President's Office (VPO)	Lake Natron is a Ramsar Wetland of International Importance (Site No. 1050) and the primary breeding site for 75% of the world's Lesser Flamingo population. Its hydrological and ecological sensitivity demands strict environmental protection;	Noted The project acknowledges that Lake Natron is a Ramsar Wetland of International Importance (Site No. 1050) and a critical breeding site for approximately 75% of the world's Lesser Flamingo population. Its hydrological and ecological sensitivity will be a key consideration in the Environmental and Social Impact Assessment (ESIA), and all project planning and mitigation measures will prioritize strict environmental protection to safeguard the lake's unique biodiversity and ecological functions.
		Any proposed development must meet the highest international environmental standards to prevent irreversible ecological damage. WWSL is required to conduct comprehensive scientific studies	Noted The project acknowledges the Vice President's Office recommendation that any development must meet the highest international environmental standards. WWSL will conduct a comprehensive Environmental and Social Impact Assessment

Sn	Stakeholder Name	Views Raised	Responses
		demonstrating full compliance with sustainability and accountability frameworks;	(ESIA) using scientific studies to evaluate potential impacts and ensure full compliance with sustainability and accountability frameworks. Findings will guide mitigation measures, decision-making, and implementation to prevent irreversible ecological damage
		WWSL must adopt only verified clean technologies that protect biodiversity, maintain water quality, and preserve flamingo breeding habitats;	Noted The project acknowledges the recommendation regarding the use of clean technologies. WWSL will apply environmentally friendly extraction technologies that protect biodiversity, maintain water quality, and preserve critical flamingo breeding habitats, ensuring that the project is implemented sustainably and with minimal ecological impact.
		While Tanzania supports sustainable industrial development, it must never come at the cost of irreplaceable ecosystems like Lake Natron; and	Noted The Environmental and Social Impact Assessment (ESIA) will guide project planning and implementation to ensure that industrial activities protect the lake's ecological integrity, biodiversity, and critical habitats
		The VPO expects WWSL to uphold the best global practices in environmental management, serving as a model for responsible resource extraction in the country.	Noted The project commits to upholding the highest global standards in environmental management, positioning WWSL as a model for responsible resource extraction in Tanzania.
15	Longido District Council	The proposed Soda Ash Project at Wosiwosi Village is expected to generate revenue and promote development at both local and national levels, bringing significant benefits to the community if implemented and managed sustainably;	Noted The project is expected to generate revenue and contribute to both local and national development when implemented and managed sustainably. WWSL will comply with all applicable taxes and service levies, and through Corporate Social Responsibility (CSR) programs , the project will support community development programs, including education, health, water supply, and infrastructure improvements such as roads. These measures aim to enhance socio-economic benefits for Wosiwosi Village and surrounding communities.
		The owner of the hunting block within the Lake Natron Game Controlled Area (North), Mr. Adam Clemence, should be consulted and engaged during the implementation of the proposed Soda Ash Project to prevent potential conflicts in the future;	Noted The project will consult and engage Mr. Adam Clemence, the owner of the hunting block within the Lake Natron Game Controlled Area (North), throughout the planning and implementation of the Soda Ash Project.
		All stakeholders involved in flamingo conservation should be engaged during the assessment to gather their views and ensure that the Project is implemented without adversely affecting the flamingo population in the area;	Noted The project will actively engage all stakeholders involved in flamingo conservation in all phases of the project
		All stakeholders should be involved in all phases of the Project;	Noted All stakeholders will be involved in all phases of the Project;
		The positive impacts of the Project can be maximized through a strong commitment to: • *Environmental conservation and responsible resource management;* • *Transparent and continuous engagement with communities and other stakeholders; and* • *Promotion of health, safety, and cultural preservation initiatives.*	Noted The project will be implemented to ensure that all positive impacts are maximized, benefiting both the local communities and the nation at large.
		The Project should prioritize employment opportunities for local residents during both construction and operation phases to improve livelihoods and enhance community well-being;	Noted The project will prioritize employment opportunities for local residents during both construction and operation phases to improve livelihoods and enhance community well-being.
		The Project is expected to improve local infrastructure, particularly roads within Wosiwosi Village, and stimulate economic growth in the surrounding communities.	Noted The project is expected to improve local infrastructure, particularly roads within Wosiwosi Village, and stimulate economic growth in the surrounding communities through the implementation of Corporate Social Responsibility (CSR) initiatives.
		The District Council is expected to benefit from the proposed Project through the payment of service levies by the project proponent;	Noted The District Council will benefit from the project through the payment of service levies by the project proponent.
		Grievances from Project Affected Persons (PAPs) should be addressed carefully, and adequate guidance should be provided to help them use their compensation funds wisely;	Noted

Sn	Stakeholder Name	Views Raised	Responses
			Grievances from Project Affected Persons (PAPs) will be addressed carefully. A Grievance Redress Mechanism will be established and managed by a designated grievance officer, who will receive all grievances and ensure they are addressed in a timely manner.
		Awareness campaigns on the prevention and control of HIV/AIDS and other communicable diseases should be conducted throughout the Project implementation period;	Noted Awareness campaigns on the prevention and control of HIV/AIDS and other communicable diseases will be conducted throughout the project implementation period. In addition, reproductive health education will be provided to school children youth and community as well
		Continuous community engagement should be maintained throughout the implementation of the Project to ensure transparency and local participation;	Noted Continuous community engagement will be maintained throughout the project implementation to ensure transparency and active local participation.
		Measures should be put in place to prevent Gender-Based Violence (GBV) and Violence Against Children (VAC) during all stages of Project implementation;	Noted Measures will be implemented to prevent Gender-Based Violence (GBV) and Violence Against Children (VAC) throughout all stages of the project.
		The Council expressed its willingness to support the implementation of the project, provided that all statutory requirements, including the ESIA certificate and other relevant approvals, are duly followed	Noted
		The Project should prioritize employment opportunities for local residents during both construction and operation phases to improve livelihoods and enhance community well-being;	Noted The project will prioritize employment opportunities for local residents during both construction and operation phases to improve livelihoods and enhance community well-being.
16	Wosiwosi Village Government Council	The project will occupy a large area, requiring the entire village to be relocated from its grazing lands.	Noted The land to be acquired for the Project will be limited to the construction of the processing plant and associated infrastructure. There will be no physical displacement of households as experienced in projects such as Engaruka or Ngorongoro, since the trona mining activities will take place within Lake Natron itself rather than in village settlement areas.
		The community is concerned that the project will cause destruction of flamingo breeding habitats.	Noted The Project Proponent clarified that the proposed activities will be designed and implemented using environmentally friendly technologies to ensure that the breeding habitats of the Lesser Flamingo are fully protected. Strict environmental management measures will be applied to avoid any disturbance to the flamingo breeding areas within Lake Natron.
		There is fear based on the Engaruka soda ash project, where many people were displaced to make way for the project.	Noted The Project Proponent clarified that, unlike the Engaruka Soda Ash Project, the proposed development at Wosiwosi will not involve physical displacement of residents. The land required is limited to the construction of the plant and associated infrastructure, while the mining of trona will take place within Lake Natron itself. Therefore, no households will be relocated, and grazing areas will be carefully planned to minimize disturbance to community land use.
		The project will lead to loss of grazing areas for livestock keepers.	Noted The Project Proponent noted the concern regarding potential loss of grazing areas. It was clarified that the project footprint is designated within a portion of the grazing land where the plant and associated infrastructure will be constructed. However, efforts will be made to minimize any interference with livestock grazing activities. Furthermore, the project will collaborate with village leaders and livestock keepers to develop appropriate mitigation measures aimed at ensuring continued access to grazing areas and promoting sustainable livestock management.
		The community requests the investor to clearly demarcate project boundaries before implementation to avoid future land conflicts.	Noted The Project Proponent acknowledges the importance of clear land demarcation to prevent potential conflicts. Prior to project implementation, the boundaries of the project area will be clearly surveyed, mapped, and demarcated in collaboration with village leaders, local authorities, and relevant government agencies to ensure transparency and mutual understanding among all stakeholders.
		The community requests to be involved in all phases of the project and to be given an opportunity to provide their views.	Noted The Project Proponent is committed to ensuring continuous community involvement throughout all phases of the project. Community members will be engaged through regular meetings, consultations, and information-sharing sessions to provide their views and feedback.

Sn	Stakeholder Name	Views Raised	Responses
		The project may limit community access to natural soda (magadi) in areas taken by the project.	Noted The Project Proponent acknowledges the community's concern regarding access to natural soda (magadi). Measures will be put in place to ensure that community members continue to benefit from this resource. Where access restrictions are unavoidable due to safety or operational reasons, alternative areas for magadi collection will be identified in consultation with the community and local authorities to ensure continued access and sustainable use.
		The WWSL is requested to allow surrounding communities to collect soda ash for domestic use.	Noted The Project Proponent recognizes the importance of natural soda (magadi) for local livelihoods and traditional uses. WWSL will collaborate with village leaders and relevant authorities to develop clear arrangements that allow surrounding communities to continue collecting soda ash for domestic and cultural purposes, provided that such activities do not interfere with project operations or compromise safety and environmental standards
		The community welcomes the project but recommends that it be implemented in a similar manner to the Magadi project in Kenya.	Noted The Project Proponent appreciates the community's positive reception of the project and their reference to the Magadi project in Kenya.
17	Pinyinyi Village Government Council	The community is concerned about the potential human impacts the project may cause.	Noted The Project Proponent recognizes the potential social impacts associated with the influx of workers, including increased risks of HIV/AIDS and other sexually transmitted infections, early or coerced marriages, and cultural or behavioral conflicts. To address these risks, the project will implement comprehensive mitigation measures, including awareness campaigns on HIV/AIDS and reproductive health, community sensitization, promotion of ethical workplace behavior, and monitoring programs to ensure that all identified social impacts are effectively managed and minimized.
		They question how local people will benefit from employment, as they belong to a different district (Ngorongoro).	Noted The Project Proponent clarified that local employment opportunities will be prioritized for residents of Wosiwosi Village and surrounding communities, in addition to qualified workers from other districts as needed. Both skilled and unskilled positions during construction and operation phases will be made accessible to local people, ensuring that the project contributes to improving livelihoods and socio-economic benefits within the host community.
		If the project extracts water from River Ewaso Ng'iro, it will deprive the community of water for domestic use and agriculture.	Noted The Project Proponent clarified that water abstraction will be carefully managed to avoid negative impacts on the community's domestic and agricultural water supply. Water requirements for the project will be sourced sustainably, and alternative arrangements or mitigation measures will be put in place in consultation with the community to ensure continued access to River Shongole for domestic and agricultural use.
		The investor should note that the river sometimes dries up, especially during dry seasons.	Noted The Project Proponent noted that River Shongole experiences seasonal reductions in flow, particularly during dry periods. Project water use will be carefully planned and monitored to avoid exacerbating water scarcity, and mitigation measures will be implemented to ensure that the community's access to water for domestic and agricultural purposes is maintained throughout the year.
		Community participation is essential, including engagement with neighboring Kenya, since the river connects both countries.	Noted Stakeholders from both Tanzania and Kenya will be engaged, particularly in relation to River Shongole, to ensure that project activities are planned and implemented collaboratively, safeguarding shared water resources and promoting sustainable transboundary management.
		The project should ensure community involvement in all phases of implementation.	Noted The Project Proponent will ensure active community involvement throughout all phases of project implementation. Regular consultations, meetings, and feedback mechanisms will be conducted to incorporate community views, address concerns, and promote transparency and inclusiveness in decision-making.
		Beyond legal CSR obligations, the WWSL should implement community development projects benefiting surrounding areas.	Noted The Project Proponent has taken this into consideration and will implement community development initiatives beyond legal CSR obligations, as the budget allows, to promote positive relationships and sustainable benefits for the surrounding communities.
		Employment opportunities should be shared fairly among all neighboring communities.	Noted

Sn	Stakeholder Name	Views Raised	Responses
			The Project Proponent will ensure that employment opportunities are distributed fairly among all neighboring communities, prioritizing local residents while also considering the skills and qualifications required for both construction and operational phases.
		CSR revenues should also be distributed equitably to avoid conflicts between the investor and local communities.	Noted The Project Proponent will ensure that CSR funds are distributed equitably among the surrounding communities. Transparent and inclusive mechanisms will be established to prevent conflicts and ensure that the benefits of the project are shared fairly.
		The community welcomes the project but urges the WWSL to consider alternative water sources, as River Shongole is vital for farming, livestock, and domestic use.	Noted The Project Proponent appreciates the community's concern and will explore alternative water sources for project operations to avoid impacting River Shongole. Measures will be implemented to ensure that the river continues to support farming, livestock, and domestic water needs for the community.
18	Magadini Village Government Council	Will the proposed 150-acre project affect other villages, or only Wosiwosi?	The Project Proponent clarified that the 150-acre project will be implemented within Wosiwosi Village, with trona extraction conducted in Lake Natron. No other villages will be directly affected, except for Matale B, where the railway infrastructure associated with the project will be constructed.
		How will community opinions be considered and reach the relevant decision-making bodies?	WWSL has contracted MTL Consulting, an independent and qualified consultant, to collect community views and document them as part of the ESIA process. In addition, during consultation meetings, the Village Executive Officer (VEO) records community opinions, which are attached to the ESIA report submitted to NEMC. NEMC then conducts site verification to validate the information and views provided before making a decision on the issuance of the Environmental Certificate.
		Will employment opportunities be fairly distributed to all surrounding communities?	The company's policy is to prioritize employment for youth from the village directly affected by the project, Wosiwosi. Subsequently, youth from surrounding villages will also be given employment opportunities based on a distribution plan agreed.
		Will the agreement cover all affected villages or only Wosiwosi?	The Memorandum of Understanding (MOU) will be signed between Wosiwosi Village and the Project Proponent. It should be noted that WWSL has obtained the Primary License for trona mining from the Minerals Commission, ensuring that the project complies with all legal requirements.
		The project will reduce available pasture for livestock, severely affecting pastoral livelihoods and threatening food security for local communities.	Noted The Project Proponent clarified that the project footprint is limited to the area required for plant construction and associated infrastructure. Efforts will be made to minimize interference with grazing lands, and mitigation measures will be developed in collaboration with village leaders and livestock keepers to ensure continued access to pasture
		Dust, chemical emissions, and effluent from the project may contaminate air and water sources, posing health risks to humans, livestock, and aquatic life.	Noted The Project Proponent will implement strict environmental management measures to control dust, emissions, and effluents. Air and water quality will be regularly monitored, and mitigation strategies will be applied to prevent contamination and protect the health of humans, livestock, and aquatic life in the surrounding area.
		Industrial activity and reduced flamingo populations will negatively affect tourism, impacting local income and businesses that rely on eco-tourism.	Noted Wosiwosi Village was selected as the project site after careful consideration of multiple factors, including tourism activities. The village was chosen because the project's impacts are expected to be minimal compared to other locations. Moreover, the processing plant will be constructed approximately 1 km from Lake Natron, further reducing potential impacts on the lake and surrounding eco-tourism resources. The Project Proponent will implement environmentally friendly technologies and strict management measures to ensure that industrial activities do not disturb flamingo populations.
		Increased industrial activity and interaction with outsiders could undermine traditional customs, social cohesion, and the cultural identity of the community.	Noted The Project Proponent recognizes the community's concern regarding potential social and cultural impacts. Measures will be implemented to preserve traditional customs and cultural identity, including community engagement programs, awareness campaigns, and participatory decision-making
		Without fair allocation, local youth may lose opportunities in tourism-related and other economic activities, leading to economic inequality.	Noted In line with the company's policy, WWSL will ensure that employment and business opportunities are fairly distributed among surrounding communities. Mitigation measures will also be implemented to protect eco-tourism activities, ensuring that tourism resources are preserved and that local youth continue to benefit from employment opportunities within the tourism sector.
		The project may trigger disputes over land ownership and use, especially if boundaries are unclear or local communities are excluded from planning decisions.	Noted

Sn	Stakeholder Name	Views Raised	Responses
			The Project Proponent will clearly demarcate all project boundaries before implementation and actively involve local communities in planning and decision-making processes. These measures will help prevent land-use disputes and ensure that community interests are fully considered and respected throughout the project lifecycle.
		Communities that depend on collecting Magadi for domestic use may be deprived of this resource, affecting household livelihoods and traditions.	Noted The Project Proponent recognizes the importance of natural soda (Magadi) for local households and cultural practices. Arrangements will be made in collaboration with village leaders to allow surrounding communities to continue collecting Magadi for domestic and traditional uses, provided that such activities do not interfere with project operations or compromise safety and environmental standards.
		Industrial operations, including factories and heavy machinery, may raise local temperatures and create microclimatic changes in the area.	Noted The Project Proponent will implement mitigation measures to minimize environmental impacts from industrial operations, including dust and heat emissions. Regular monitoring and environmentally friendly technologies will be applied to prevent significant microclimatic changes and ensure that local temperature and ecological conditions remain stable.
		Construction and industrial activity could destroy habitats for native wildlife, disrupt migration routes, and reduce biodiversity in the area.	Noted The Project Proponent will implement strict environmental management and mitigation measures to protect native wildlife habitats, maintain migration corridors, and preserve biodiversity. Environmentally friendly technologies, careful site planning, and ongoing monitoring will be employed to minimize ecological disturbance throughout construction and industrial operations.
		The natural scenic beauty and ecological integrity of the area may be compromised, affecting both wildlife and the aesthetic value of the environment.	Noted The Project Proponent will implement measures to preserve the natural scenic beauty and ecological integrity of the area. By using environmentally friendly technologies, maintaining buffer zones, and monitoring impacts, the project aims to protect wildlife and ensure that the aesthetic and ecological value of the environment is sustained.
		The influx of workers could strain local resources, increase demand for land, water, and services, and lead to social tensions in the community.	Noted The Project Proponent recognizes that the influx may also include people coming to seek employment opportunities. Measures will be put in place to manage this, including prioritizing local residents for jobs, regulating worker accommodations, and monitoring the use of land, water, and services to prevent strain on community resources and reduce potential social tensions.
		The investor should develop mitigation measures to prevent land conflicts during project implementation.	Noted The Project Proponent will develop and implement mitigation measures to prevent land conflicts during project implementation. This will include clearly demarcating project boundaries, engaging local communities in planning decisions, and establishing grievance mechanisms to address any disputes promptly and fairly.
		All stakeholders should remain engaged in every phase of the project.	Noted The Project Proponent will ensure continuous engagement with all stakeholders throughout every phase of the project. Regular consultations, feedback mechanisms, and participatory decision-making processes will be maintained to address concerns and incorporate stakeholder input effectively.
		Project planning should minimize impacts on grazing lands, wildlife, cultural sites, and tourism assets.	Noted The Project Proponent will ensure that project planning minimizes impacts on grazing lands, wildlife habitats, cultural sites, and tourism assets
19	Matale B Government Council	The community seeks clarity on whether soda ash will be extracted only in Matale B or if operations will extend into surrounding village lands.	The Project Proponent clarified that soda ash extraction will be conducted in Lake Natron, within the designated project area in Wosiwosi Village. No extraction will take place in surrounding village lands, except for the railway infrastructure, which will pass through Matale B.
		Residents want assurances on mitigation measures for dust, accidents, and other health or safety risks, including protocols to respond to industrial hazards.	The Project Proponent will implement comprehensive health, safety, and environmental management measures to mitigate risks from dust, accidents, and other industrial hazards.
		The community requests that education programs be provided to ensure girls and other vulnerable groups are protected from potential exploitation by factory workers.	The Project Proponent through the community relation officer will implement education and awareness programs targeting girls and other vulnerable groups to protect them from potential exploitation. These initiatives will include community sensitization, reproductive health education, and engagement with local leaders to promote safety and social well-being.
		Residents want confirmation on whether they can continue collecting Magadi for household use even after the project starts.	The Project Proponent will allow surrounding communities to continue collecting Magadi for household and traditional uses, provided that such activities do not interfere with project operations or compromise safety and environmental standards.

Sn	Stakeholder Name	Views Raised	Responses
		Villagers request that job opportunities created by the project be distributed fairly among all surrounding communities.	The Project Proponent will ensure that employment opportunities are distributed fairly among all surrounding communities. Priority will be given to residents directly affected by the project, followed by neighboring villages, in accordance with agreed-upon allocations and local community consultations.
		The community inquired about the educational programs needed to equip students with skills relevant for employment in the factory, ensuring long-term benefits for students.	The Project Proponent clarified that the plant will employ professionals from diverse fields, including environmental experts, sociologists, engineers, accountants, and other specialists. The community is encouraged to prepare and equip themselves to take advantage of the various employment and skill-development opportunities that will arise from the project.
		Industrial activity may reduce pasture for livestock, affecting livelihoods and food security.	WWSL clarified that the project footprint is limited to the area required for plant construction and infrastructure. Efforts will be made to minimize interference with grazing lands, and the project will collaborate with village leaders and livestock keepers to develop mitigation measures that support sustainable livestock management and protect local livelihoods.
		Without clear boundaries, disputes between Matale B and Wosiwosi villages may intensify, requiring mitigation measures.	WWSL will clearly demarcate all project boundaries before implementation and actively involve both Wosiwosi and Matale B village leaders in planning and decision-making. This approach will help prevent land-use disputes and ensure that community interests are respected throughout the project.
		Dust from extraction and transport could degrade air quality, harm livestock, and affect residents' health.	WWSL will implement dust control and air quality management measures. These measures aim to protect residents' health, livestock, and the surrounding environment from potential impacts of dust.
		Transportation of soda ash, including by train, could endanger livestock and community members if proper safety protocols are not in place.	WWSL will implement strict safety protocols for soda ash transportation, including secure handling, designated transport routes, and community awareness campaigns. Measures will also include fencing, signage, and monitoring to ensure the safety of livestock and residents during both road and rail transport.
		Industrial activity may affect traditional land use, social cohesion, and access to local resources like Magadi.	WWSL will implement measures to minimize impacts on traditional land use, social cohesion, and access to local resources such as Magadi. This includes clearly demarcating project areas, engaging communities in decision-making, and establishing mechanisms to ensure safe and equitable access to resources while maintaining cultural and social integrity.
		If jobs and resources are not equitably shared, some residents may miss economic opportunities from the project.	WWSL will ensure that employment opportunities and access to project-related resources are distributed fairly among all affected communities. Mitigation measures and community engagement will be implemented to promote equitable participation, enabling residents to benefit from the economic opportunities generated by the project.
		Without proper education and awareness programs, vulnerable groups could be exposed to social risks.	WWSL will implement education and awareness programs targeting vulnerable groups, including youth and women, to mitigate social risks. These programs will cover reproductive health, HIV/AIDS prevention, personal safety, and community engagement to ensure that all groups are informed, protected, and able to benefit safely from the project.
20	Tanzania National Park (TANAPA)	The project is expected to bring substantial economic benefits to the adjacent communities and the country at large;	Noted WWSL acknowledges and appreciates TANAPA's observation. Indeed, the project is anticipated to generate significant economic benefits at both local and national levels. It will create direct and indirect employment opportunities, stimulate business growth, enhance local infrastructure, and contribute to national revenue through taxes and exports. Additionally, community development initiatives will be implemented to ensure that surrounding communities benefit equitably from the project's operations.
		TANAPA recommends that all residual impacts of the project be carefully addressed and that practical mitigation measures be effectively implemented.	Noted WWSL appreciates TANAPA's recommendation and fully agrees with the importance of addressing all residual impacts. Comprehensive Environmental and Social Management Plans (ESMPs) will be developed and implemented to ensure that all identified impacts are effectively mitigated. Continuous monitoring and evaluation will also be conducted in collaboration with relevant authorities, including TANAPA, to ensure that mitigation measures remain practical, effective, and responsive to changing environmental and social conditions.
		Based on the anticipated economic benefits, TANAPA expresses positive support for the project.	Noted The Project Proponent appreciates TANAPA's positive support and recognition of the project's potential economic benefits to the surrounding communities and the nation. The project is committed to ensuring that these benefits are realized through responsible implementation, adherence to environmental and social safeguards, and collaboration with all stakeholders including TANAPA to promote sustainable development in the area.
21	Tanzania Rural and Urban Roads Agency (TARURA)	The proposed project should prioritize the improvement of key access roads connecting Longido to Wosiwosi to enhance accessibility and mobility. Currently, the following roads are in poor condition and require urgent rehabilitation: • The Matale-Wosiwosi Road (60 km), which is presently in poor condition.	Wosiwosi Company Limited acknowledges and appreciates the comments provided by TARURA regarding the condition of key access roads within the project area. The Company recognizes the importance of the Matale–Wosiwosi Road and the Gelai Lumbwa–Magadini Road in facilitating efficient transportation, not only for project implementation but also for supporting local community access and socio-economic activities.

Sn	Stakeholder Name	Views Raised	Responses
		• The Gelai Lumbwa-Magadini Road (45.8 km), which is also in poor condition.	In this regard, Wosiwosi Company Limited will engage with relevant authorities, including TARURA and the respective local government institutions, to explore feasible options for improving these roads.
22	Ngorongoro District Council	The proposed project may result in several environmental and social impacts that require careful consideration and mitigation:	Wosiwosi Company Limited acknowledges and appreciates the concerns raised by the Ngorongoro District Council regarding the potential environmental and social impacts of the proposed soda ash project.
		Impacts on Water Resources: • Increased water demand for soda ash extraction may place pressure on available water resources. • Potential reduction in freshwater availability could affect local communities, wildlife, and livestock.	The Company recognizes that the project may have implications on water resources, including increased water demand and potential effects on freshwater availability for local communities, wildlife, and livestock. In response, the Company will undertake detailed hydrological assessments and implement sustainable water management measures to ensure efficient use and protection of water resources.
		Water Pollution and Soil Contamination: • Discharge of saline waste may degrade water quality. • Improper handling of chemical residues could lead to soil contamination.	With regard to concerns on water pollution and soil contamination, Wosiwosi Company Limited is committed to implementing appropriate waste management systems, including proper handling, treatment, and disposal of saline waste and chemical residues, in compliance with national environmental standards.
		Impacts on Biodiversity: • The project area is part of a globally significant ecosystem. • It serves as a breeding site for lesser flamingos and other wildlife species, which may be affected by project activities.	The Company also acknowledges the ecological sensitivity of the project area, particularly its importance as a habitat for biodiversity, including lesser flamingos. A comprehensive biodiversity assessment will be conducted, and mitigation measures will be developed to minimize impacts on critical habitats and species.
		Land Degradation: • Project activities may lead to land degradation and disruption of natural habitats.	In addressing potential land degradation, the Company will adopt best practices in land management, including site rehabilitation and restoration plans to ensure minimal disturbance to the environment
		Given these potential impacts, the project should be implemented in full compliance with established Environmental Impact Assessment (EIA) frameworks, ensuring that appropriate mitigation measures are identified and applied to address all anticipated impacts	Overall, the project will be implemented in full compliance with the Environmental Impact Assessment (EIA) requirements and relevant national and international environmental standards. Wosiwosi Company Limited remains committed to working closely with stakeholders to ensure that all identified impacts are effectively mitigated and managed
23	Ngorongoro District Executive Director (DED)	There is a need to ensure that the project is sustainable in the long term, particularly in relation to environmental protection and resource use.	The Company is committed to ensuring the long-term sustainability of the project by integrating environmental, social, and economic considerations into project design and implementation. Sustainable resource use, continuous monitoring, and adaptive management strategies will be applied throughout the project lifecycle.
		The project may affect natural resources within the area, and appropriate measures should be in place to safeguard them.	The Company acknowledges the potential impacts on natural resources and will implement mitigation measures as outlined in the Environmental and Social Management Plan (ESMP). These include minimizing resource extraction impacts, protecting sensitive areas, and restoring affected environments where necessary.
		The economic feasibility of the project should be clearly demonstrated, including how benefits will be distributed to local communities.	The project has undergone economic and financial feasibility assessments to ensure its viability. In addition, the Company is committed to promoting local economic development through employment opportunities, local procurement, and support to community livelihood initiatives.
		The project appears to rely heavily on water availability, which may pose risks given the sensitivity of the area.	Recognizing the importance of water resources, the Company will conduct detailed hydrological studies and implement efficient water management practices, including water conservation, recycling where feasible, and monitoring to prevent over-extraction and ensure sustainability.
		The project is located in an ecologically sensitive area, which requires careful planning and strict adherence to environmental regulations	The Company acknowledges that the project area is environmentally sensitive. As such, a comprehensive Environmental Impact Assessment (EIA) has been undertaken, and strict adherence to national environmental regulations and international best practices will be maintained. Additional measures will be implemented to protect critical habitats and biodiversity.
		The area supports important socio-economic activities such as livestock keeping and other livelihood practices, which should not be negatively affected by the project	The Company recognizes the significance of existing socio-economic activities such as livestock keeping and other livelihoods. Measures will be put in place to avoid, minimize, or compensate for any adverse impacts, while enhancing positive contributions to community development.
		The Government and local authorities rely significantly on tourism revenues generated from the Engaresero/Lake Natron area. Therefore, the project should be implemented in a manner that does not interfere with or reduce opportunities for revenue collection from tourism activities.	Wosiwosi Company Limited acknowledges the importance of tourism revenue in the Engaresero/Lake Natron area and will ensure that project activities are carefully planned and managed to avoid interference with tourism operations. The Company will collaborate with relevant authorities to maintain and, where possible, enhance tourism opportunities alongside the project.

Sn	Stakeholder Name	Views Raised	Responses
		The project should ensure inclusive participation of all relevant stakeholders, particularly local communities surrounding the Lake Natron area, throughout the project lifecycle.	The Company is committed to inclusive and continuous stakeholder engagement throughout the project lifecycle. All relevant stakeholders, particularly local communities surrounding the project area, will be actively involved through consultations, information sharing, and participatory decision-making processes.
		Project benefits should be clearly defined, communicated, and equitably shared among relevant stakeholders, especially the local communities.	Wosiwosi Company Limited will establish mechanisms to ensure that project benefits are clearly defined, transparently communicated, and equitably shared. Priority will be given to local communities through employment opportunities, local procurement, and community development initiatives.
		Site validation is essential and should be conducted through a participatory approach involving key stakeholders to enhance transparency and acceptance.	The Company agrees that site validation is important and will ensure that it is conducted in a participatory manner, involving key stakeholders to promote transparency, inclusiveness, and acceptance of project decisions.
		The final Environmental Impact Assessment (EIA) report should be shared with all relevant key stakeholders to ensure transparency and promote informed decision-making.	Wosiwosi Company Limited will ensure that the final Environmental Impact Assessment (EIA) report is disclosed to all relevant stakeholders in accordance with national regulatory requirements, to enhance transparency and support informed decision-making.
24	National Development Cooperation (NDC)	The Soda Ash Project at Lake Natron can be implemented, given that the Lesser Flamingo population is not significantly disturbed to an extent that would affect their breeding	Wosiwosi Company Limited acknowledges the comment provided by the National Development Corporation regarding the importance of safeguarding the lesser flamingo population at Lake Natron. The Company recognizes that Lake Natron is a critical breeding habitat for lesser flamingos and is committed to ensuring that project activities do not significantly disturb their breeding patterns. In this regard, comprehensive biodiversity assessments have been undertaken to understand species distribution, breeding cycles, and habitat sensitivity Appropriate mitigation measures will be implemented, including maintaining buffer zones around breeding areas, scheduling project activities to avoid critical breeding periods, and continuous monitoring of flamingo populations in collaboration with relevant authorities and experts. The Company will ensure that all project activities are carried out in compliance with national environmental regulations and international best practices to protect biodiversity. Wosiwosi Company Limited remains committed to balancing project development with conservation priorities to ensure that the lesser flamingo population is not adversely affected.
25	Tanzania Bureau of Standards (TBS)	The project proponent is advised to ensure product certification through the Tanzania Bureau of Standards online platform (TBS website) by utilizing the e-service application system. In addition, the project should comply with the following applicable standards: TZS 860 and TZS 845. Adherence to these standards will ensure product quality, safety, and compliance with national regulatory requirements.	Wosiwosi Company Limited acknowledges the guidance provided by the Tanzania Bureau of Standards regarding product certification and compliance with applicable standards. The Company will ensure that all relevant products are certified through the TBS online e-service application system as required. In addition, the Company commits to adhering to the specified standards, including TZS 860 and TZS 845, as well as any other applicable national standards, to ensure product quality, safety, and full compliance with regulatory requirements.
26	Lake Natron GCA North (Adam Clements Safaris Ltd),	Adam Clements Safaris Ltd is a tenant within the proposed project area. However, since the area falls under the jurisdiction of the Tanzania Wildlife Management Authority (TAWA), the company recommends consulting the authority to obtain official comments on the project.	Wosiwosi Company Limited acknowledges the comment provided by Adam Clements Safaris Ltd regarding the need to engage the Tanzania Wildlife Management Authority. The Company recognizes that the project area falls under the jurisdiction of TAWA and confirms that the Authority will be formally consulted to obtain official guidance and comments on the proposed project. Wosiwosi Company Limited is committed to working closely with TAWA and other relevant stakeholders to ensure that all project activities comply with wildlife conservation requirements and applicable regulatory frameworks.
27	National Environment Management Authority (NEMA) in Kenya	Flamingo breeding sites should be clearly identified, demarcated, and strictly protected from mining and development activities.	Wosiwosi Company Limited acknowledges the importance of protecting flamingo breeding sites and will ensure that all such areas are clearly identified, demarcated, and strictly conserved. Project activities will be planned and implemented to avoid any disturbance to these sensitive habitats.
		Processing facilities, including factories and associated infrastructure, should be located at least 500 meters away from residential settlements to minimize potential impacts.	The Company will ensure that processing facilities, including factories and associated infrastructure, are appropriately located at safe distances from residential settlements. A minimum buffer zone of 500 meters will be considered, alongside other environmental and social factors, to minimize potential impacts.
		Continuous monitoring of both surface water and groundwater should be undertaken, focusing on water levels, quality, and chemical characteristics.	Wosiwosi Company Limited will implement a comprehensive water monitoring program covering both surface water and groundwater. This will include regular assessment of water levels, quality, and chemical characteristics to ensure sustainable water resource management.
		Given the environmental sensitivity of the area, a water treatment plant should be established prior to any discharge of effluent to ensure compliance with environmental standards.	In recognition of the environmental sensitivity of the area, the Company will establish an appropriate water treatment system prior to any effluent discharge. This will ensure that all discharges meet national environmental standards and do not adversely affect the surrounding environment.
		The use of advanced and environmentally sound technologies is strongly recommended. It is noted that appropriate technology can	The Company is committed to utilizing advanced and environmentally sound technologies in project implementation. These technologies will be selected to minimize environmental impacts and enhance operational efficiency, in line with best practices and sustainability principles.

Sn	Stakeholder Name	Views Raised	Responses
		significantly reduce environmental impacts, potentially mitigating up to 75% of anticipated effects.	
27	Tanzania National Roads Agency (TANROADS)	The project proponent should ensure that transportation of soda ash complies with the requirements of Tanzania National Roads Agency, particularly with respect to axle load control regulations. All vehicles used for transporting materials must adhere to the prescribed axle load limits to prevent damage to road infrastructure.	Wosiwosi Company Limited acknowledges the requirements of the Tanzania National Roads Agency and will ensure that all transportation of soda ash strictly complies with axle load control regulations. All vehicles engaged in the project will adhere to the prescribed load limits to prevent damage to road infrastructure.
		The project proponent should ensure that soda ash products comply with relevant national standards, including adherence to applicable Tanzania Standards to guarantee product quality and safety transportation.	The Company will ensure that all soda ash products comply with relevant national standards, including applicable Tanzania Standards to guarantee product quality, safety, and regulatory compliance.
		The project should consider the potential impact of heavy vehicle traffic on road conditions and ensure that appropriate measures are in place to minimize deterioration of roads and maintain safety standards	Wosiwosi Company Limited will assess and manage the potential impacts of increased heavy vehicle traffic on road conditions. Appropriate mitigation measures will be implemented, including proper transport planning, routine vehicle maintenance, and coordination with relevant authorities to minimize road deterioration and ensure
28	Coordinator for the Ngorongoro Lengai UNESCO Global Geopark and Head of Museum Geopark Programs at the Ngorongoro Conservation Area Authority (NCAA)	Although the proposed trona extraction activities will be conducted within Lake Natron, which lies outside the Ngorongoro Lengai UNESCO Global Geopark (UGGp) boundary, some permanent project facilities and logistical activities are proposed to be located within the Geopark boundary, as indicated on the project layout map; According to the UNESCO Global Geoparks Operational Guidelines, Article 3(vii), extraction of minerals, fossils, or rock products for business purposes is prohibited within UNESCO Global Geopark territories It was recommended that the project facilities be relocated outside the Geopark boundary, particularly towards the Gwara, Hemah, or Mtowabaga areas.	WWSL acknowledges the concern regarding the location of some proposed permanent facilities and logistical activities within the Ngorongoro Lengai UNESCO Global Geopark boundary. The company confirms that the trona extraction activities will be undertaken within Lake Natron, outside the designated Geopark boundary, and commits to continued engagement with relevant authorities to ensure compliance with applicable regulations and conservation requirements. WWSL recognizes the UNESCO Global Geoparks Operational Guidelines and understands the importance of protecting the integrity and conservation value of the Ngorongoro Lengai UNESCO Global Geopark. The ESIA has therefore considered potential impacts associated with the proposed facilities and activities within or near the Geopark area. The recommendation to relocate project facilities outside the Geopark boundary towards areas such as Gwara, Hemah, or Mtowabaga has been noted. WWSL will further review the project layout and assess the technical, environmental, and operational feasibility of alternative locations in consultation with relevant authorities during the detailed project design stage.

APPENDIX 7: STAKEHOLDERS ENGAGEMENT LETTER

WOSWOSI SODA LIMITED
P.O.BOX 77910 DAR ES SALAAM
Email: mr.kaoneka@gmail.com
Mobile No. 0712288647

16th February 2026

ADAM CLEMENCE SAFARIS
ARUSHA.

Ref: Stakeholder Engagement on the Proposed Trona Extraction and Soda Ash Production Project at Lake Natron.

We refer to the above subject, which is of significant importance.

We write to formally inform your esteemed company of our intention to undertake trona extraction from Lake Natron and to develop a Soda Ash Production Facility within your LAKE NATRON G.C.A NORTH hunting block at Wosiwosi Village, Longido District, Arusha Region, and United Republic of Tanzania. This initiative forms part of our broader commitment to advancing Tanzania's industrial capacity while upholding the highest standards of environmental and social responsibility.

The proposed development includes the construction of a modern soda ash processing plant and supporting infrastructure, including access roads, a 5-kilometre railway line to the Kenya border, a hospital, and staff housing. According to the current design, approximately 1.5 square kilometres of land will be allocated for the processing plant and township. All project components will be situated at a safe and carefully planned distance from the ecologically sensitive areas surrounding Lake Natron.

The facility is designed to extract approximately 1,000,000 tons of trona per annum, with an expected annual production of 660,000 tons of soda ash for both domestic consumption and international export markets.

We fully acknowledge your presence and operations in the area, as well as the ecological and cultural significance of Lake Natron, particularly in relation to the nature of your business.

We are currently undertaking a comprehensive Environmental and Social Impact Assessment (ESIA) and are proactively engaging all relevant stakeholders. As the holder of the hunting block within which the project is proposed to be located, we consider Adam Clemence Safaris to be a key stakeholder in this process. We therefore respectfully invite your observations, recommendations, and guidance to ensure that the proposed project does not adversely affect your operations and to identify the most appropriate framework for coexistence.

We welcome the opportunity to collaborate with your company in promoting a development model that balances ecological integrity with national economic progress.

We look forward to your valued response.

Yours sincerely,

Yesaya Kaoneka (Environmental Expert)
Woswosi Soda Limited

APPENDIX 8: STAKEHOLDER CONCERNS FROM THE PREVIOUS ESIA STUDY OF 2007

APPENDIX 8A: RECORDS FROM TANZANIA

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUES	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT EIS
NEMC- 5 October 2006	• Mr Joseph Kombe, Senior Environmental Office, NEMC • Mr. Gwalema, Senior Environmental Officer, NEMC • Mr Kevin Burton, ESIA Project Manager, Norconsult A.S • Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Ms. Zainab Kuhanwa, Environmental Scientist, Norconsult (T) Ltd	The project may result in transboundary environmental and social impacts due to its proximity to the international border and reliance on Lake waters influenced by inflows from the Ewaso Ngiro River originating in Kenya, necessitating formal cross-border stakeholder consultation.	Consultations have been conducted with The National Environment Management Authority (NEMA) of Kenya on19th January 2026. Issues raised by NEMA in response to the proposed Project are presented in section 5.6.7 and attached in Appendix 6 of Volume 2. NEMA is an authority in Kenya which is mandated to ensure sustainable management of the environment through exercising general supervision and coordination of all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment. In addition, the current EIS includes an assessment of potential transboundary impacts and proposes mitigation and monitoring measures aimed at minimizing adverse environmental and social effects associated with the project.
		The Consultant should follow up on key actions for the proposed project, including identification and demarcation of the project area, identification and consultation of all stakeholders, and consideration of all ongoing and planned activities within the project area	A site layout plan has been developed, referring to (Figure 2.1 and 2.2) of the EIS report. Upon award of the Mining License, the Project proponent will demarcate the mining area as Section 52(b) of the Mining Act, 2010 (Cap 123). Different stakeholders have been identified and engaged during development of this EIA, their concerns have been presented in Chapter 5 and in Appendix 6 in Volume 2. Engagements with stakeholders will continue throughout the project lifetime.
		Future upstream developments on the Ewaso Ngiro River, including proposed hydropower projects in Kenya, may alter river flows and water quality, potentially resulting in cumulative and transboundary impacts on Lake Natron and its sensitive ecosystem	The proposed hydropower Project (Ewasongiro Multi-Purpose Dam) is currently shelved by the government of Kenya due to transboundary objections, lack of political will and lack of financial support. A water balance study on the Lake and River Ewasongiri was conducted as part of this ESIA and is Appended in Appendix 12 in Volume 2 In addition, stakeholder consultations were undertaken with relevant authorities in Kenya, including NEMA Kenya, to obtain views regarding potential transboundary impacts. The project also proposes environmental monitoring and adaptive management measures to track any significant changes in the lake ecosystem and water resources during project implementation.
		The proposed development of the industrial area may result into negative environmental and social impacts, including cultural impacts on indigenous communities due to population influx, potential effects on the Ramsar conservation status of the area, disruption of wildlife corridors with increased risk of wildlife vehicle collisions, and adverse impacts on rare and endangered species, particularly flamingos for which Lake Natron is a key breeding site.	**Cultural impacts on indigenous communities due to population influx** The ESIA has assessed the potential cultural and social impacts associated with population influx during both construction and operation phases. Mitigation measures include prioritizing local employment opportunities, implementing a worker Code of Conduct, conducting awareness programmes on local customs and traditions, and maintaining continuous engagement with indigenous communities such as the Maasai and Sonjo. The project will also establish a grievance mechanism to address community concerns promptly and minimize disruption to traditional lifestyles and cultural practices**.** **Potential effects on the Ramsar conservation status of the area** Article 3.1 requires parties to "promote the conservation of wetlands... and as far as possible the wise use of wetlands." "Wise use" is defined as "maintenance of ecological character" not zero extraction, but sustainable use. Refer to Section 2.4.1 (Mining and Dredging System). The proposed mining operation employs a Cutter Suction Dredger (CSD), specifically selected and configured to minimise environmental disturbance while enabling efficient recovery of trona deposits from the Lake Natron basin. The methodology is designed to align with the Ramsar Convention's "wise use" principle, emphasizing: • Controlled, spatially limited extraction to avoid disruption of hydrological regimes; • Protection of critical habitats, including flamingo breeding and feeding zones; • Maintenance of the lake's ecological character and hydrological integrity; • Adaptive management protocols to respond to real-time environmental monitoring. This approach ensures that trona recovery is both commercially viable and ecologically responsible, consistent with internationally recognised standards for wetland conservation. **Disruption of wildlife corridors with increased risk of wildlife vehicle collisions.** The ESIA identifies key wildlife movement corridors within and around the project area and incorporates mitigation measures to minimize disturbance. Measures include designated transport routes, enforcement of strict vehicle speed limits, installation of wildlife crossing signage, driver awareness training, restriction of night-time driving where feasible, and regular monitoring of wildlife movement patterns in collaboration with wildlife authorities. **Adverse impacts on rare and endangered species, particularly flamingos, for which Lake Natron is a key breeding site.**

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUES	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT EIS
			The project design has intentionally avoided critical flamingo breeding and nesting habitats. Mining activities will occur within a designated area located away from breeding colonies, and extraction will use controlled Cutter Suction Dredging methods to minimize disturbance. Continuous ecological monitoring, including flamingo population surveys, water quality monitoring, and adaptive management measures, will be implemented throughout the project lifecycle to ensure that impacts on endangered species remain minimal.
		Land use changes into an industrial area due to the project will impact critical existing habitats	The ESIA includes a detailed land use and habitat assessment to identify sensitive ecological areas within and around the project footprint. Project infrastructure has been planned to avoid critical habitats wherever possible, while disturbed areas will be minimized through careful site planning. Habitat protection measures, restricted access zones, progressive rehabilitation, and biodiversity monitoring will be implemented to reduce long-term impacts on surrounding ecosystems.
		The consultant should consider having alternative sites to clearly outline the pros and cons of each selection	An alternatives assessment has been included in the ESIA, comparing different project siting and development options based on environmental, technical, economic, and social considerations. The selected site was identified as the most feasible option due to the availability of trona reserves, reduced disturbance to critical flamingo breeding habitats, and the ability to minimize impacts on tourism, wildlife corridors, and surrounding communities.
		How will the project ensure ecosystem balance? Especially the aquatic ecosystem	The Project will maintain ecosystem balance in Lake Natron by regulating water levels to preserve natural hydrological conditions, using electric-powered equipment to reduce pollution risks, and carefully controlling extraction to avoid sensitive aquatic habitats. Continuous water quality monitoring and alignment with the Ramsar Convention principles will help sustain key ecological processes such as photosynthesis, while biodiversity protection measures will safeguard important species like the Lesser Flamingo, ensuring the lake's ecological integrity is preserved.
		Need for extensive consultation at all levels, and the consultants quote/ cite examples of similar projects that would convince the public that this project will be feasible if all negative impacts are addressed	The current EIS has emphasized the need for extensive stakeholder consultation at all levels, including local communities, government authorities, conservation institutions, non-governmental organizations, and relevant stakeholders from both Tanzania and Kenya. Accordingly, a comprehensive stakeholder engagement process was undertaken during the preparation of the current EIS to ensure that stakeholders' views, concerns, and recommendations were adequately captured and incorporated into the project design and assessment process. The details of the consultation process, issues raised, and corresponding responses are presented in the stakeholder engagement section 5 and in Appendix 6 of the EIS Report. In addition, the EIS has referenced and reviewed experiences from similar mineral extraction and industrial development projects, including the Magadi Soda Ash Project in Kenya, which has operated within a sensitive ecosystem for many years under established environmental management and monitoring systems. (section xx)
NDC 27th October 2006	• Mr Ramson Milangali, Ag. Technical Director, NDC. • Mr. Malindi, Legal Officer, NDC. • Mr Isaack Mamboleo, Project Engineer, NDC. • Mr. Abdallah Mwakasisi, Project Engineer, NDC. • Ms. Ester, Financial analyst, NDC. Mr. Arthur, Financial analyst, NDC. Ms. Kahatano, Financial analyst, NDC. • Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Ms. Zainab Kuhanwa, Environmental Scientist, Norconsult (T) Ltd	What if brine concentration is at Lesser Flamingos breeding site?	The current ESIA has addressed this concern by confirming that the designated mining license area is located approximately 7.5 km from the nearest known breeding sites of the Lesser Flamingo. This distance refers to the boundary of the mining license, with actual dredging operations planned to occur further within the license area, thereby increasing the separation from sensitive habitats. In addition, resource assessments indicate that the approved mining area contains brine reserves sufficient to sustain operations for over 100 years. As such, there is no anticipated need for expansion toward flamingo breeding areas. The ESIA therefore concludes that the risk of brine concentration or associated mining activities affecting Lesser Flamingo breeding sites is negligible. This is further supported by the implementation of environmental management measures and ongoing monitoring to ensure protection of sensitive ecological receptors.
		Concern of the site on the eastern shore as there are some hunting blocks while western side is the tourist area and the breeding site for Flamingos, which will raise land use conflicts.	This concern is addressed by providing updated site layout that provides the project sitting and zone considerations. From the layout, the proposed infrastructure and mining activities are located within a designated mining license area that is strategically selected to avoid key sensitive zones, particularly on the western shoreline which supports tourism activities and critical Lesser Flamingo breeding habitats. The current EIS also incorporated land use mapping and stakeholder consultations to identify the existing land uses (including hunting blocks, tourism zones and conservation areas.) The project design avoids direct overlap with tourism spots and ecologically sensitive zones.
		NDC is not only a stakeholder but also the Client for the proposed project and requested that the stakeholders' list be shared with the Consultant to ensure proper engagement and consultation throughout the project.	NDC, along with other stakeholders who were not consulted have been added to the current EIS. The updated list is provided in Appendix 2 Volume2
		The Government of Kenya had previously planned to construct a hydropower plant on the Ewaso Ngiro River, which could have had potential transboundary impacts on Lake Natron and its ecosystem, leading to the project being stopped by Tanzania.	The proposed construction of the power plant on the Ewaso Ngiro river is currently scrapped due to financial constraint and lack of political support. It is considered a non-active or foreseeable development. Hence there is no transboundary impacts in Lake Natron and its ecosystem

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUES	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT EIS
		The project is located within Lake Natron Ramsar site. While Tanzania is committed to its protection, the lack of a formal Management Plan makes it challenging to define what development activities may be permitted within the site	Currently, there is no officially released Integrated Management Plan for the Lake Natron Ramsar site. The current ESIA conducted along with previous ones conducted can be used as a foundation point for the creation of the Integrated Management Plan
The Ministry of Water (Water Resources and Utilisation) 2nd November 2006	• Mr Joseph Kubena, Officer from the office of Director for Water Resources. • Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Ms. Zainab Kuhanwa, Environmental Scientist, Norconsult (T) Ltd	Is there any new input going to be added in Lake Natron during the extraction of soda ash?	There will be no inputs added to the Lake Natron during the extraction of soda ash. The extraction method uses a Cutter Suction Dredger which naturally extracts brine without the addition of external chemical reagents. The operation is designed as a closed-loop system, where the process water is recycled to minimize discharge. No industrial effluents or untreated waste =water will be discharged directly into Lake Natro.
		The Consultant was informed that, as part of the EIA process, they are responsible for developing the Terms of Reference (ToR)	The consultant has developed the ToR as part of the EIA process
		The Consultant should ensure consultation with the Central Basin office, including both the Singida headquarters and the Arusha regional office, to determine any water abstraction requirements from Lake Natron and assess potential impacts on the lake's ecosystem and other water users.	The comment is noted. Consultations were undertaken with the relevant offices of the Central Basin Water Board, including the Singida Headquarters and the Arusha Regional Office, as part of the stakeholder engagement process for the EIS. The consultations focused on potential water abstraction requirements from Lake Natron, possible impacts on the lake ecosystem, and potential effects on other water users within the basin. The views and recommendations provided by the authorities have been considered and incorporated into the EIS Report, including the assessment of water resource use, hydrological impacts, and proposed mitigation measures.
		The Consultant should consult the Arusha sub-office to gather information on local and traditional water users of Lake Natron, as existing data on these stakeholders is currently insufficient.	Consultations were undertaken with the Arusha sub-office to obtain information regarding local and traditional water users of Lake Natron. The information gathered during the consultation process has been incorporated into the EIS Report to strengthen the baseline data on water resource use and to support the assessment of potential impacts on local and traditional water users.
		The products of the project will be exported?	The finished soda ash product will be exported to international markets such as Europe. At the same time, it will be sold to the local Tanzanian market as well.
		If the project is approved, the processing plant should be located within the Ramsar site while worker accommodations should be situated outside the site to minimize disturbance and protect the Lake Natron Ramsar heritage.	It is planned that the processing plant will be located 2km from the shoreline of Lake Natron and the township accommodations will be located approximately 1km. In total, the accommodations will be approximately 3km from the shorelines of Lake Natron.
		Although these suggestions are outside the direct scope of the ESIA, they are relevant during the project's operation phase, particularly regarding water abstraction. The project should involve Ministry of Water staff, especially hydrologists, during the installation and monitoring of flow measurement facilities to ensure proper water accounting and allocation. The project should also explore alternative water sources to minimize disturbance to the existing water source and its associated ecosystems during operations.	Recommendation is added in the current EIS under the management plan for water resource.
WCST -2nd November 2006	• Mr Lota Melamari, CEO/Coordinator, WCST Mr. Paul Nnyiti, Senior Conservation Officer, WCST • Mr. Aloyce Kimaro, Head of Project, Uluguru Mountains Conservation Project, WCST • Mr. Said Mbwana, Programme Development Officer • Mr David Parry, Land use specialist, Norconsult A.S • Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd	The project may be complex, and concerns were raised regarding the potential profitability of soda ash extraction given that the area's ecosystems are likely to be significantly altered	Within the mining boundary of the proposed project, the substantial trona reserves provides sufficient quantities to support operations for over 150 years. This long term availability provides a strong basis for the projects economic viability without the need to expand into environmentally sensitive areas. The project has been specifically designed to minimize ecological disturbance. The selected extraction method (Cutter Suction Dredging) allows for controlled, localized brine abstraction without large-scale physical alteration of the lakebed or surrounding habitats.
		A large number of workers during the construction phase raised concerns about potential pressure on limited local resources and impacts on the ecosystem. How will the project manage these effects?	In the current EIS, in section 2.5, the project will implement a controlled workforce strategy where the number of workers is planned and phased according to construction activities to avoid unnecessary population surges. Where feasible, priority will be given to local residents for employment to reduce in-migration. Pressure on local resource will be minimized by establishing self-contained construction camps with dedicated facilities for accommodation, water supply, sanitation, energy and waste management.
		Waste management, especially the risk of oil and diesel spills at the project site, could lead to contamination. How will the project prevent and manage such spills?	The proposed project will not utilize any chemicals during the extraction of trona from the Lake Natron till the processing plant. The dredgers will be electric based instead of using generators and a solar farm will be implemented to provide alternative sources of power for the township. In each phase, the oils and lubricants from maintenance activities will be stored in lined storage areas. Maintenance activities will be done in designated, contained areas away from sensitive receptors and ecosystems
		How will the project manage the impacts of a significant influx of people at the construction site, including labour, suppliers, and opportunistic immigrants, which may exceed the reported workforce and put pressure on local resources and the ecosystem?	The project will implement a controlled workforce strategy where the number of workers is planned and phased according to construction activities to avoid unnecessary population surges. Where feasible, priority will be given to local residents for employment to reduce in-migration. Pressure on local resource will be minimized by

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUES	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT EIS
	• Ms. Zainab Kuhanwa, Environmental Scientist, Norconsult (T) Ltd		establishing self-contained construction camps with dedicated facilities for accommodation, water supply, sanitation, energy and waste management.
		How will the project ensure that Lake Natron's role as a critical breeding site for flamingos is protected, particularly regarding the use of fresh water from the Peninj River, which flamingos depend on for their survival?	In the current EIS, freshwater will not be abstracted from the Penini River, rather it will abstract from Ewaso Ngero river. Penini river is recognized as a critical freshwater source and therefore will be preserved without direct interference from project activities. The project will not modify natural flow regimes or divert water from rivers that support the lake ecosystem.
		The project should consider that its extraction methodology is not disturb Flamingos	The current EIS explains the Cutter Suction Dredging system which extracts trona from the lakebed without disturbing or affecting the flamingos
		Ewaso Ngiro Hydropower Project in Kenya that was stopped by Tanzania but now Tanzania is expecting/ proposing to extract soda ash from Lake Natron it may begin again	The Ewaso Ngiro Hydropower Project in Kenya is currently on hold due to no political backing and lack of funds from the Kenyan Government. There is no evidence that suggests the project will be resumed again as the Kenya government has not announced any update.
		How will consultations with local communities, particularly vulnerable groups such as the Wasonjo, Ndorobos, and Maasai, be facilitated, given the apparent lack of capacity in district institutions to manage and monitor the development process?	The current EIS has provided for an inclusive stakeholder engagement process involving local communities and vulnerable groups, including the Wasonjo, Ndorobos, and Maasai communities, throughout the project planning and assessment process. Consultations were conducted through meetings, focus group discussions, and engagement with community leaders and representatives to ensure that the views and concerns of vulnerable groups were adequately captured and documented. In addition, the project will continue to implement stakeholder engagement and grievance management mechanisms throughout the project lifecycle to promote effective communication and participation of affected communities. The EIS also recognizes the capacity challenges within some district institutions and therefore recommends continued collaboration with relevant government authorities, local leadership, and other stakeholders to strengthen coordination, monitoring, and oversight during project implementation
		There is concern that the protection of flamingos, as part of Tanzania's World Heritage obligations, must be prioritized, and that the economic benefits of soda ash extraction should not compromise the ecological and conservation objectives	The proposed project is designed to avoid significant impacts in critical habitats rather than relying solely on mitigation. The current EIS states that the mining boundary of the proposed project holds substantial trona reserves providing sufficient quantities to support operations for over 100 years. This eliminates the need to expand into sensitive ecological zones as the mining area holds sufficient resource for long-term operation.
Chief Technical Advisor for Wetlands at the Wildlife Division-3rd November 2006	• Mr Larsen, Wetlands technical adviser, Wildlife Division. • Mr. Kaita, Wetlands Officer/Game Officer, Wildlife Division. • Mr David Parry, Land use specialist, Norconsult A.S • Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Ms. Zainab Kuhanwa, Environmental Scientist, Norconsult (T) Ltd	availability of data for wildlife movement within the proposed project area	This has been presented in Chapter 4 of the ESIA report, Baseline conditions for fauna species for references.
		Has the company had this kind of project before?	No, the company has not had this kind of project before.
		Who is the ornithologist among the team members for this project?	Onesmo Haule - A Wildlife Conservation Officer from Siha District Council, Kilimanjaro. He conducted the fauna baseline study of the project which includes birds. The detailed data has been presented on the fauna baseline report and on chapter 4 of the ESIA study under the fauna section.
		Is the project going to change the quality and quantity of the water?	The proposed project will not change the quality and quantity of the water as there are inputs that are returned to the lake. The process will be a closed-loop system with water being recycled instead of returning it to the lake.
		What will be the potential of sewage water during production?	During the production phase, the potential for sewage water will be moderate as most of the sewage will be from the township and the offices. All wastewaters will be collected and treated using appropriate on-site sewage systems.
		Have the consultants visited Magadi and assessed the social impacts experienced from that project?	Yes. The consultants visited the Magadi Project in Kenya and assessed the environmental and social impacts associated with the project. In addition, the government institution, the Tanzania Wildlife Research Institute (TAWIRI), also visited the area and prepared a report on their observations and findings. The report is attached in Appendix 12 of Volume 2 of the EIS Report.
		Previously the Kenyan Government has a plan to construct Hydropower Plant at Ewaso Ngiro River, which will have potential impacts on Lake Natron and its ecosystem. As the project was stopped by Tanzania would the proposed Soda Ash Project not cause cross border resentment?	The proposed Hydropower Plant has been scrapped as the project experienced no political backing and financial constraints. As of now, the project does not seem feasible.
		Will the project construct airstrip?	The current proposed project will not construct an airstrip.
Division Forestry and Beekeeping	• Mr. Aloyce Tango, Act. Director Forestry and	If the project takes place, population numbers would increase and put pressure on the Gelai forest which would then loose its value/ function for catchment.	The project will implement a controlled workforce strategy where the number of workers is planned and phased according to construction and operation activities to avoid unnecessary population surges. Where feasible, priority will be given to local residents for employment to reduce in-migration. Pressure on local resources will be minimized

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUES	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT EIS
Division -7th November 200	Beekeeping Division, Ministry of Natural Resources and Tourism. • Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Ms. Zainab Kuhanwa, Environmental Scientist, Norconsult (T) Ltd		by establishing self-contained construction camps with dedicated facilities for accommodation, water supply, sanitation, energy and waste management.
		Potential mitigation measures for impact should focus on the long term rather than short term plans.	The EIS has proposed mitigation measures that focus on both short-term and long-term management of potential environmental and social impacts associated with the project. Emphasis has been placed on sustainable mitigation strategies, continuous environmental monitoring, adaptive management, restoration measures, and long-term stakeholder engagement to ensure effective management of impacts throughout the entire project lifecycle, including post-closure phases
		The proponent /project could not be responsible for the management of the Gelai Forest Reserve so the parties responsible should be identified and notified early in the project development.	The management of the Gelai Forest Reserve falls under the mandate of the relevant authorities within the Ministry of Natural Resources and Tourism and not the project proponent. Nevertheless, the relevant responsible parties and authorities have been identified and engaged during the stakeholder consultation process to ensure that issues related to the management and conservation of the Gelai Forest Reserve are considered during project development and implementation
		How will the project address the limited local capacity for managing natural resources within the area?	The proposed project infrastructure, including the township will be located within the defined project boundaries of the project. The current EIS document in section 1 contains the updated layout of the proposed project. Workers and residents of the township will be prohibited to utilize the natural resources (wood) for any use as the township will be fully run by solar power provided by the solar farm.
		Would it be valuable for the ESIA process to include staff from relevant divisions, such as forestry officers, to assist in the investigations?	The current ESIA study has actively involve relevant government technical staff, including forestry, wildlife, and water officers, as part of the ongoing stakeholder engagement and verification studies.
Division of Antiquities-8th November 2006	• Mr Chediel Simon Msuya, Conservator – Head of Research • Ms Jane Kessy, Conservator • Ms Maro Eliwasa, Head of Conservation • Dr. Flora Ismail, ESIA Team leader, Norconsult (Tanzania) Ltd • Mr David Parry, Land use Specialist, Norconsult A.S • Ms. Zainab Kuhanwa, Environmental Scientist, Norconsult (Tanzania) Ltd	It is recommended that the project team include an archaeologist to address the significant palaeontological and archaeological importance of the Peninj site, including the presence of hominid remains and stone tools, and to fill gaps in existing data	An archaeological study has been conducted for the current EIS, and the findings including baseline data, a management plan, mitigation measures, and a monitoring plan have been incorporated into Section 4.4, section 5.7.9, section 7.4.1-7.4.3, section 8.7.11, section 9.2.9
		The project should consider that Lake Natron is a wetland of international importance, designated as a Ramsar site, home to rare species such as the Lesser Flamingo, and a popular tourist destination for walking safaris, ensuring that these ecological and socio-economic values are protected.	This is well noted. The proponent is considering this and will continue to consider it throughout the project implementation
		Cultural Impact Assessment should be conducted, given the project's proximity to a World Heritage site, the Ngorongoro Conservation Area (NCAA).	In the current EIS, Cultural Impact Assessment was conducted as part of ESIA study. (Section 4.4, section 5.7.9, section 7.4.1-7.4.3, section 8.7.11, section 9.2.9)
		the project should consider the archaeological significance of areas	The project has considered the archaeological significance of the area, and a dedicated archaeological study has been conducted, with findings including baseline data, a management plan, mitigation measures, and a monitoring plan incorporated into Section 4.4, section 5.7.9, section 7.4.1-7.4.3, section 8.7.11, section 9.2.9of the EIS.
		It is advised that the project anticipate and manage potential human pressure resulting from an influx of hopeful business people attracted by the project, to minimize strain on local resources and the surrounding environment	The project will implement a controlled workforce strategy where the number of workers is planned and phased according to construction and operation activities to avoid unnecessary population surges. Where feasible, priority will be given to local residents for employment to reduce in-migration. Pressure on local resources will be minimized by establishing self-contained construction camps with dedicated facilities for accommodation, water supply, sanitation, energy and waste management.
WWF	• Mr. Hermann Mwageni, Country Representative, WWF • Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Ms. Zainab Kuhanwa, Environmental Scientist, Norconsult (T) Ltd	Lake Natron is one of the potential breeding sites for Flamingos in Africa, thus it was crucial for the proponent to know where the concentration of the resource (soda) was before putting up the plant	The proponent conducted detailed resource mapping to identify soda concentration zones prior to plant siting, while also assessing the ecological sensitivity of Lake Natron as a flamingo breeding site. The dredgers location was selected to avoid critical breeding and feeding areas, and the current EIS includes mitigation measures to minimize disturbance to flamingo habitats.
		There is little understanding of how the ecosystem functions at Lake Natron and how such a project would impact the ecosystem and the environment in general	The ESIA study addresses this through the detailed baseline studies that describe key habitats, ecological processes, and ecosystem services within Lake Natron. These include freshwater inflows and surrounding habitats that support biodiversity, such as the Lesser Flamingo. The studies establish a scientific baseline for species distribution, habitat condition, and ecosystem functioning, supported by habitat mapping and continuous monitoring. This baseline is essential for predicting how proposed project activities could alter environmental conditions, including changes in hydrology, habitat availability, and species distribution. Potential impacts may include disruption of freshwater inflows, degradation of breeding and feeding habitats, increased ecological stress on specialized species, and changes in ecosystem services.

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUES	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT EIS
		Population influx whereby the demand for charcoal and firewood will increase as a result deforestation which will lead to soil erosion thereafter sedimentation to the lake and this might have some impacts on Flamingos.	The project will implement a controlled workforce strategy where the number of workers is planned and phased according to construction and operation activities to avoid unnecessary population surges. Where feasible, priority will be given to local residents for employment to reduce in-migration. Pressure on local resources will be minimized by establishing self-contained construction camps with dedicated facilities for accommodation, water supply, sanitation, energy and waste management.
		the project will result to traffic accidents and disturbance to the surrounding wildlife	The ESIA study has outlined comprehensive mitigation measures to address the potential for traffic accidents and disturbance to surrounding wildlife, including enforcement of strict speed limits, designation of specific transport routes, driver training and awareness programs, installation of warning signage, and scheduling of vehicle movements to avoid peak wildlife activity periods. Additional measures such as regular vehicle maintenance, controlled access to project roads, and ongoing monitoring will further reduce risks to both communities and fauna within and around Lake Natron, ensuring that impacts are effectively minimized and managed.
		Strategic Impact Assessment to be undertaken for the proposed project and closely monitored by an independent body/interested parties.	An ESIA has been conducted to address project-specific impacts, including transboundary and cumulative effects.
		The project will result to increase sexual transmitted diseases such as HIV/AIDS	It is anticipated that there will be an influx of workers and increased economic activity associated with the project may increase the risk of communicable diseases, including HIV/AIDS and other sexually transmitted infections (STIs). To address this, the Project will implement a comprehensive Community Health and Safety Management Plan that includes HIV/AIDS and STI awareness and prevention programmes for workers and surrounding communities. Measures will include regular health education campaigns, distribution of awareness materials in collaboration with local health authorities and healthcare providers, voluntary counselling and testing services, enforcement of worker codes of conduct, and promotion of responsible behavior within worker camps and nearby communities. In addition, the Project will prioritize local employment where feasible to reduce population influx and associated social risks. Continuous monitoring and engagement with local communities will also be undertaken throughout the project lifecycle to minimize public health impacts.
Commissioner for Minerals (Ministry of Energy and Minerals) 29th November 2006	• Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Ms Zainab Kuhanwa, Environmental Scientist, Norconsult (T) Ltd • Mr Ujas Dave, Project Manager, TATA Chemicals • Mr Rahul Soryh, Assistant project manager, TATA Chemicals • Mr Abdallah S. Mandoga, Project Engineer, NDC • Mr Said H. Malindi, Legal Officer, NDC • Mr Paul Masanja, Chief Inspection for Mines, Ministry • Mr George Kasesa, Geologist, Ministry • Mr Mwakilembe Assa, Engineer, Ministry • Mr Mwanjisi Frederick, Engineer, Ministry • Mr Slimu Mtigile, Mining Engineer, Ministry • Mr Massawe Getty, Mining Engineer, Ministry	Value of the scoping notice to the Sonjo and Maasai who have no access to newspapers	It is anticipated that some local communities, including the Sonjo and Maasai, may have limited access to newspapers and other formal communication channels. Therefore, stakeholder engagement was not limited to newspaper scoping notices alone. Additional consultation methods were undertaken, including village meetings, public gatherings, consultations through village leaders and local government authorities, and direct community engagement conducted in accessible locations and local languages where necessary. These approaches ensured that information regarding the proposed project and the ESIA process reached potentially affected communities effectively and allowed them adequate opportunity to raise concerns and provide input.
		community concerns be addressed early in project development to avoid future conflict.	The ESIA process has incorporated early and continuous stakeholder engagement with local communities, government authorities, conservation organizations, and other interested parties. Community concerns and recommendations gathered during consultations have been integrated into project planning, impact assessment, and mitigation measures. In addition, the Project will establish a grievance redress mechanism to provide communities with an accessible platform for raising concerns throughout the construction and operation phases. Continuous communication and consultation will be maintained to promote transparency, trust, and effective conflict prevention. All consulted stakeholders and their views are in Chapter 5.6.
		concerns were raised about the composition of the soda ash resource and the potential for local use of any by-products from the extraction process, given that soda ash is primarily used by industries that are limited in Tanzania, which may restrict local value addition beyond revenue generation.	The proposed project is expected to contribute to the national economy through employment creation, infrastructure development, government revenues, and support services. In addition to export opportunities, the project may support local industrial development through the supply of soda ash and associated by-products to domestic industries such as glass manufacturing, detergents, chemicals, and other industrial applications where feasible.
		The project should provide employment opportunities to local people	The project will prioritize employment of qualified local residents during both construction and operation phases where skills are available. In addition, training and capacity-building programmes will be implemented to improve local participation and enhance long-term socio-economic benefits for surrounding communities.
		What are the concerns of other stakeholders particularly Ministry of Natural Resources and Tourism with regards the project?	Concerns raised by stakeholders, including the Ministry of Natural Resources and Tourism, mainly relate to the protection of flamingo breeding habitats, conservation of the Ramsar site, wildlife movement corridors, pressure on natural resources, tourism impacts, and management of population influx. These concerns have been incorporated into the ESIA through baseline studies, impact assessment, stakeholder engagement, and development of mitigation and monitoring measures within the ESMP.

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUES	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT EIS
	• Mr Henry Mditi, Mining Engineer, Ministry • Mr Benjamini Ndiwangahe, mining Engineer, Ministry • Mr Ally Samaje, Head Licensing Unit, Ministry		
IUCN 11th January 2007	• Dr Isssa, Head IUCN, Country Office • Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Mr Ujas Dave, Project Manager, TATA Chemicals • Mr Rahul Soryh, Assistant project manager, TATA Chemicals • Mr Abdallah S. Mandoga, Project Engineer, NDC	The ESIA should be comprehensive to allow the government to make an informed decision.	The current ESIA is comprehensive, covering the environmental, social, and transboundary aspects to support the government in making an informed decision. All relevant baseline data, impact assessments, mitigation measures, management and monitoring plans have been included in the current EIS report.
		Species quantification; it is not well known how many life forms are dependent on the Lake ecosystem.	The ESIA study has provided baseline data on flora, fauna, and aquatic species within the project area in Chapter 4 section 4.2.13, including information on species composition, abundance, and distribution. While complete species quantification for the entire Lake ecosystem remains challenging due to data gaps, the current EIS presents the best available information to support decision-making.
		Pollution from the introduction of new access to the area; opening up the area by improving access, the environment was somewhat self-protecting due to poor access.	While improved access may increase the risk of pollution, the current EIS assesses potential impacts from the proposed access roads, including waste management, vehicle emissions, and spill response. Mitigation measures such as access controls, regular monitoring, and community awareness programs have been proposed to prevent the opening up of the area leading to environmental degradation.
		Socio-economic, migrant populations cause imbalance on utilisation of both social services and natural resources. Health issues particularly HIV/AIDS	The current EIS addresses socio-economic impacts, including potential pressures from migrant populations on social services and natural resources. Specific mitigation measures have been proposed, including a HIV/AIDS awareness and prevention program as part of the project's health and safety management plan, to address the identified health risks
		Employment, the staffing policy should show gender sensitivity	The project's staffing policy will explicitly incorporate gender sensitivity, promoting equal opportunities for women and men in recruitment, training, and employment benefits. This commitment will be reflected in the project's Human Resources and Community Development Plans.
		Capacity for implementation of the EMP, the ESIA should incorporate capacity building as a key component for the EMP to improve capacity of civil societies and assist the WD. It should be corporate responsibility to address the EMP	ESIA has incorporated capacity building as a key component of the EMP, specifically targeting local civil societies and the relevant stakeholders to strengthen their oversight and implementation capabilities. WWSL recognizes that effective EMP implementation is part of corporate responsibility and will allocate resources for training, technical support, and collaborative monitoring.
		Climate variability/ changes; local conditions prescribe extreme differences what would be the contribution of the project to air and water pollution.	The current EIS assesses the project's potential contributions to air and water pollution under local climate variability and extreme conditions, including dry and wet seasons. Mitigation measures have been designed to minimize emissions and effluent discharges regardless of climatic fluctuations.
		Transboundary issues, consult extensively with stakeholders. The East African Commission has guidelines to address natural resources	We consulted NEMA Kenya, and their views have been incorporated into the Stakeholder Engagement chapter.
		Use the ESIA for Lake Natron as a capacity building experience for local expertise, organize a knowledge-based workshop on the ESIA to build the experience into training and teaching for the various programmes available	WWSL will use the ESIA process for Lake Natron as a capacity-building opportunity for local expertise by organizing a knowledge-based workshop. The workshop will translate ESIA findings and lessons into training and teaching materials for relevant academic and technical programmes.
Commissioner for Energy (Ministry of Energy and Minerals) 15th January 2007	• Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Dr. MUA Lutengano, Asst Commissioner Energy • Mr B. Diliwa, Petrol and Gas Songosongo • Mr I Maulid • Mr E. Bugaberwa • Mr A. Lyatuu	The effect of effluents on the flamingos	The Project acknowledges concerns regarding the potential effects of effluents on flamingos and their breeding habitat at Lake Natron. The ESIA has incorporated wastewater and effluent management measures designed to prevent contamination of the lake and surrounding ecosystems. The proposed operation includes controlled wastewater management systems, water recycling processes, and continuous monitoring of water quality to minimize the risk of impacts on aquatic ecology and flamingo breeding areas. In addition, the selected project location is located away from the most sensitive flamingo nesting and breeding zones, and biodiversity monitoring programs will be implemented throughout the project lifecycle to ensure that any potential impacts on flamingos and other wildlife are identified early and effectively managed through the Environmental and Social Management Plan (ESMP).
		Local wind regimes have energy potential and could also be considered	While wind energy may have potential, WWSL will primarily utilize electricity, solar, and battery technologies that are environmentally friendly, while continuing to assess all viable low-impact energy options.
		Transboundary – have the Kenyans been consulted	We consulted NEMA Kenya, and their views have been incorporated into the Stakeholder Engagement chapter.

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUES	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT EIS
		Consult more with TANESCO on power options for economically viable source. For environmentally friendly energy source, if option is not economically viable, consultation/ negotiation with government should be made to provide assistance	WWSL consulted TANESCO to explore economically viable and environmentally friendly power options for the project.
		Project could source energy from national grid off Mto wa Mbu line or possibly consider extending line from Arusha as there are plans to connect Namanga from Kenya.	WWSL will evaluate the feasibility of sourcing energy from the national grid via the Mto wa Mbu line, as well as the potential extension from Arusha, particularly given planned connectivity to Namanga from Kenya. These options will be considered alongside other energy sources in the project's power supply assessment.
WILDLIFE DIVISION 11 April, 2007	• Dr. Flora Ismail, ESIA Team leader, Norconsult (T) Ltd • Mr. David Parry, Land use Specialist, Norconsult A.S • Felia Lyimo, Ag. Director Wildlife Division • N. J. Mwina, Principal Game Officer (IMDS), Wildlife Division • S. A. Okudo, Principal Game Officer/ LAW, Wildlife Division • Louis Nzali Principal Game Officer / NB, Wildlife Division • Erasto Tarimo, Wildlife Division • Benson Kibonde, Wildlife Division	The proposed site area (Wosiwosi) is currently under Game Control status and would need to be formally degazetted prior to the establishment of the plant.	Consultations with the Coordinator for the Ngorongoro Lengai UNESCO Global Geopark and the Head of Museum Geopark Programs at NCAA confirmed that, while the trona extraction occurs outside the Geopark boundary, some permanent facilities fall within it. As per UNESCO Global Geoparks Operational Guidelines Article 3(vii), mineral extraction for business purposes is prohibited within Geopark territories, and WWSL will address this constraint in project siting and design.
		The project should recognize the importance of the Engaruka corridor for migratory wildlife populations and consider undertaking an aerial survey to supplement community-based information and better inform impact assessment and planning.	WWSL recognizes the importance of the Engaruka corridor for migratory wildlife populations and will consider undertaking an aerial survey to complement existing community-based information, thereby improving the impact assessment and planning process.
		EIA should be detailed	The current EIA has been prepared to a detailed EIS covering all relevant environmental and social aspects as required by national and international standards
		The road to Loliondo was inevitable and that the Soda Ash project would only influence the size of the road and the volume of traffic	The current EIS assesses these impacts and proposes mitigation measures for increased traffic, including dust control, road safety, and wildlife crossing considerations.
		Flamingo to be dealt with as "wildlife" and not separately	This is addressed in the ESIA study, which provides a comprehensive fauna baseline study where flamingos are considered as part of the broader wildlife community within Lake Natron. The study therefore assesses impacts on wildlife as an integrated system rather than treating flamingos as a separate category.
		The project would have a large beneficial impact on the Tanzanian economy and that at the national level it was important	The project is expected to generate significant beneficial impacts on the Tanzanian economy, including direct and indirect employment, increased government revenue through taxes and royalties, infrastructure development, and technology transfer.
IUCN-SSC / Wetlands International Flamingo Specialist Group	Dr. Brooks Childress, Chair	The location of project facilities is critical, as facilities situated closer to the lake shore and Lesser Flamingo breeding areas are likely to cause significant disruption to the breeding process. There is particular concern regarding the proposed pipeline across the lake surface, as large crèches of juvenile Lesser Flamingos move long distances across the lake to access fresh water, and such infrastructure could adversely affect chick survival.	The project facilities are located away from the bleeding site, and the significance of this impact is very low-negative.
		There is concern that the planned introduction of Artemia brine shrimp, a non-native species, could reduce the food supply of Lesser Flamingos, which rely exclusively on algae and diatoms. Prior to any introduction, long-term scientific studies should be conducted to assess potential impacts on indigenous crustaceans, cyanobacteria, and diatom abundance.	The project has no plan to introduce Artemia brine shrimp
		There is concern that the proposed soda ash extraction could alter lake water levels and chemistry, which are critical for Lesser Flamingo breeding. Insufficient water could dry out nesting areas and cause chick mortality, while excessive water could flood nests, leading to breeding failure. Changes in water chemistry may also reduce the abundance of algae, the primary food source for Lesser Flamingos	The current EIS includes a detailed assessment of potential changes to lake water levels and chemistry from the proposed extraction, recognizing their critical importance for Lesser Flamingo breeding. Mitigation measures have been developed to maintain hydrological balance, prevent nesting area desiccation or flooding, and preserve algae abundance as the flamingos' primary food source. Continuous monitoring of water quality and flamingo breeding success will be implemented.

APPENDIX 8B: RECORDS FROM KENYA

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUE	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT ESIA
Ewaso Ngiro South Development Authority (ENSDA) February 22, 2007	• Mr. Francis M. Nkako, Managing Director • Ewaso Ngiro South Development Authority (ENSDA), Narok, Kenya. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd.	What are other stakeholders consulted for this project?	A wide range of stakeholders has been consulted for this project, including government ministries (Ministry of Minerals, Ministry of Water, Ministry of Natural Resources and Tourism, Ministry of Land, Vice President's Office, NEMC), government agencies (TANROADS, TAWIRI, TARURA, OSHA, GCLA, TFS, TANESCO, TANAPA, TMA, NDC, TBS), regional and local administrations (Arusha Region, Longido and Ngorongoro District Councils, Wards, and Villages), international organizations (UNESCO, Ramsar, WWF, IUCN, NCAA), hunting companies, women and youth groups, community members, landowners, politicians, and Kenyan stakeholders (NEMA Kenya). Details are presented in the Stakeholder Engagement chapter 5.
		There is concern about the source of freshwater for the project and the potential impacts on the Ewaso Ngiro catchment, which the developer should carefully consider	The current EIS identifies the source of freshwater for the project and assesses potential impacts on the Ewaso Ngiro catchment. WWSL will carefully manage water abstraction to avoid significant hydrological effects, and mitigation measures, including water conservation and monitoring, have been incorporated into the environmental management plan.
		It is very important for the developer to take into consideration what is happening upstream before embarking on investments on Lake Natron i.e. it is important to understand what is happening at the headwaters in the catchment areas.	WWSL recognizes the importance of understanding upstream activities in the catchment headwaters before proceeding with investment in Lake Natron. The current EIS includes an assessment of catchment conditions, including land use and hydrological dynamics, and WWSL will continue to monitor upstream developments as part of project risk management.
		It is recommended that a Kenyan delegation of experts visit the proposed soda ash project area at Lake Natron as part of the EIA study. Consultations with UNDP/GEF in Tanzania should also be conducted, given their involvement in the Great Rift Valley Lakes and the valuable information they can provide	WWSL will propose that a delegation of Kenyan experts be invited to visit the proposed soda ash project area at Lake Natron as part of the ongoing EIA process, to facilitate cross-border understanding and collaboration. Furthermore, consultations have been conducted with NEMA Kenya, and their views have been incorporated into the EIS report to include valuable technical information and regional insights.
		Being a Ramsar site, there is a need to in-build conservation measures into development activities so as to have a proper balance.	The ESIA study includes a flora, fauna and aquatic conservation management plan with mitigation measures designed to ensure that development activities within Lake Natron are consistent with its Ramsar site status. These measures aim to protect biodiversity, minimize habitat disturbance, and maintain ecological integrity while allowing for sustainable development.
		It is recommended that both Kenya and Tanzania be actively involved in the proposed project, for example through the East African Community (EAC), to address potential transboundary and bilateral issues.	WWSL supports active involvement of both Kenya and Tanzania in the proposed project, including through the East African Community (EAC) framework, to effectively address transboundary and bilateral issues. This approach will be integrated into the ongoing stakeholder engagement and environmental management processes.
		It is recommended that the project develop a well-defined Corporate Social Responsibility (CSR) policy that ensures social investments benefit the local community, including support for schools, public health, and care for retired employees, to ensure the project "gives back" to the community.	WWSL will develop a well-defined Corporate Social Responsibility (CSR) policy ensuring that social investments directly benefit local communities, including support for schools, public health, and care for retired employees, thereby ensuring the project gives back to the community.
		It is recommended that the project consider the increasing freshwater demand in the area and ensure that monitoring of the hydrological system is jointly conducted by both Tanzania and Kenya to manage this scarce resource effectively.	WWSL will consider the increasing freshwater demand in the area and ensure that monitoring of the hydrological system is jointly conducted by both Tanzania and Kenya to manage this scarce resource effectively.
NEMA, Kajiado February 27, 2007	• Mr. William Maritim, District Environment Officer, Kajiado, Kenya. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd.	Concern was expressed regarding degradation of the Ngurumani escarpment catchment on the Kenyan side due to agricultural activities, which is affecting water flows into Lake Natron. The importance of community sensitization and cross-border biodiversity initiatives in protecting the lake was also highlighted	WWSL recognizes that degradation of the Ngurumani escarpment catchment on the Kenyan side due to agricultural activities is affecting water flows into Lake Natron. The importance of community sensitization and cross-border biodiversity initiatives in protecting the lake is therefore well noted, and WWSL will support collaborative efforts under relevant regional frameworks.
		The developer should prioritize cleaner production by adopting clean technologies, as this would minimize or avoid significant adverse emissions from the project	WWSL will prioritize cleaner production by adopting clean technologies to minimize or avoid significant adverse emissions from the project.

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUE	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT ESIA
		The project should ensure sustainable development, with particular attention to the condition of the catchment, and support the local economy by implementing robust environmental management systems and cleaner production measures	WWSL will ensure sustainable development by paying particular attention to catchment conditions, supporting the local economy, and implementing robust environmental management systems alongside cleaner production measures.
		The developer should maintain strong community relations through a well-defined Corporate Social Responsibility (CSR) policy, demonstrating genuine concern for local affairs, while also fostering positive political and social relations between Tanzania and Kenya.	WWSL will maintain strong community relations through a well-defined CSR policy that demonstrates genuine concern for local affairs. Additionally, the project will foster positive political and social relations between Tanzania and Kenya through continued cross-border engagement and transparency.
		The project should consider promoting ecotourism initiatives within the area to support wildlife conservation, while ensuring that the local community is aware of and able to benefit from these conservation efforts.	This is well noted and will be taken into consideration throughout the project phases
		The study should assess the long-term impacts of the facility, including potential effects on public health, staff health and safety, and environmental quality. It should also consider social amenities and how employee welfare will be provided for in this remote location	The current EIS includes an assessment of the facility's long-term impacts on public health, staff health and safety, and environmental quality.
		The project should aim to create a largely self-sustaining town to minimize interactions between migrant populations and local communities, while maximizing positive economic impacts such as employment, exports, investments, and generation of foreign exchange.	WWSL will aim to create a largely self-sustaining town to minimize potential tensions between migrant populations and local communities, while maximizing positive economic impacts including employment, exports, investment, and foreign exchange generation. This approach will be reflected in the project's social and workforce management plans.
Nature Kenya February 26, 2007	• Mr. Paul Matiku, the Executive Director, Nature Kenya, Nairobi. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd.	According to the EIA study, Lake Natron should remain undisturbed, and the report is available at the Department of Ornithology at the Museums of Kenya headquarters for reference.	This is well noted, the ESIA report will be available at the Department of Ornithology at the Museums of Kenya headquarters for reference.
		Lake Natron is a major breeding site for flamingos. Disrupting the Lake Natron system would affect the global population of flamingos. No development is equal to losing a species or significant population of a species that is threatened	This is well acknowledged, the ESIA study has provided the proper Environmental and Social Management plan on chapter 8, to mitigate environmental and social impacts on the project area. The proponent will consider it throughout the project cycle.
		It is recommended that NEMA (Kenya) be given the opportunity to review and approve the project or provide input on the EIA report. The agency should be informed, through the EIA process, of potential impacts and proposed mitigation measures, as identified by Kenyan stakeholders. Given Lake Natron's status as a Ramsar site of national importance, implementing the proposed project may be challenging.	WWSL will formally request that NEMA Kenya be given the opportunity to review the EIA report and provide input, particularly on potential transboundary impacts and proposed mitigation measures as identified by Kenyan stakeholders. It is recognized that Lake Natron's status as a Ramsar site of national importance presents challenges, and WWSL remains committed to addressing all environmental sensitivities through rigorous assessment and mitigation.
		The project's high-water requirements would necessitate powerful turbines, which could inadvertently pull fish and potentially people, and there is a risk that oil leaks from machinery could pollute the lake waters	The project's water intake design will include appropriate screening and safeguards to prevent entrainment of fish or people. Furthermore, strict operational protocols and spill prevention measures will be implemented to eliminate the risk of oil leaks polluting lake waters.
		The project should carefully weigh the benefits of mining Lake Natron against the potential benefits of ecotourism. Consideration should be given to investing in infrastructure and other initiatives that enhance both the economic and environmental value of the lake.	The Project recognizes the importance of balancing soda ash mining at Lake Natron with the preservation of the lake's ecological and ecotourism value. The ESIA highlights that the Project has adopted improved technologies, including an electricity-powered Conventional Monohydrate Process, to reduce pollution and environmental disturbance compared to previous proposals. The selected project location at Wosiwosi Village is positioned away from key flamingo breeding areas, sensitive springs, and major ecotourism zones. In addition, the Project includes biodiversity protection, water

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUE	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT ESIA
			resource management, environmental monitoring, and continued engagement with conservation and tourism stakeholders such as UNESCO, WWF, IUCN, and TATO. The Project also aims to support local infrastructure development, including roads, water supply, and electricity services, in a manner that can enhance both economic opportunities and the long-term environmental sustainability of the Lake Natron area.
Nature Kenya February 26, 2007	• Mr. Enock Kanyanya, Conservation Programme Manager, Nature Kenya, Nairobi. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd.	The project should recognize that Lake Natron is a critical breeding ground for flamingos, which are highly sensitive to disturbances and will abandon their nests if the site is disrupted. The fragile nest structures are easily affected by minor disturbances. Lessons from the Ewaso Ngiro Hydropower Project EIA, where the project was shelved for environmental reasons, should also be considered.	The current ESIA study has confirmed that the designated mining license area is located approximately 7.5 km from the nearest known breeding sites of the Lesser Flamingo. This distance refers to the boundary of the mining license, with actual dredging operations planned to occur further within the license area, thereby increasing the separation from sensitive habitats.
		Population increase could attract other bird species, such as crows and pelicans, which may threaten flamingos by preying on their eggs and chicks, potentially affecting breeding success.	While population increase in the area could potentially attract opportunistic bird species such as crows and pelicans, the current EIS includes measures to manage waste and disturbance that may reduce such risks. Flamingo breeding success will be monitored, and adaptive management will be applied if predation pressure increases
		Refer to the 13 recommendations made by the IUCN at the 1993 workshop on the conservation of Lake Natron, as these provide important guidance for protecting the lake's ecological values.	Noted. WWSL will refer to the 13 recommendations made by the IUCN at the 1993 workshop on the conservation of Lake Natron, which provide important guidance for protecting the lake's ecological values. These recommendations will be considered in the final EIS and project design.
		The project could lead to a decrease in successful flamingo hatcheries, causing a significant decline in their populations. Given the importance of flamingos to ecotourism in Kenya, including at Lake Nakuru National Park, the project may have adverse cross-border impacts on Kenya's tourism sector.	The current ESIA study has confirmed that the designated mining license area is located approximately 7.5 km from the nearest known breeding sites of the Lesser Flamingo. This distance refers to the boundary of the mining license, with actual dredging operations planned to occur further within the license area, thereby increasing the separation from sensitive habitats.
WWF EARPO March 08, 2007	• Dr. Taye Teferi, Conservation Programme Director, WWF EARPO. • Dr. Musonda Mumba, Freshwater Programme Coordinator, WWF EARPO. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd.	Lake Natron is the primary breeding site for flamingos in the Eastern African region, and all populations in Nakuru and Taita originate from this site. Environmental factors, such as low water levels in Ewaso Ngiro, reduced inflow streams, and deforestation in catchments, are already affecting flamingos and the lake ecosystem. The project should assess potential impacts on flamingos, fish species, and biodiversity, including effects from human settlement, sewage, and pollution	Detailed potential impacts on flamingos, fish species, and biodiversity in general have been discussed in detail in chapter 7, section 7.4 (fauna and aquatic resources) for reference.
		The project should include provision for collecting baseline data on flamingos and fish at Lake Natron, with a focused research study to support ongoing monitoring.	The baseline data have been presented in detail in Chapter 4 of the ESIA report under the fauna and Aquatic baseline study. A standalone baseline study for fauna and Aquatic studies has been attached as Appendices for references.
		The project should evaluate the ecotourism value of Lake Natron against the benefits expected from the soda ash project, taking lessons from the Magadi experience into consideration.	Lake Natron has high but fragile eco-tourism value, mainly because it is the key breeding site for the Lesser Flamingo, with unique landscapes and cultural attractions that support a growing but niche tourism sector. Although current earnings are relatively small, its long-term potential is significant and irreplaceable due to its global ecological importance. In contrast, the proposed soda ash project offers strong economic and industrial benefits, including large-scale production of raw materials for manufacturing, job creation, foreign exchange earnings, and contributions to national industrial growth. Experiences from Lake Magadi show that such projects can provide steady long-term revenue and support industrial supply chains, though often with environmental trade-offs.
		Appropriate mitigation measures should be designed to address impacts related to pollution, human settlement, and operational activities	In this EIS document, management and monitoring of liquid and solid waste management is present in Chapter 7 and 8.

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUE	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT ESIA
Eastern African Wildlife Society, Nairobi February 20, 2007	• Mr. Peter Odhiambo, Programme Officer Wetlands, Kenya Wetlands Forum, Nairobi. • Ms. Catherine Mungai, Project Officer, Kenya Wetlands Forum, Nairobi. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd.	Lake Natron is ecologically important as the primary breeding site for Lesser Flamingos and is a Ramsar wetland of international significance. Any development may negatively affect the lake's ecological functions, including its capacity to support flamingo breeding.	This is agreed. This impact has been discussed in the ESIA report and the proper mitigation measures has been provided on chapter 8 on the Flora and fauna Management plan.
		Lake Natron plays a hydrological role for wildlife and local communities in a water-scarce area; the lake's capacity to meet high water demands (>100m³/h) and sustain domestic water use is uncertain.	Lake Natron serves a critical hydrological role for wildlife and local communities in a water-scarce area, and the current EIS evaluates the uncertainty of meeting high project water demands (exceeding 100m³/h) alongside sustaining domestic water use. Mitigation measures include water-efficient technologies, demand management, and ongoing monitoring.
		Potential impacts from project-generated waste and the displacement of local communities (specifically the Maasai) and disruption of their traditional routes.	In this EIS document, management and monitoring of liquid and solid waste management is present in Chapter 7 and 8. This also includes socio-economic impacts.
		The project should provide clear plans for waste management to prevent environmental degradation.	The current EIS includes a clear waste management plan covering solid, liquid, and hazardous wastes, designed to prevent environmental degradation through proper collection, treatment, and disposal methods.in chapter 8
National Museums of Kenya February 09, 2007	• Mr. Ronald Mulwa, Research Scientist & IBA Monitoring Co-coordinator, Department of Ornithology, Nairobi. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd	The project should provide for the collection of data on flamingos and fish at Lake Natron to establish baseline information. The project should assess potential impacts on flamingo breeding, fish species, and overall biodiversity.	This has been described in detail on chapter 4 of the ESIA report under the fauna and Aquatic baseline study. A standalone baseline studies for fauna and Aquatic studies has been attached as Appendices for references.
		The project should evaluate the ecotourism value of the lake versus the expected benefits from the soda ash project.	Lake Natron's ecotourism value comes from its unique ecosystem, flamingo breeding habitat, Ramsar status, and scenic natural features, all of which rely on an undisturbed environment. The soda ash project, on the other hand, is expected to bring economic benefits such as revenue generation, employment, and industrial growth through mineral extraction and processing. However, while the project provides economic gains, it may compete with the long-term ecological and tourism value of the lake, which depends on maintaining its natural conditions.
		Impacts from pollution, human settlement, and sewage related to the project. The project should develop appropriate mitigation measures for pollution, human settlement, sewage, and other operational impacts.	In this EIS document, an update management and monitoring plan for liquid and solid waste is added.
		No other suitable breeding grounds exist in East Africa; other lakes' breeding attempts are often futile. Focused research by experts should be carried out to support long-term monitoring of flamingos and fish at Lake Natron.	This is well noted and will be considered during execution. n of the project
IUCN East Africa Regional Office (EARO), Nairobi, Kenya. March 06, 2007	• Ms. Maureen Babu, Project Officer, IUCN EARO, Nairobi. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd.	Lake Natron is a Ramsar site and conservation of the site is very important. It would also be beneficial to learn from the experiences, both positive and negative, of the soda ash project in Lake Magadi in Kenya.	This has been noted, and the client maintains good communication regarding a similar project in Kenya. This will be taken into consideration throughout all project phases.
		The project should take into account the EAC Guidelines on the management of shared ecosystems, which are signed by Tanzania, Kenya, and Uganda, as Lake Natron is a shared ecosystem. These guidelines should be used to guide the conduct of the EIA study.	Noted. The guidelines was used to guide the ESIA and the aquatic baseline study.
ICIPE Campus, Nairobi February 28, 2007	• Mr. Paul Kariuki Ndang'ang'a, Species Programme Manager, BirdLife International, Nairobi. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd.	Lake Natron is the primary breeding site for the Lesser Flamingo, hosting over 75% of the East African population, and any disturbance could threaten this near-threatened species. Changes in water levels, salinity, human activity, or machinery could destroy nests and reduce algal food availability, while minimal interchange with other populations means the loss cannot be compensated elsewhere. The proposed soda ash project would likely exacerbate these threats and impact the survival of the species.	The proposed project infrastructure and supporting facilities are strategically located away from the breeding areas for flamingoes. The designated mining area shown in Figure 2.1 shows potential trona reserve which can last for over 100years. There will be no need for further expansion to other areas of the lake. This will ensure that the project will not move the to sensitive areas of the flamingo breeding area.

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUE	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT ESIA
		The project should assess impacts on Lesser Flamingo populations, breeding success, and food availability while minimizing disturbances by limiting human access and machinery near breeding areas. Water management strategies must maintain stable levels and salinity to support flamingo breeding and algal growth, and baseline studies with long-term monitoring should be established. The project should comply with the International Single Species Action Plan for the Conservation of the Lesser Flamingo and meet all commitments of the involved countries.	-The project may have the potential to negatively affect Lesser Flamingo populations through habitat disturbance, reduced breeding success, and food scarcity. However, with carefully enforced exclusion zones, seasonal restrictions, and low-impact operational design, it is possible to reduce disturbances and protect the ecological integrity of the breeding system -The project will comply with the International Single Species Action Plan for the Conservation of the Lesser Flamingo and meet all commitments of the involved countries.
Magadi Soda Company, Magadi, Kenya March 07, 2007	• Mr. Lemarron Kaanto, Community Development Manager, Magadi Soda Company, Magadi. • Mrs. Pauline Wainaina, Environmental Consultant, Norken Ltd	Water is a sensitive issue and the community needs to feel assured that the project will not affect the supply of water for community use	In the Current EIS, in section 2.2.4, the project will store water from Ewaso Nyiro River using an automated system. The system will take water at a controlled rate mimicking the natural flow of the river. Once the required amount is meet, the system will stop taking water. The stored will be used for processing and normal use at the township. The project will also provide water for the local communities through these stored water.
		The community is often concerned whether the smoke from the plant will affect their pastures and cattle.	In the current EIS, the proposed project will be primarily use electricity as its main source of power for mining and production. The project in Lake Natron will fully utilize electrical power from the national grid and solar farm to power the township. In addition, the dredgers will be electrically run and will not use any sort of generator or engine for power. This source of power will ensure that the receiving environment will not be affected.
		It is important to look at the dynamics of the project area and the communities involved. The developer must be aware of the intricacies involved in communities.	The current EIS document covers all the stakeholders that are involved in this project.
		The development at Lake Natron must be proactive in its approach to the community rather than waiting for problems to arise within the local communities. Stakeholder forums are very important tools and there should be a focal point/contact person both at the company and in the community.	The current EIS document covers all the stakeholders that are involved in this project.
African Conservation Centre Offices, Nairobi February 6, 2007	• Mr. James Ndungu, Deputy Director, African Conservation Centre • Mr. Ken Mwathe, Head of Ecology, African Conservation Centre • Mr. Ole Petenya Yusuf-Shani, Project Director, Shompole Group Ranch Eco-Tourism Development Project and Secretary-Shompole Community Trust • Mr. Walter Barongo Nyatwang'a, Environmental Consultant, Norken Ltd.	The proposed project may have negative impacts on eco-tourism activities that are taking place around Lake Natron	The project may have the potential to pose a risk to eco-tourism around Lake Natron. However, with the implementation of the environmental and social mitigation measures, these impacts can be minimized to low-negative significant, allowing the project and eco-tourism to coexist.
		Noise will disturb flamingos since they are sensitive to noise	In the current EIS, the proposed dredger systems will utilize power from the national grid (Electricity) as compared to most dredgers that rely on on-board generators or engines to provide power. This choice will ensure that the noise levels are minimized as much as possible. In addition, it is shown that the nearest breeding ground for flamingos is approximately 4.9km away from the boundary of the mining licence. The dredgers will not be located at the edge of the license, rather they will be located in the middle of the mining license as that is where the biggest concentration of trona is. This is location adds another 1km or so which further increases the distance away from the breeding grounds. This distance should have extremely little to no effect on the breeding grounds of the flamingo's.
Ngurumani Escarpment, Kenya February 20, 2007	• Mr. Julius Tanchu, Horticulture farmer Mr. Joseph Sirai, Village Elder Entosopia and Horticulture farmer • Jacob Senkera, Horticulture farmer • Mr. Walter Barongo Nyatwang'a, Environmental Consultant, Norken Ltd.	The project will risk the safety of the Tanzanian Maasai kinspeople.	In this current EIS, the Tanzanian Maasai kinspeople were among the stakeholders which were consulted. There concerns were taken and considered into this document. The proposed project location is an area which does not have any cultural heritage significance.
		Concern was raised that the proposed project might impose restrictions on water use in the Ngurumani area, which forms part of the catchment supplying water to Lake Natron.	The proposed project design does not intend to control, divert or restrict community access to water resources in the Ngurumani area and any other community area.

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUE	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT ESIA
Osupuko Market, Kenya February 20, 2007	• Mr. Musa Leseyio, Horticulture farmer and official Lenegwara Self-help, Horticultural producers • Sampueti Ole Moya, Horticulture farmer and official Lenegwara Self-help, Horticultural producers • Mr. Naftali Atonya, Ministry of Agriculture • Sarara Kiruti, Horticulture farmer and official Lenegwara Self-help, Horticultural producers • Senteli Moya, Horticulture farmer and official Lenegwara Self-help, Horticultural producers • Julius Tanchu, Horticulture farmer and official Lenegwara Self-help, Horticultural farmers • Joseph Sirai, Horticulture farmer and official Lenegwara Self-help, Horticultural producers • Mr. Walter Barongo Nyatwang'a, Environmental Consultant, Norken Ltd.	Concern was raised that smoke and fumes from soda ash operations, as observed at Magadi, may lead to the drying of trees around Lake Natron.	In the current ESIA, the proposed project will utilize power from the national grid as well as a solar farm (Section 2.4.3). This will ensure that the impact of smoke will not affect the receiving environment.
		Concern was raised whether the project would rely on water from the Ewaso Nyiro River, which is used by horticulturists and livestock farmers.	In the Current EIS, in section 2.2.4, the project will store water from Ewaso Nyiro River using an automated system. The system will take water at a controlled rate. Once the required amount is meet, the system will stop taking water. The stored will be used for processing and normal use at the township. The project will also provide water for the local communities through these stored water.
		There is a need for the EIA to clearly establish the impacts of smoke from the plant on forests and wild animals.	In the current EIS, the proposed project will utilize power from the national grid as well as a solar farm (Section 2.4.3). This will ensure that the impact of smoke will not affect the receiving environment.
Kenya Wildlife Service February 21, 2007	• Sergeant David Muange, the in-charge, Kenya Wildlife Service, Ngurumani Sub-station • Mr. Mike Kareithi, warden, Kenya Wildlife Service, Ngurumani Sub-station • Mr. Walter Barongo Nyatwang'a, Environmental Consultant, Norken Ltd.	The proposed project has the potential of disrupting the traditional wildlife migratory corridors - Oldonyo Sambu near Lake Natron	In the current EIS section 2.2, the approved mining area contains brine reserves sufficient to sustain operations for over 100 years. As such, there is no anticipated need for expansion into other areas of the lake. This means the potential is unlikely to disrupt the traditional wildlife migratory corridors – Oldonyo Sambu near Lake Natron.
		The project should see the need to put in place measures to ensure that the lesser flamingoes' breeding sites are not disturbed.	Proper mitigation measures have been put to ensure that the lesser flamingoes' breeding sites are not disturbed. The client will follow throughout the project implementation
Kenyatta International Conference Centre (KICC), Nairobi March, 08, 2007	• Mr. Maurice Mbegera, Director, Compliance and Enforcement, National Environment Management Authority (NEMA), Kenya • Mr. Walter Barongo Nyatwang'a, Environmental Consultant, Norken Ltd	Lake Natron is a Ramsar site. All Ramsar sites have guidelines on their use, which should be followed.	This will be adhered to throughout the project construction, operation, and decommissioning phases.
		Lake Natron is a breeding ground for lesser Flamingos. The lake is rich in algae, which flamingos feed on. The flamingos move between Lake Natron in Tanzania and Lake Nakuru in Kenya, and the project shouldn't interfere with the flamingos before they are a major tourism attraction in Lake Nakuru.	The project activities will not interfere with flamingos through the implementation of proper mitigation measures, as it has been described in the Fauna Management Plan
		Transboundary issues like water rights, Corporate Social Responsibility, and grazing rights and tourism activities should be agreed upon from the onset, so that they don't act as a break for the project implementation.	In the current EIS, all the stakeholders have been consulted to ensure water rights, corporate social responsibilities, grazing rights and tourism activities all coexist. WWSL will establish continuous communication with Central Water Board about the water rights needed for production.
Osupuko Market, Kenya February 23, 2007	• Mr. Merita Ole Kisioki, Assistant Chief, Olkiramatia sub-location and Acting Chief, Olkiramatia Location. • Mr. Joseph Sirai, Village Elder Entosopia and Horticulture farmer • Mr. Walter Barongo Nyatwang'a, Environmental Consultant, Norken Ltd.	Concern was raised that the proposed project should not release fumes or smoke into the environment. Observations from the Magadi soda plant indicate that nearby trees are drying, and similar impacts at Lake Natron could contribute to desertification in an area with minimal rainfall.	In the current EIS, the proposed project will be primarily use electricity as its main source of power for mining and production. As compared to the project in Magadi, the project in Lake Natron will fully utilize electrical power from the national grid and solar farm to power the township. In addition, the dredgers will be electrically run and will not use any sort of generator or engine for power. This source of power will ensure that the receiving environment will not be affected as compared to the project in Lake Magadi.
		Transboundary issues like water rights and pastoralist movement of livestock should be addressed before the project is implemented	In this current EIS, the proposed project will utilize water from lake ewase ngero river and store the water needed in metal silos. The proposed project will be able to provide water access to surrounding communities from the stored water they have gathered.
Shompole lodge offices, Kenya February 22, 2007	• Mr. John Ole Langoi, Community Liaison Officer, Shompole Conservancy and Former councillor	The migratory labour would change the naturalness of the area by introducing activities (commercial) that will change the existing land uses.	The current EIS assesses these potential socio-economic changes and proposes mitigation measures, including workforce accommodation planning and land use monitoring.

NAME OF THE STAKEHOLDER & DATE	PARTICIPANTS	RAISED ISSUE	HOW THE CONCERN HAS BEEN ADDRESSED IN THE CURRENT ESIA
	• Graham Rambell, Shompole Lodge Manager • Mr. Julius Tanchu, Horticulture farmer and Interpreter • Mr. Walter Barongo Nyatwang'a, Environmental Consultant, Norken Ltd.	Breeding areas for flamingoes may be affected this may lead to reduction of flamingo numbers hence affect tourist bird watching activity. Lake Natron has endemic species which might be affected by the proposed project.	The proposed project infrastructure and supporting facilities are located away from the breeding areas for flamingoes. However, the project activities will be conducted to avoid key breeding zones and include measures to control disturbance, pollution, and water use. Overall, the impact is expected to be low negative and manageable with proper mitigation. The current ESIA has addressed this concern by confirming that the designated mining license area is located approximately 7.5 km from the nearest known breeding sites of the Lesser Flamingo. This distance refers to the boundary of the mining license, with actual dredging operations planned to occur further within the license area, thereby increasing the separation from sensitive habitats.
		Smoke and fumes from the factory will modify the environment of the area.	In the current EIS, the proposed project will be primarily use electricity as its main source of power for mining and production. The solar farm will be used to supply the township with sufficient power. In addition, the dredgers will be electrically run and will not use any sort of generator or engine for power. The only source of fumes and smoke which will be vehicles meant for transportation of workers and the final product. Mitigation measures are in place to ensure that this effect is minimized as much as possible.
		The proposed project will greatly affect the visual spectrum of the area. Shompole lodge is popular with its clientele because of its serenity and wildness.	The proposed project will implement visual amenities measures to ensure the visual spectrum of the area is not affected greatly. This will involve replacing any tree's or shrubs that have been removed during the construction phase.
Shompole, Kenya February 22, 2007	• Mr. John Ole Langoi, Community Liaison Officer, Shompole Conservancy and Former councillor • Rev. Peter Kasinegi, Restoration Church Pastor • Mr. Julius Tanchu, Horticulture farmer and Interpreter • Mr. Walter Barongo Nyatwang'a, Environmental Consultant, Norken Ltd.	The project will affect tourism activities, especially bird viewing	The project may have the potential to cause some disturbance to birdwatching activities, especially during construction, due to noise and increased human activity. However, key bird habitats are located away from the main project site, and mitigation measures will be implemented to minimize impacts. Overall, the impact on tourism (bird viewing) is expected to be low-negative and manageable.
		The project will release fumes and smoke to the surroundings which will affect human being and vegetation	In the current EIS, the proposed project will be primarily use electricity as its main source of power for mining and production. The solar farm will be used to supply the township with sufficient power. In addition, the dredgers will be electrically run and will not use any sort of generator or engine for power. The only source of fumes and smoke which will be vehicles meant for transportation of workers and the final product. Mitigation measures are in place to ensure that this effect is minimized as much as possible.
		Transboundary issues should be addressed early before project implementation	The proposed Hydro Electric power project by the Kenyan Government is currently on hold indefinitely. The reason for this is lack of political and financial backing for the project to begin. Therefore, there is currently no transboundary issue that is related to the project

APPENDIX 9: SODA ASH AQUATIC BIODIVERSITY REPORT

AQUATIC FAUNA ASSESSMENT FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION IN LAKE NATRON AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD AND LONGIDO DISTRICT IN ARUSHA REGION-TANZANIA

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EXECUTIVE SUMMARY

The proposed Soda Ash Extraction and Processing Project at Lake Natron aims to produce up to 660,000 metric tonnes of soda ash per annum through the extraction and processing of trona from the lake's subsurface brine deposits. Given the ecological sensitivity of Lake Natron, home to several endemic fish species of the *Alcolapia* genus and important freshwater inflow habitats a detailed aquatic fauna baseline assessment was conducted by MTL Consulting Company Limited between 28th September and 3rd October 2025. The study focused on inflowing streams and shoreline zones within the proposed dredging and brine abstraction areas to evaluate fish assemblages, benthic macroinvertebrate communities, and overall aquatic habitat characteristics.

The survey identified three endemic *Alcolapia* species, *A. alcalica* (Common Natron tilapia), *A. latilabris* (Wide-lipped Natron tilapia), and *A. ndalalani* (Narrow-mouthed Natron tilapia) all restricted to the Lake Natron basin and adjacent inflowing streams. According to the IUCN Red List (2025), *A. alcalica* is classified as Endangered, while *A. latilabris* and *A. ndalalani* are Vulnerable. These species were recorded exclusively within freshwater inflow zones, reflecting the critical ecological role of these habitats as breeding, nursery, and refuge areas within an otherwise hypersaline and alkaline system. Benthic macroinvertebrates recorded included Gerridae (pond skaters) and Chironomidae (non-biting midges), taxa known for their tolerance to fluctuating alkaline conditions. No aquatic fauna was found along the exposed shoreline near the proposed dredging point due to extreme salinity and absence of vegetation.

The findings highlight that while Lake Natron's main body is biologically constrained by harsh physicochemical conditions, its inflowing streams serve as ecological refugia that sustain endemic aquatic life. The major potential impacts of the proposed project include hydrological alteration, sedimentation, pollution, and habitat disturbance. However, these impacts are expected to be localized and manageable through proper mitigation such as maintaining natural water flow regimes, implementing sediment control, treating effluents, and conducting continuous ecological monitoring. The study concludes that the soda ash project is environmentally feasible, provided that stringent mitigation and monitoring measures are integrated into all project phases to protect the inflowing stream ecosystems and maintain Lake Natron's ecological integrity.

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LIST OF ABBREVIATIONS AND ACRONYMS

CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EMP	Environmental Management Plan
GPS	Global Positioning System
IFC	International Financial Cooperation
IUCN	International Union for Conservation of Nature
LSA	Local Study Area
NEMC	National Environment Management Council
WWSL	Woswosi Soda Limited
UTM	Universal Transverse Mercator

1 INTRODUCTION

1.1 Project Overview

Woswosi Soda Limited (WWSL), a limited liability company incorporated on 22nd September 2022 under Section 15 of the Companies Act (2002) with Certificate No. 157942433, has initiated plans to develop a large-scale soda ash mining and processing project at Lake Natron in northern Tanzania. The project will consist of a mining section and a soda ash extraction plant designed to produce approximately 1,000,000 metric tonnes per annum (MTPA) of trona, with an expected soda ash output of 660,000 MTPA based on a 70% recovery rate. Extraction will involve pumping sodium carbonate brine from depths of 3 to 20 meters below the surface of Lake Natron to the processing facility for refinement. The project area is covered by two prospecting licenses—PL-12236/2023 and PL-13190/2025—spanning a combined area of about 550.688 km².

Lake Natron is one of the most unique saline and alkaline lakes in the East African Rift Valley, located near the Kenyan border northeast of Ngorongoro Crater. The lake is hydrologically and ecologically significant, supporting a specialized assemblage of aquatic life adapted to extreme conditions of high salinity, temperature, and alkalinity. It is globally renowned as the primary breeding site of the Lesser Flamingo (*Phoeniconaias minor*) and sustains several endemic fish species of the genus *Alcolapia*, which are restricted to its inflowing streams and associated wetlands. Given the ecological importance and sensitivity of the Lake Natron basin, understanding the baseline status of aquatic biodiversity is essential prior to project implementation. The lake's inflowing streams and spring-fed habitats support fish and benthic macroinvertebrate communities that serve as key indicators of aquatic ecosystem health and water quality (FAO, 2016; IFC, 2012).

As stipulated under the EMA, the ESIA aims to assess the potential impacts for proposed Soda Ash Production Project activities on the environment. To address such impacts, Woswosi Soda Limited planned to conduct an ESIA for the proposed Project in compliance with the National Standards and the requirements of the Environmental Management Act CAP 191 R.E 2023 and the EIA and Audit Regulations of 2005 and its last amendments of 2024.

As part of the ESIA study, an Aquatic baseline assessment is required to be conducted in line with the National legal requirement to identify and classify individual Aquatic species found in the proposed Project site. This will assist in the articulation of the potential direct and indirect impacts of Project activities on Aquatic species and ecosystems and finally suggest appropriate mitigation measures to alleviate or reduce the level of impacts.

1.2 Objectives and Scope

A primary objective of the aquatic biology field studies was to conduct an aquatic baseline assessment in line with the National legal requirement to identify and classify individual Aquatic species found in the proposed Project site. The results of surveys will provide a species checklist sampled in the proposed project area, upon which facilitation of impact assessment, development of mitigation measures, and overall environmental management plan should be based.

Specifically, the assignment strives to achieve the following:

- Assess the composition of benthic macro-invertebrates and aquatic fauna (including fish), classify their taxa, and map their distribution within aquatic ecosystems in the Project footprint.
- Determine the abundance and diversity of fish species and benthic macro-invertebrates within the Project footprint, highlighting spatial and seasonal variations.
- To conduct the Critical Habitat Assessment (CHA) to identify critical habitat areas in the Project footprint.
- Identify habitat characteristics within the Project footprint, with emphasis on critical aquatic and benthic habitats such as wetlands, streams, riverbeds, and substrate zones that serve as breeding, feeding, and refuge areas.
- Identify and map species of special conservation concern, including fish and benthic macro-invertebrates listed on the IUCN Red List or CITES, with attention to endemic, rare, critically endangered, and threatened taxa.
- Evaluate the cumulative and residual impacts of Project activities on both fish populations and benthic macro-invertebrate communities and propose feasible mitigation and management measures.
- Identify priority ecosystem services linked to benthic and aquatic fauna within the Project footprint and recommend sustainable management and conservation strategies.
- Identify and assess invasive alien species of both fish and benthic macro-invertebrates in the Project footprint and provide targeted control and mitigation measures for their management.
- To provide the Management and the monitoring Plan of the Project according to the study conducted.

2 METHODOLOGY

2.1 Description of the Study Site

The proposed project is located at Lake Natron, in northern Tanzania, near the Kenyan border and northeast of the Ngorongoro Crater, within the eastern branch of Africa's Great Rift Valley. Nestled between volcanic hills and deep craters, Lake Natron lies at the lowest point of the Rift Valley (600 meters above sea level) and is considered one of the world's most caustic bodies of water. The lake is shallow, with a depth of less than three meters, and its width varies depending on water levels. It stretches 57 kilometers in length and 22 kilometers in width. The area experiences irregular seasonal rainfall, mainly between December and May, with temperatures often exceeding 40°C. Lake Natron serves as the only known successful breeding site for the Lesser Flamingo in East Africa and is the most significant global breeding site for this species. Figure 2.1 shows the detailed geographical boundaries.

The field survey for benthic and aquatic fauna assessment for the proposed Soda Ash Production Project was conducted from 28th September 2025 to 03rd October 2025 with the aim to assess the potential impacts of the proposed Soda Ash Production Project activities on the environment and suggest appropriate mitigation measures so as to alleviate or reduce the level of impacts.

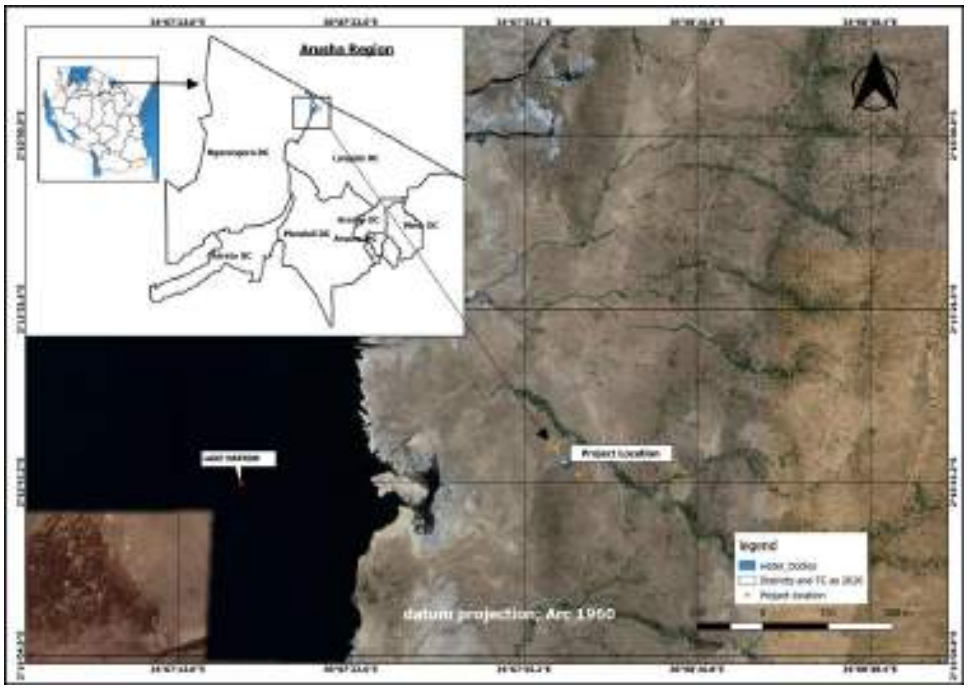

Figure 2.1: Soda Ash Project Location

(Source: MTL Consulting, 2025)

2.2 Sampling Location

Sampling for this study was conducted along the shoreline and inflowing streams of Lake Natron, focusing on areas within and adjacent to the proposed dredging and brine extraction zones. These areas were identified as the most likely to experience direct or indirect impacts from project activities. Sampling locations were selected opportunistically, based on habitat accessibility and representativeness. The selected sites included inflowing freshwater

streams, spring outlets, and vegetated littoral zones where aquatic fauna were most likely to be present. At each site, habitat characteristics such as substrate type, aquatic vegetation cover, flow condition, and the presence of emergent or submerged plants were documented to provide ecological context for the observed fish and benthic macroinvertebrate assemblages. The general locations of the sampling sites are illustrated in Figure 2.2.

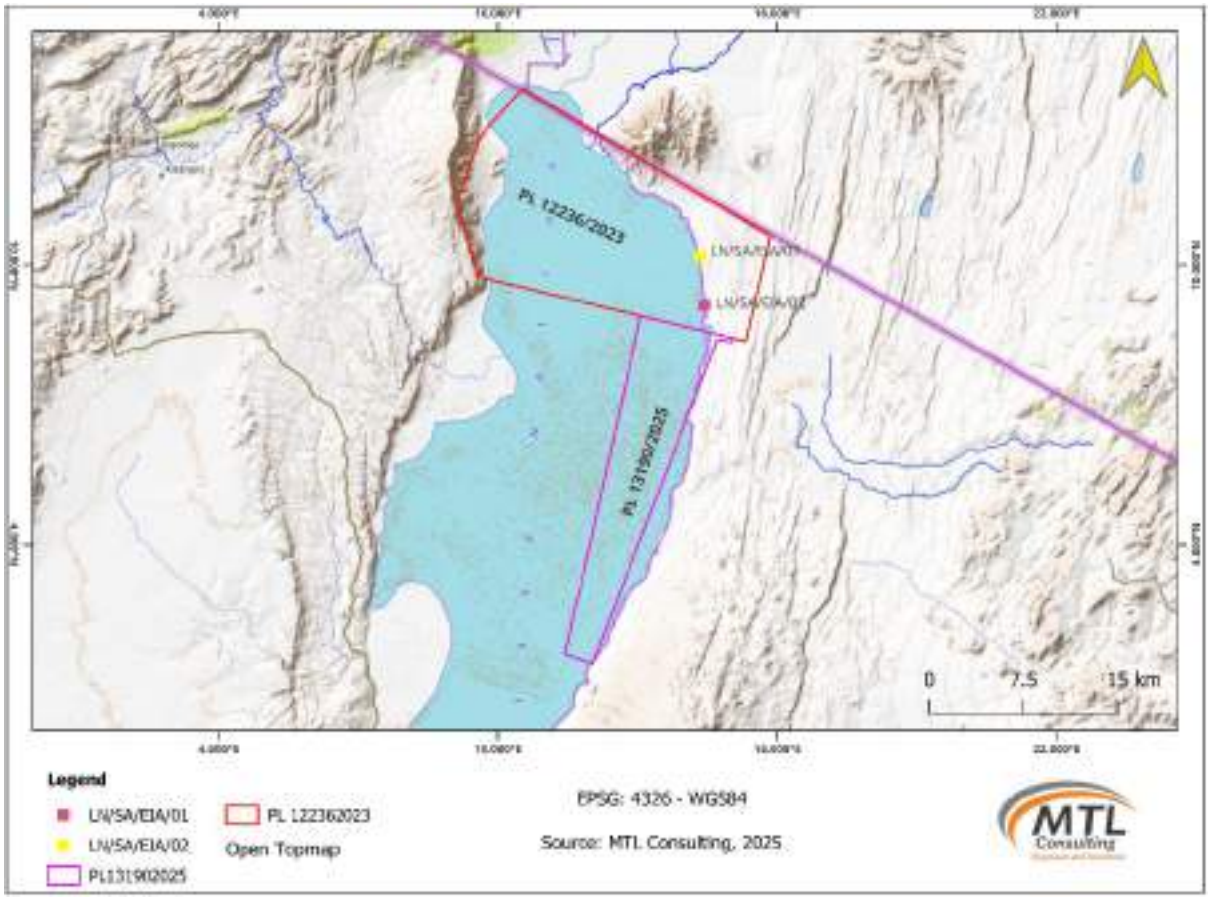

Figure 2.2: Fish and macroinvertebrates sampling points for proposed Project area

(Source: MTL Consulting, 2025)

2.3 Sampling Procedures

Aquatic fauna sampling was conducted using standardized field methods to ensure data reliability and comparability. At each location, the composition and percentage of riparian cover, as well as substrate and habitat characteristics, were recorded to provide ecological context. Each sampling site was precisely georeferenced using GPS (UTM ARC-1960) to ensure accurate positioning and facilitate long-term monitoring or follow-up studies in the same areas.

2.4 Benthic Invertebrates

Benthic invertebrates were collected using two different sampling devices: a modified D-net with a 500 µm mesh size attached to a metal frame (0.1 m²) and a Surber sampler. At each sampling station, the metal frames of both samplers were placed on the substrate, ensuring they were in direct contact with the benthic surface. A heavy stick was then used to disturb the substrate within the frame, effectively dislodging invertebrates and other organisms from

the sediment and surface materials. These dislodged organisms were allowed to drift freely into the net positioned just downstream of the frame. After collecting the material in the net, it was emptied into a white tray, where large debris, such as rocks, leaves, and other coarse materials, was removed. Water was then added to the tray to allow the invertebrates to swim freely and facilitate their separation from any remaining sediment. The invertebrates were subsequently transferred into labeled glass specimen jars and filled with a 70% ethanol solution for preservation. The jars were transported to the laboratory for further analysis. In the laboratory, macroinvertebrate samples were sorted under a binocular microscope, allowing for detailed examination of the organisms. Identification was carried out using several general invertebrate textbooks and manuals, including Gerber and Gabriel (2002), Ruppert and Barnes (1994), and Day *et al.* (2003). However, due to the limited availability of published literature and taxonomic keys specific to Tanzanian stream fauna, many specimens could only be identified to the lowest taxonomic level with certainty. As a result, most specimens were classified only to the family level, with the aim of providing a broader understanding of the species composition and diversity within the sampled habitats.

2.5 Fish sampling and identification.

The sampling was conducted using a combination of small mesh gill nets and seine nets, allowing for the capture of fish species across the shallow shoreline and inflowing stream habitats associated with the proposed dredging and brine abstraction areas of Lake Natron. Gill nets of small mesh sizes were set across narrow stream sections and shallow lake edges for short durations to capture both juvenile and adult individuals. Nets were positioned parallel to the shoreline and in slow-flowing sections of the inflowing streams to target fish moving between different microhabitats. In shallow areas dominated by soft mud substrates, seine nets were manually hauled to encircle and collect fish occupying nearshore habitats.

Captured fish were identified in the field using external morphological characteristics, with reference to standard taxonomic keys provided by Eccles (1992) and Skelton (1993). After identification and counting, all fish were released back into their natural habitat to minimize disturbance to the population. This approach provided an accurate representation of the fish assemblages present within the inflowing streams and littoral habitats of Lake Natron, supporting baseline ecological characterization within the project footprint (Plate 2.1).

2.6 Determination of conservation status

Once the fish species were identified, an effort was made to assess their conservation status. Species of conservation concern are those considered to be at risk of extinction, as classified by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, and/or those listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendices. Additionally, the Tanzania Fish Conservation Rankings (URT, 2009c) were consulted, which provide a comprehensive list of fish species considered to be threatened within Tanzanian waters. Beyond global and national assessments, particular attention was also given to species that are native or endemic to the region. Native species are those that occur naturally within the local ecosystem, while endemic species are found only in that specific geographic area. These species are often of heightened conservation significance because they contribute uniquely to the biodiversity and ecological integrity of the region. The preservation of such species is critical, as they may play vital roles in maintaining ecosystem functions, and their loss could have disproportionate effects on local biodiversity.

To further refine conservation priorities, the conservation status of each species was cross-referenced with other available resources and expert opinions, considering both local and international perspectives on species vulnerability. This approach ensures that the most accurate and comprehensive understanding of each species' conservation status is applied, supporting informed conservation planning and management decisions.

Sample collection of macroinvertebrates for further identification

Onsite Identification and measuring of fish length

Plate 2.1: Sample collection and identification of fish and benthic macroinvertebrate at the proposed project site

(Source: MTL Consulting, 2025)

2.7 Assumptions

The study assumed that aquatic habitats, as well as macroinvertebrate and fish populations, were evenly distributed across the sampling stations. Consequently, the chosen sampling points were considered representative of the most common aquatic habitat types found in the Project area. As a result, the collected samples of macroinvertebrates and fish were assumed to reflect the organisms present in the project area during the sampling season.

3 RESULTS AND DISCUSSION

3.1 Habitat Characteristics

Habitat characteristics encompass the physical, chemical, and biological attributes of an environment that define the living conditions for aquatic organisms. These include physical factors such as substrate type, vegetation cover, and flow dynamics, which provide essential habitats for feeding, breeding, and refuge (Gibb *et al.,* 2006). Chemical properties such as alkalinity, salinity, and nutrient concentration strongly influence species distribution and tolerance limits (Wetzel, 2001). Biological features, including species composition, abundance, and trophic interactions, serve as indicators of ecological integrity and resilience (Tilman *et al.,* 2001). In the Lake Natron project area, habitat characteristics are largely shaped by the lake's hypersaline and alkaline conditions, shallow depth, and the inflow of freshwater streams and springs. These inflowing systems create narrow ecological gradients where water quality transitions from relatively fresh, oxygenated conditions to the highly saline and mineral-rich environment of the main lake body.

Two sampling points were examined during the survey (Table 3.1). Sampling Point 1, located in an inflowing stream entering the lake, exhibited muddy substrates, slow moving water, and moderate aquatic vegetation. These conditions provide microhabitats suitable for fish and other aquatic organisms. Indeed, three species of Alcolapia (formerly Oreochromis) *Alcolapia alcalica*, *Alcolapia ndalalani*, and *Alcolapia latilabris* were recorded at this site, reflecting the ecological significance of the inflowing streams as refugia and feeding habitats for native fish (Plate 3.1). In contrast, Sampling Point 2, situated along the shoreline near the proposed dredging area, was characterized by rocky gravel substrates, absence of freshwater inflow, and extremely high alkalinity. The habitat was devoid of aquatic vegetation, and no fish or benthic macroinvertebrates were observed during the survey. These conditions are consistent with the extreme physicochemical environment typical of Lake Natron's open shoreline zones, where biological diversity is severely limited by salinity and pH stress.

Table 3.1: Location and habitat characteristics of the sampling points

SN	Sampling point	Sampling Code	Coordinates (37 UTM)	Habitat characteristics
1	Point 1	LN/SA/EIA/02	0180698 9750066	Inflowing stream entering Lake Natron, characterized by a muddy substrate and shallow water conditions.
2	Point 2	LN/SA/EIA/01	2.22095S 36.122429 E	Shoreline area adjacent to the proposed dredging point, characterized by rocky-gravel substrate, absence of stream inflow, and high alkalinity levels.

(Source: MTL Consulting, 2025)

3.2 Macro Invertebrates

During the survey of the inflowing streams feeding Lake Natron, benthic macroinvertebrates were collected, reflecting a community adapted to the slightly alkaline and variable water conditions of these habitats. The Gerridae (pond skaters) were observed on the water surface, indicating moderate tolerance to environmental variability. The Chironomidae (non-biting midges) were abundant in stream sediments and organic debris, reflecting high tolerance to

chemical and thermal fluctuations (Table 3.2). These findings confirm that the inflowing streams provide the primary benthic habitat in the Lake Natron basin, as the main lake's hypersaline and alkaline conditions are unsuitable for most invertebrates. This assemblage provides a baseline for freshwater ecosystem health and highlights the ecological importance of these streams in sustaining aquatic biodiversity in this extreme environment.

Table 3.2: Benthic Macroinvertebrates Collected from Inflow Streams of Lake Natron

Taxonomic Group	Family	Pollution Tolerance
Hemiptera	Gerridae (Pond skaters)	Moderately tolerant
Diptera	Chironomidae (non-biting midges)	Highly tolerant

(Source: MTL Consulting, 2025)

3.3 Fish Diversity and Abundance

The fish assemblage recorded from the inflowing streams feeding Lake Natron comprises three closely related cichlid species: *Alcolapia alcalica* (Common Natron tilapia), *Alcolapia latilabris* (Wide-lipped Natron tilapia), and *Alcolapia ndalalani* (Narrow-mouthed Natron tilapia). A total of 33 individuals were observed across the sampled sites, with *Alcolapia latilabris* being the most abundant. All three species were found coexisting within the same stream habitats that discharge into the southern part of Lake Natron, indicating overlapping ecological preferences and tolerance to similar physicochemical conditions. According to the IUCN Red List (IUCN, 2025), *Alcolapia alcalica* is classified as Endangered, while *Alcolapia latilabris* and *Alcolapia ndalalani* are Vulnerable. Two of these species (*Alcolapia latilabris* and *Alcolapia ndalalani*) are strictly endemic to the Lake Natron basin, whereas *Alcolapia alcalica* also occurs in nearby Shombole swamps and Lake Magadi in Kenya, reflecting a slightly wider but still restricted distribution. The occurrence of all three taxa within the same freshwater inflows highlights the critical importance of these stream environments as refugia within an otherwise hypersaline and alkaline system where open lake waters are unsuitable for fish. The findings confirm that these species have adapted to extreme conditions of high salinity, alkalinity, and temperature but remain highly dependent on the stability and quality of inflowing freshwater and spring systems. Any alteration of these hydrological inputs, such as through the proposed soda ash extraction activities by Woswosi Soda Limited, could significantly affect water chemistry, flow, and temperature regimes, thereby threatening the persistence of these sensitive populations. Maintaining the natural hydrological regime, preventing pollution, and conserving inflow channels are therefore essential to ensure the continued survival of Lake Natron's unique *Alcolapia* species and the ecological integrity of this globally significant saline-alkaline ecosystem (Table 3.3 and Plate 3.1).

Table 3.3: Diversity and abundance of fish identified at the proposed Project area

SN	Scientific name	Common/Local name	Number individuals	IUCN status	Geographical range
1	*Alcolapia alcalica*/Oreochromis alcalicus	Common Natron tilapia	14	Endangered (EN)	Lake Natron drainage, Shombole swamps and Lake Magard
2	*Alcolapia Ndalalani*/*Oreochromis ndalalani*	Narrow-mouthed Natron tilapia	4	Vulnerable (VU)	Endemic to Lake Natron basin
3	*Alcolapia latirabris*/ *Oreochromis*/ *atilabris*	Wide-lipped Natron tilapia	15	Vulnerable (VU)	Endemic to Lake Natron basin

(Source: MTL Consulting, 2025)

Alcolapia alcalica

Alcolapia ndalalani

Alcolapia latirabris

Plate 3.1: Representative fish species observed at the proposed project site

(Source: MTL Consulting, 2025)

3.4 Invasive Alien Fish Species in the Project Footprint

During the survey conducted within the inflowing streams and adjacent areas of the proposed soda ash extraction project at Lake Natron, no invasive alien fish species were recorded within the project footprint. The fish community was exclusively composed of *Alcolapia alcalica*, *Alcolapia ndalalani*, and *Alcolapia latilabris*—species that are native and endemic (or near-endemic) to the Lake Natron basin. These species are highly specialized and adapted to the

saline and alkaline waters of the area. However, it is recommended that strict biosecurity measures be implemented during project development, particularly during construction and operational activities involving the transfer of water, equipment, or biological material from other catchments. Preventing the accidental introduction of invasive fish species is essential to safeguard the integrity of Lake Natron's unique and fragile aquatic ecosystem.

3.5 Priority Ecosystem Services in the Project Footprint

3.5.1 Livestock grazing

Several areas around the inflowing streams and access routes within the proposed soda ash extraction project area at Lake Natron showed clear evidence of livestock grazing and trampling, particularly near watering points where cattle, goats, and sheep access freshwater for drinking (Plate 3.2). These inflow streams and adjacent saline flats provide critical resources for local pastoralist communities, who depend on them not only as watering sites but also as natural salt lick areas rich in soda ash and other mineral deposits. The soda ash and associated alkaline minerals occurring naturally in the soils and sediments are traditionally consumed by livestock to supplement essential minerals such as sodium and calcium, improving digestion, milk production, and overall animal health. This mineral supplementation is a well-recognized benefit among Maasai pastoralists who graze their herds in the Lake Natron basin. Access to these freshwater and mineral rich areas is therefore crucial for maintaining livestock productivity and resilience in this semi-arid environment. Healthy livestock populations are central to local livelihoods, providing meat, milk, hides, and income through trade, and thus represent one of the most important ecosystem services sustained by the Lake Natron system (Ahlström *et al.,* 2014).

Observed livestock near the lake during the survey

Plate 3.2: Representative photo of ecosystem services provided by the proposed project site

(Source: MTL Consulting, 2025)

4 ASSESSMENT OF PROJECT IMPACTS

4.1 Potential Impact of the Project Activities on the Aquatic Fauna

The potential impacts that may occur across various areas within the project footprint are associated with the construction and operation of key facilities, including brine extraction wells, dredging areas, processing plants, access roads, and supporting infrastructure. These impacts span multiple phases of the project construction, operation, and decommissioning and include effects on aquatic habitats, water quality, and biodiversity. The following outlines the anticipated impacts on aquatic fauna and proposes mitigation measures to minimize adverse effects and ensure sustainable project implementation.

The construction and operation of the proposed soda ash project at Lake Natron could affect aquatic fauna through water quality degradation, habitat disturbance, and ecological disruption, particularly in the shoreline and inflowing stream habitats. The main anticipated impacts are as follows:

4.1.1 Water Pollution and Contamination

Construction phase: Activities such as dredging, excavation, handling of construction materials, and machinery operation may introduce pollutants into the inflowing streams and adjacent shoreline areas through runoff or accidental spills. Potential contaminants include hydrocarbons, lubricants, and cement residues, which can reduce water quality and impair survival and reproduction of sensitive aquatic fauna. Although only a few fish species were recorded and no macroinvertebrates were observed at the shoreline site, pollution could further limit habitat suitability and threaten stream populations.

Operation phase: Continuous brine pumping and processing may alter the salinity and alkalinity of inflowing streams or nearshore zones if not properly managed may affect the few aquatic fauna adapted to specific physicochemical conditions like in that of Lake Natron

Decommissioning phase: Improper handling of residual materials during decommissioning may release pollutants into the water column. Strict containment and proper disposal protocols are essential to prevent contamination and protect aquatic habitats.

Suggested Mitigation Measures

- To minimize water pollution and contamination, all fueling, mixing, and chemical handling must occur on impermeable, contained platforms to prevent spills.
- Wastewater and brine effluent should be treated before discharge using sedimentation or neutralization ponds.
- Natural vegetation buffers must be retained along shorelines to filter runoff.
- Regular maintenance and spill response plans will reduce leak risks from machinery and storage areas.
- Continuous water quality monitoring should detect early contamination.
- During decommissioning, remove all fuel tanks and treat contaminated soil before site closure.

4.1.2 Alteration of water flow

Construction phase: Dredging and installation of brine extraction infrastructure may modify local flow patterns in inflowing streams and along the shoreline. Such disturbances can disrupt natural water movement, alter sediment transport, and affect shallow breeding and feeding habitats for fish. These hydrological changes may also reduce habitat quality and food availability for fish

Operation phase: During operation, continuous brine pumping and abstraction activities may further alter the hydrological balance of the shoreline and inflowing streams. Modifications in flow direction, velocity, and discharge patterns could interfere with the natural seasonal flooding and drying cycles that sustain aquatic biodiversity. Reduced inflow or localized drawdown may also increase salinity and alkalinity, affecting the survival of aquatic species adapted to narrower environmental ranges.

Decommissioning phase: The removal of infrastructure could again disturb sediment and water flow regimes, potentially causing temporary instability. However, with careful restoration and sediment stabilization, natural hydrodynamic conditions can gradually be restored to support ecosystem recovery

Suggested Mitigation Measures

- Construction designs should maintain natural drainage to avoid altering stream discharge or lake inflow.
- Preserve riparian vegetation for bank stability and flow regulation.
- During operation, regularly monitor flow patterns and sediment movement.
- After decommissioning, restore drainage and stabilize channels to recover natural flow regimes.

4.1.3 Sedimentation and Erosion

Construction phase: Site preparation and dredging activities associated with the establishment of access routes, construction platforms, and brine intake systems are expected to increase soil disturbance within the shoreline and inflowing stream zones. Earthworks, excavation, and vehicle movement on unpaved surfaces can loosen fine sediments, which are then transported into nearby streams and the lake through runoff, especially during rainfall events. Elevated sediment loads can reduce light penetration, smother benthic substrates, and degrade habitat quality for fish and benthic macroinvertebrates.

Operation phase: During the operational phase, continuous vehicle movement, maintenance works, and brine abstraction activities may perpetuate localized erosion, especially along the inflow channels and access roads. Disturbance of streambanks and removal of vegetation for maintenance access can destabilize soils, causing chronic sediment input into the aquatic system. Sediment deposition near the brine intake or discharge points may gradually change substrate composition from coarse gravel or sand to fine silt and mud reducing habitat complexity essential for macroinvertebrate colonization and fish spawning.

Decommissioning phase: Decommissioning activities, including the removal of pipelines, intake structures, and associated foundations, may resuspend accumulated sediments and disturb shoreline substrates. If unmanaged, this can trigger secondary sediment plumes and

short-term increases in turbidity. The loss of temporary erosion control measures during this phase can exacerbate surface runoff and slope instability.

Suggested Mitigation Measures

- Minimize vegetation clearing to control runoff.
- Stockpiles and exposed soils should be covered or compacted.
- Disturbed sites must be revegetated with native species immediately after construction.
- Maintain embankments and drainage structures during operation to prevent erosion.
- Limit vehicle movement near water bodies.
- After decommissioning, grade and stabilize slopes using bioengineering methods to prevent renewed sedimentation.

4.1.4 Noise Pollution

Construction phase: Noise and vibration are among the most immediate and unavoidable environmental impacts expected during the construction phase of the soda ash extraction infrastructure and brine abstraction system. Key noise generating activities will include dredging, pile driving, the operation of heavy machinery (such as excavators, bulldozers, and pumps), and vehicle traffic associated with material transport along the shoreline and inflowing stream zones. These activities will introduce both airborne and underwater acoustic disturbances into the aquatic environment. Underwater noise is particularly significant as it can propagate efficiently in shallow saline water bodies like Lake Natron, where sound transmission is enhanced by high mineral content and limited depth. Fish species recorded during the baseline survey, including *Alcolapia alcalica*, *Alcolapia latilabris*, and *Alcolapia ndalalani*, are adapted to calm, spring fed environments and may be sensitive to abrupt acoustic disturbances. Studies have shown that exposure to intense or continuous underwater noise can cause stress responses in fish, including elevated cortisol levels, erratic swimming, reduced feeding efficiency, and temporary or permanent hearing threshold shifts (Popper & Hawkins, 2012; Slabbekoorn *et al*., 2010).
Chronic or impulsive noise may also disrupt key biological behaviors such as spawning, parental care, and migration within shallow stream channels, especially during the breeding period.

Operation phase: During the operation of the soda ash processing plant and pumping system, persistent low-frequency mechanical noise from pumps, conveyors, and generators may continue to propagate through the brine abstraction channels and shoreline areas. Although less intense than construction noise, its continuous nature can lead to chronic stress and behavioral modification among aquatic organisms. For endemic species with small distribution ranges such as *A. ndalalani* and *A. latilabris*, these disturbances can fragment populations and limit access to feeding or breeding habitats.

Decommissioning phase: Noise generation during decommissioning will likely arise from dismantling, equipment removal, and debris handling. While these impacts are expected to be temporary, they can still cause short-term behavioral disturbance and displacement of aquatic

fauna. If pile extraction or demolition is involved, sudden acoustic pulses may resemble construction-phase impacts.

Suggested Mitigation Measures

- Use modern, well-maintained machinery fitted with silencers to reduce noise.
- Restrict noisy works like pile driving to daylight hours and low sensitivity periods like breeding season.
- Employ vibratory techniques instead of impact hammers when feasible.
- Establish buffer zones and noise barriers near aquatic habitats.
- Monitor underwater noise levels during operation and control vessel speeds near the site.
- Apply similar measures during decommissioning to limit disturbance.

4.1.5 Wastewater and Solid Waste

Construction phase: During the construction phase, the establishment of access roads, plant foundations, brine abstraction infrastructure, and workers' camps will generate substantial volumes of domestic sewage, greywater, and solid waste. Untreated wastewater from kitchens, sanitation facilities, and cleaning activities could easily enter the inflowing streams or shoreline through surface runoff, particularly during rainfall events. Such discharges would introduce high organic loads and nutrients, increase biochemical oxygen demand (BOD) and foster eutrophic conditions that reduce dissolved oxygen levels, threatening aquatic life. The endemic *Alcolapia* species recorded in the baseline survey are physiologically adapted to alkaline but oxygen stable waters, and even short-term oxygen depletion can lead to stress or mortality.

Operation phase: The operational phase presents more complex and sustained risks associated with industrial wastewater and brine management. Effluent streams from soda ash processing and brine pumping activities will likely contain elevated concentrations of sodium carbonate, chlorides, and suspended solids, which if inadequately treated, can significantly alter the lake's chemical balance. Discharge of such alkaline effluents may elevate pH beyond the natural range, disrupt ionic balance, and compromise the survival of sensitive aquatic organisms, including macroinvertebrates that serve as bioindicators of water quality.

Decommissioning phase: During decommissioning, the dismantling of processing units, brine pipelines, and ancillary infrastructure presents renewed risks of pollutant release and sediment disturbance. If old septic tanks, sumps, or waste pits are not properly emptied and decontaminated, residual sludge and leachate could infiltrate the groundwater or flow into nearby streams, extending pollution impacts beyond the project's active lifespan. Solid debris, including metals, concrete fragments, and abandoned materials, may be left exposed, contributing to soil and water contamination during runoff events. Improper removal or disposal of industrial waste from decommissioning could compromise long term ecosystem recovery and habitat rehabilitation efforts.

Suggested Mitigation Measures

- Implement a comprehensive waste management plan covering collection, treatment, and safe disposal.
- Treat sewage through constructed wetlands or oxidation ponds before discharge. S
- Solid waste must be segregated, covered, and sent to approved disposal sites.
- Keep waste storage areas away from watercourses to prevent leachate.
- Train workers on waste handling and emergency spill response.
- During decommissioning, remove and rehabilitate all waste and sanitation facilities to restore site integrity.

4.1.6 Loss, Disturbance, and Degradation of Aquatic Habitats

Construction phase: Construction activities such as site clearing, dredging, and installation of brine intake systems will cause direct loss and alteration of shoreline and stream habitats, which serve as breeding and feeding areas for *Alcolapia* species and other aquatic organisms. Disturbance of sediments and vegetation removal will reduce habitat complexity, leading to the displacement of fish and macroinvertebrates and a decline in local biodiversity.

Operation phase: Continuous abstraction and infrastructure presence may modify hydrological regimes, alter flow patterns, and promote sediment deposition around intake points. These gradual physical and chemical shifts can reduce the productivity of littoral zones, limit recolonization by benthic fauna, and fragment habitats critical to the lake's endemic fish populations.

Decommissioning phase: The removal of structures and disturbed soils may further destabilize the shoreline, releasing trapped sediments and pollutants. Without proper rehabilitation, these actions can prolong habitat degradation.

Suggested Mitigation Measures

- Restrict construction to already disturbed zones and mark sensitive habitats to avoid damage.
- Limit dredging to defined areas and avoid breeding seasons.
- Restore disturbed vegetation using native riparian species immediately after works.
- Design embankments with gentle slopes to support recolonization.
- Maintain environmental flows during operation.
- After decommissioning, regrade and replant all disturbed shorelines to restore natural habitats and biodiversity.

4.2 Mitigation Measures for Sustainable Management of Priority Aquatic Resources and Ecosystem Services in the Project Footprint

4.2.1 Environmental Conservation Awareness and Water Resource Management

In the Lake Natron project area, raising awareness among the local Maasai communities on the importance of conserving water resources and fragile aquatic ecosystems is crucial. The inflowing streams and shallow lake margins serve as vital water sources for livestock and

wildlife, and any contamination or overuse could have significant ecological and socio-economic consequences. Awareness programs should focus on sustainable water use, prevention of pollution from livestock activities, and the long-term benefits of protecting the lake's hydrology and biodiversity. Emphasis should also be placed on the shared responsibility of the company and local communities in maintaining the ecological integrity of Lake Natron, ensuring that soda ash extraction does not compromise traditional livelihoods or the natural environment.

4.2.2 Community-Led Conservation Programs

Given the strong communal governance systems among the Maasai, supporting community-based conservation initiatives will be essential for maintaining the ecological balance around the project footprint. Establishing or strengthening local environmental committees and collaborating with traditional leaders can promote the protection of inflowing streams and shoreline habitats from degradation. Through participatory monitoring, the Maasai community can help identify early signs of environmental stress, such as reduced water flow or habitat degradation, and work with project authorities to implement appropriate conservation actions.

4.2.3 Capacity Building for Sustainable Land and Water Use

Capacity building programs should target both community members and project workers to promote sustainable land and water management practices. Training should include topics such as soil erosion control, maintenance of vegetation buffers along streams, prevention of sediment runoff, and responsible waste disposal. Education on the ecological value of wetlands and saline habitats will enhance local understanding of how these systems support water quality and biodiversity. Empowering the community with this knowledge fosters long term stewardship and aligns traditional practices with modern conservation principles.

4.2.4 Capacity Building for Livestock Management

As livestock keeping is the primary livelihood activity, promoting improved grazing and watering practices is vital. The project should support the establishment of designated livestock watering points to minimize trampling and erosion along streambanks and lake margins. Training programs should encourage rotational grazing systems and improved herd management practices that focus on maintaining smaller but healthier and more productive herds. Awareness on the safe use of soda rich waters for livestock should also be integrated to prevent potential health effects while ensuring sustainable coexistence between livestock activities and aquatic ecosystem conservation.

5 AQUATIC FAUNA MANAGEMENT PLAN

The Aquatic Fauna Management Plan (AFMP) provides a structured framework for safeguarding native aquatic fauna and maintaining ecosystem integrity during the construction, operation, and decommissioning of the Soda Ash Project at Lake Natron. This plan outlines measures to prevent or mitigate impacts on inflowing streams, littoral habitats, and the alkaline lake ecosystem. While soda ash extraction and brine pumping are expected to have localized impacts, rigorous monitoring of water quality, sedimentation, and aquatic biodiversity will ensure early detection of any ecological changes. Active engagement with the local Maasai community, relevant government authorities, and research institutions is encouraged to promote shared stewardship and transparency. Table 5.1 summarizes key activities, potential impacts, and recommended mitigation measures across the project lifecycle.

Table 5.1: Aquatic Fauna Management Plan

Project Phase	Key Activities	Potential Impacts	Recommended Mitigation Measures	Timeframe
Construction Phase	• Site clearing, including removal of vegetation and topsoil • Installation of brine abstraction and intake infrastructure	• Loss of shoreline and stream vegetation may increase erosion and sedimentation, smothering benthic habitats • Fragmentation of riparian zones may disrupt inflow streams and reduce habitat quality • Degradation of ecosystem services such as livestock watering points	• Clearly demarcate and restrict site clearance to the minimum footprint • Conduct pre-construction ecological verification surveys to identify sensitive habitats • Avoid critical areas and schedule major works outside the rainy season to reduce sediment runoff • Use environmentally sensitive construction methods and maintain flow continuity in inflowing streams • Implement the Biodiversity Action Plan (BAP) to address habitat loss and species protection•	Life of Construction Phase
	• Construction of buildings, roads, and infrastructure; movement of heavy machinery; storage and handling of materials and chemicals	• Soil compaction and surface runoff may degrade water quality • Accidental spills of fuel, lubricants, and construction chemicals may harm aquatic fauna • Increased sedimentation may smother benthic habitats	• Establish strict waste handling and chemical management protocols • Provide spill kits and train workers in emergency response • Maintain secondary containment for fuels and hazardous chemicals	Life of Construction Phase

Project Phase	Key Activities	Potential Impacts	Recommended Mitigation Measures	Timeframe
Operational Phase	• Routine plant operations, brine pumping, township activities, maintenance, and storage of chemicals • Movement of vehicles and machinery along access roads and shoreline	• Risk of hydrocarbon or chemical leakage into inflowing streams or lake • Localized shoreline erosion from vehicle traffic and boat operations • Chronic noise disturbance affecting aquatic fauna	• Monitor water quality continuously (turbidity, pH, TDS, DO) • Schedule high-noise operations to minimize disturbance to aquatic fauna	Life of the operational phase
Decommissioning Phase	• Dismantling plant, township structures, brine pipelines, and access roads • Site restoration	• Sedimentation and erosion from soil disturbance • Potential contamination from residual chemicals or construction debris • Disturbance of riparian and shoreline habitats	• Schedule decommissioning and revegetation during dry periods to reduce runoff • Properly remove and dispose of all waste and contaminated materials • Restore shoreline and streambank vegetation using native species to stabilize soils • Conduct post-decommissioning water quality monitoring to verify ecosystem recovery	Life of Decommissioning Phase

(Source: MTL Consulting, 2025)

6 MONITORING PROGRAMME AND EVALUATION

To ensure sustainable management of aquatic ecosystems within the project footprint, a comprehensive monitoring program will be implemented throughout the construction, operational, and decommissioning phases. This program is designed to detect and address any ecological changes promptly, verify the effectiveness of mitigation measures, and support adaptive management of water quality, habitats, and aquatic fauna.

6.1 Monitoring Procedures

It is recommended that during the construction and operation of the proposed jetty Project, develop, implement, and maintain an Aquatic Ecology Monitoring Plan to ensure the proper implementation and effectiveness of mitigation measures. Specifically, the monitoring should focus on:

- **Regular Water Quality Monitoring:**
  Frequent sampling of inflowing streams and nearshore Lake Natron habitats will measure turbidity, pH, dissolved oxygen, total dissolved solids, hydrocarbons, heavy metals, and nutrient levels. This enables early detection of sedimentation, brine spillage, or chemical contamination associated with plant, township, or brine abstraction activities.
- **Aquatic Fauna and Habitat Assessments:**
  Periodic surveys will track the presence and abundance of native fish and benthic macroinvertebrates in streams and shoreline habitats. Changes in species diversity, recruitment, or habitat use will be recorded. Emphasis will be placed on sensitive and endemic tilapia species that rely on shallow inflows and stream margins. Vegetation covers and substrate integrity should also be monitored to detect erosion or habitat degradation.
- **Noise and Vibration Monitoring:**
  Underwater and shoreline noise levels will be measured during high impact construction activities, including machinery operation and pipeline installation. Activities will be scheduled to avoid periods when aquatic species are most vulnerable, and mitigation measures should be applied if noise thresholds are exceeded.
- **Hydrology and Flow Observation:**
  The inflowing streams and nearshore zones of Lake Natron should be regularly monitored to assess any changes in water movement, flow velocity, and connectivity caused by construction of the plant, township, brine pipelines, or other infrastructure. Any alterations that disrupt natural hydrodynamics, reduce water exchange, or fragment habitats should be identified promptly.
- **Source Attribution of Impacts:**
  Scientific monitoring should be applied to differentiate between ecological changes caused by project activities such as sedimentation from construction, brine spills, shoreline disturbance and natural seasonal or climatic variations. This includes comparing baseline water quality, habitat condition, and fauna abundance with ongoing measurements to identify deviations specifically linked to project operations.

- **Adaptive Management:**
  Establish a system for real-time data analysis to allow for rapid adjustments to construction practices and mitigation measures whenever thresholds are exceeded. Monitoring results should directly inform updates to the Environmental Management Plan (EMP) and Biodiversity Action Plan (BAP).
- **Stakeholder Engagement and Transparency:**
  Local Maasai communities, relevant government agencies, and research institutions should be actively involved in the monitoring program to ensure transparency and shared responsibility for ecosystem stewardship. Regular reporting of monitoring results should also be shared with stakeholders to maintain accountability and inform adaptive management decisions.

6.2 Indicators, Measurements, and Monitoring Extent

The aquatic ecology monitoring program employs sensitive and practical indicators to track potential impacts of soda ash extraction, plant and township construction, and associated infrastructure on Lake Natron's inflowing streams and nearshore habitats. Selected indicators provide early warnings of ecological changes before they become irreversible, while distinguishing natural variability from project-related impacts. The program focuses on habitat integrity, water quality, fauna abundance, and community observations, ensuring adaptive management is informed by robust evidence (Table 6.1).

Table 6.1: Types of Indicators and measurements for monitoring

Indicator Type	Measurement	Monitoring Tools / Equipment	Monitoring Frequency	Performance Indicator
Condition / Habitat Indicators	• Species richness and composition of fish and benthic macroinvertebrates in inflowing streams and shoreline habitats. • Relative abundance of endemic tilapia species. • Physical habitat quality: substrate condition, aquatic vegetation cover, and shoreline stability.	Seine net, gill net, hand/dip net, underwater camera, GPS mapping tools	Baseline before construction, then quarterly during construction and biannually during operation.	• Stable or improved species composition and richness. • No significant loss of spawning or nursery habitats. • Shoreline and streambank vegetation maintained or recovering.
Water Quality Indicators	• Turbidity, suspended sediment, dissolved oxygen, pH, temperature, electrical conductivity, nutrient levels (nitrate, phosphate), hydrocarbon residues	Multi-parameter water quality meter, turbidity meter, sediment traps, and laboratory chemical analysis.	Monthly during construction, then quarterly during operation.	• Turbidity and sediment within acceptable limits. • DO sufficient for aquatic fauna health. • No detectable hydrocarbon contamination in inflows or lake.
Noise and Vibration Indicators	• Underwater and nearshore noise levels during construction and heavy machinery operations	Underwater hydrophones, vibration meters.	Daily during high impact construction as needed for operational activities	• Noise maintained below disturbance thresholds for fish and macroinvertebrates.

Indicator Type	Measurement	Monitoring Tools / Equipment	Monitoring Frequency	Performance Indicator
				• Sensitive spawning or juvenile habitats remain unaffected.
Response Indicators	• Signs of ecosystem recovery or deterioration, including habitat condition and fauna abundance. • Changes in juvenile fish or macroinvertebrate recruitment.	Seine net, gill net, dip net and visual habitat surveys	Biannually post-construction and during operation.	•Stabilization or recovery of fish and macroinvertebrate populations compared to baseline. • Juvenile recruitment maintained in inflowing streams and shoreline habitats..
Community/Stakeholder Indicators	• Community reporting of unusual water conditions, livestock impacts, or habitat disturbance. • Level of participation in monitoring	Structured interviews, participatory shoreline surveys, and mobile reporting apps.	Ongoing, with monthly community review meetings.	• High community engagement and reporting. • Rapid response to incidents within 24–48 hours of detection.

(Source: MTL Consulting, 2025)

6.3 Proposed Monitoring Site Locations

Monitoring of aquatic fauna and habitats will focus on areas most likely to be affected by soda ash extraction, plant and township construction, brine pipelines, and access roads. Sampling will target both shoreline zones and inflowing streams to capture the main ecological gradients and habitat types.

To support robust assessment and long-term ecological monitoring, the program should focus on:

- **Impact Zones:** Areas directly influenced by construction and operational activities, including inflowing streams entering Lake Natron, shoreline areas adjacent to the plant and township, and stream segments upstream and downstream of intake or discharge points. These zones will be regularly monitored to track changes in fish populations, macroinvertebrate communities, substrate condition, and vegetation cover.
- **Near Field Reference Zones:** Upstream or lateral areas outside immediate construction influence, representing baseline conditions within similar habitats. These zones will provide comparative data to help distinguish project related impacts from natural variations.
- **Far Field Reference Zones:** Remote areas several kilometers away from the project footprint, representing regional background conditions unaffected by the project. These zones will help detect cumulative or widespread environmental changes and ensure regional context is incorporated into monitoring.

6.4 Evaluation and Reporting

Baseline data from pre-construction surveys of inflowing streams and shoreline habitats of the lake will serve as the reference for assessing potential impacts of soda ash extraction, plant and township construction, brine pipelines, and access roads on aquatic fauna and habitat conditions in Lake Natron. The monitoring program will track changes in fish populations, particularly endemic tilapia species, benthic macroinvertebrates, aquatic vegetation, and substrate condition, while documenting any incidents such as spills, habitat disturbance, or unusual mortality events, with rapid response measures in place. Monthly reports will summarize monitoring activities, key observations, environmental incidents, and community inputs from local Maasai observers. Quarter summaries will evaluate the effectiveness of mitigation measures and guide adaptive management to address emerging issues. Annual evaluations will compare monitoring results against baseline data and project objectives, informing adjustments to management practices and supporting the long-term ecological sustainability of Lake Natron and its inflowing streams, while ensuring transparency, community participation, and evidence-based decision making throughout all project phases.

7 CONCLUSION AND RECOMMENDATION

The aquatic baseline study established that the inflowing streams and nearshore zones of Lake Natron support a limited, yet highly specialized aquatic community dominated by endemic *Alcolapia* species and pollution tolerant macroinvertebrates. These organisms are uniquely adapted to the lake's extreme alkaline and saline environment but depend strongly on the stability and quality of freshwater inflows for survival and reproduction. The shoreline areas near the proposed dredging point were largely devoid of aquatic life due to elevated salinity, lack of vegetation, and absence of freshwater input. No invasive alien species were recorded during the survey, indicating that the lake's ecological system remains relatively undisturbed. The findings demonstrate that while the proposed Soda Ash Project overlaps with habitats of ecological significance particularly inflowing streams the anticipated impacts on aquatic biodiversity are expected to be localized, minimal, and reversible if appropriate mitigation and management measures are implemented.

To safeguard these sensitive ecosystems, it is recommended that Woswosi Soda Limited (WWSL) maintain natural stream flow regimes, strictly manage wastewater and effluent discharge, implement erosion and sediment control during construction, and minimize noise and vibration during operation. Restoration of disturbed habitats using native vegetation should be prioritized, and long-term ecological monitoring should be conducted to track changes in water quality and aquatic life. Furthermore, meaningful engagement with local communities is encouraged to enhance awareness and foster stewardship of the lake's ecological resources. With careful adherence to these measures, the soda ash project can proceed sustainably while preserving the ecological integrity and biodiversity of Lake Natron and its inflowing freshwater systems.

REFERENCES

Ahlström, A. (2014). "Livestock and land use: Impacts on water quality." *Agricultural Water Management*, 132, 1-11.

Allsopp, M., Silliman, B. R., & Montoya, J. M. (2014). Ecosystem services and sustainability in coastal and marine systems. *Ecological Economics, 107*, 179-190.

Dudgeon, D. (2000). Large-scale freshwater ecosystems: the need for the integration of approaches. *Freshwater Biology*, 43(3), 373-391.

Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z., Knowler, D. J., Leveque, C., Naiman, R. J., Prieur-Richard, A. H., Soto, D., Stiassny, M. L. J., & Sullivan, C. A. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews, 81*(2), 163-182.

Eccles, D.H., 1992. FAO species identification sheets for fishery purposes. Field guide to the freshwater fishes of Tanzania. FAO/UNDP Project URT/87/016. 145 pp.

Frissell, C. A. (1986). "A hierarchical framework for stream habitat classification: Viewing streams in a watershed context." *Environmental Management*, 10(2), 199-214.

Gibb, H. (2006). "Structural habitat characteristics of forests." *Forest Ecology and Management*, 233(1), 44-52.

Gomi, T., (2005). *Ecosystem Consequences of Stream Sedimentation: The Impact of Land-Use Change and Resource Extraction.* Environmental Management, 35(4), 518-529.

International Finance Corporation (IFC). (2012). Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. Retrieved from https://www.ifc.org

International Union for Conservation of Nature (IUCN). (2020). The IUCN Red List of Threatened Species. Retrieved from https://www.iucnredlist.org

IUCN – The World Conservation Union, 2001. IUCN Red List Categories and Criteria: Version

IUCN, 2017. IUCN Red List of Threatened Species. Version 2017-1.

Lake, P. S. (2003). Ecological effects of perturbation by drought in flowing waters. *Freshwater Biology*, 48(7), 1161-1172

Lowe-McConnell, R. H. (1999). *Fish Communities in Tropical Freshwaters: A Comparative Analysis of the Fish Fauna of Lake Victoria and Other African Lakes*. Springer.

Miller, R. W. (2013). *Erosion and Sediment Control in the Oil and Gas Industry: Best Management Practices.* Journal of Soil and Water Conservation, 68(4), 78-89.

Poff, N. L. R., Allan, J. D., Bain, M. B., Karr, J. R., Prestegaard, K. L., Richter, B. D., & Sparling, D. (1997). The natural flow regime. BioScience, 47(11), 769-784.

Popper, A. N., & Hawkins, A. D. (2012). *The Effects of Anthropogenic Sources of Sound on Fishes.* Journal of Fish Biology, 81(4), 1225-1237.

Seeley, M. E., Chifamba, M., & Johnson, J. (2021). "Assessing the Conservation Status of Endemic Fish Species in African Great Lakes." *Aquatic Conservation: Marine and Freshwater Ecosystems*, 31(2), 422-433.

Slabbekoorn, H. (2010). *A noisy spring: The impact of globally rising underwater sound levels on fish.* Trends in Ecology & Evolution, 25(5), 250-258.

Tadesse, T., Abebe, A., & Assefa, A. (2020). "Impact of Environmental Changes on Endemic Fish Species in Lake Victoria." *Freshwater Biology*, 65(11), 2082-2095.

Tilman, D., (2001). "Biodiversity and ecosystem stability in a decade-long grassland experiment." *Nature*, 411(6839), 299-302.

UNICEF & WHO. (2019). "Progress on household drinking water, sanitation and hygiene 2000-2017: Special focus on inequalities." Geneva: World Health Organization.

Wetzel, R. G. (2001). *Limnology: Lake and River Ecosystems*. Academic Press.

APPENDIX 10: PROSPECTING LICENCES

PL 12236/2023

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF MINERALS

MINING COMMISSION

PROSPECTING LICENCE NO. PL 12236/2023

GRANTED PURSUANT TO SECTION 32 OF THE MINING ACT, CAP. 123

WHEREAS **M/S Ngaresero Valley Company Limited** of **P.O. Box 6514, Dar Es Salaam, Tanzania** has fulfilled the conditions for grant of Prospecting Licence pursuant to Section 31 of ***The Mining Act, Cap. 123***;

I, Eng. Yahya I. Samamba, **EXECUTIVE SECRETARY**, subject to the provisions of ***The Mining Act, Cap. 123*** and of the regulations made thereunder or which may come into force during the continuance of this Licence, or any renewal thereof and pursuant to the powers conferred upon me under Section 32 of ***The Mining Act, Cap. 123*** hereby grant to M/S **Ngaresero Valley Company Limited** (hereinafter called the Licensee) a **Prospecting Licence - Industrial Minerals,** to prospect for **Soda Ash,** in **Longido** and **Ngorongoro** District(s), over an area described in Annex A (hereinafter called the Licence Area), conferring on the Licensee the right to carry on such prospecting operations, abide to Annex B, Annex C and Annex D and execute such other works as are necessary for that purpose.

This Licence, unless sooner cancelled, suspended or surrendered pursuant to the provisions of ***The Mining Act, Cap. 123*** shall be valid for a period of **forty eight (48)** months, effective from the date of grant.

Granted this 27 day of March 2023

Eng. Yahya I. Samamba
EXECUTIVE SECRETARY

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ANNEX A

DESCRIPTION OF THE LICENCE AREA

Subject to Section 95 of the Mining Act, Cap. 123 the Licence is in **Longido** and **Ngorongoro** District(s), QDS **27/2, 28/1, 28/3** defined by lines of latitude and longitude having the following corner coordinates (Arc 1960):

Corner	Latitude	Longitude
1	- 02 deg. 12 min. 27.27 sec.	36 deg. 10 min. 29.50 sec.
2	- 02 deg. 16 min. 59.19 sec.	36 deg. 09 min. 27.22 sec.
3	- 02 deg. 14 min. 12.53 sec.	35 deg. 57 min. 55.15 sec.
4	- 02 deg. 10 min. 59.56 sec.	35 deg. 57 min. 2.52 sec.
5	- 02 deg. 08 min. 12.90 sec.	35 deg. 57 min. 59.53 sec.
6	- 02 deg. 06 min. 6.18 sec.	35 deg. 59 min. 50.95 sec.
7	- 02 deg. 06 min. 17.55 sec.	36 deg. 00 min. 11.17 sec.

Legend	
Licensed boundary	
Licence Code	PL 12236/2023
District	Longido, Ngorongoro
Direction	N

An area of approximately **291.41** Square Kilometres.

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PL 13190/2025

THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF MINERALS
MINING COMMISSION

PROSPECTING LICENCE NO. PL 13190/2025

GRANTED PURSUANT TO SECTION 32 OF THE MINING ACT, CAP. 123

WHEREAS **M/S NGARESERO VALLEY COMPANY LIMITED** of **P.O BOX 60514, Dar Es Salaam, Tanzania** has fulfilled the conditions for grant of Prospecting Licence pursuant to Section 31 of ***The Mining Act, Cap. 123***;

I, Eng. Ramadhani M. Lwamo, **ACTING EXECUTIVE SECRETARY**, subject to the provisions of ***The Mining Act, Cap. 123*** and of the regulations made thereunder or which may come into force during the continuance of this Licence, or any renewal thereof and pursuant to the powers conferred upon me under Section 32 of ***The Mining Act, Cap. 123*** hereby grant to M/S **NGARESERO VALLEY COMPANY LIMITED** (hereinafter called the Licensee) a **Prospecting Licence - Industrial Minerals,** to prospect for **Soda Ash,** in **Ngorongoro** and **Longido** Districts, over an area described in Annex A (hereinafter called the Licence Area), conferring on the Licensee the right to carry on such prospecting operations, abide to Annex B, Annex C and Annex D and execute such other works as are necessary for that purpose.

This Licence, unless sooner cancelled, suspended or surrendered pursuant to the provisions of ***The Mining Act, Cap. 123*** shall be valid for a period of **forty eight (48)** months, effective from the date of grant.

Granted this 14th day of January 2025

Eng. Ramadhani M. Lwamo
ACTING EXECUTIVE SECRETARY

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PL 13190/2025

INITIAL PERIOD

From Date	To Date	Prep. Fee and Rent (USD)	ERV Number	Date	Signature of ES
Preparation	Fee	200.00	924251275288793	07/09/2024	
14/04/2025	13/04/2026	8,864.96	924251275288793	07/09/2024	

FOR EXECUTIVE SECRETARY
MINING COMMISSION

FIRST RENEWAL

I HEREBY CONSENT TO THE FIRST RENEWAL OF PROSPECTING LICENCE NO. ..... of M/S .....of P. O. Box .....
for Licence Area described in Annex 'A' and conditions prescribed in Annex 'B','C' and Annex 'D' for a period of.....months effective from the .....day of.....year.....

EXECUTIVE SECRETARY

From Date	To Date	Annual Rent	ERV Number	Date	Signature of ES

SECOND RENEWAL

I HEREBY CONSENT TO THE SECOND RENEWAL OF PROSPECTING LICENCE NO. ..... of M/S .....of P.O. Box .....
for Licence Area described in Annex 'A' and conditions prescribed in Annex 'B','C' Annex 'D' for a period of.....months effective from the .....day of.....year.....

EXECUTIVE SECRETARY

From Date	To Date	Annual Rent	ERV Number	Date	Signature of ES

2/7

PL 13190/2025

ANNEX A

DESCRIPTION OF THE LICENCE AREA

Subject to Section 95 of the Mining Act, Cap. 123 the Licence is in **Ngorongoro** and **Longido** Districts, QDS **28/3, 40/1** defined by lines of latitude and longitude having the following corner coordinates (Arc 1960):

Corner	Latitude	Longitude
1	- 02 deg. 30 min. 51.70 sec.	36 deg. 02 min. 51.43 sec.
2	- 02 deg. 30 min. 26.89 sec.	36 deg. 01 min. 38.75 sec.
3	- 02 deg. 29 min. 35.62 sec.	36 deg. 01 min. 51.02 sec.
4	- 02 deg. 28 min. 29.18 sec.	36 deg. 02 min. 4.72 sec.
5	- 02 deg. 27 min. 22.53 sec.	36 deg. 02 min. 23.05 sec.
6	- 02 deg. 15 min. 54.45 sec.	36 deg. 04 min. 55.51 sec.
7	- 02 deg. 16 min. 51.34 sec.	36 deg. 08 min. 54.37 sec.
8	- 02 deg. 17 min. 0.93 sec.	36 deg. 08 min. 51.87 sec.
9	- 02 deg. 16 min. 55.73 sec.	36 deg. 08 min. 12.65 sec.
	With Exclusions Of The Following Corner Coordinates;	
1	- 02 deg. 16 min. 55.84 sec.	36 deg. 07 min. 48.13 sec.
2	- 02 deg. 16 min. 55.84 sec.	36 deg. 07 min. 52.56 sec.
3	- 02 deg. 16 min. 37.30 sec.	36 deg. 07 min. 53.03 sec.
4	- 02 deg. 16 min. 36.01 sec.	36 deg. 07 min. 46.72 sec.
5	- 02 deg. 16 min. 36.38 sec.	36 deg. 07 min. 46.92 sec.
6	- 02 deg. 16 min. 36.01 sec.	36 deg. 07 min. 46.61 sec.
1	- 02 deg. 16 min. 45.26 sec.	36 deg. 08 min. 11.21 sec.
2	- 02 deg. 16 min. 41.71 sec.	36 deg. 08 min. 11.21 sec.
3	- 02 deg. 16 min. 37.60 sec.	36 deg. 07 min. 53.75 sec.
4	- 02 deg. 16 min. 45.22 sec.	36 deg. 07 min. 53.68 sec.
1	- 02 deg. 21 min. 22.59 sec.	36 deg. 06 min. 28.77 sec.
2	- 02 deg. 18 min. 44.47 sec.	36 deg. 07 min. 29.80 sec.
3	- 02 deg. 18 min. 44.51 sec.	36 deg. 07 min. 19.36 sec.
4	- 02 deg. 18 min. 31.73 sec.	36 deg. 07 min. 19.68 sec.
5	- 02 deg. 18 min. 31.83 sec.	36 deg. 07 min. 27.92 sec.
6	- 02 deg. 18 min. 13.70 sec.	36 deg. 07 min. 26.37 sec.
7	- 02 deg. 18 min. 14.04 sec.	36 deg. 07 min. 26.00 sec.
8	- 02 deg. 18 min. 16.40 sec.	36 deg. 07 min. 22.18 sec.
9	- 02 deg. 18 min. 30.26 sec.	36 deg. 07 min. 19.71 sec.
10	- 02 deg. 18 min. 22.62 sec.	36 deg. 07 min. 19.90 sec.
11	- 02 deg. 17 min. 20.43 sec.	36 deg. 04 min. 37.27 sec.
12	- 02 deg. 20 min. 28.37 sec.	36 deg. 03 min. 55.53 sec.
1	- 02 deg. 18 min. 16.40 sec.	36 deg. 07 min. 21.74 sec.

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2	- 02 deg. 18 min. 11.65 sec.	36 deg. 07 min. 27.54 sec.
3	- 02 deg. 17 min. 59.18 sec.	36 deg. 07 min. 18.63 sec.
4	- 02 deg. 18 min. 1.69 sec.	36 deg. 07 min. 13.88 sec.
1	- 02 deg. 18 min. 5.32 sec.	36 deg. 07 min. 23.39 sec.
2	- 02 deg. 17 min. 52.34 sec.	36 deg. 07 min. 36.97 sec.
3	- 02 deg. 17 min. 52.34 sec.	36 deg. 07 min. 36.74 sec.
4	- 02 deg. 17 min. 50.81 sec.	36 deg. 07 min. 30.94 sec.
5	- 02 deg. 17 min. 59.09 sec.	36 deg. 07 min. 19.23 sec.
1	- 02 deg. 17 min. 51.93 sec.	36 deg. 07 min. 37.49 sec.
2	- 02 deg. 17 min. 33.52 sec.	36 deg. 07 min. 42.88 sec.
3	- 02 deg. 17 min. 33.52 sec.	36 deg. 07 min. 42.76 sec.
4	- 02 deg. 17 min. 31.94 sec.	36 deg. 07 min. 39.35 sec.
5	- 02 deg. 17 min. 49.95 sec.	36 deg. 07 min. 30.89 sec.
1	- 02 deg. 17 min. 34.34 sec.	36 deg. 07 min. 47.20 sec.
2	- 02 deg. 17 min. 13.36 sec.	36 deg. 07 min. 51.99 sec.
3	- 02 deg. 17 min. 12.88 sec.	36 deg. 07 min. 53.73 sec.
4	- 02 deg. 16 min. 56.22 sec.	36 deg. 07 min. 52.41 sec.
5	- 02 deg. 16 min. 56.53 sec.	36 deg. 07 min. 52.41 sec.
6	- 02 deg. 16 min. 55.91 sec.	36 deg. 07 min. 46.62 sec.
7	- 02 deg. 17 min. 14.56 sec.	36 deg. 07 min. 47.66 sec.
8	- 02 deg. 17 min. 13.49 sec.	36 deg. 07 min. 51.53 sec.
9	- 02 deg. 17 min. 15.35 sec.	36 deg. 07 min. 47.05 sec.
10	- 02 deg. 17 min. 32.56 sec.	36 deg. 07 min. 41.08 sec.
1	- 02 deg. 18 min. 43.85 sec.	36 deg. 07 min. 30.54 sec.
2	- 02 deg. 18 min. 39.69 sec.	36 deg. 07 min. 30.62 sec.
3	- 02 deg. 18 min. 33.82 sec.	36 deg. 07 min. 30.69 sec.
4	- 02 deg. 18 min. 33.67 sec.	36 deg. 07 min. 20.50 sec.
5	- 02 deg. 18 min. 43.16 sec.	36 deg. 07 min. 19.49 sec.

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PL 13190/2025

Legend	
Licensed boundary	
Licence Code	PL 13190/2025
Districts	Ngorongoro and Longido
Direction	N

An area of approximately **88.6496** Square Kilometres.

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APPENDIX 11: SODA ASH FAUNA BIODIVERSITY REPORT

TERRESTRIAL FAUNA BASELINE STUDY FOR THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION IN LAKE NATRON AT WOSIWOSI VILLAGE, GELAI LUMBWA WARD, LONGIDO DISTRICT IN ARUSHA REGION, TANZANIA.

Consultant:

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Project Proprietor:

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Ukwamani, Nearby Kawe Mosque, Kinondoni

P.O Box 77910,

Dar Es Salaam, Tanzania

Mobile No. 0767080734

Submission Date: 12th November 2025

ACKNOWLEDGEMENTS

The consultant wishes to extend sincere appreciation to all individuals and institutions that contributed to the successful completion of the Fauna Baseline Survey conducted at the proposed Soda Ash Project site in Lake Natron, Longido District, from 28 September to 4 October 2025.

Special acknowledgment is extended to MTL Consulting Limited for their coordination, logistical support, and technical collaboration throughout the exercise. Appreciation is also directed to the Longido District Tourism Officer Mr Emmanuel , Woswosi Soda Limited representatives Mr. Kaoneka and the respective Village Executive Officers, Village Chairpersons and Maasai Traditional Leaders (Laigwanans) for their warm reception, valuable insights, and active participation during the field activities.

The consultant further recognizes the efforts of the drivers, casual labourers, community members and all other team participants whose cooperation and commitment ensured the smooth and effective implementation of the survey.

The contribution and commitment of all stakeholders were helpful in ensuring the smooth execution and successful completion of this baseline assessment.

EXECUTIVE SUMMARY

WosWosi Soda Limited (WWSL), incorporated on 22nd September 2022 under Certificate No. 157942433, is a limited liability company established to engage in soda ash mining and processing. The project encompasses a mining section and a soda ash extraction plant, targeting 1,000,000 metric tonnes per annum (MTPA) of trona, yielding an estimated 660,000 MTPA of soda ash at a 70% recovery rate. Brine will be pumped from depths of 3–20 meters in Lake Natron to the processing plant, within two prospecting licenses covering approximately 550.688 sq. km. Soda ash, a critical industrial raw material, supports glass, detergent, and chemical production. WWSL aims to foster national industrialization, economic growth, employment, and infrastructure development. The company prioritizes environmental compliance and sustainability, commissioning MTL Consulting Limited for Environmental and Social Impact Assessment studies on flora, fauna, hydrology, and socio-economic factors. WWSL seeks to balance economic benefits with protection of Lake Natron, a Ramsar wetland and key breeding site for the Lesser Flamingo.

The study focussed on terrestrial fauna i.e. mammals, amphibians, reptiles and birds based on main habitat types. Different sampling techniques were used depending on an animal group to: i) assess fauna composition, indicate their spatial occurrence in their habitats; ii) determine the abundances and diversities of fauna; iii) assess critical habitats such as migratory/dispersal routes, nesting sites, roosting sites for different fauna; iv) Identify and show spatial distribution of species of conservation importance (under the IUCN Red List and those of CITES) as well as Endemic/rare species; v) describe the cumulative and residual effects of the project activities on fauna and propose possible mitigation measures of the effects; vi) identify priority ecosystem services and suggest mitigation measures for sustainable management; and vii) identify and assess invasive alien species of fauna in the Project footprint and provide control/mitigation measure for their management.

The proposed Trona Extraction and Soda Ash Production Project at Lake Natron is guided by Tanzania's sectoral policies and legal frameworks, including the National Environmental Policy (2021), Wildlife Policy (2007), Forest Policy (1998), Energy Policy (2015), Tourism Policy (1999, reviewed 2023), and Mineral Policy (2009), which collectively promote sustainable natural resource management, conservation, and socio-economic development. Legislation such as the Environmental Management Act, Wildlife Conservation Act, Forest Act, and Mining Act ensures mandatory compliance with environmental and social safeguards, while international conventions including the Convention on Biological Diversity, UNFCCC, Equator Principles, and IFC Performance Standards require biodiversity protection, climate mitigation, and responsible stakeholder engagement. The project must therefore integrate environmental, social, and ethical considerations throughout its lifecycle, balancing industrial development with conservation of Lake Natron's Ramsar-designated wetland, critical flamingo breeding habitats, and broader ecological and community interests.

The fauna baseline survey at Lake Natron employed a stratified, habitat-based design to capture species diversity, abundance, and distribution across all major habitats, integrating both field and desktop review methods aligned with national and international standards. Sampling sites, including lake shorelines, riverine areas, grasslands, and woodlands, were strategically selected for representativeness, accessibility, and ecological significance. Field surveys, conducted between

September 28 and October 3, 2025, used transects, opportunistic sightings, timed searches, and local knowledge to assess mammals, birds, reptiles, and amphibians. The study also mapped habitats, characterized ecological features, and identified priority ecosystem services, enabling comprehensive baseline data collection to inform impact assessment, mitigation planning, and sustainable management of the proposed soda ash project within Lake Natron's ecologically sensitive landscape.

A total of 15 large and medium sized mammal species were recorded during the field survey. Mammals were identified through direct sightings, footprints/tracks, through droppings, joint assessment interview as well as through body part remains. Zebra and Grants gazelle were the most recorded species through their droppings and footprints along the shoreline as well as in grassland or scrubland along Lake Natron which then confirm their use of freshwater spring found along Lake Natron

The field survey at Lake Natron recorded 15 large and medium-sized mammal species, identified through direct sightings, tracks, droppings, body remains, and local knowledge. Zebra and Grant's gazelle were the most frequently observed, using shorelines, grasslands, and scrublands, indicating reliance on freshwater springs. Of the 15 species, survey five (05) species namely Giraffe (*Giraffa Camelopardalis*), Plains Zebra (*Equus quagga*), Lesser Kudu (*Tragelaphus imberbis*), Gerenuk (*Litocranius walleri*) and Fringe-eared Oryx (*Oryx beisa ssp. callotis*) are being considered as species of conservational importance highlighting the ecological importance of the area and the need for careful management.

A total 76 species of avifauna were identified, the list composed of two near threatened (NT) species Lesser Flamingo - *Phoeniconaias minor* and Kori Bustard - *Ardeotis kori*; one endangered (EN) species Steppe eagle - *Aquila nipalensis*; and *one Vulnerable (VU) species* Tawny Eagle - *Aquila rapax*, but none of them was considered invasive. Lake Natron and nearby habitats support numerous waterbird and migratory species making it an important stopover for migrant's avifauna. Moreover, 26 species were of different migration type.

No herpetofauna were observed within the core area of Lake Natron, likely due to the lake's extreme saline and alkaline conditions, which limit aquatic amphibian presence. However, local knowledge indicated three (03) amphibian species inhabit surrounding seasonal streams, temporary pools, and freshwater springs. Additionally, seven (07) reptile species were reported, all classified as Least Concern by the IUCN, with none of conservation significance, highlighting that while herpetofauna occur in the broader landscape, the lake itself provides limited habitat for these groups.

The proposed soda ash extraction and processing project at Lake Natron may impact terrestrial and aquatic fauna through habitat loss, fragmentation, disturbance from noise, light, and human activity, hydrological alterations, pollution, and reduced ecological connectivity. Construction activities such as site clearing, infrastructure development, and road creation can displace mammals like zebras, Grant's gazelles, and lesser kudus, while operational water abstraction and effluent discharge may affect lake salinity, aquatic habitats, and food availability for Lesser Flamingos and amphibians. Cumulative effects, including land-use changes and settlement expansion, could further fragment wildlife corridors and disrupt ecosystem functions, threatening species diversity and resilience.

To mitigate these impacts, measures include minimizing the project footprint, progressive habitat rehabilitation, restricting human access near sensitive areas, and reducing noise and light pollution. Sustainable water use, effluent treatment, and regular environmental monitoring are recommended, alongside maintaining ecological connectivity, protecting freshwater springs, supporting wildlife-friendly pastoralism, and promoting eco-tourism. Long-term biodiversity monitoring, stakeholder collaboration, and adaptive management are essential to safeguard priority species and ecosystem services while enabling sustainable project operations.

The Lake Natron soda ash project incorporates a comprehensive adaptive monitoring program to ensure effective mitigation of environmental impacts. Woswosi Soda Limited will track terrestrial and aquatic fauna, including Lesser Flamingos, terrestrial mammals, and herpetofauna, using indicators such as population trends, species presence, habitat condition, and responses to noise and light disturbances. Monitoring will be conducted at strategic locations including the lake shoreline, wetlands, inflowing streams, and surrounding villages at regular intervals from daily to annually, with findings guiding adaptive management and mitigation adjustments.

Lake Natron, unlike the industrially developed Lake Magadi, is ecologically sensitive and globally significant, hosting key Lesser Flamingo breeding areas on central soda islands, northeastern flats, and shorelines. Wosiwosi village, selected for project infrastructure, lies outside these core breeding zones, reducing direct disturbance. Nevertheless, strict environmental safeguards, controlled water use, pollution prevention, maintenance of ecological corridors, and ongoing biodiversity monitoring are essential to protect flamingo habitats, preserve ecosystem integrity, and ensure sustainable soda ash operations while minimizing impacts on the lake’s unique and sensitive ecological systems.

The Lake Natron soda ash project is feasible, provided that strict environmental safeguards, controlled water use, habitat protection measures, and continuous biodiversity monitoring are implemented to minimize impacts on critical ecosystems, particularly Lesser Flamingo breeding sites, thereby ensuring sustainable industrial development alongside conservation of the lake’s unique ecological and Ramsar-designated values.

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1 INTRODUCTION

1.1 Background

Woswsoi Soda Limited (WWSL) is a limited liability company incorporated on the 22nd of September 2022 under Section 15 of the Companies Act, 2002. The company is registered under Certificate No. 157942433. WWSL was established specifically to engage in soda ash mining and processing. The project will consist of a mining section and a soda ash extraction plant, with a production capacity of at least 1,000,000 metric tonnes per annum (MTPA) of trona and an expected soda ash output of 660,000 MTPA, based on a 70% recovery rate. It will involve the pumping of sodium carbonate solution (brine) from depths of 3 to 20 meters below the surface of Lake Natron to the extraction plant for processing. The project area is comprised of two prospecting licenses: PL-12236/2023 and PL-13190/2025, covering areas of approximately 290.891 sq. km and 259.797 sq. km respectively.

The proposed project seeks to utilize the natural trona deposits found within the Lake Natron basin for the production of soda ash (sodium carbonate) which is a key industrial raw material used in glass manufacturing, detergents, chemical industries and various other applications. WWSL's strategic goal is to contribute to the national industrialization agenda and economic growth through value addition, employment creation and infrastructure development in the project area.

In implementing this initiative, WWSL emphasizes compliance with national environmental legislation and international best practices. The company is committed to ensuring that all project activities are carried out in an environmentally sustainable and socially responsible manner. Accordingly, WWSL has engaged MTL Consulting Limited to undertake the required Environmental and Social Impact Assessment (ESIA) studies including baseline surveys on fauna, flora, hydrology and socio-economic aspects of the Lake Natron ecosystem.

Through this development, WWSL aims to balance economic benefits with the protection of Lake Natron's unique ecological and cultural significance which is globally recognized as a critical breeding site for the Lesser Flamingo (*Phoeniconaias minor*) and an important Ramsar-designated wetland.

1.2 Objective and scope of the Study

The study should cover the Project area and the surrounding environment. The results of surveys should provide fauna checklists by main habitat types, which should facilitate impact assessment, development of mitigation measures, and an overall environmental management plan.

The overall aim of the study is to provide the ecological state of terrestrial fauna (Birds, Reptiles, Large and Medium mammals) to assist in the assessment of environmental impacts and develop mitigation and management measures to minimize the impacts associated with the Project.

Different techniques should be used to sample faunal species of different taxa in the study area. The techniques should differ depending on the taxonomic groups and should provide identification of the species present, as well as provide abundance or relative abundance indices depending

on the site situation. Specifically, the assignment should strive to achieve, but not be limited to, the following:

The terrestrial fauna study should strive to achieve the following:

- Assess fauna composition, classify and map their occurrence in their habitats confined in the vegetation categories occurring within the Project area.
- Determine the abundances and diversities of fauna within the Project area;
- Identify and map habitat characteristics within the Project area and assess critical habitats such as migratory routes, nesting sites, roosting sites, and home ranges for different fauna (small mammals, birds, reptiles, amphibians, and invertebrates);
- Identify and map fauna species of special concern falling under the International Union for Conservation of Nature (IUCN) Red List and those of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) with concern to endemic/rare, critically endangered, and threatened species.
- Provide the baseline conditions in areas potentially affected by the Project to understand potential impacts and provide appropriate mitigation and management measures.
- To conduct a systematic review to identify priority ecosystem services in the project footprint and suggest mitigation measures for sustainable management.
- Identify and assess invasive alien species of fauna in the Project footprint and provide control/mitigation measures for their management.
- Provide baseline fauna checklists with emphasis on rare/threatened species (based on the IUCN Red List, CITES category, and level of feeding on the food pyramid), migratory and mega-fauna species.
- Describe the cumulative and residual effects of the Project activities on fauna and propose appropriate mitigation measures.

1.3 Study Location and Proposed Facilities

The proposed project is located at Lake Natron, in northern Tanzania, near the Kenyan border and northeast of the Ngorongoro Crater, within the eastern branch of Africa's Great Rift Valley. Nestled between volcanic hills and deep craters, Lake Natron lies at the lowest point of the Rift Valley (600 meters above sea level) and is considered one of the world's most caustic bodies of water. The lake is shallow, with a depth of less than three meters, and its width varies depending on water levels. It stretches 57 kilometers in length and 22 kilometers in width. The area experiences irregular seasonal rainfall, mainly between December and May, with temperatures often exceeding 40°C. Lake Natron serves as the only known successful breeding site for the Lesser Flamingo in East Africa and is the most significant global breeding site for this species. Most of the breeding takes place from October to November, although successful breeding can occur throughout the year. There are several key reasons why this lake is preferred by the Lesser Flamingo

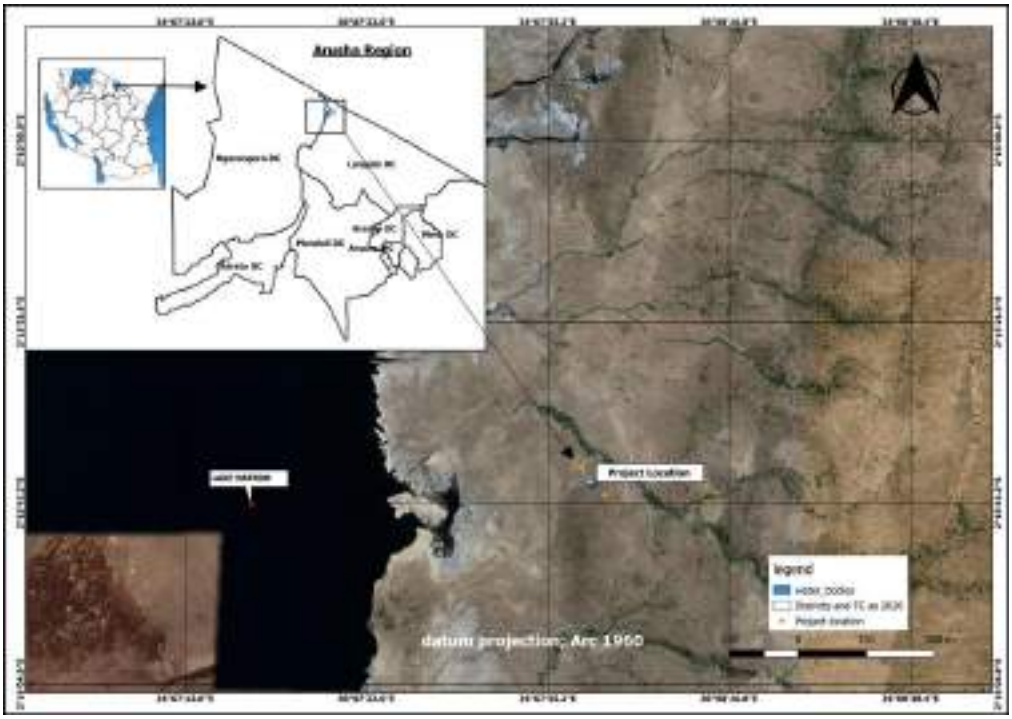


Figure 1.1: Soda Ash Project Location

(Source: MTL Consulting, 2025)

As stipulated under the Enviornmental Management Act CAP 191 R.E 2023, the ESIA aims to assess the potential impacts for proposed Soda Ash Production Project activities on the environment. To address such impacts, WWSL planned to conduct an ESIA for the proposed Project in compliance with the National Standards and the requirements of the Environmental Management Act of 2004 and the EIA and Audit Regulations 2005 and its last amendments of 2024.

As part of the ESIA study, Fauna baseline required to be conducted in line with the National legal requirement to identify and classify individual Fauna species found in the proposed Project site. This will assist in the articulation of the potential direct and indirect impacts of Project activities on Fauna species and ecosystems and finally suggest appropriate mitigation measures to alleviate or reduce the level of impacts.

1.4 Study Team

The fauna baseline survey was conducted by Mr. Onesmo P. Haule, a Biodiversity expert working with MTL Consulting Limited. The work was carried out in close collaboration with the MTL Consulting ESIA team, representatives from the Longido District Council, Woswosi Soda Limited (WWSL) and local community leaders to ensure integration of scientific, social and local ecological knowledge into the assessment.

2 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

The implementation of the proposed Trona Extraction and Soda Ash Project at Lake Natron is subject to a range of national policies, legal instruments and institutional frameworks that regulate environmental management, mineral resource utilization and biodiversity conservation. Compliance with these frameworks is essential to ensure that the project is developed in an environmentally sustainable and socially responsible manner.

This section outlines the national policies, legal instruments and institutional arrangements that govern or must be adhered to in the course of developing and operating the proposed project. It further highlights the relevant international conventions and agreements to which Tanzania is a party, and which reinforce the country's commitment to environmental protection, biodiversity conservation and sustainable development.

2.1 Relevant National Policies

The proposed Trona Extraction and Soda Ash Production Project at Lake Natron is influenced by several sector specific policies that guide sustainable natural resource management, energy use, and mineral development in Tanzania. These policies complement the broader environmental policy framework by ensuring that sectoral activities contribute to national development goals while maintaining environmental integrity.

2.1.1 National Environmental Policy (NEP), 2021

The NEP (2021) provides primary guidance on sustainable environmental management in Tanzania. It emphasizes the integration of environmental considerations into development planning, the preventive principle, ecosystem integrity and community participation. The policy requires that major development projects such as mining and industrial activities undergo Environmental and Social Impact Assessments (ESIAs) to mitigate potential adverse impacts.

2.1.2 National Wildlife Policy, 2007

The policy underscores the conservation of wildlife resources and their habitats while promoting sustainable use. Given Lake Natron's ecological significance as a Ramsar site and a key breeding ground for the Lesser Flamingo, the policy requires that any development in or near wildlife habitats ensures minimal disturbance and implements adequate mitigation measures.

2.1.3 National Forest Policy, 1998

The policy provides the framework for the sustainable management and conservation of forest resources in Tanzania. The policy emphasizes the need to maintain ecological balance, protect watersheds, and conserve biodiversity while promoting sustainable utilization of forest products to support socio-economic development.

2.1.4 National Energy Policy (2015)

The policy supports the development of energy-intensive industries such as soda ash production while promoting environmental protection, efficient energy use, and adoption of cleaner technologies that minimize environmental pollution and carbon emissions.

2.1.5 National Tourism Policy (1999, reviewed 2023)

Given the coexistence of tourism and conservation at Lake Natron, this policy encourages development activities that maintain the aesthetic and ecological integrity of tourism destinations, ensuring minimal conflict between industrial development and ecotourism values

2.1.6 The Mineral Policy of Tanzania, 2009

This policy promotes sustainable development of the mineral sector by ensuring that mineral resources are exploited efficiently and responsibly. It advocates for adherence to environmental standards, equitable sharing of benefits, and community engagement in mining areas.

2.2 Relevant National Legal Framework

This framework comprises various national laws that collectively govern the planning, implementation, and monitoring of development projects with potential environmental and social impacts. Compliance with these laws is mandatory for all project proponents, ensuring that economic development proceeds in harmony with environmental protection, biodiversity conservation, and community welfare.

The key legislative instruments relevant to this project are summarized below.

2.2.1 The Environmental Management Act, CAP 191 R.E. 2023

The Environmental Management Act (EMA) provides the principal legal foundation for environmental protection and sustainable management in Tanzania. It mandates that all major development projects including mining and industrial operations should undergo an Environmental and Social Impact Assessment (ESIA) before its implementation.

The Act establishes the National Environment Management Council (NEMC) as the authority responsible for reviewing, approving, and monitoring environmental compliance. Under the EMA, the project must adhere to pollution control standards, waste management requirements and environmental monitoring obligations throughout its life cycle.

2.2.2 The Wildlife Conservation Act CAP 283 R.E 2023

The Wildlife Conservation Act governs the protection and management of wildlife and their habitats, both within and outside protected areas. It prohibits harmful activities that may threaten wildlife populations or degrade sensitive ecosystems.

Considering that Lake Natron is a key breeding site for the Lesser Flamingo (Phoeniconaias minor) and an ecologically sensitive Ramsar site, this Act requires the project to collaborate with the Tanzania Wildlife Research Institute (TAWIRI) and the Wildlife Division in biodiversity monitoring and mitigation planning.

2.2.3 The Forest Act, CAP 323 R.E. 2023

The Forest Act provides for the sustainable management and conservation of forest resources. It regulates vegetation clearing, forest product use, and land conversion in forested areas.

Given the semi-arid vegetation around Lake Natron, any removal of trees or woodland must be conducted under approved permits and accompanied by compensatory or restorative measures.

2.2.4 The Mining Act, CAP 123 R.E 2023

The Mining Act regulates the exploration, extraction, and processing of mineral resources in Tanzania. It requires mining rights holders to ensure environmental compliance and to contribute to local socio-economic development.

In relation to the proposed project, the Act mandates that the proponent obtain a mining licence and implement environmental and social management plans consistent with the ESIA recommendations. It also provides for corporate social responsibility (CSR) to benefit surrounding communities and requires the restoration of mined areas upon project closure.

2.3 International Standards, Guidelines, and Conventions

Tanzania is a signatory to several international and regional environmental conventions and agreements that promote the sustainable management of natural resources and the protection of biodiversity, ecosystems and human welfare. These conventions are legally binding at the national level and have been integrated into Tanzania's policies, legislation, and institutional frameworks.

The proposed project must therefore be consistent with the principles, objectives, and obligations of these conventions to ensure compliance with international environmental standards and to promote global environmental stewardship.

The key international agreements relevant to this project are summarized below.

2.3.1 Convention on Biological Diversity (CBD)

The Convention on Biological Diversity emphasizes the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from genetic resources. Tanzania ratified the CBD in 1996 and has since developed the National Biodiversity Strategy and Action Plan (NBSAP).

For the proposed project, this convention requires the proponent to;

- Assess potential impacts on species diversity, particularly endemic and migratory species
- Implement biodiversity conservation measures in project design and operation
- Promote community participation in resource management and benefit sharing.

Given that the Lake Natron basin hosts critical habitats for migratory birds, the CBD obligations are central to ensuring that biodiversity values are maintained during and after project implementation.

2.3.2 Equator Principles

The Equator Principles are a voluntary set of guidelines adopted by financial institutions to ensure that projects they finance are developed in a socially responsible and environmentally sustainable

manner. While voluntary, adherence to EPs demonstrates commitment to international environmental and social standards and facilitates access to global financing.

For the Lake Natron project, the EPs require that:

- Environmental and social risks are assessed, mitigated, and managed throughout all project phases;
- Stakeholder engagement, particularly with local communities and Maasai indigenous groups, is transparent and inclusive;
- Impacts on biodiversity, cultural heritage, and community well-being are avoided or minimized;
- Comprehensive Environmental and Social Management Plans (ESMPs) are developed, implemented, and monitored.

2.3.3 United Nations Framework Convention on Climate Change (UNFCCC, 1992)

Tanzania is a Party to the UNFCCC, which seeks to stabilize greenhouse gas concentrations and mitigate human-induced climate change.

The proposed soda ash extraction and processing activities may involve significant energy use and emissions. Therefore, under UNFCCC principles, the project must:

- Adopt energy-efficient technologies
- Implement climate change mitigation and adaptation strategies
- Monitor and report emissions in line with national climate commitments.
- This aligns with the country's efforts to reduce emissions and promote low-carbon industrial development.

2.3.4 International Finance Corporation (IFC) Performance Standards

The IFC Performance Standards provide benchmarks for identifying and managing environmental and social risks. It is the Company's intention to adhere to the IFC Performance Standards, as it is likely that it will approach international lenders as part of its financing arrangements for the Project.

The updated ESIA will therefore be consistent with the eight IFC Performance Standards and associated guidance notes, which together define the optimal environmental, social and health standards to be upheld throughout the life of a project. Specifically, the terrestrial ecology survey will comply with the following Performance Standards:

- IFC Performance Standard 1 (PS1) – Assessment and Management of Environmental and Social Risks and Impacts; and
- IFC Performance Standard 6 (PS6) – Biodiversity Conservation and Sustainable Management of Living Natural Resources. IFC PS6 is the document most pertinent to terrestrial ecology.

In summary, these international conventions establish the broader environmental and ethical obligations under which the Lake Natron Soda Ash Project must operate. Compliance with these agreements not only fulfills Tanzania's international commitments but also enhances the project's environmental credibility and alignment with global sustainability goals.

3 STUDY METHODS

3.1 Study Design

The fauna baseline survey at Lake Natron was designed using a stratified habitat based survey approach, combined with different sampling techniques depending on certain taxa. Proposed infrastructures contained in the study area were also considered in the development of the study methodologies and resource allocation. The design was intended to capture species diversity, abundance and distribution ensuring that all major habitats supporting different fauna groups were sampled. In addition, the design of the technical study methodologies also considered the requirements available in the national and international levels for fauna assessment.

3.2 Sampling Sites and Survey Coverage

The survey of terrestrial fauna species at Lake Natron was conducted across well selected sampling sites to ensure comprehensive spatial coverage of the study area and representation of all major habitat types.

Sampling sites were selected based on habitat representativenes including lake shoreline, riverine areas, open grasslands or woodland patches. Also, areas with known species richness potential were prioritized. Site accessibility and safety were also taken into account minimizing risk to field staff. Sites were distributed to provide uniform coverage across the study area, capturing ecological aspects and human disturbance zones.

The strategic selection of sampling sites and systematic survey coverage provided a strong and representative dataset of fauna species at Lake Natron. The approach ensured spatial and temporal representativeness, captured species-habitat associations, and produced reliable baseline information for impact assessment and mitigation planning in the proposed soda ash project area.

Lake Natron, Longido

Grassland along Lake Natron, Longido

Plate 3.1: Habitats found in the project area during field survey in October 2025.

(Source: MTL Consulting 2025)

3.3 Survey Approach and Methods

3.3.1 Literature Review-Review of Existing Information (desktop work)

This desktop review provides guidance for the design and implementation of the fauna baseline survey at Lake Natron, ensuring alignment with international best practices and lessons learned from similar projects.

Field observations were preceded by review of existing sources of information about the historical biological resources of the project area and the methods used in their assessment. That was then followed by field visits for data collection in pre-determined sampling sites, covering the project area, and the surrounding environment.

Soda ash extraction is commonly associated with alkaline lakes and trona deposits, which often represent ecologically sensitive environments supporting unique species assemblages particularly avifauna such as flamingos, small mammals, and reptiles. Environmental assessments in such contexts typically highlight, high species sensitivity whereby alkaline lakes serve as critical breeding, feeding, and nesting habitats.

Industrial operations can influence both fauna behavior and habitat quality and therefore there is a need for extensive baseline data essential for mitigating project impacts on biodiversity and ecosystem function. The only active known soda ash project in East Africa is Lake Magadi which uses solar evaporation and mechanical recovery.

3.3.2 Field Sampling

Terestrial fauna baseline assesment took place between September 28, 2025, up to October 03, 2025, and the project are of interest was surveyed for various fauna species. The assessment involved transect walks, opportunistic sightings and visual inspections.

To accomplish terrestrial fauna survey, five complimentary data collection techniques were employed:

- Surveys of large mammals and medium sized mammals was undertaken on foot using line transect methods (Western and Grimsdell, 1979);
- Opportunistic recording of mammals (directly and indirectly), birds, reptiles and amphibians was undertaken throughout the fieldwork;
- Surveys of birds along line transects was undertaken (Buckland *et al.,* 2001);
- Timed constrained search (TCS) was utilised to sample amphibians and reptiles; and
- Joint assessment interview with local residents using field guides and their inherent knowledge of the fauna groups.

Details on data collection techniques for each taxon is as presented below:

3.3.3 Fauna Surveys

a) Mammals

A walkthrough of the site was done during the site survey whereby mammal species were identified by visual sightings as well as using track, droppings and roosting sights and available habitat.

Transects were visually scanned for mammals (species and habitat type) on either side of the transect (limited only by visual line of site). In addition, signs such as droppings, footprints, burrows or ground nests; and body remains such as skeletons were scanned for within a fixed width of 2 m on each side of the transect.

b) Birds

A line-transect was established at each survey site and subsequently walked by one observer to note habitat type and avifauna species sighted or heard (Bibby *et al.* 2000; Thomas *et al.* 2010). The starting point was purposively selected, but the direction of navigation was maintained as much as the terrain allowed. Birds considered being of special conservation importance such as threatened according to the international union for conservation of Nature (IUCN) Red List, Palaearctic migrants and those that fall in different CITES categories were given additional attention. The survey also aimed at identifying evidence of breeding and/or roosting sites within the proposed project area, and invasive species. Bird identification was carried out with the aid of Helm Field Guides to Birds of East Africa (Kenya, Tanzania, Uganda, Rwanda and Burundi) (Stevenson and Fanshawe, 2012).

c) Reptiles and Amphibians

An in-depth amphibian surveys requires intense nocturnal surveys throughout the Project footprint. This was beyond the current scope of the assessment, and the area was predominantly surveyed diurnally for potential habitat for the herpetofauna. Direct/opportunistic observations were completed along trails or paths within the Project area. Amphibians and reptile's identification was carried out using the Pocket Guide to the Reptiles and Amphibians of East Africa (Spawls *et al.,* 2006) Joint assessment of Mammals, Birds and Reptiles

3.3.4 Joint Assessment of Mammals, Birds, and Reptiles

Joint assessment with local residents surrounding project area were undertaken using field guides and their inherent knowledge to gain an understanding primarily on species of birds, mammals and herpetofauna known to occur in the area based on their local experience and sightings. The interview stated with;

- Recalling of animals they have been seeing in the area,
- Presence of alien invasive species known to occur in the AOI,
- Identify whether there are potential migratory routes or wildlife corridor; and
- Recognising animals through plates in the field guides.

The respondents were supplied with three field guides, one field guide at a time. The procedure involved going over the field guides, one plate page at a time, starting with the Field Guides to Birds of East Africa (Kenya, Tanzania, Uganda, Rwanda and Burundi) (Stevenson and Fanshawe, 2012), then Field Guide to Mammals of Tanzania (Foley *et al.,* 2014) and finally, Pocket Guide to the Reptiles and Amphibians of East Africa (Spawls *et al.,* 2006). All species identified through this procedure were verified through literature.

3.3.5 Identification of Priority Ecosystem Services in the Project Footprint

In order to identify and assess Priority Ecosystem Services within the project footprint of the proposed Lake Natron Soda Ash Project, different methodology such as field survey and stakeholder's consultation was used which enables the integration of ecological and social data to identify ecosystem services that are both ecologically significant and socio-economically valuable to the local communities. As terrestrial fauna specialist, we focused our interest on fauna species that are used by local communities for example as food, medicine, cultural services, or to be sold or traded; areas in which these resources are concentrated, rarity/abundance, intensity of use and degree of dependency on the resource, and presence of alien invasive species known to occur in the project area.

3.3.6 Habitat mapping and characterization

Habitat mapping and characterisation for the proposed Lake Natron Soda Ash Project involve systematic identification and description of the various ecological habitats found within and around the project footprint. The exercise provides an understanding of key environmental features such as salt crusts, grasslands and freshwater inflows, all of which play crucial roles in maintaining the ecological integrity of Lake Natron.

By understanding the ecological roles of each habitat type can help to propose effective mitigation and conservation measures. Ultimately, detailed habitat mapping and characterisation ensure that resource extraction activities are aligned with biodiversity conservation principles and the sustainable management objectives of Lake Natron's fragile ecosystem.

4 RESULTS AND DISCUSSION

4.1 Fauna Species

The terrestrial fauna groups that were surveyed within and surrounding Lake Natron environs included birds (avifauna), mammals and herpetofauna. The surveys also involved joint assessments with a local community member, direct sightings, and evidence of fauna existence from trampling, trails and droppings within the areas proposed for the Soda ash project and its associated infrastructure including the processing plant and township infrastructures. The following sections describes the results of the fauna surveys.

4.1.1 Mammals

Lake Natron and its surrounding environs host a remarkable diversity of wildlife species adapted to the area's unique saline-alkaline ecosystem and semi-arid conditions. A total of 15 large and medium sized mammal species (Table 4.1 and Plate 4.1) were recorded during the field survey. Mammals were identified through direct sightings, footprints/tracks, through droppings, joint assessment interview as well as through body part remains. Zebra and Grants gazelle were the most recorded species through their droppings and footprints along the shoreline as well as in grassland or scrubland along Lake Natron which then confirm their use of freshwater spring found along Lake Natron.

According to IUCN Red List, out of 15 identified species during the survey five (05) species namely Giraffe (*Giraffa Camelopardalis*), Plains Zebra (*Equus quagga*), Lesser Kudu (*Tragelaphus imberbis*), Gerenuk (*Litocranius walleri*) and Fringe-eared Oryx (*Oryx beisa ssp. callotis*) are being considered as species of conservational importance (Table 4.2).

Table 4.1: Species of medium and large sized mammals as per field surveys (October 2025)

SN	Common name	Scientific name	IUCN status
1	Giraffe	*Giraffa camelopardalis*	VU
2	Kirk's Dik-dik	*Madoqua kirkii*	LC
3	Plains Zebra	*Equus quagga*	NT
4	Grant's Gazelle	*Nanger granti*	LC
5	Common Wildebeest	*Connochaetes taurinus*	LC
6	Lesser kudu	*Tragelaphus imberbis*	NT
7	Thomson's gazelle	*Eudorcas thomsonii*	LC
8	Warthog	*Phacochoerus africanus*	LC
9	Spotted hyena	*Crocuta crocuta*	LC
10	Gerenuk	*Litocranius walleri*	NT
11	Fringe-eared Oryx	*Oryx beisa ssp. callotis*	VU
12	African Savanna Hare	*Lepus victoriae*	LC

SN	Common name	Scientific name	IUCN status
13	Southern African hedgehog	*Atelerix frontalis*	LC
14	Common Genet	*Genetta genetta*	LC
15	African Civet	*Civettictis civetta*	LC
Note: VU = Vulnerable; NT = Near Threatened; LC = Least Concern			

(Source: MTL Consulting, 2025)

Southern African hedgehog

Plains Zebra Carcas

C. Spotted hyena faeces

D. Grant's Gazelle pellets

Plate 4.1: Mammals identified during the field survey in October 2025.

(Source: MTL Consulting 2025)

4.1.2 Birds

Lake Natron is internationally recognized as one of the most important bird areas (IBAs) in East Africa supporting a rich diversity of avifauna adapted to its saline and alkaline environment. The lake is best known as the world's main breeding site for the Lesser Flamingo. During the breeding season, hundreds of thousands of flamingos congregate on the shallow mudflats, feeding primarily on cyanobacteria (*Spirulina platensis*).

In total the survey revealed 76 species of avifauna (Appendix A) composed of two near threatened (NT) species Lesser Flamingo - *Phoeniconaias minor* and Kori Bustard - *Ardeotis kori*; one endangered (EN) species Steppe eagle - *Aquila nipalensis*; and *one Vulnerable (VU) species* Tawny Eagle - *Aquila rapax*, but none of them was considered invasive. Lake Natron and nearby habitats support numerous waterbird and migratory species making it an important stopover for migrant's avifauna. Moreover, 26 species were of different migration type (**Error! Reference source not found.**).

Table 4.2: Migratory bird species recorded in October 2025

S/N	Order	Family	English Name	*Scientific Name*	IUCN Status	Migration type
1	Phoenicopteriformes	Phoenicopteridae	Greater Flamingo	Phoenicopterus roseus	LC	Nomadic migrant
2	Phoenicopteriformes	Phoenicopteridae	Lesser Flamingo	*Phoeniconaias minor*	**NT**	Nomadic migrant
3	Pelecaniformes	Ardeidae	Grey Heron	*Ardea cinerea*	LC	Palearctic Migrant
4	Pelecaniformes	Ardeidae	Intermediate Egret	*Ardea intermedia*	LC	Partial Migrant
5	Pelecaniformes	Ardeidae	Little Egret	*Egretta garzetta*	LC	Partial Migrant
6	Pelecaniformes	Ardeidae	Cattle Egret	*Bubulcus ibis*	LC	Partial Migrant
7	Pelecaniformes	Threskiornithidae	Sacred Ibis	*Threskiornis aethiopicus*	LC	Intra-African Migrant
8	Anseriformes	Anatidae	Spur-winged Goose	*Plectropterus gambensis*	LC	Nomadic migrant
9	Anseriformes	Anatidae	Cape Teal	*Anas capensis*	LC	Nomadic migrant
10	Podicipediformes	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	LC	Palearctic Migrant
11	Columbiformes	Columbidae	Laughing Dove	*Spilopelia senegalensis*	LC	Nomadic migrant
12	Columbiformes	Columbidae	Emerald-spotted Wood Dove	*Turtur chalcospilos*	LC	Nomadic migrant
13	Columbiformes	Columbidae	Red-eyed Dove	*Streptopelia semitorquata*	LC	Nomadic migrant
14	Columbiformes	Columbidae	Ring-necked Dove	*Streptopelia capicola*	LC	Nomadic migrant
15	Columbiformes	Columbidae	Namaqua Dove	*Oena capensis*	LC	Nomadic migrant
16	Cuculiformes	Cuculidae	Diederik Cuckoo	*Chrysococcyx caprius*	LC	Partial Migrant
17	Charadriiformes	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	LC	Partial Migrant

S/N	Order	Family	English Name	*Scientific Name*	IUCN Status	Migration type
18	Charadriiformes	Charadriidae	Common Ringed Plover	*Charadrius hiaticula*	LC	Palearctic Migrant
19	Charadriiformes	Scolopacidae	Little Stint	*Calidris minuta*	LC	Palearctic Migrant
20	Charadriiformes	Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	LC	Palearctic Migrant
21	Ciconiiformes	Ciconiidae	Abdim's Stork	*Ciconia abdimii*	LC	Intra-African Migrant
22	Ciconiiformes	Ciconiidae	Black Stork	*Ciconia nigra*	LC	Palearctic Migrant
23	Accipitriformes	Accipitridae	Tawny Eagle	*Aquila rapax*	**VU**	Nomadic migrant
24	Accipitriformes	Accipitridae	Steppe eagle	*Aquila nipalensis*	**EN**	Palearctic Migrant
25	Coraciiformes	Alcedinidae	Grey-headed Kingfisher	*Halcyon leucocephala*	LC	Intra-African Migrant
26	Passeriformes	Hirundinidae	Barn Swallow	*Hirundo rustica*	LC	Palearctic Migrant
Note: EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern						

(Source: MTL Consulting, 2025)

4.1.3 Reptiles and Amphibians

There was no herpetofauna recorded either seen or heard during the field survey in Lake Natron core area and this can be accounted by the Lake Natron's extreme saline and alkaline waters which may limit the occurrence of true aquatic amphibians within the lake itself.

During the joint assessment interview with locals, they identified three (03) amphibian's species which are known to occur in the surrounding environment especially in seasonal streams, temporary pools formed during the rainy season and freshwater springs along the lake margins.

Additionally, seven (07) reptile's species were identified during joint assessment interview (Table 4.3). None of them is of conservation significance.

Table 4.3: Reptiles and Amphibians identified during interview in October 2025

SN	Common name	Scientific name	IUCN status
1	Guttural Toad	*Sclerophrys gutturalis*	LC
2	Parker's Toad	*Poyntonophrynus parkeri*	LC
3	Senegal Land Frog	*Kassina senegalensis*	LC
4	Red spitting Cobra	*Naja pallida*	LC
5	Link-marked Sand Snake	*Psammophis biseriatus*	LC
6	Red-spotted Beaked Snake	*Rhamphiophis rubropunctatus*	LC
7	Speckle-lipped Mabuya	*Trachylepis maculilabris*	LC
8	Spotted Bush Snake	*Philothamnus semivariegatus*	LC
9	Rhombic Egg Eater	*Dasypeltis scabra*	LC
10	Puff Adder	*Bitis arietans*	LC
Note: LC = Least Concern			

(Source: MTL Consulting, 2025)

4.2 Fauna species of Conservation concern

None of the terrestrial fauna species recorded during October 2025 survey are categorised as rare, endemic or critically endangered. However, nine (09) species including four (04) avifauna and five (05) large mammals are considered species of conservation significance according to IUCN red list.

- Avifauna: Two near threatened (NT) species Lesser Flamingo - *Phoeniconaias minor* and Kori Bustard - *Ardeotis kori*; one endangered (EN) species Steppe eagle - *Aquila nipalensis*; and one Vulnerable (VU) species Tawny Eagle - *Aquila rapax,*
- Mammals: Three near threatened species Plains Zebra (*Equus quagga*), Lesser Kudu (*Tragelaphus imberbis*) and Gerenuk (*Litocranius walleri*); two Vulnerable Species Giraffe (*Giraffa Camelopardalis*) and Fringe-eared Oryx (*Oryx beisa ssp. callotis*)

4.3 Priority Wildlife Resources and Ecosystem Services in the Project Footprint

The Lake Natron area represents one of the most ecologically significant landscapes in northern Tanzania, hosting important wildlife populations and ecosystem functions. The most critical wildlife resource is the Lesser Flamingo (*Phoeniconaias minor*) which relies exclusively on Lake Natron as its sole regular breeding site in East Africa. The lake's salinity conditions dominated by Spirulina algae provide both food and a natural barrier against predators which then creating a safe breeding environment. Other notable avifauna resources include the Greater Flamingo (*Phoenicopterus roseus*), Pied avocet (*Recurvirostra avosetta*) and Chestnut-banded Plover (*Charadrius pallidus*) all of which depend on the lake natron for foraging and nesting.

In the terrestrial habitats surrounding the lake environment, wildlife species such as Grant's gazelle, zebra, giraffe, lesser kudu and hyena form essential parts of the ecosystem and maintain ecological connectivity with nearby conservation areas such as the Lake Natron Game Controlled Area.

The ecosystem services provided by the Lake Natron are equally valuable, supporting both ecological integrity and local livelihoods. Key provisioning services include freshwater from inflowing streams and springs, grazing lands and seasonal forage for pastoral communities as well as usage of salt deposits by locals. Regulating services involve microclimate regulation and soil stabilization by grassland. Additionally, cultural services are significant as Lake Natron is not only a Ramsar Site but also a center for eco-tourism, traditional knowledge and spiritual value to local Maasai communities (Plate 4.2).

Salt extracted from Lake Natron to be used by locals

Livestock grazing along Lake Natron

Plate 4.2: Ecosystem services found in Lake Natron during the field survey

(Source: MTL Consulting 2025)

4.4 Critical Habitat Assessment

A Critical Habitat Assessment (CHA) is an essential component of environmental and biodiversity management for projects located within or near sensitive ecosystems. The proposed Lake Natron Soda Ash Project lies within a globally recognized biodiversity hotspot requiring a comprehensive evaluation of habitats that are vital for maintaining species of global, national or regional conservation concern. The CHA follows the principles outlined in the International Finance Corporation (IFC) Performance Standard 6 (PS6) and the Equator Principles, which require the identification, protection and sustainable management of critical habitats before project implementation.

According to IFC PS6, critical habitat refers to areas with high biodiversity value, including:

- Habitats supporting globally or regionally significant concentrations of threatened species.
- Endemic or restricted range species habitats.
- Key biodiversity areas (KBAs), including protected or internationally recognized conservation sites.
- Habitats supporting unique assemblages or ecological processes essential for ecosystem functioning.
- Areas providing vital ecosystem services for human well-being and biodiversity persistence.

Portions of the Lake Natron project area qualify as Critical Habitat under IFC due to the presence of globally significant species and vital ecological functions due to being the only regular breeding site for the Lesser Flamingo (*Phoeniconaias minor*) in East Africa. Freshwater inflows and springs provide essential freshwater inflows maintaining the lake's ecological balance and these areas host amphibians and macroinvertebrates which then forms important microhabitats for biodiversity. Meanwhile the surrounding environment serves as buffer ecosystems mitigating dust, erosion and nutrient flows into the lake system.

4.5 Study Limitations

The major limitation associated with the sampling approach is the narrow time-based window of sampling. Ideally, a site should be visited several times to ensure a comprehensive fauna species list.

5 POTENTIAL IMPACT OF THE PROJECT ACTIVITIES ON FAUNA AND POTENTIAL MITIGATION MEASURES

5.1 Potential Impact of Project Activities on Fauna

The proposed soda ash extraction and processing project could potentially alter habitats, water systems and ecological dynamics that sustain diverse groups of mammals, birds, reptiles, amphibians and invertebrates that are ecologically adapted to the Lake Natron saline and surrounding environment. The potential impacts can be categorized based on the project's life cycle starting from construction, operation and cumulative effects with emphasis on both direct and indirect impacts.

5.1.1 Construction Phase Impacts

During the construction phase, activities such as site clearing, establishment of processing facilities and infrastructure development are likely to cause habitat loss and fragmentation. The removal of vegetation and surface disturbance will displace terrestrial fauna such as zebras, Grant's gazelles, lesser kudus and smaller mammals.

Heavy machinery operations and increased human presence are expected to generate noise, vibrations and artificial light which can disturb wildlife, especially nocturnal and migratory species. Disturbance may trigger avoidance behavior or displacement of animals from their preferred habitats. Furthermore, accidental wildlife mortality may occur due to vehicle collisions, particularly along newly constructed access roads that intersect wildlife movement corridors.

5.1.2 Operational Phase Impacts

The operation phase involves continuous extraction, processing, and transportation of soda ash, which may impose long-term ecological pressures. The most significant concern even posed in the previous IUCN comment relates to hydrological alterations caused by water abstraction from inflowing river and springs. Reduction in freshwater inflow due to processing and township usage could increase lake salinity beyond the tolerance limits for *Spirulina platensis* which is the cyanobacteria that form the main diet of Lesser Flamingos. This would lead to declines in food availability and flamingo population sustainability.

Additionally, uncontrolled emissions and effluents from processing activities could cause pollution, leading to contamination of aquatic habitats as a result amphibians and reptiles would be particularly vulnerable to such pollutants. Continuous noise and lighting at the plant site may disrupt breeding cycles and feeding behavior of birds and other nocturnal fauna.

5.1.3 Cumulative and Indirect Impacts

Beyond the direct construction and operational effects, the soda ash project may cause broader cumulative impacts when combined with land-use changes like expanding livestock grazing, road construction and settlements in the Lake Natron basin. These pressures can fragment wildlife corridors linking the lake to surrounding conservation areas. Indirectly, reduced water availability and vegetation loss may disrupt ecosystem functions, lowering faunal diversity and resilience.

Without maintaining ecological connectivity, the long-term declines of key species such as the Lesser Flamingo will have significant impacts on ecological, cultural and tourism.

5.2 Potential Mitigation Measures of each identified potential impact

5.2.1 Habitat Loss and Fragmentation

Activity: Land clearing, road construction and facility establishment may lead to loss and fragmentation of terrestrial habitats critical to fauna.

Mitigation Measures

- To avoid construction of the project facilities within sensitive zones used by lesser flamingo and a perfect project layout must be designed to minimize the project footprint.
- Implement progressive rehabilitation and re-vegetation of disturbed sites using native plant species.
- Prohibit off-road vehicle movement and unnecessary vegetation clearing.

5.2.2 Disturbance from noise, light and human activity

Activity: Increased noise, vibration and artificial lighting during construction and operation may disturb wildlife breeding, feeding and migratory behavior.

Mitigation Measures

- Restrict construction activities to daylight hours near sensitive fauna habitats.
- Use of low-intensity bulbs to reduce light pollution, especially near flamingo breeding zones.
- Enforce buffer zones and exclusion areas where human access is restricted during critical breeding seasons.
- Provide awareness training to workers on wildlife sensitivity and behavior near fauna habitats.

5.2.3 Hydrological alteration and water usage

Activity: Use or diversion of freshwater from the stream/river for processing and township use may alter the lake's hydrological balance, affecting salinity, aquatic habitats and food availability for flamingos and amphibians.

Mitigation Measures

- Limit water usage from the river to sustainable levels as approved by relevant water authorities.
- Develop and implement a Water Management Plan to monitor water usage in the project facilities and water inflow into the Lake Natron.
- Prioritize water recycling and reuse within project infrastructure facilities.

5.2.4 Pollution and contamination risks

Activity: Waste discharge, dust and chemical spillage from construction and processing may contaminate soil and water which may threatening aquatic and terrestrial fauna.

Mitigation Measures

- Construct and maintain lined waste containment systems to prevent seepage and install proper wastewater treatment systems before discharge.
- Ensure regular monitoring of surface and groundwater quality for early detection of contamination.
- Enforce strict waste handling, storage and disposal practices consistent with national and IFC standards.

5.2.5 Loss of ecological connectivity and corridor function

Activity: Project infrastructure development activities may block wildlife routes and reduce ecological connectivity between Lake Natron and other surrounding ecosystems

Mitigation Measures

- Identify and map wildlife routes prior to construction and always maintain vegetative cover
- Monitor wildlife movement patterns through ecological surveys and adjust mitigation measures as needed.

The project proponent should establish long-term biodiversity monitoring programs for indicator species such as the Lesser Flamingo and always maintain the collaboration with other stakeholders such as NEMC, TAWIRI, TAWA, WWF and Nature Tanzania to implement and integrate project actions. Also, the project owner should conduct periodic Environmental Audits to ensure compliance and adaptive management.

5.3 Mitigation Measures for Sustainable Management of Priority Wildlife Resources and Ecosystem Services in the Project Footprint

The under mentioned measures may help to ensure ecosystem functioning and dynamics in the project area:

- Entry into the project area for various reasons should be regulated through entry permit.
- Protect springs and inflowing river from pollution, sedimentation and encroachment
- Treat effluent and runoff before discharge into natural systems to prevent contamination.
- Implement species specific measures for flagship fauna particularly Lesser Flamingos to safeguard breeding success.
- Support traditional pastoralist practices that are compatible with wildlife conservation such as rotational grazing.

- In addition, the project should promote eco-tourism opportunities linked to flamingo breeding and conservation to create incentives for protection.

6 FAUNA MANAGEMENT PLAN

The Lake Natron ecosystem supports globally significant fauna, including the Lesser Flamingo (*Phoeniconaias minor*), migratory birds, mammals, reptiles, and amphibians. The proposed soda ash project may impact fauna through habitat alteration, disturbance, pollution and hydrological changes. The Fauna Management Plan (FMP) (Table 6.1) provides a framework to conserve biodiversity, maintain ecological functions and ensure sustainable coexistence of project activities with wildlife.

The objectives of the FMP may include, to minimize negative impacts of project activities on fauna populations and habitats; to maintain ecological connectivity and critical habitats; to monitor and manage species of conservation concern; and integrating adaptive management, stakeholder engagement and community participation.

The FMP applies to all project phases: pre-construction, construction, operation and decommissioning, covering:

- Terrestrial fauna (mammals, reptiles, amphibians, invertebrates)
- Avifauna (resident and migratory birds)
- Aquatic fauna in inflows and the lake
- Ecosystem services supporting wildlife, such as wetlands, woodlands, and grasslands

Mitigation measures should be built into the base of the project and should be considered as part of the “pre-mitigation” scenario; and additional mitigations must be recommended if the impact assessment indicates it necessary.

It is also imperative that the plan utilizes the following documentation including register and catalogues for efficient and effective mitigation outcomes:

- Detailed designed datasheets for recording information including incidents, fatalities and sightings as part of the monitoring of the terrestrial fauna taxa;
- Up to date rehabilitation plan;
- Speed limit signage;
- Up to date register of monitoring data on migratory species, roosting/congregatory sites, dispersal routes; and
- An updated alien invasive site map.

The Fauna Management Plan ensures that the Soda Ash Project balances development with biodiversity conservation. Through habitat protection, species-specific measures, pollution control, connectivity maintenance, monitoring, and adaptive management, priority wildlife resources and ecosystem services are safeguarded, maintaining the ecological integrity and global significance of Lake Natron.

Table 6.2 describes key elements of the Fauna Management Plan that are to be monitored throughout the project cycle.

Table 6.1: Fauna Management Plan

Phase	Interaction	Impact	Mitigation Measures	Period for Implementation	Responsible	Management Cost (USD)
Construction Phase	Site clearing, i.e., removal of vegetation and topsoil, and the construction of the new infrastructure; General construction activities involving: • Vehicles and heavy machinery movement; and • Waste management activities, including handling of waste material and disposal of waste material	• Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material, and increased erosion potential; • Displacement of fauna, such as invertebrates, birds, and mammals; • Fragmentation of terrestrial habitat affecting wildlife movements; • Impairement of ecosystem services.	• Avoid construction in critical habitat and the area of clearance must be clearly demarcated. This must be limited to the required footprint to avoid unnecessary clearing of vegetation. Fragmented areas requiring rehabilitation should be vegetated with suitable native plant species preferably with economic value (where possible) as determined by a qualified botanist • Establish a permit system to clear vegetation as an authorization process that has to be approved by the Environmental Department before any land clearance is done • Large trees that can be left in-situ should be avoided and maintained where possible; • The impact of loss of biodiversity must be managed in accordance with the established Biodiversity Action Plan (BAP); • Undertake progressive rehabilitation of disturbed areas that will in future ensure ecosystem resilience; • Undertake re-vegetation assessment study on regular basis to check the extent of land rehabilitation and rate ecosystem restoration in relation to the natural environment. This is suggested to be implemented during operation stage; • Whilst the removal of vegetation is underway, key monitoring methods should be focused on the prevention of proliferation of dust emissions and spread during the construction and operational phase. • Wherever possible, surface infrastructure and vehicle movement should be placed outside key ecological areas to prevent impacts such as contamination, erosion and sedimentation; • Areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorized vehicles and personnel;	Life of Construction Phase	• WWSL	• 3000
Operational Phase	• General operational activities including use and maintenance of dredging machinery used in extraction also during operational may involve storage and handling of equipments used in trona extraction • Emmision and effluent from processing activities may cause chemical pollution	• Increased vehicle movement in the area, during operation may increases the risk of faunal casualties due to road kill; • Increased erosion, runoff and compaction of soil and consequently sedimentation potential in key ecological areas; • Changes to the landscape with subsequent removal of floral and faunal habitats and a decrease in biodiversity as result of species loss (faunal and floral);	• All bare patches of soil to be vegetated, preferably with native grass species which will colonize open and disturbed patches quickly; • Implement concurrent rehabilitation and restoration of all sensitive environment, wetlands and priority ecosystem service areas and affected erosion sites; • No material may be dumped or stockpiled within any biodiversity sensitive areas; and • Undertake progressive rehabilitation activities • Treat effluent; dust suppression; spill prevention; proper waste management.	• Life of Operational Phase	• WWSL	• 3000

Phase	Interaction	Impact	Mitigation Measures	Period for Implementation	Responsible	Management Cost (USD)
Decommissioning and Rehabilitation	• Demolition and removal of infrastructure; and • Post-closure monitoring and rehabilitation.	• Increasing the risk of faunal casualties due to road kill during closure activities; • Changes to the landscape with subsequent removal of faunal habitats and a decrease in biodiversity (faunal and floral);	• Rehabilitation to be conducted dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation which may impact Lake Natron; • Address compacted areas by profiling and revegetating the area; • The reprofiled landscape to be topsoiled and revegetated to allow free drainage close to the conditions it was prior operational activities; • All existing litter/debris to be removed from the lake offshore/wetland areas and littering to be prohibited on an on-going basis; and • All chemical and hydrocarbon spills to be immediately cleaned up and treated accordingly • Compare with baseline data to confirm restoration success	• Life of Decommissioning and Rehabilitation Phase	• WWSL	• 3000

(Source: MTL Consulting, 2025)

Table 6.2: Terestrial fauna monitoring element, rationale for monitoring, frequency of monitoring and accountable

Monitoring Element	Comment	Frequency	Responsibility
Alien Invasive Management	During the operational phase the presence of Alien invasive species should be detected and monitored every six (6) months. An active programme to control presence and spread of feral animals and alien invasives will need to be instituted so that they are controlled by means appropriate to the species. This can be performed for the entire life of the project and five years after rehabilitation.	Annually during the wet season for the first five years after rehabilitation.	WWSL
Red Data listed fauna	All protected and Red Data terrestrial fauna species must be identified and their sites geo-referenced prior to any construction takes place.	Monitored at least once in 6 months from rehabilitation	WWSL
Fauna biodiversity	This will be closely linked to main habitats/vegetation types to enable scientific conclusions and comparisons. To successfully monitor faunal biodiversity, a solid baseline data (pre-construction) will be established through the first round of fauna assessment of the area. This needs to be supplemented with regular repeats to compile a reasonable comparison between the pre-construction faunal communities present and faunal communities found in the same areas during various stages of construction and operation of the proposed project. It is recommended that this monitoring be carried out throughout the project cycle.	Monitored every 6 months from rehabilitation	WWSL

(Source: MTL Consulting, 2025)

7 MONITORING PROGRAMME AND EVALUATION

The findings of the monitoring studies will help in determining if the existing mitigations are sufficient to minimize the impacts or if additional mitigation measures should be implemented. This process is intended as an adaptive management system, so the mitigation and management approach will be adapted based on any new findings which could arise from the monitoring program. The proposed approach, indicators, measurements and extent of monitoring are presented below:

7.1 Monitoring Procedures

The Woswosi Soda Limited should establish, implement and maintain the terrestrial ecology monitoring plan for the project to ensure proper implementation and effectiveness of mitigation measures. More specifically monitoring will aim at:

- Ensuring that the magnitude of impacts and sensitivity of receptors are verified regularly in order to rapidly adapt the management plan;
- Determining if the environmental, social and community health changes that are observed to be occurring are attributable to project activities or are the result of other activities or natural variation; and
- Adopting a continual review and improvement in Project design and execution.

7.2 Indicators, Measurements, and Monitoring Extent

The indicators presented in the terrestrial ecology monitoring approach should be used to monitor the project effects on biodiversity. Applying indicators is an approach to offset budgets and outcomes, and such indicators need to be selected very smart. Biodiversity indicators in this report are also sufficiently sensitive to provide an indication of changes prior to irreversible damage happening. These indicators serve to indicate/signify where no significant change is occurring, and also where the threshold between insignificant and significant change lies.

Three types of indicators and Guidelines on Biodiversity Monitoring have been suggested to monitor effectiveness of mitigation measures (Table 7.1)

Table 7.1: Types of Indicators and measurements for monitoring

Monitoring Component	Key Indicators	Measurement / Method	Monitoring frequency	Responsible
Avifauna (Birds)	Population trends of Lesser Flamingo and other key bird species	Ground and aerial counts Photographic surveys Observation of breeding colonies	Monthly during breeding season Entire lake margin and adjacent wetlands	WWSL
Terrestrial Mammals	Species presence and abundance Movement corridors	Transect surveys Incident reporting via community liaison	Quarterly	WWSL

Monitoring Component	Key Indicators	Measurement / Method	Monitoring frequency	Responsible
Herpetofauna (Reptiles & Amphibians)	Species diversity and abundance	Visual encounter surveys Pitfall traps and night searches	Biannual (wet and dry seasons)	WWSL
Noise and Light Disturbance	Noise level (dB) and artificial light intensity	Portable sound meters and lux meters Night-time observation of fauna response	Weekly (during construction), Quarterly (during operation)	WWSL
Rehabilitation and Restoration	Fauna recolonization	Field surveys	Biannually (post-construction and decommissioning phase)	WWSL

(Source: MTL Consulting, 2025)

7.3 Evaluation and Reporting

The evaluation and reporting of the monitoring programme will be on-going as follows:

- **Daily:** General fauna monitoring, and reporting of incidents impacting biodiversity and emergency response;
- **Monthly:** Compilation of monitoring progress, environmental training delivered, details on any major incidents/events, general progress of the monitoring program;
- **Quarterly:** Summary report on quarterly biodiversity monitoring programs, review quarterly performance and apply adaptive management if required; and
- **Annual:** Review annual biodiversity monitoring program, prepare annual report to include evaluation results for the year against targets and biodiversity objectives.

The baseline data collected as part of biodiversity surveys will serve to assess Project impacts and efficiency of mitigation measures, as well as biodiversity gain and loss.

7.4 Proposed fauna monitoring locations

Fauna monitoring for the Lake Natron Soda Ash Project aims to track changes in wildlife populations, habitat condition and ecosystem health across the project footprint and surrounding landscapes. Monitoring locations have been strategically selected to represent the diversity of habitats found in the area, including the lake's saline flats, freshwater inflows and human settlement zones. Suggested key monitoring sites include; Lake Natron shoreline in Wosiwosi village, Engaresero wetlands and Ngarenyuki stream (Ewasongiro) which is the main river that flows in Lake Natron. These areas will be closely monitored for population trends, nesting success, hydrological changes, and vegetation cover to ensure that critical habitats remain functional.

Additional monitoring locations can be in project processing site and nearby villages such as Engaresero and Pinyinyi which can experience fauna displacement, noise impacts and pollution

risks from project operations. A five-kilometer buffer zone will serve as a reference area for comparison with impacted sites.

8 ADDRESING COMMENTS FROM PREVIOUS TECHNICAL REVIEW OF THE ES AND RISK MANAGEMENT PLAN FOR THE PROPOSED SODA ASH MINING IN LAKE NATRON RAMSAR SITE.

Woswosi Soda Limited contacted Nature Tanzania to review their previous Environmental Statement (ES) and Risk Management Plan for the proposed soda ash project at Lake Natron. Below is detailed response addressing some highlighted comments particulary concerning Lesser Flamingo ecology in Lake Natron:

8.1 Comparative analysis between Lake Magadi and Lake Natron soda ash project

Lake Magadi is one of the most saline and smallest, alkaline lake in the Rift Valley. The project facility is owned and operated by Tata Chemicals Magadi Ltd and produces around 350,000 tonnes/year. Lake Magadi represents a mature, industrially adapted soda ash operation in a naturally hypersaline environment with moderate ecological sensitivity. Lake Magadi receives limited inflows (closed basin) from temporary streams hence its water is highly saline and alkaline. These extreme chemical conditions limit the growth of *Spirulina platensis* (the blue-green algae that forms the main food of Lesser Flamingos). As a result, Lake Magadi does not host significant flamingo breeding or feeding activity. Only small numbers of flamingos visit occasionally when conditions allow for temporary algal growth in less saline pools or during rainy seasons.

In contrast, hydrogeology of Lake Natron is more complex than that of Lake Magadi. Lake Natron is ecologically pristine and globally significant, particularly as the only breeding site of the Lesser Flamingo in East Africa. The lake is fed mainly by Ewasong'iro river whereby the intermittent inflows maintain hypersaline conditions but with fresher spring zones. Its mix of saline and fresh inflows (from the Ewaso Ng'iro and Engare Sero rivers) creates microhabitats where *Spirulina* flourishes in high productivity.

Therefore, while both lakes are saline basins within the Rift Valley and host soda ash resources, Lake Natron's ecological value and fragility make it a far more sensitive and conservation critical site than Lake Magadi. Sustainable management, strict monitoring and alternative extraction technologies would be essential to avoid irreversible impacts.

8.2 Main breeding sites for Lesser Flamingo in Lake Natron

During joint assessment interview conducted in Wosiwosi, Pinyinyi and Magadini village, it highlighted that the locals are aware about the breeding sites for Lesser flamingo though they don't know exact location. According to literature review, the main breeding areas for Lesser Flamingos in Lake Natron are located on the central and northeastern parts of the lake, where the soda crust islands and shallow saline flats form naturally isolated and predator-free nesting grounds

8.2.1 Central Soda Islands (Mid lake region)

These are raised soda crust platforms that emerge during the dry season (July–October) as lake levels drop which then creates the islands isolation by hypersaline water offers protection from terrestrial predators such as hyenas. This is where most large breeding colonies (up to 1 million birds) are concentrated during favorable years. The main breeding area falls within Pinyinyi Ward.

8.2.2 Northeastern lake surfaces

Located near the inflow of the Ewaso Ng'iro River, this area maintains a balance between freshwater input and saline concentration, supporting dense blooms of *Spirulina platensis* which is the main food for flamingos. Presence of shallow, warm waters encourage algal productivity, ensuring adequate food supply for both adults and chicks lesser flamingo. The area falls within Pinyinyi and Engaresero Wards

8.2.3 Eastern Shoreline

Most of the eastern shoreline falls within Engaresero and these areas serve as pre-breeding congregation and feeding zones, where adults feed and prepare before moving to nesting sites. They also function as chick-rearing zones once chicks begin to forage independently in shallower waters.

8.2.4 Southern shoreline

The area within Engaresero and Magadini Villages acts as seasonal feeding areas during water level fluctuations whereby seasonal algal mats form here.

8.2.5 Proposed site for the development of soda ash project facilities

While Wosiwosi Village lies within the Lake Natron Basin, it is not part of the main Lesser Flamingo breeding zones, which are located toward the central and northeastern soda islands of the lake. From an ecological viewpoint, this position offers certain advantages for minimizing direct disturbance to the critical breeding habitats of flamingos. The Wosiwosi area is located on the northwestern periphery of Lake Natron and is characterized by relatively stable ground conditions, lower salinity levels and proximity to permanent freshwater sources, making it more suitable for infrastructure development such as processing facilities, staff housing, or access routes compared to the fragile saline flats where flamingos' nest.

However, although Wosiwosi is outside the core nesting zones, it still lies within the ecological influence area of the lake's hydrological and biological systems. Activities in Wosiwosi particularly those involving water abstraction, construction runoff, or increased human and livestock movement could indirectly affect water quality and ecological balance especially in the northeastern breeding flats. Therefore, site selection in Wosiwosi should be accompanied by strict environmental safeguards, including:

- Water use and waste management control to prevent pollution of inflow streams.
- Maintenance of ecological corridors between Wosiwosi and the main lake wetlands.
- Regular ecological monitoring of hydrological and wildlife indicators.

As stated above, the suitable breeding areas lies in areas with freshwater springs where there is a mix of saline and fresh inflows which creates microhabitats where *Spirulina* thrives in high productivity. The selected site was observed to have low concentration of flamingo as on the selected site there was no any streams or freshwater springs which may support production of *Spirulina* algae which is the main food for Lesser flamingo.

The proposed project will involve extracting trona from Lake Natron using initial two dredges that will be located within the lake at a distance almost between 1.74km and 3.64km to the shoreline, transporting it as a slurry to a processing plant that will be located almost 2.84km from the shoreline, and then processing it by crushing, washing, and centrifuging to remove impurities.

Selecting Wosiwosi as a potential project development site represents a rational balance between ecological protection and logistical feasibility, but it demands strong environmental controls and ongoing biodiversity monitoring to ensure the integrity of Lake Natron's unique flamingo breeding ecosystem remains uncompromised.

Plate 8.1: Proposed project site location for production of soda ash

(Source: MTL Consulting, 2025)

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

The proposed Lake Natron Soda Ash Project is technically and economically feasible, with favorable mineral deposits and accessible terrain in peripheral areas such as Wosiwosi and Engaresero. However, Lake Natron's global significance as the only regular breeding site for the Lesser Flamingo demands exceptional environmental diligence. Project operations must therefore uphold ecosystem integrity, ensuring minimal disruption to the lake's hydrology, habitats, and wildlife. Key considerations include implementing strict environmental management plans, fauna and water quality monitoring and community inclusive governance frameworks that align with national policies and international standards such as the IFC Performance Standards and Equator Principles.

Ultimately, the project's success depends on adopting a balanced approach that integrates economic gain with ecological stewardship, ensuring Lake Natron remains both a center of sustainable development and a refuge for biodiversity.

9.2 Recommendations

The following recommendations are set forth as means to mitigate the potential causes of biodiversity loss and health hazards to local community within the Project Area of Influence as follows:

(i) Establish a comprehensive fauna monitoring program to track species trends in abundance and diversity, especially flamingos. This will help to correct the situation before it is too late;

(ii) Rehabilitation of disturbed sites should be implemented to reduce extent of disturbed habitats during the project lifecycle. Whenever vegetation is cleared for construction, the top soil should be removed carefully and well preserved according to technicalities that favour top soils biological activity including seed bank to perpetuate for re-use during rehabilitation operations. If possible, the project, through its Environment Department, should establish a tree nursery of indigenous trees for planting in areas to be rehabilitated such as waste rock dump sites, bare areas that will not be mined as well as areas no longer been mined;

(iii) Integrate climate change adaptation measures through design project infrastructure to withstand flooding and extreme temperature fluctuations.

(iv) Indigenous tree species should be planted alongside roads and around buildings to prevent dust caused by vehicle movement from affecting humans and wildlife;

(v) The administrative part of the project should have, among the departments, an Environmental Department, which will ensure that national and international standards of project operations are abided by;

(vi) Speed limits within the project site to be enforced on the strict basis for general safety, and to minimize the incidences of road kills;

(vii) Night driving on the mine site needs to be restricted to essential activities;

(viii) Awareness programmes need to be implemented to highlight the importance of wildlife and general biodiversity to staff and contractors on the project site. The importance of biodiversity and penalties associated with unnecessary destruction need to be incorporated into site induction programmes;

(ix) The IFC standards require that a development demonstrates no net loss of biodiversity. This can be achieved through maintaining an on-going register of animals seen in the project area and its surrounding environments. The register should include date seen, species/ animal group, locality, group size and name of the observer. Staff and contractors should be encouraged to report sightings;

(x) Selected members of the staff team need to be trained and equipped to handle venomous snakes and other dangerous animals, and available on call during project operating hours. Animals presenting a risk to project activities need to be trans-located to nearby areas instead of being killed. Records be kept on where such animals are shifted to together with photographs from which the correct identification is verified by appropriate specialists;

(xi) Local community should be given employment priority especially for non-skilled labour to ensure good cooperation between the project and neighbouring community.

Based on the baseline information, and impact assessment significance ratings, it is the opinion of the specialist that this Project is feasible with consideration of the highlighted mitigation measures not to harm unique biodiversity hotspot for Lesser Flamingo. The Project may potentially inflict irreversible damage to natural habitats of protected fauna species; however, it is highly recommended that concurrent rehabilitation, management, and mitigation measures are correctly implemented to minimise all potential impacts on overall terrestrial and aquatic biota.

REFERENCES

IFC 2012a. *Performance Standards on Environmental and Social Sustainability*. International Finance Corporation, World Bank Group, January 1, 2012. Available at: www.ifc.org/policyreview.

IUCN 2025. The IUCN Red List of Threatened Species. Version 2025-2. <https://www.iucnredlist.org> (Accessed: October 2025).

Kahurananga, J., & Nzunda, E. (1978). The breeding of the Lesser Flamingo (Phoeniconaias minor) on Lake Natron, Tanzania, in 1974. East African Wildlife Journal, 16(1), 1–8. https://doi.org/10.1111/j.1365-2028.1978.tb00211.x

Kingdon, J. (2012). *The Kingdon Field Guide to African Mammals*. Bloomsbury Publishing, London.

Meffe G.K., Nielsen, L.A., Knight, R.L., Schenborn, D.A., 2002. Ecosystem Management: Adaptive, Community-Based Conservation. Island Press, Washington, DC.

Rajpurohit, K. S., & Sridhar, S. (2020). Comparative assessment of soda ash exploitation potential in East African saline lakes: Lessons from Lake Magadi and implications for Lake Natron. African Journal of Environmental Science and Technology, 14(3), 92–104.

Reuben M. J. Kadigi, Ken M., Adam D., Japhet K., Freddy K., (2014). Soda Ash Mining in Lake Natron: A Reap or Ruin for Tanzania?

Rich, M., & Thompson, C. (2018). Relative Importance of Habitat Characteristics and Interspecific Relations in Determining Terrestrial Carnivore Occurrence. *Frontiers in Ecology Evolutuion.*

Stephen S., Howell K., Drewes., 2006. "A Field Guide to the Reptiles of East Africa" Princeton University Press

Spawls, S., Howell, K.M. and Drewes, R.C. (2006). Pocket Guide to the Reptiles and Amphibians of East Africa. A & C Black, London.

Stevenson, T., and Fanshawe, J. (2012). Field Guide to the Birds of East Africa (Kenya, Tanzania, Uganda, Rwanda and Burundi). Christoher Helm, London.

Tanzania Wildlife Research Institute (TAWIRI). (2021). Ecological Monitoring Report: Lake Natron Ramsar Site. Arusha: TAWIRI.

United Republic of Tanzania (URT). (2017). Lake Natron Ramsar Site Integrated Management Plan (2017–2027). Dar es Salaam: Ministry of Natural Resources and Tourism.

Wetlands International. (2022). Lesser Flamingo Conservation and Breeding Ecology at Lake Natron, Tanzania. Nairobi: Wetlands International Eastern Africa.

World Bank Group. (2019). Biodiversity Baseline Assessment for the Proposed Lake Natron Soda Ash Development Project. Washington, DC: International Finance Corporation (IFC) Environmental and Social Division.

WWF-Tanzania. (2018). Sustainable Development and Biodiversity Conservation in the Lake Natron Basin. Dar es Salaam: WWF Eastern Africa Programme Office

APPENDICES

APPENDIX A: AVIFAUNA CHECKLIST FOUND IN PROPOSED SODA ASH PROJECT IN LAKE NATRON

S/N	Order	Family	English Name	*Scientific Name*	IUCN Status
1	Struthioniformes	Struthionidae	Common Ostrich	*Struthio camelus*	LC
2	Phoenicopteriformes	Phoenicopteridae	Greater Flamingo	Phoenicopterus roseus	LC
3	Phoenicopteriformes	Phoenicopteridae	Lesser Flamingo	*Phoeniconaias minor*	**NT**
4	Pelecaniformes	Ardeidae	Grey Heron	*Ardea cinerea*	LC
5	Pelecaniformes	Ardeidae	Intermediate Egret	*Ardea intermedia*	LC
6	Pelecaniformes	Ardeidae	Yellow-billed Egret	*Ardea brachyrhyncha*	LC
7	Pelecaniformes	Ardeidae	Little Egret	*Egretta garzetta*	LC
8	Pelecaniformes	Ardeidae	Cattle Egret	*Bubulcus ibis*	LC
9	Pelecaniformes	Threskiornithidae	Sacred Ibis	*Threskiornis aethiopicus*	LC
10	Otidiformes	Otididae	Kori Bustard	*Ardeotis kori*	**NT**
11	Anseriformes	Anatidae	Egyptian Goose	*Alopochen aegyptiaca*	LC
12	Anseriformes	Anatidae	Spur-winged Goose	*Plectropterus gambensis*	LC
13	Anseriformes	Anatidae	Cape Teal	*Anas capensis*	LC
14	Podicipediformes	Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	LC
15	Galliformes	Numididae	Helmeted Guineafowl	*Numida meleagris*	LC
16	Galliformes	Phasianidae	Crested Francolin	*Ortygornis sephaena*	LC
17	Pteroclidiformes	Pteroclidae	Chestnut-bellied Sandgrouse	*Pterocles exustus*	LC
18	Pteroclidiformes	Pteroclidae	Black-faced Sandgrouse	*Pterocles decoratus*	LC
19	Columbiformes	Columbidae	Laughing Dove	*Spilopelia senegalensis*	LC
20	Columbiformes	Columbidae	Emerald-spotted Wood Dove	*Turtur chalcospilos*	LC
21	Columbiformes	Columbidae	Red-eyed Dove	*Streptopelia semitorquata*	LC
22	Columbiformes	Columbidae	Ring-necked Dove	*Streptopelia capicola*	LC
23	Columbiformes	Columbidae	African Mourning Dove	*Streptopelia decipiens*	LC
24	Columbiformes	Columbidae	Namaqua Dove	*Oena capensis*	LC
25	Cuculiformes	Cuculidae	White-browed Coucal	*Centropus superciliosus*	LC
26	Cuculiformes	Cuculidae	Diederik Cuckoo	*Chrysococcyx caprius*	LC

S/N	Order	Family	English Name	*Scientific Name*	IUCN Status
27	Charadriiformes	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	LC
28	Charadriiformes	Recurvirostridae	Pied Avocet	*Recurvirostra avosetta*	LC
29	Charadriiformes	Charadriidae	Kittlitz's Plover	*Charadrius pecuarius*	LC
30	Charadriiformes	Charadriidae	Common Ringed Plover	*Charadrius hiaticula*	LC
31	Charadriiformes	Charadriidae	Three-banded Plover	*Charadrius tricollaris*	LC
32	Charadriiformes	Charadriidae	Chestnut-banded Plover	*Anarhynchus pallidus*	LC
33	Charadriiformes	Charadriidae	Blacksmith Lapwing	*Vanellus armatus*	LC
34	Charadriiformes	Charadriidae	Crowned Lapwing	*Vanellus coronatus*	LC
35	Charadriiformes	Scolopacidae	Little Stint	*Calidris minuta*	LC
36	Charadriiformes	Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	LC
37	Ciconiiformes	Ciconiidae	Abdim's Stork	*Ciconia abdimii*	LC
38	Ciconiiformes	Ciconiidae	Yellow-billed Stork	*Mycteria ibis*	LC
39	Ciconiiformes	Ciconiidae	Black Stork	*Ciconia nigra*	LC
40	Caprimulgiformes	Apodidae	White-rumped Swift	*Apus caffer*	LC
41	Accipitriformes	Accipitridae	Tawny Eagle	*Aquila rapax*	**VU**
42	Accipitriformes	Accipitridae	Steppe eagle	*Aquila nipalensis*	**EN**
43	Accipitriformes	Accipitridae	African Fish Eagle	*Haliaeetus vocifer*	LC
44	Accipitriformes	Accipitridae	African Harrier-Hawk	*Polyboroides typus*	LC
45	Coliiformes	Coliidae	Speckled Mousebird	*Colius striatus*	LC
46	Coliiformes	Coliidae	Blue-naped Mousebird	*Urocolius macrourus*	LC
47	Bucerotiformes	Bucerotidae	Red-billed Hornbill	*Tockus erythrorhynchus*	LC
48	Bucerotiformes	Bucerotidae	African Grey Hornbill	*Lophoceros nasutus*	LC
49	Coraciiformes	Alcedinidae	Grey-headed Kingfisher	*Halcyon leucocephala*	LC
50	Coraciiformes	Coraciidae	Lilac-breasted Roller	*Coracias caudatus*	LC
51	Coraciiformes	Meropidae	Little Bee-eater	*Merops pusillus*	LC
52	Piciformes	Lybiidae	Black-throated Barbet	*Tricholaema melanocephala*	LC
53	Piciformes	Indicatoridae	Lesser Honeyguide	*Indicator minor*	LC
54	Passeriformes	Laniidae	Northern Fiscal	*Lanius humeralis*	LC
55	Passeriformes	Macrosphenidae	Red-faced Crombec	*Sylvietta whytii*	LC
56	Passeriformes	Platysteiridae	Chinspot Batis	*Batis molitor*	LC
57	Passeriformes	Dicruridae	Fork-tailed Drongo	*Dicrurus adsimilis*	LC
58	Passeriformes	Alaudidae	Fischer's Sparrow-lark	*Eremopterix leucopareia*	LC
59	Passeriformes	Alaudidae	White-tailed Lark	*Mirafra albicauda*	LC

S/N	Order	Family	English Name	*Scientific Name*	IUCN Status
60	Passeriformes	Cisticolidae	Tawny-flanked Prinia	*Prinia subflava*	LC
61	Passeriformes	Cisticolidae	Winding Cisticola	*Cisticola marginatus*	LC
62	Passeriformes	Cisticolidae	Rattling Cisticola	*Cisticola chiniana*	LC
63	Passeriformes	Hirundinidae	Barn Swallow	*Hirundo rustica*	LC
64	Passeriformes	Motacillidae	Grassland Pipit	*Anthus cinnamomeus*	LC
65	Passeriformes	Pycnonotidae	Common Bulbul	*Pycnonotus barbatus*	LC
66	Passeriformes	Buphagidae	Red-billed Oxpecker	*Buphagus erythrorynchus*	LC
67	Passeriformes	Sturnidae	Superb Starling	*Lamprotornis superbus*	LC
68	Passeriformes	Nectariniidae	Scarlet-chested Sunbird	*Chalcomitra senegalensis*	LC
69	Passeriformes	Nectariniidae	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	LC
70	Passeriformes	Ploceidae	White-browed Sparrow-Weaver	*Plocepasser mahali*	LC
71	Passeriformes	Ploceidae	Black-headed Weaver	*Ploceus cucullatus*	LC
72	Passeriformes	Ploceidae	Grosbeak Weaver	*Amblyospiza albifrons*	LC
73	Passeriformes	Ploceidae	Grey-capped Social-weaver	*Pseudonigrita arnaudi*	LC
74	Passeriformes	Ploceidae	Red-billed Quelea	*Quelea quelea*	LC
75	Passeriformes	Ploceidae	Cardinal Quelea	*Quelea cardinalis*	LC
76	Passeriformes	Estrildidae	Cut-throat Finch	*Amadina fasciata*	LC
Note: EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern					

APPENDIX 12: TAWIRI REPORT

SUBMISSION OF RECOMMENDATIONS FOR ESTABLISHMENT OF THE PROPOSED TRONA EXTRACTION AND SODA ASH PRODUCTION AT LAKE NATRON IN WOSIWOSI VILLAGE, GELAI LUMBWA WARD- LONGIDO DISTRICT IN ARUSHA REGION-TANZANIA

April, 2025

1.0 INTRODUCTION

Ngaresero Valley Company Limited (NVCL) is a limited liability company incorporated on September 22, 2022, under Section 15 of the Companies Act, 2002, with registration number 157942433. The company was established to specialize in Soda Ash mining and processing. Initially, NVCL plans to develop Trona extraction operations within Lake Natron and construct a Soda Ash production plant on the lakeshore at Wosiwosi Village, Gelai Lubwa Ward, Longido District, in the Arusha Region of Tanzania.

Notably, NVCL has been granted two licenses, PL-12236/2023 and PL-12235/2023, covering approximately 290.891 sq. km and 259.797 sq. km, respectively, under Section 31 of the Mining Act, Cap. 123. The project aims to extract 1,000,000 MT of brine annually, recovering 80% of Sodium Carbonate from Soda Brine during excavation and 70% from the final Soda Ash product, with an annual production target of 660,000 MT of Soda Ash.

Since the Soda Ash plant is proposed to be established within the protected area (at lake Natron); the comprehensive Environmental Impact Assessment (EIA) studies are mandatory for all development projects listed under the "First Schedule" of the Environmental Management (Environmental Impact Assessment and Audit) (Amendment) Regulations, 2018, and the "Third Schedule" of EMA, Cap. 191. Additionally, the Wildlife Conservation Act CAP. 283 R.E. 2022 mandates that all major projects and activities within or near Game Reserves (GRs) or Game Controlled Areas (GCAs) undergo full EIA to mitigate both social and environmental impacts likely to occur in all phases of the project cycle.

To comply with these legal requirements, NVCL has commissioned Mr. Yesaya Kaoneka to conduct an EIA for the proposed project site. As stipulated by EMA 2004, all key stakeholders must be involved in the EIA process, including the Tanzania Wildlife Research Institute (TAWIRI). The TAWIRI Act,1980 CAP 280 no 4 provides the institute's mandate to conduct, coordinate, and oversee all wildlife research in the country to provide scientific advice for fostering sustainable development and conservation. This necessitates TAWIRI to participate in all EIAs projects within wildlife-protected areas in Tanzania.

On February 26, 2025, TAWIRI received a formal request from Ngaresero Valley Company Limited (NVCL) seeking scientific advice and recommendations regarding the proposed Trona extraction and Soda Ash production plant at Wosiwosi Village, located in Gelai Lumbwa Ward, Longido District, Arusha Region. Given the ecological sensitivity of the area, TAWIRI’s insights were crucial in the decision-making process, ensuring that environmental and socio-

economic impacts are thoroughly assessed and mitigated to strike a balance between the development project and conservation goals.

To fulfil this request, on March 5, 2025, TAWIRI researchers Dr. Asanterabi Lowasa and Dr. Wilfred Marealle, accompanied by Mr. Emmanuel, the Longido District Game Officer, conducted a site visit at the proposed project location. The objective was to evaluate the potential impacts of the Soda Ash plant on local flora, fauna, and the Wosiwosi community. Before the visit, the team conducted a theoretical analysis of the proposed monohydrate extraction method, drawing insights from existing empirical studies on similar soda ash production plants in other places, including Kenya.

Beyond theoretical analysis, the site visit provided first-hand knowledge of the proposed extraction area. The research team engaged in direct observations of the local environment and consulted key stakeholders, including the Wosiwosi Village Natural Resources and Environmental Committee. These discussions were aimed at understanding local perspectives, aspirations, and expectations regarding the proposed soda ash project. Additionally, the team assessed the current state of natural resources, particularly wildlife and their habitats, to anticipate potential ecological impacts likely to occur across all three project phases: Preparation Phase, Operation Phase, and Decommissioning Phase.

A key concern was the Lake Natron ecosystem, particularly its significance as a breeding and feeding ground for the lesser flamingo. The team sought to determine how Trona extraction might affect this internationally recognized RAMSAR site. Furthermore, the Environmental Impact Statement (EIS) report was critically analyzed to validate whether its findings accurately reflected on-the-ground conditions. Given the global ecological importance of Lake Natron, the assessment also considered international environmental agreements and conservation commitments.

During the theoretical and empirical review process, the researchers identified a comparable project, called the TATA Chemicals Magadi Limited soda ash extraction plant, operating in Kenya since the 1900s to date. Recognizing its relevance, the team conducted a comparative ecological study between the Magadi-Kenya project and the proposed Wosiwosi project in Tanzania. To gain further insights, the team visited Lake Magadi in Kenya from March 25–26, 2025, to explore the project design, implementation strategies, and Environmental and Social Management Plan.

This comparative analysis was important to provide valuable lessons in designing sustainable mining operations while minimizing ecological disruption and ensuring compliance with both national and international environmental standards and legal issues.

2.0 OBJECTIVES AND METHODOLOGY

2.1 Objectives of the Site Visit at Wosiwosi Village

The visit aimed to evaluate the extent of compliance with the following requirements:

a) Section 81 (1)– (3) of the Environmental Management Act, Cap. 191;
b) The Environmental Management (Environmental Impact Assessment and Audit) (Amendment) Regulations, 2018, in conjunction with the Environmental Impact Assessment and Audit Regulation, 2005 (hereinafter referred to as the "Principal Regulations"); and
c) The Wildlife Conservation Act, CAP. 283 R.E. 2022.

2.2 Methodology and Approach

To fulfil the aforementioned objective, the following methods were employed:

a) Theoretical and empirical review

b) Physical observation of the project site;

c) Stakeholders' consultations- using Focus Group Discussions with Wosiwosi community members, and Village Environmental Committee, and technical staff from Longido DED's Office.

d) Comparative study at Lake Magadi- Kenya

3.0 FINDINGS/OBSERVATIONS

3.1 Project Location and Accessibility

The Lake Natron Game Controlled Area (GCA) was established by Government Notice in 1974 and spans approximately 3,000 square kilometres. This ecologically significant area includes a

wetland of international importance, covering 224,781 hectares (2,248 km²). It is located between Monduli and Longido districts to the east and Ngorongoro to the west, at coordinates 2° 30' S, 36° E (Figure 1).

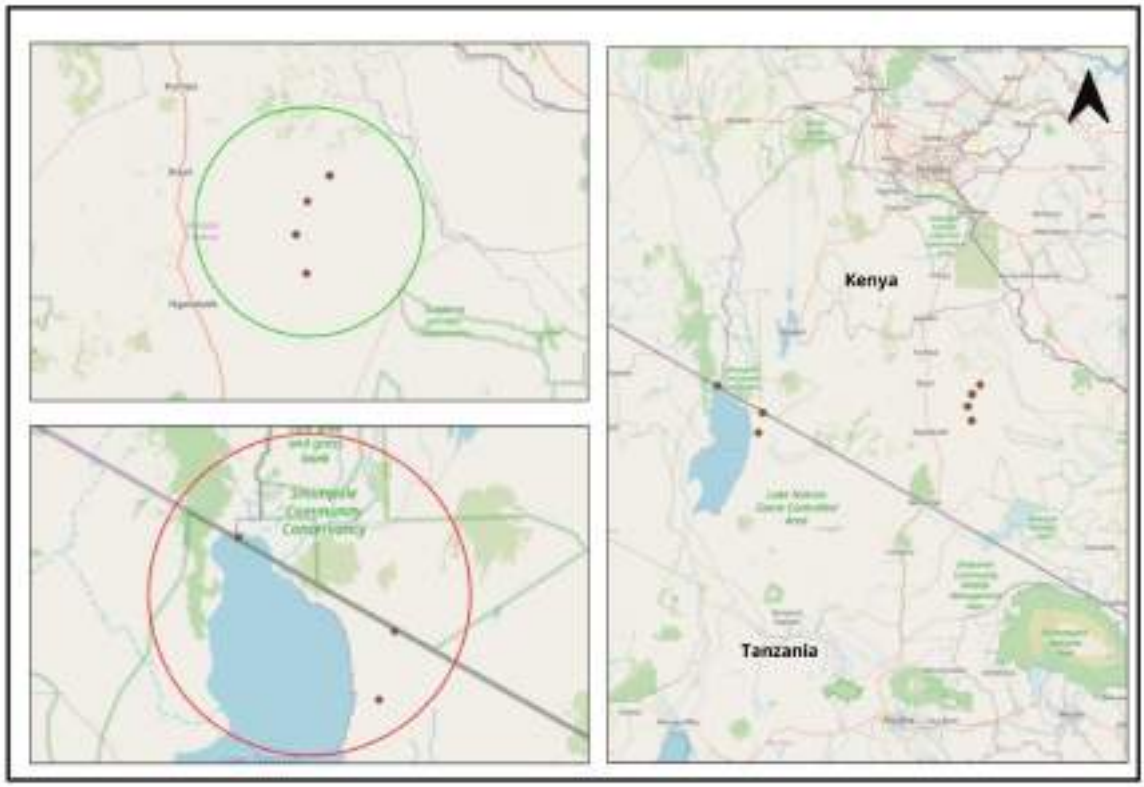


Figure 1: Study Area map with proposed soda ash extraction points

The area experiences irregular seasonal rainfall, primarily from December to May, with an annual average of approximately 800 millimetres. Temperatures around the lake frequently exceed 40°C, and the water's alkalinity can reach a pH level between 9.5 and 12.

Recognizing its ecological significance, Lake Natron was designated a Ramsar Site (Wetland of International Importance) on July 4, 2001. Located within the Great Rift Valley, the landscape is characterized by rugged terrain, thorn trees, and bushland. The area is also home to Oldonyo Lengai, Africa's highest active volcano, revered by the Maasai as "The Mountain of God."

Currently, the Lake Natron GCA is utilized for tourism and hunting concessions, with seven (7) hunting blocks operated by six (6) hunting companies. The proposed soda ash plant is planned for construction in the Lake Natron GCA North block, which is managed by Adam Clements Safaris Ltd (Table 1).

Table 1: Hunting Blocks within Lake Natron GCA and Longido GCA.

S/N	HUNTING BLOCK NAME	HUNTING COMPANY
1.	Longido GCA North	Michel Mantheakis Safaris Ltd
2.	Lake Natron GCA North	Adam Clements Safaris Ltd
3.	Lake Natron GCA West	Kilombero North Safaris Ltd
4.	Lake Natron GCA South	Robin Hurt Safaris Ltd
5.	Lake Natron GCA East	Green Mile Safaris Ltd
6.	Monduli Juu Open Area	Tanzania Big Game Safaris Ltd
7.	Engasurai Hunting Area – EWMA	Kilombero North Safaris Ltd

Source: Land Tenure Improvement Project (LTIP) - ESMP Report for Issuance of CCRO in Longido District Council, 2024, as well as EIS draft report for this project

3.2 Biophysical Features

3.2.1 Flora

A significant portion of the proposed project site consists of bareland, characterized by minimal vegetation cover. The terrain is predominantly open, with only a few scattered stands of Acacia species woodlands interspersed throughout the area. These woodlands, mainly composed of drought-resistant Acacia trees, provide limited canopy cover and are adapted to the region's semi-arid climate.

In addition to the sparse Acacia woodlands, the site features open grasslands, which serve as seasonal grazing areas for both wildlife and livestock. These grasslands are influenced by rainfall patterns, meaning their productivity fluctuates between wet and dry seasons.

The lack of dense vegetation suggests that the area's soil composition and climatic conditions may not support extensive plant growth. However, the existing vegetation plays a crucial role in the local ecosystem, providing habitat for small mammals, insects, and birds while also preventing excessive soil erosion.

Given the environmental characteristics of the site, any large-scale development, such as the proposed Trona extraction and soda ash production plant, must consider ecological

sustainability, biodiversity conservation, and land-use compatibility to mitigate potential environmental impacts.

3.2.2 Fauna

Lake Natron and its surrounding ecosystem host a diverse range of wildlife species, adapted to the region's semi-arid climate and alkaline lake conditions with high species diversity, richness, and evenness during the wet season (Ponsian et al., 2024). The area's biodiversity includes both terrestrial and aquatic species, with a mix of large mammals, birdlife, reptiles, and smaller fauna that rely on the lake's unique ecosystem for survival (Kenana et al., 2013).

3.2.2.1 Avian Species

Lake Natron is globally renowned as the primary breeding ground for the lesser flamingo (*Phoeniconaias minor*), with over 1.5-2.5 million individuals, representing 75% of the world's population, depending on its shallow, highly alkaline waters for nesting (Gereta et al., 2003; Matagi, 2004). The lake's harsh, salty environment deters most predators, providing a haven for flamingos to breed and rear their young (Tebbs et. al., 2013). Other notable bird species include: Greater Flamingo (*Phoenicopterus roseus*), White Stork (*Ciconia ciconia*)- a migratory species that frequents the area, Glossy Ibis (*Plegadis falcinellus*), African Spoonbill (*Platalea alba*), Black-winged Stilt (*Himantopus himantopus*), Ostrich (*Struthio camelus*)-The largest bird species in the region, commonly seen in open grasslands, Pelicans, Cormorants, and Herons (BirdLife International, 2012).

3.2.2.2 Mammals

The savanna and grassland ecosystems surrounding Lake Natron support a variety of large herbivores and carnivores, including: Buffalo (*Syncerus caffer*), zebra (*Equus burchelli*), Fringe-eared Oryx (*Oryx gazella cullotis)*, the Lesser Kudu (*Ammelaphus imberbis*), Gerenuk (*Litocranius walleri*), wildebeest (*Connochaetes taurinus)*-Frequently migrates through the region, especially during seasonal movements, Grant's Gazelle (*Nanger granti*) and Thomson's Gazelle (*Eudorcas thomsonii*), Giraffe (*Giraffa camelopardalis tippelskirchi*), hyena (*Crocuta crocuta*) and, lions (*Panthera leo*)-Occasionally sighted in the more vegetated areas (BirdLife International 2012; Kenana et al., 2013).

3.2.2.3 Reptiles & Amphibians

The harsh conditions around Lake Natron support a variety of reptiles (Hughes & Hughes, 1992), including: Monitor Lizards (*Varanus spp*.), spiny-tailed Lizards (*Uromastyx spp*.), and various Snake Species-including pythons, cobras, and vipers, which inhabit the grasslands and woodlands.

3.2.2.4 Aquatic & Microbial Life

While the lake's high alkalinity and extreme temperatures make it inhospitable for most fish species, it supports unique salt-loving (halophilic) bacteria and algae, which serve as the primary food source for flamingos (BirdLife International 2012); Nonga & Mdegela, 2017; Kaale et al., 2024).

- Spirulina algae (*Arthrospira fusiformis*)-Rich in carotenoids, giving flamingos their signature pink colour.
- Alkaline Tilapia (*Alcolapia alcalica*)-One of the few fish species that thrive in the lake's extreme conditions.

3.2.3. Wetland

Lake Natron, designated as a Ramsar Site due to its international ecological significance, is a shallow, alkaline lake stretching approximately 57 kilometers in length and 22 kilometers in width, covering a total area of 1,254 km². It lies within the Great Rift Valley and is characterized by its extreme alkalinity, high evaporation rates, and seasonal water level fluctuations (TAWA, 2025).

Hydrology and Water Sources

Despite its harsh conditions, Lake Natron is sustained by several key water sources (Matagi, 2004). The available water sources for the lake are;

i. **Southern Ewaso Ng'iro River**- The primary water source, originating from central Kenya, delivers fresh and mineral-rich water into the lake.
ii. **Engaresero River**- Flows from the southwest near Engaresero Village, contributing seasonal runoff.
iii. **Pinyinyi River** -Drains from the northwestern region of the Loliondo District, Tanzania, further replenishing the lake.
iv. **Hot and Cold Springs** – These geothermal springs release mineral-rich water, further increasing the lake's alkalinity and unique chemical composition.

However, the lake's water levels fluctuate seasonally, with inflows largely dependent on rainfall in the surrounding catchment areas, thus affecting the physical–chemical variables in the lake waters, affecting flamingo populations (Mgimwa & Lugomela, 2021).

3.3 Main findings (site visit at Wosiwosi village and comparative study at lake Magadi in Kenya)

3.3.1 Physical observations

During the ecological assessment at the proposed soda ash plant site in Wosiwosi, the research team observed Lesser Flamingos (*Phoeniconaias minor*), a globally significant species that relies on Lake Natron for breeding and feeding. In addition, indirect signs of ostrich (*Struthio camelus),* buffalo (*Syncerus caffer*), and zebra (*Equus burchelii*) were recorded, indicating that the area supports a diverse range of terrestrial wildlife species. The presence of these animals highlights the ecological value of the site and suggests that it serves as an important habitat for both avian and mammalian fauna.

To assess potential environmental impacts, a comparative study was conducted at Lake Magadi in Kenya, where a soda ash plant has been reported to be in operation since 1915.

Observations within a 400-meter radius of the Lake Magadi facility confirmed the presence of:

i. Lesser Flamingos (*Phoeniconaias minor*)
ii. Greater Flamingos (*Phoenicopterus roseus*)
iii. White Pelicans (*Pelecanus onocrotalus*)
iv. Zebras (*Equus burchellii*)

The proximity of these species to the Magadi plant suggests that wildlife, particularly water birds, can coexist with industrial operations, provided that both social and environmental management plans are adhered to by the proponent (Plate 1).

ENVIRONMENTAL IMPACTS:

Dust and Noise pollution

The research team also evaluated the environmental impact of the operational soda ash plant at Lake Magadi, Kenya, focusing on two key factors:

i. Dust generation- Observations revealed that dust emissions from the plant were minimal, likely due to dust suppression measures or the natural wind patterns in the area.
ii. Noise pollution- Noise levels from plant operations were also observed to be low, suggesting that the facility's design and operational practices effectively minimize disturbance to wildlife.

Implications for the Wosiwosi Project

The findings from Magadi, Kenya, suggested that if proper environmental management strategies for controlling dust and noise pollution are in place, the presence of a soda ash plant may have a limited impact on flamingo and other water bird populations. This suggests that similar mitigation measures could be adopted at the Wosiwosi site to minimize noise and dust pollution and mitigate negative impacts likely to affect wildlife behaviours.

However, further environmental impact assessments (EIA) should be considered, including:

i. Flamingo breeding and feeding behaviors in relation to industrial activities.
ii. Long-term ecosystem changes due to habitat modification.
iii. Comprehensive mitigation measures, including dust and noise control strategies.

Plate 1: Existing situation at TATA Chemicals Magadi Limited in Kenya.

Power lines at Lake Magadi (TATA Chemicals Company)

During the site assessment, the team observed power lines fitted with colored marker balls as part of an environmental management and wildlife safety strategy. These power lines, which are critical for supplying electricity to industrial facilities such as the soda ash plant, posed a known hazard to large birds, including flamingos, pelicans, and other waterfowl (Plate 2).

Mitigation Measure Adopted by TATA Chemicals Company

The use of colored marker balls was implemented by TATA Chemicals Company as part of its Monitoring and Environmental Management Plan following power line collision incidents involving birds. Power line collisions are a significant threat to large birds, particularly in areas like Lake Natron and Lake Magadi, where birds frequently move between feeding and nesting sites. The introduction of marker balls aligns with best practices in avian conservation, ensuring that essential infrastructure does not pose an excessive risk to wildlife populations.

These high-visibility markers help mitigate by reducing bird collisions through:

i. Increasing visibility of power lines, especially in low-light or foggy conditions.
ii. Allowing birds to adjust their flight paths and avoid dangerous obstacles.
iii. Reducing the risk of mortality for species such as flamingos, which are known to have poor frontal vision and often collide with power lines during flight.

Implications for the Wosiwosi Soda Ash Project

Considering the presence of Lesser Flamingos and other bird species in the Wosiwosi project area, similar avian-friendly power line mitigation measures should be incorporated into the Environmental and Social Management Plan (ESMP). These may include:

i. Installing more marker balls on all transmission lines near wetlands and bird migration routes.
ii. Using bird flight diverters or reflective spirals to further enhance visibility.
iii. Conducting regular monitoring to assess the effectiveness of these measures and make necessary adjustments.

By implementing such strategies, the project can minimize its impact on bird populations, aligning with both local environmental regulations and international conservation guidelines.

Plate 2: Coloured balls installed on powerlines

3.3.2 Stakeholders consultations at Wosiwosi village.

Despite the proposed project site being within a hunting block owned by Adam Clements Safaris, local stakeholders reported that they were not involved in the process of allocating the concession to that hunting company. In Tanzania, hunting concession allocation to companies is done through an electronic auctioning system, where interested companies register online, select hunting blocks, pay fees, and participate in a bidding process, with successful bidders receiving a Hunting Block Allocation Certificate. As a result, the local community feel that they have not benefited from hunting-related economic activities, leading to concerns over land use rights, revenue distribution, and community involvement in natural resource management.

However, unlike the hunting concession process, stakeholders in Wosiwosi Village have been made aware of the proposed establishment of a soda ash plant in their area (see plate 3). The local community expressed enthusiasm about the project, anticipating multiple socioeconomic benefits, including:

i. Employment opportunities for residents.
ii. Improved social services, such as better schools, healthcare facilities, and access to clean water.

iii. Potential infrastructure development, including road networks, railway and electricity supply improvements.

Their positive outlook indicates a strong expectation for the project to contribute to local development needs, but it also underscores the importance of inclusive stakeholder engagement to ensure that the community's interests are adequately considered and addressed.

Plate 3. Stakeholders' consultation at Wosiwosi Village in Longido

Social Considerations including Gender and Economic Inclusion: Lessons from Lake Magadi-Kenya

During the visit to Lake Magadi in Kenya, the team observed that gender inclusivity was an integral part of the socioeconomic structure surrounding the existing soda ash plant. In particular, women's groups were actively supported to participate in eco-tourism activities, such as beadwork and handicraft sales. Also, local women were empowered through small-business initiatives, creating alternative income sources beyond industrial employment. Hence, these initiatives helped diversify the local economy, ensuring that economic benefits were shared across different community segments, including women and marginalized groups.

Implications for the Wosiwosi Soda Ash Project

To maximize community benefits, it will be crucial for the Wosiwosi soda ash project to:

i. Ensure meaningful stakeholder participation in decision-making, particularly regarding land use and revenue-sharing mechanisms.
ii. Develop community benefit programs, including employment quotas for locals and investment in essential social services.
iii. Adopt gender-inclusive policies, by considering both man and women with more focus to youth and women-led enterprises. Also integrating local communities into eco-tourism and soda ash supply chain activities shall be considered.

iv. Establish transparent community engagement frameworks, ensuring that the expectations of stakeholders align with the project's actual economic and environmental impact to ensure positive support from the local community.

3.3.3 Trona and Soda ash extraction method

The Environmental Impact Statement (EIS) report outlines that the proposed trona and soda ash extraction will employ the Monohydrate Mining Operational Method. This process consists of two key phases:

1. Trona extraction, which involves:

    - Dredging- Removing trona-bearing sediments from the lakebed.
    - Crushing- Breaking down extracted trona into smaller particles.
    - Slurry transport- Moving the processed trona for further refinement.

2. Soda ash production, which includes:

    - Calcination- heating trona to produce soda ash.
    - Dissolving & Clarification- purifying extracted materials.
    - Evaporation & Crystallization- extracting sodium carbonate crystals.
    - Centrifugation & Drying- removing excess moisture.
    - Packaging & Shipping- preparing the final product for distribution.

This method is expected to maximize yield, reduce operational costs, and enhance sustainability in natural soda ash production. However, it may pose potential environmental risks that require careful mitigation. For instance, the trona extraction process and soda ash production are likely to increase water turbidity, limiting light penetration, which could disrupt aquatic ecosystems (Prestlglacomo et al., 2007). Additionally, it may release trapped pollutants, including heavy metals and toxic substances, leading to water quality degradation. A potential rise in salinity levels could alter the lake's chemical composition, affecting the growth of spirulina algae, the primary food source for Lesser Flamingos.

To mitigate these potential environmental risks, the following measures should be considered:

1. Water Quality Monitoring

    - Regular testing for heavy metals, salinity levels, and turbidity to track changes in water chemistry.
    - Implementation of filtration and sedimentation control measures to minimize pollutant release.

2. Sustainable Dredging Practices

    - Controlled dredging zones to avoid highly sensitive flamingo nesting areas.
    - Adoption of low-impact dredging techniques to reduce sediment resuspension.

3. Wildlife Protection Strategies

- Establishing buffer zones around key flamingo habitats.
- Implementing a seasonal operational schedule to avoid peak flamingo breeding periods. For example, Lesser flamingos flock to Lake Natron during the dry season, typically from September to October, to lay their eggs and hatching peaks go around December. The harsh conditions of the lake also deter predators, making it a safe breeding ground.

4. Ecosystem Restoration Initiatives

    - Rehabilitation of disturbed areas through ecological restoration projects.
    - Monitoring of spirulina algae populations to ensure their continued viability.

5. Community and Stakeholder Involvement

    - Engaging local conservation groups, researchers, and community members in environmental monitoring.
    - Developing alternative economic programs to balance conservation and development goals.

Therefore, by integrating scientific research, conservation strategies, and sustainable mining practices, the project can minimize its environmental and social impacts while achieving its economic objectives and sustainable conservation.

3.3.3 Impact on flamingo populations

The presence of the soda ash plant could have significant ecological impacts, potentially threatening the Lesser Flamingo population, as Lake Natron serves as their primary breeding site. The harsh conditions of the lake also deter predators, making it a safe breeding ground. Increased sedimentation and turbidity may negatively affect cyanobacteria, the flamingos' main food source (Krienitz et al., 2016). Additionally, noise pollution and disturbances from dredging activities could lead to nest abandonment, ultimately reducing flamingo populations.

Beyond flamingos, other wildlife species, including invertebrates and various birds, may also be affected due to habitat degradation, food scarcity, and nesting disruptions, further stressing the fragile ecosystem of the lake.

3.3.4 Other Impacts:

i Impact from emissions of hazardous gases

Soda ash production generates various emissions, including dust, carbon dioxide (CO_2), water vapour, and other hazardous gases. These emissions can have far-reaching environmental, wildlife, and human health implications, requiring careful management to mitigate their impacts:

1. Air Pollution & Climate Change:

- CO_2 emissions contribute to global warming and climate change, exacerbating temperature fluctuations that can alter local ecosystems.
- Dust and particulate matter can degrade air quality, affecting vegetation growth and potentially altering soil composition by depositing harmful particles.

2. Water Contamination:

    - Acidic gases and fine particulates may settle into water sources, leading to acidification and contamination of nearby wetlands, rivers, and groundwater.
    - This could alter the chemical balance of Lake Natron, affecting the organism's dependent on its unique saline environment.

iii. Wildlife Impacts:

1. Flamingo Habitat Disturbance:

    - The release of hazardous gases may affect cyanobacteria, the primary food source of Lesser Flamingos, potentially leading to population declines.
    - Increased airborne particulates can settle on breeding grounds, reducing the suitability of nesting sites.

2. Respiratory Issues in Animals:

    - Birds and mammals exposed to high dust concentrations may experience breathing difficulties, affecting their overall health and survival rates.
    - Prolonged exposure to emissions can also alter migratory patterns of certain species due to environmental stress.

3. Toxic Exposure:

    - If hazardous gases like sulfur oxides (SO_x) and nitrogen oxides (NO_x) are released, they can cause respiratory distress in wildlife, affecting reproduction and survival rates.

iv. Human Health Impacts:

1. Respiratory Problems:

    - Workers and nearby communities may experience increased cases of asthma, bronchitis, and other respiratory illnesses due to prolonged exposure to dust and airborne pollutants.

2. Waterborne Diseases:

    - If pollutants seep into drinking water sources e.g. the anticipated water wells that are promised by the prospector (NVCL), they can likely result into the risk of waterborne illnesses, leading to long-term health complications.

3. Livelihood Disruptions:

- Reduced water quality and soil degradation may affect agriculture, livestock farming, and fishing, impacting local communities' economies.

Mitigation measures

To minimize these risks, it is essential:

- To implement strict emission controls,
- Air filtration systems, and;
- Continuous environmental monitoring to balance industrial operations with sustainability and public health.

3.3.5 Regulatory Compliance

1. National Regulatory Policies

a) Environmental Management Act; EMA 204 (Cap. 191)

The act mandates Environmental Impact Assessments (EIA) to be done before initiating major development projects, including industrial projects. The soda ash plant could contradict environmental protection guidelines if it leads to ecosystem degradation and is deemed unsustainable.

b) The Wildlife Conservation Act no 5 of 2009 (Cap. 283 R.E. 2022)

Lake Natron and its surrounding areas are protected habitats under this act. Any activity that disrupts wildlife, particularly the breeding sites of Lesser Flamingos, would contravene the Act’s provisions on wildlife conservation.

c) The Wetlands Management Regulations (2018)

These regulations govern the sustainable use and protection of wetlands, including Ramsar Sites like Lake Natron. The proposed soda ash extraction and industrial activity could violate restrictions on wetland degradation by increasing water pollution, altering hydrological cycles, and damaging critical habitats.

d) The Mining Act (Cap. 123)

This act provides guidelines for responsible mineral extraction, ensuring environmental sustainability and community benefits. If the soda ash project fails to implement adequate mitigation measures, it may breach sustainable mining requirements.

e) The Tanzania Investment Policy (2020)

Promotes investments aligned with sustainable development goals (SDGs). Local communities have raised concerns about the lack of proper consultation and participation in the allocation of hunting concessions to the Adam Clement hunting company at Wosiwosi and benefit-sharing mechanisms, which may lead to non-compliance with the policy's community development objectives. However, the developer for the proposed Soda Ash plant seems to align with investment policy by involving the local community in the decision-making process on how the benefits accrued from the plan will trickle down to the community.

3.3.6 Grievance Redress Mechanisms

Since the proposed site for the soda ash plant is already designated as a tourist hunting block, there is a high potential for conflict between the two investors, Ngaresero Valley Company Limited (NVCL) and Adams Clements Safaris Limited, due to their competing interests and land use priorities.

3.3.6.1. Conflicting Interests

Ngaresero Valley Company Limited (NVCL) aims to develop a soda ash extraction and processing plant, which will involve industrial operations, dredging, and infrastructure development. Adams Clements Safaris Limited, as the holder of the hunting concession, relies on the area's undisturbed natural environment to attract high-end hunting tourists, whose experience depends on the presence of wildlife and minimal human disturbances.

3.3.6.2. Potential Areas of Conflict

a) Habitat Disruption and Wildlife Decline

The establishment of a soda ash plant may alter the landscape, disturb wildlife habitats, and reduce animal populations, thereby diminishing the quality of the hunting experience. Hunting companies rely on a stable wildlife population, whereas industrial operations often disrupt ecosystems, leading to fewer game animals for tourists.

b) Noise, Pollution, and Disturbance

Industrial activities, such as dredging, heavy machinery operations, and transportation, could generate significant noise, dust, and pollution. This contradicts the quiet, pristine environment required for hunting tourism, as human-induced disturbances can drive game animals away from the area.

c) Legal and Contractual Disputes

If Adams Clements Safaris Limited has a valid long-term lease for the hunting block, they may challenge the soda ash project through legal means, arguing that the new investment violates their contractual rights. This could lead to court disputes, government intervention, and potential delays in project implementation.

d) Stakeholder and Community Concerns

Local communities and conservation organizations may take sides, further escalating conflicts. If communities benefit more from hunting tourism (e.g., through revenue-sharing and conservation incentives), they may oppose the industrial project. Conversely, if they see economic gains from the soda ash plant, they may support industrialization over conservation.

e) Regulatory Challenges and Land-Use Planning

The Tanzanian government may face challenges in balancing industrial development and conservation commitments. If no proper land-use zoning and stakeholder consultations are conducted, conflicts between the investors may escalate, requiring government mediation.

3.3.6.3 Possible mitigations

To mitigate these conflicts, the following strategies could be considered:

1. Stakeholder Engagement & Negotiation- Encourage dialogue between the two investors (Adam Clamence Hunting and Ngaresero Valley Company), government agencies, and local communities to find a mutually beneficial solution.
2. Environmental and Social Impact Assessments (ESIA)- Conduct a detailed impact study to evaluate the feasibility of coexistence between industrial operations and hunting activities.
3. Land-Use Zoning Adjustments- The government may need to redefine land use plans, either by relocating one of the investments or setting clear operational boundaries.
4. Compensation & Alternative Concessions- If necessary, compensation mechanisms or an alternative hunting block could be offered to Adams Clements Safaris Limited.

Without proper conflict resolution mechanisms, the coexistence of industrial operations and hunting tourism in the same area may become unsustainable, leading to economic losses and long-term ecological consequences.

4.0 Conclusion and recommendations

Following an extensive evaluation, TAWIRI research findings showed that the proposed project site at Lake Natron is a globally unique ecosystem, recognized as a Ramsar Wetland of International Importance. It is the only regular breeding site for 1.5–2.5 million Lesser Flamingos, representing 75% of the global population. The lake's delicate balance of salinity, cyanobacteria, and freshwater springs supports this critical biodiversity, which is highly sensitive to disturbances such as those posed by industrial activities. Therefore, any development plan in this area should consider the aforementioned scientific facts.

Since the EMA Act, 2004 sections 89 and 90 as well as EIA & EA regulations,2005 section 26 and 27 call for the council to hold a public hearing to make a fair and informed decision

or when it considers it necessary for the protection of the environment; then the proposed trona extraction and soda ash production project at Wosiwosi Village should also be subjected to public hearing by council to incorporate the general public's views in the EIS report. This will foster more transparency, encouraging more community engagement, to promote a wider informed decision-making, that would ensure sustainable environmental management, socio-economic benefits, and regulatory compliance.

However, if Public opinion would support the proposed project to be established at Wosiwosi village; then TAWIRI propose, several critical recommendations which should be carefully addressed throughout the project's lifecycle including:

1. Bird Collision Prevention Measures

Many bird species, including Lesser Flamingos, are at risk of colliding with power lines, which may lead to injuries or fatalities. Birds may fail to detect power lines in flight due to poor visibility, or they may notice them too late to take evasive action. Developer should mitigate this by:

- installing coloured marker on power lines, especially along migratory and flight corridors.
- These markers will improve visibility from a distance, reducing the risk of collisions and enhancing bird conservation efforts.

2. Water Quality Management and Flamingo Conservation

Lake Natron's delicate ecosystem is highly sensitive to changes in water chemistry, which could impact flamingo food because they rely on spirulina algae as their primary food source. To safeguard this critical habitat:

- Implement continuous water quality monitoring to detect and address any pollutants that may result from the project.
- Maintain optimal salinity levels (8.5–10.5 pH) to support the growth of spirulina algae, ensuring a stable food supply for Lesser Flamingos.
- Enforce mitigation strategies to preserve flamingo breeding sites, reducing potential disturbances from industrial activities.

3. Brine and Recycled Water Monitoring for Heavy Metals

- Brine and recycled water from the extraction and processing plant should undergo regular laboratory testing to assess the presence of heavy metals and other contaminants.
- This will help prevent the degradation of water quality, which could have adverse effects on aquatic life and wetland ecosystems.

4. Flamingo Population and Habitat Monitoring

Given that Lake Natron is the world's most important breeding site for Lesser Flamingos, the project should incorporate a long-term monitoring strategy to assess the impact of industrial activities on flamingo populations. This should include:

- Employing a qualified ornithologist to regularly survey flamingo numbers, nesting patterns, and behavior.
- Monitoring potential habitat disturbances and implementing corrective measures when necessary.
- Studying migration trends to ensure minimal disruption to flamingo movement patterns.
- Implementing a seasonal operational schedule to avoid peak flamingo breeding periods because from September to October they lay their eggs and hatching peaks go around December.

5. Air Pollution Control and Emission Reduction

Soda ash production is associated with the release of dust, carbon dioxide (CO_2), water vapour, and other hazardous emissions, which could impact air quality, biodiversity, and human health. To address these risks (Whiteside & Herndon, 2018):

- Install an Electrostatic Precipitator (ESP) to suppress dust and smoke emissions, ensuring cleaner air and reduced particulate matter.
- Utilize Direct Air Capture (DAC) technology to minimize CO_2 emissions, contributing to global climate change mitigation efforts.

6. Regulatory Compliance and International Agreements

The project must adhere to national environmental policies, sectoral regulations, and international treaties to ensure responsible and legal operations. This includes compliance with:

- Tanzania Development Vision 2050, which promotes sustainable industrialization.
- The RAMSAR Convention, which protects wetlands of international significance, including Lake Natron.
- The Convention on Biological Diversity (CBD) to uphold biodiversity conservation efforts.
- The United Nations Framework Convention on Climate Change (UNFCCC) to align with climate action strategies and any other policies, laws and conventions may be relevant to the development of the Soda Ash project

7. Avoiding Investor Conflicts Over Land Use

The Ministry of Natural Resources and Tourism (MNRT)/TAWA and the Ministry of Minerals should coordinate discussions to establish a clear framework for land-use planning at the proposed project site. This will help:

- Prevent overlapping interests between investors such as Ngaresero Valley Company Limited and Adams Clements Safaris Limited, which operates a hunting concession in the same area.
- Promote coexistence between industrial activities and wildlife conservation efforts, ensuring mutual benefits for all stakeholders and the Tanzanian Government at large.

8. Community Engagement and Socio-Economic Benefits

Active community involvement is crucial in ensuring that local residents benefit from the project while mitigating social conflicts. Recommended measures include:

- Facilitating public participation in decision-making regarding alternative livelihood opportunities deemed to be important to them.
- Implementing women and youth empowerment programs that encourage local entrepreneurship, such as:
    - Establishing eco-tourism ventures (e.g., cultural tourism, handicrafts, and guided tours, aligning the local community the soda ash value chain).
    - Supporting education, health services, and access to clean water as part of the project's corporate social responsibility (CSR) initiatives.
- Ensuring that local communities gain employment and training opportunities in the soda ash industry.

8. Increasing government revenue

- The Tanzania Revenue Authority should establish and monitor revenue collection points between the border of Wosiwosi (Tanzania side) and Lake Magadi (Kenya) to ensure effective tax collection from the soda ash project. This is especially important given the current plan of constructing a railway line connecting Wosiwosi to Lake Magadi.
- Also, the possibility to construct a railway line connecting Wosiwosi to the Arusha railway line can increase tax revenue from Tanzanian ports like Dar es Salaam and Tanga for exporting the soda ash, as well as creating more employment opportunities through the Soda ash value chain

9. Location of licensed trona extraction points

After the coordinates were plotted, it became evident in the ESIA report that some of the licensed points do not fall within the Tanzanian territory as initially assumed, but are instead situated in the Magadi area of Kenya. This discrepancy highlights the need for careful verification and accurate representation of all spatial data. To ensure the integrity and reliability of the report, the actual and verified geographic locations of the licensed points must be indicated in the documentation, particularly in Figure 1, to avoid any cross-border misunderstandings and to reflect the true jurisdictional boundaries.

10. Public hearing

it is strongly recommended that a public hearing be held before the project begins, ensuring the involvement of all key stakeholders, including local government authorities, to address concerns and incorporate valuable input into the planning and implementation process.

5.0 Reference

BirdLife International (2012). Environmental Advocacy at Work: Lessons Learnt from the Campaign to Save Lake Natron from Plans to Build a Soda Ash Factory. BirdLife International, Africa Partnership Secretariat, Nairobi, Kenya.

Gereta, E. J., Wolanski, E., & Chiombola, E. (2003). Assessment of the environmental, social and economic impacts on the Serengeti ecosystem of the developments in the Mara River catchment in Kenya. Frankfurt Zoological Society: Tanzania.

Hughes, R. H. and J. S Hughes, 1992. A Directory of African Wetlands. IUCN. Gland, Switzerland. PP.254

Kaale, S. E., Machang'u, R. S., & Lyimo, T. J. (2024). Metagenomic Analysis of Bacterial Communities in Waters of Lake Natron, Arusha, Tanzania. Tanzania Journal of Science, 50(5), 1147-1167.

Kenana, LM., Bakari, SK., Bitok, E. Machoke, NM., Hamza, K, Mukeka, J, Chepkwony R.K., & Mwiu, SN, (2013). Total aerial count for Amboseli- West Kilimanjaro and Magadi-Natron cross-border landscape, April 2013. A Technical Report for KWS, Kenya and TAWIRI, Tanzania

Krienitz, L., Krienitz, D., Dadheech, P. K., Hübener, T., Kotut, K., Luo, W., ... & Versfeld, W. D. (2016). Food algae for Lesser Flamingos: a stocktaking. *Hydrobiologia*, *775*, 21-50.

lotic and lentic ecosystems. Lake and Re,eroir Management 23:231-244.

Matagi, S. V. (2004). A biodiversity assessment of the Flamingo Lakes of eastern Africa. Biodiversity, 5(1), 13-26.

Mgimwa, E.F., John., J. & Lugomela, C.V. (2021). The influence of physical–chemical variables on phytoplankton and lesser flamingo (Phoeniconaias minor) abundances in Lake Natron, Tanzania. African Journal of Ecology. Pp 1–9. DOI: 10.1111/aje.12863

Nonga HE, Mdegela RH & Sandvik M. (2017). Cyanobacteria and cyanobacterial toxins in the alkaline-saline Lakes Natron and Momela, Tanzania. Tanz. Vet. J. 32: 108–116.

Ponsian, E.K., Usangila, E., Masenga, E.H., Munisi, E., Mwakalebe, G., Wokusima, Z, M., Ngw'eli, ML., Mdaki, M., Mikole, M., and Meney, R. (2024). Comparative Analysis of Bird Diversity, Richness and Evenness in Three Protected Areas in Northern

Tanzania. International Journal of Biodiversity and Conservation. Vol. 16(3), pp. 123-136 July-September 2024 DOI: 10.5897/IJBC2023.1609.

Prestlglacomo, A.R., Effler, S.W., O'Donnell', D., Hassett J.M., Mlchalenko, E.M., Lee, Z & Weldemann, A. (2007). Turbidity and suspended solids levels and loads in a sediment enriched stream: implications for impacted

TAWA (2025). '*Home to millions of flamingos'*. https://www.tawa.go.tz/attraction-details/lake-natron. Visited 10th March 2025.

Tebbs, E. J., Remedios, J. J., Avery, S. T., & Harper, D. M. (2013). Remote sensing the hydrological variability of Tanzania's Lake Natron, a vital Lesser Flamingo breeding site under threat. Ecohydrology & Hydrobiology, 13(2), 148-158.

Whiteside, M., & Herndon, J. M. (2018). Aerosolized coal fly ash: Risk factor for COPD and respiratory disease. *Journal of Advances in Medicine and Medical Research*, *26*(7), 1-13.

APPENDIX 13: WATER QUALITY LAB RESULTS

CLIENT: MOSHONI SODA LIMITED

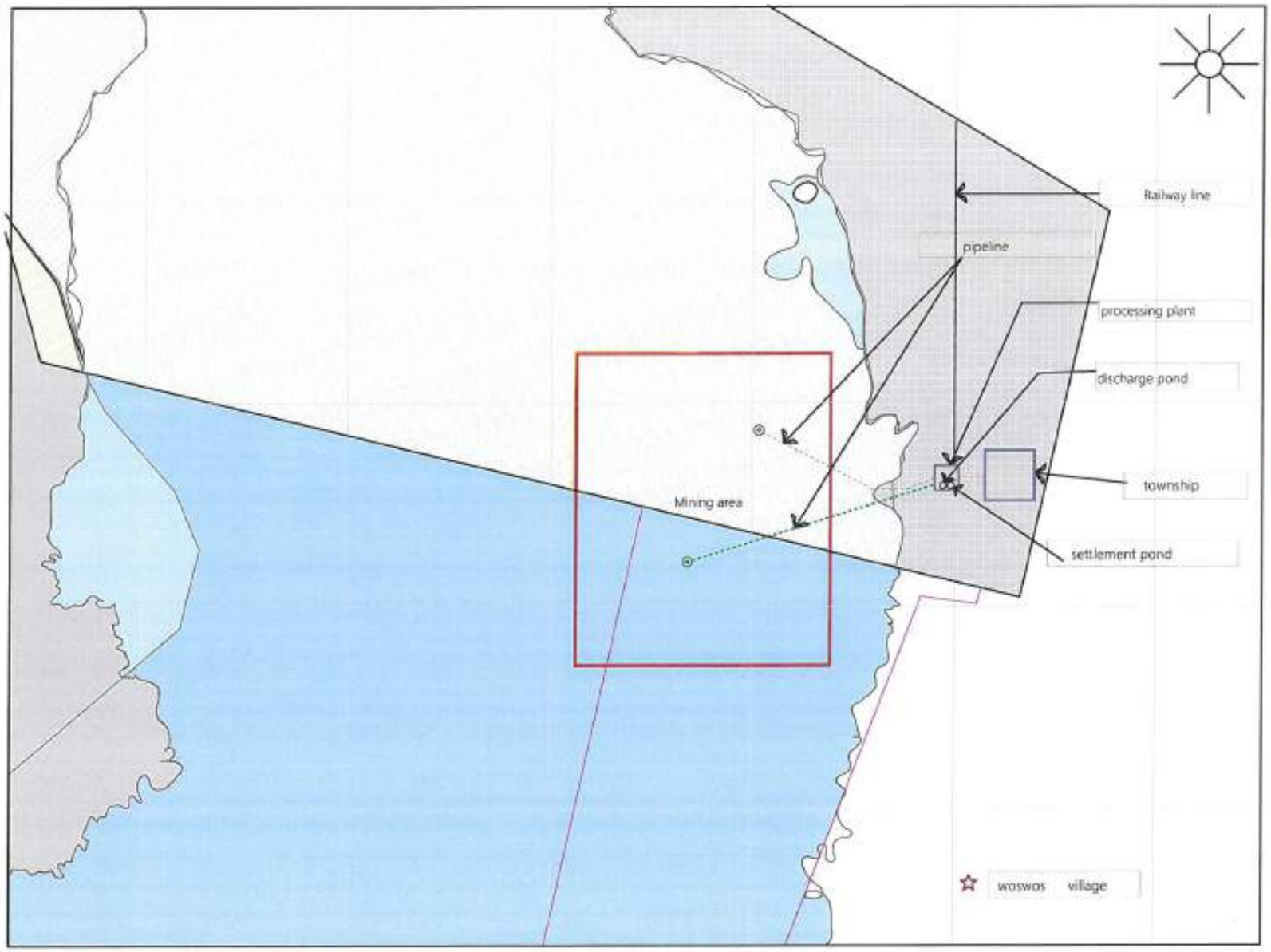
SOURCE: LAKE MAGADI - SODA ASH PROJECT

SEDIMENT: (1)

DATE RECEIVED: 20/Feb/2026. 0712288647

	PARAMETER	UNIT	RESULT
1.	PH	–	10.64.
2.	EC	mS/cm	46.82.
3.	Lead	mg/l	0.393.
4.	Copper	mg/l	0.457.
5.	Zinc	mg/l	2.381.
6.	Cadmium	mg/l	0.148.
7.	Chromium	mg/l	0.293
8.	Nickel	mg/l	1.171.
9.	Sodium	mg/l	135.1.
10.	Potassium	mg/l	147.35.
	Kleglint	0.5106	
		0.5019.	
11.	Magnesium	mg/l	186.52

APPENDIX 14: SITE LAYOUT PLAN



legend

- CONTOURS
- PROCESSING PLANTS
- SETTLEMENT PONDS
- DAMS
- WATER VILLAGE
- PIPELINE (2)
- RAILWAY LINE
- ESTIMATED DISTANCE APART
- INDEX CONTOURS
- INTERMEDIATE CONTOURS

General Notes

1. All works to be carried strictly according to Local Authority and other relevant authorities requirements.

2. All Dimensions are in "millimeters" unless specified otherwise. All Dimensions to be Verified on Site

3. "DO NOT Scale" from the drawing. Only "figured Dimensions " and levels are to be used.

4. All relevant details, Levels, Dimensions, Depth of excavations, Flush Heights and number of steps to be "determined on site" prior to ARCHITECTS APPROVAL. Any Discrepancies to be Reported to the Architect immediately.

No.	Remarks/Issue	Date

Project title

Client

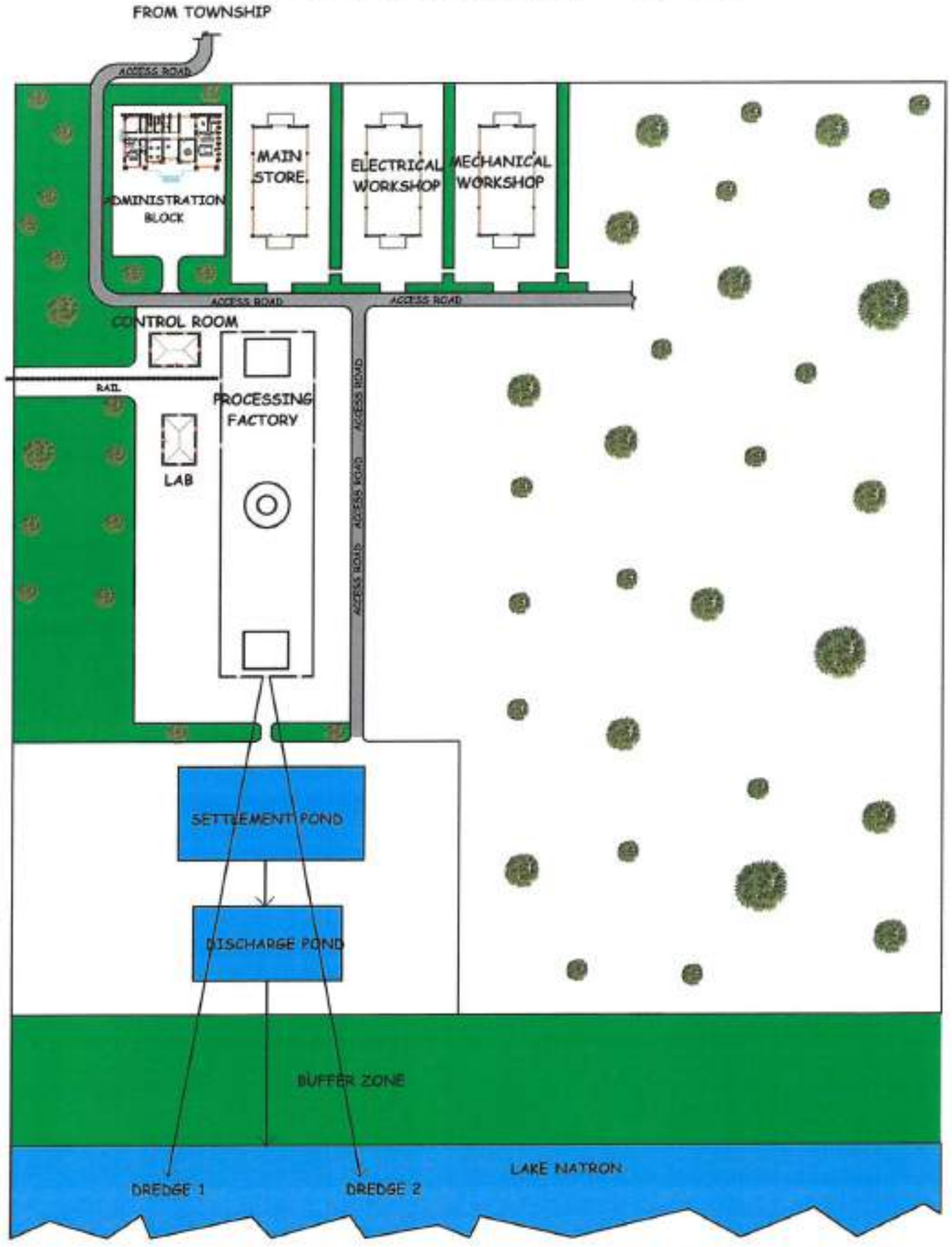
Drawing title
Overall layout plan

Sign:

ARCHITECTS AND QUANTITY SURVEYORS REGISTRATION BOARD TANZANIA

Location Region	Issue date
DAR ES SALAAM	january, 2026
Dwg No	Submission date
	january, 2026
Scale	Revision
Designed	DRAWN BY
Arch ABDUL	Arch ABDUL

PROCESSING PLANT LAYOUT



General Notes

1. All works to be carried strictly according to Local Authority and other relevant authorities' requirements.

2. All Dimensions are in "millimeters" unless specified otherwise. All Dimensions to be Verified on Site.

3. "DO NOT Scale" from the drawing. Only "figured Dimensions" and levels are to be used.

4. All relevant details, Levels, Dimensions, Depth of excavations, Plinth Heights and number of steps to be "determined on site" prior to ARCHITECT'S APPROVAL. Any Discrepancies to be Reported to the Architect immediately.

No.	Revisions/Issues	Date

Project title

Client

Drawing title: Overall layout plan

Location: Region: DARES SALAAM

Issue date: January 2026

Drwg No:

Submission date: January 2026

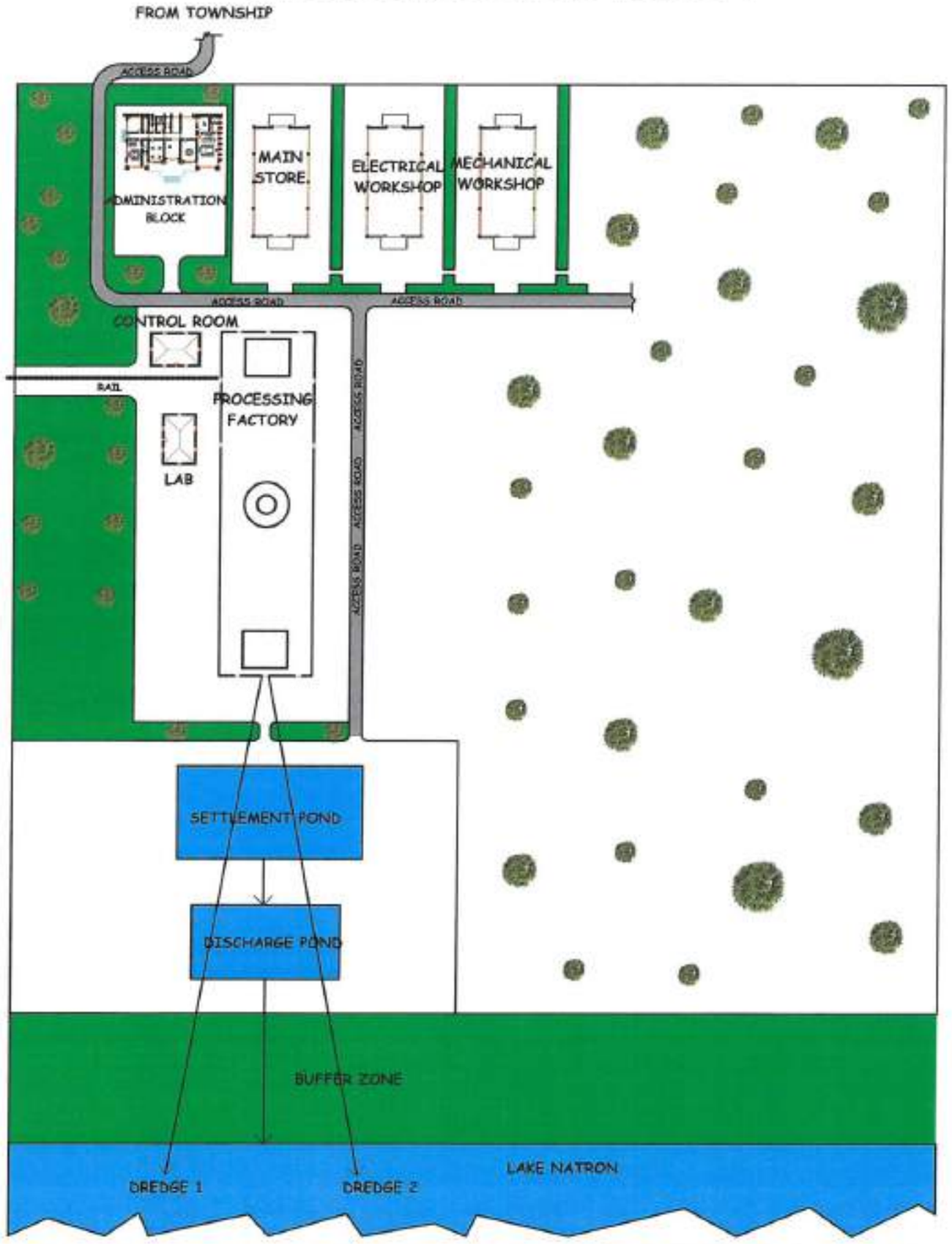
Scale:

Revision:

Designed: Arch ABDUL

DRAWN BY: Arch ABDUL

PROCESSING PLANT LAYOUT



General Notes

1. All works to be carried strictly according to Local Authority and other relevant authorities requirements.

2. All Dimensions are in "millimetres" unless specified otherwise. All Dimensions to be Verified on Site.

3. "DO NOT Scale" from the drawing. Only "figured Dimensions " and levels are to be used.

4. All relevant details, Levels, Dimensions, Depth of excavations, Plinth Heights and number of steps to be "determined on site" prior to ARCHITECTS APPROVAL. Any Discrepancies to be Reported to the Architect immediately.

No.	Revision/Issue	Date

Project title

Client

Drawing title
Processing plant layout

Location /Region
DAR ES SALAAM

Issue date
January 2020

Dwg No
D-10...

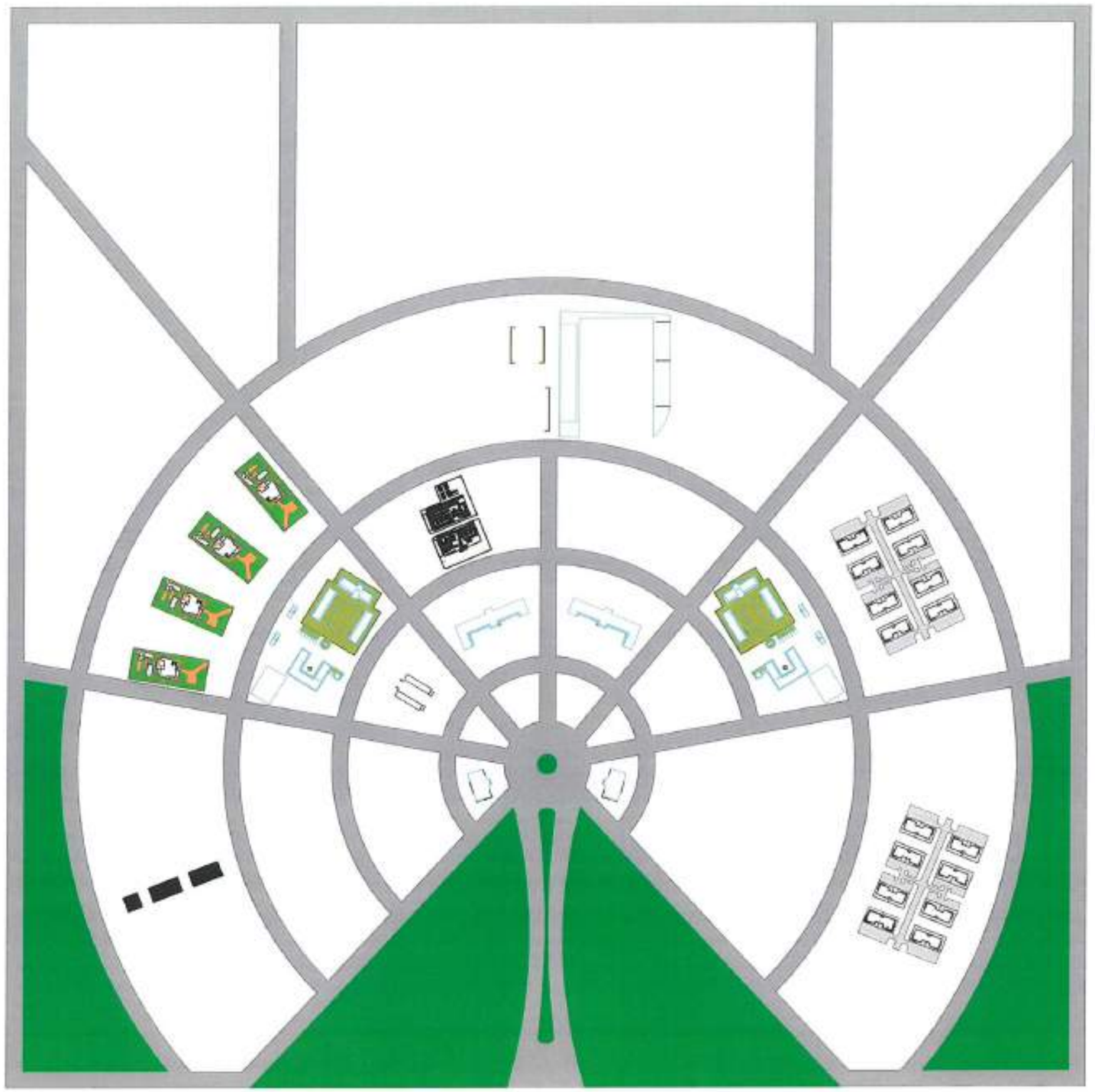
Submission date
January 2020

Scale

Revision

Designed
Arch ABDUL

DRAWN BY
Arch ABDUL



General Notes

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4. All relevant details, Levels, Dimensions, Depth of excavations, Finish Heights and number of steps to be "referenced on site" prior to ARCHITECTS APPROVAL. Any Discrepancies to be Reported to the Architect immediately

No	Revision/Issue	Date

Project title

Client

Drawing title

Overall site layout plan

ARCHITECTS AND QUANTITY SURVEYORS REGISTRATION BOARD TANZANIA
Engineering Design Consultants Ltd
EAPL 195.2018/10/12
Sign:

Location / Region	Issue date
DAR ES SALAAM	January 2020
Drwg No	**Submission date**
Dr02	January 2020
Scale	**Revision**
Designed	**DRAWN BY**

APPENDIX 15: EMERGENCY RESPONSE PLAN

EMERGENCY PREPAREDNESS AND RESPONSE ACTION PLAN (EPRAP).

9.1 INTRODUCTION

The Emergency Preparedness and Response Action Plan (EPRAP) for Soda Ash Production at Lake Natron outlines the strategic framework and operational procedures necessary to effectively prepare for, respond to, and recover from potential emergencies associated with industrial activities in this ecologically sensitive region. The plan is designed to protect human life, ensure the safety of workers and nearby communities, and minimize potential environmental impacts on Lake Natron's unique ecosystem, particularly its role as a critical breeding site for the lesser flamingo.

Lake Natron, located in northern Tanzania, is a hypersaline lake with high ecological significance and fragile biodiversity. The development of soda ash extraction and processing in this area requires a robust risk management framework due to potential hazards such as fuel spills, fire, equipment failure, or natural disasters. This EPRAP aligns with national regulations, international best practices, and the principles of sustainable industrial development.

The primary objectives of this plan are to:

- Identify potential emergency scenarios related to soda ash production and processing;
- Establish clear procedures for emergency prevention, detection, and mitigation;
- Define roles and responsibilities for internal response teams and external stakeholders;
- Provide communication protocols for timely reporting and public notification;
- Ensure compliance with environmental protection standards and safety regulations;
- Support training, simulation exercises, and continuous improvement of response capabilities.

This document is intended for use by plant operators, emergency response personnel, environmental regulators, and local authorities. It is a living document that will be reviewed and updated regularly to reflect operational changes, lessons learned, and evolving risks.

9.2 SCOPE

This Emergency Preparedness and Response Action Plan (EPRAP) outlines strategies to prevent, prepare for, respond to, and recover from emergencies and disasters associated with soda ash production operations at Lake Natron. The plan ensures the safety of personnel, protection of the environment, preservation of local biodiversity (including flamingo habitats), and minimal disruption to surrounding communities.

9.3 RESPONSIBILITIES

Effective emergency preparedness and response depend on clearly defined roles and responsibilities across all levels of the organization. For soda ash production at Lake Natron—an environmentally sensitive and operationally complex site—clear delegation of duties ensures swift, coordinated, and efficient response to any emergency. The following outlines the key responsibilities of stakeholders involved in the EPRAP:

9.3.1 Plant Manager

- Overall leadership during emergency situations.
- Authorizes activation of the Emergency Response Plan.
- Coordinates with external agencies (e.g., fire, medical, environmental).
- Ensures resources are available for emergency response and recovery.
- Leads post-incident reviews and corrective actions.

9.3.2 Health, Safety, and Environment (HSE) Officer

- Maintains and updates the EPRAP in line with current risks and regulations.
- Conducts regular risk assessments and emergency drills.
- Provides training for all personnel on emergency procedures.
- Monitors compliance with safety and environmental regulations.
- Advises Incident Commander during emergencies on environmental and safety implications.

9.3.3 Emergency Response Team (ERT)

- Executes evacuation, containment, fire-fighting, and first-aid duties.
- Performs search and rescue operations within the plant if necessary.
- Coordinates directly with the HSE Officer during response efforts.
- Maintains readiness through regular training and equipment checks.

9.3.4 Department Heads / Supervisors

- Account for all personnel in their areas during an emergency.
- Ensure their teams are trained and familiar with emergency exits and procedures.
- Report any incidents or unsafe conditions to the HSE Officer immediately.

9.3.5 Communications Officer / Public Relations Liaison

- Coordinates communication with external stakeholders, including local communities and the media.
- Ensures that accurate, timely information is disseminated during an emergency.
- Prepares official statements in consultation with the Incident Commander.

9.3.6 Local Authorities & Emergency Services

- Support the site response team with additional firefighting, medical aid, and law enforcement as needed.
- Coordinate with plant management for evacuations, environmental assessments, and post-incident investigations.

9.3.7 All Employees and Contractors

- Report hazards or incidents immediately to supervisors or HSE.
- Follow instructions from the ERT or Incident Commander during an emergency.
- Participate in safety drills and training programs.
- To use appropriate PPE as recommended by Safety personnel especially employees working with chemicals, noise and dusty environment.
- Knowing the location of assembly point.

9.4 GENERAL EMERGENCE CONDITIONS

Soda ash (sodium carbonate) production in Lake Natron, Tanzania, has raised several environmental, social, and logistical concerns. Here are potential general emergencies associated with such a project.

9.4.1 Environmental Emergencies

- **Ecosystem disruption**: Lake Natron is a critical breeding site for lesser flamingos. Soda ash extraction could alter water salinity and pH, threatening their habitat.
- **Water contamination**: Industrial runoff or chemical spills may pollute the lake or nearby groundwater, impacting biodiversity and local communities.

- **Dust and air pollution**: Mining and processing may release particulate matter and gases, affecting air quality.
- **Loss of biodiversity**: Disruption of fragile ecosystems could threaten endemic plant and animal species.

9.4.2 Industrial/Operational Emergencies

- **Chemical spills**: Accidental release of hazardous materials (e.g., sodium carbonate, sulfuric acid) during processing or transportation.
- **Fire or explosion**: Risk due to flammable materials or equipment malfunction.
- **Infrastructure failure**: Collapse of processing plants, pipeline leaks, or power outages could halt operations and cause safety risks.

9.4.3 Natural Disaster Emergencies

- **Earthquakes or volcanic activity**: Lake Natron lies near the East African Rift, a seismically active region.
- **Flooding**: Unseasonal heavy rains or climate change effects could lead to flash floods, affecting both operations and surrounding communities

9.4.4 Social and Humanitarian Emergencies

- **Community displacement**: Land acquisition for industrial facilities could force local populations to relocate.
- **Health emergencies**: Pollution or exposure to chemicals might lead to respiratory or skin diseases among workers and nearby residents.
- **Conflict with local communities**: Tensions may arise over land use, resource allocation, or environmental degradation

9.4.5 Supply Chain and Logistical Emergencies

- **Transportation accidents**: Spills or crashes during transport of soda ash or raw materials on poorly maintained roads.
- **Fuel or raw material shortages**: Disruption in supply can halt production and lead to financial loss.
- **Security risks**: Theft, vandalism, or sabotage of industrial infrastructure.

9.5 EMERGENCE SITUATION LEVELS

The "Emergence Situation Levels" for soda ash production in Lake Natron would refer to tiers or categories that assess the severity or urgency of a situation—typically environmental, socio-economic, or industrial—linked to soda ash development in this ecologically sensitive region. Lake Natron, located in northern Tanzania, is a highly alkaline lake and a critical breeding site for the lesser flamingo. Soda ash (sodium carbonate) extraction from this lake has raised concerns due to its potential environmental impact.

9.5.1 Level 1: Early Warning / Emerging Risks

- Minor deviations from environmental norms (e.g., pH changes in lake water).
- Increased human activity or interest in industrial expansion.
- Community or NGO concerns start to emerge.
- Need for monitoring and early stakeholder engagement

9.5.2 **Level 2: Moderate Risk / Escalating Concern**

- Observable impacts on biodiversity (e.g., changes in bird migration or breeding).
- Initial signs of habitat disruption or pollution.
- Community resistance or protests begin.
- Reports of regulatory non-compliance or safety concerns in production.
- Mitigation and response plans need to be activated.

9.5.3 Level 3: High Risk / Immediate Threat

- Clear evidence of environmental degradation (e.g., flamingo nesting failure).
- Water quality degradation or ecosystem shifts in Lake Natron.
- Widespread community opposition; possible legal or international attention.
- Industrial accidents or failures (e.g., chemical spills).
- Suspension or review of operations may be required.

9.5.4 Level 4: Critical / Emergency State

- Severe and irreversible ecological damage detected.
- Collapse of key species populations or ecosystem services.
- National or international intervention required.
- Complete shutdown of operations and crisis management activated

9.6 GENERAL EVACUATION PROCEDURES

Here's a general evacuation procedure tailored for a soda ash production facility at Lake Natron. These procedures ensure worker and environmental safety during emergencies such as chemical spills, fires, earthquakes, or toxic gas leaks;

(i) Emergency Notification

Activate emergency alarm system (audible and visual signals).
Notify:

- All facility personnel
- On-site emergency response team
- Local emergency services and environmental authorities

(ii) **Immediate Actions**

- Cease all operations immediately and secure hazardous materials (shut off valves, stop machinery, etc.) if safe to do so.
- Personnel must **follow designated evacuation routes** as posted in work areas.
- Use **personal protective equipment (PPE)** if the evacuation involves chemical exposure (e.g., respirators for soda ash dust or caustic soda fumes).

(iii) Evacuation Routes & Assembly Points

- Evacuate via clearly marked and unobstructed routes leading to pre-designated assembly points.

Assembly points should be:

- ✓ Upwind from the production area
- ✓ On high ground, given the proximity to Lake Natron
- ✓ Away from potential chemical release zone

(iv) Headcounts and Accountability

- Supervisors perform headcounts at the assembly points.
- Any missing personnel must be reported immediately to emergency responders.

- Use evacuation registers or roll calls to account for all employees and visitors

(v) Special Assistance

- Assign personnel to assist individuals with disabilities or injuries.
- Provide transportation if needed for those who cannot walk long distances.

(vi) Communication

- Use radios, megaphones, or mobile systems for clear communication during evacuation.
- Ensure all personnel are aware of emergency contact numbers and communication procedures.

(vii) All-Clear Signal

- Do not re-enter the facility until the official "All Clear" is given by the Emergency Coordinator or safety officer.

(viii) Post-Evacuation Actions

- Participate in debriefing sessions and incident reporting.
- Reassess and revise the Emergency Response Plan (ERP) based on the event.

9.7 EMERGRNCE RESPONSE PROCEDURES

9.7.1 Emergency Preparedness

- **Risk Assessment**: Identify hazards such as chemical spills (sodium carbonate, lime), fire, explosions, equipment failure, and exposure to corrosive substances.
- **Emergency Response Team (ERT)**: Assign trained personnel with roles including first aid, fire response, evacuation coordination, and communication.
- **Training & Drills**: Conduct regular simulations covering chemical spill response, fire drills, first aid, and evacuation procedures.

9.7.2 Incident Detection & Reporting

- **Monitoring Systems**: Install gas detectors, temperature sensors, and surveillance for early detection of abnormalities.
- **Alert Mechanisms**: Use alarms (audible and visual), SMS alerts, and public address systems.
- **Reporting Protocol**:

  ✓ Notify shift supervisor immediately.
  ✓ Contact emergency response team.
  ✓ Inform local authorities (fire, health, environmental agencies).

9.7.3 Immediate Response Actions

(i) **Chemical Spills (e.g., Sodium Carbonate)**

- Evacuate non-essential personnel.
- Isolate the spill area.
- Use personal protective equipment (PPE).
- Neutralize using appropriate neutralizing agents (if applicable).
- Contain with spill barriers; prevent runoff into Lake Natron.

(ii) **Fires or Explosions**

- Trigger fire alarm and activate fire suppression systems.

- Evacuate the facility per the fire evacuation plan.
- Fire brigade and trained personnel handle suppression.
- Shut down critical equipment to prevent escalation.

(iii) **Exposure or Injury**
- Move the victim to safety.
- Administer first aid or CPR as needed.
- Call for medical support.
- Record the incident for reporting and investigation.

(iv) **Evacuation Plan**
- **Evacuation Routes**: Clearly marked, unobstructed, and regularly inspected.
- **Assembly Points**: Safe zones away from hazardous areas, ideally upwind.
- **Accountability**: Roll call to ensure all personnel are safe.
- **Transport**: Emergency vehicles ready for injured or at-risk individuals.

(v) **Environmental Protection**
- **Spill Containment**: Prevent chemicals from reaching Lake Natron or surrounding habitats.
- **Waste Handling**: Use certified waste disposal units for cleanup residues.
- **Reporting**: Immediate notification to environmental authorities and local communities.

(vi) **Post-Incident Procedures**
- **Debriefing**: Review actions taken, successes, and shortcomings.
- **Investigation**: Conduct root-cause analysis.
- **Documentation**: Incident report submitted to management and relevant authorities.
- **Recovery Plan**: Restore operations safely and gradually.
- **Counseling**: Psychological support for affected employees.

(vii) Coordination with External Agencies
- **Fire Department**
- **Health Facilities**
- **Local Government**
- **Environmental Protection Agencies**
- **Community Leaders** (for transparency and public reassurance)

9.8 EMERGRNCE DRILLS
- Emergence drills shall be held on a regular basis. Drills shall be held in areas that do have daily operational activities to ensure that they can be activated and respond quickly and efficiently.
- Everyone in the mine, including employees, visitors, contractors must obey the instructions in the area they occupy when the alarm is sounded.

9.9 ACCIDENT / INCIDENT REPORTING OBLIGATION
- All incidents / accidents shall be reported.
- Notify the Manager responsible, Safety Manager and Environmental personnel if the Accident/Incident has lead into Environmental impacts.

- Report all incidents and accidents using Incident/Accident form to ensure that corrective measures are in place to prevent re occurrence in future.
- The filled Incident and Accident form shall be signed off when all corrective actions are done.

9.10 TRAINING PROGRAMS

- Employees shall be trained depending upon the Training needs of each section.
- Occupational Health, Safety and Environmental Meetings shall be held in monthly basis to ensure that issues arise from each department are communicated and managed accordingly.
- Key personnel shall be trained on evacuation procedures, use of fire equipment's, first Aid procedure etc.
- Notices indicating contact details for first aiders or appointed persons, the emergency contact number, and where the first-aid box is, shall be posted at the site

9.11 DISPLINARY ACTION

Disciplinary action shall be taken to those who shall not act positively to this plan.

9.12 EMERGENCE CONTACT DETAILS

(Telephone number to be inserted after the company has been constructed and employment concluded)

Table 9.1: Project Contact Numbers

S/N	NAME	TITLE	CONTACT

Table 9.2. Locals Emergence Contact Details

S/N	NAME	TITLE	CONTACT

Table 9.3: List of Emergence Response Team.

S/N	NAME	TITLE	CONTACT

APPENDIX 16: PROPOSED DREDGER INSTRUCTION MANUAL

ELLICOTT PRELIMINARY SPECIFICATIONS

FOR
B1870 ELECTRIC BUCKET-WHEEL SUCTION DREDGER

Ngaresero Soda Company Ltd.

Tanzania

GENERAL DESCRIPTION

The specifications included herein are preliminary and subject to verification prior to a contract.

Ellicott Dredges LLC is pleased to offer a custom, Dismountable, Electric Powered Bucket-Wheel Dredge This dredge will feed into a Floating Beneficiation / Processing Plant.

The dredge incorporates Ellicott's extensive experience in the design and construction of electric bucket-wheel type dredges for similar applications.

The Bucket-Wheel cutter has increased power from your existing unit, as does the dredge pump.

The dredge is designed and built to heavy-duty standards, to offer long life and minimum maintenance and repair costs.

The Beneficiation / Processing Plant is not included in this proposal. Also, this dredge does not include on-board living accommodations.

Details about the dredge are covered in the following pages.

PRINCIPAL DIMENSIONS AND PARTICULARS

Suction Pipe Minimum I.D. (mm): 356
Discharge Pipe Minimum I.D (mm) 356
Digging depth, (m): 10
Ladder length, approximate (m) (13.1)

Mean draft, operating condition - approximate (m) 1.22

Total Approximate Assembly Dry Weight (kg) 186,000

HULL:
Length (excluding Spud Carriage), (m) 25
Width (m): 8.23
Depth (m) 1.83
Shell plate thickness (mm) 7.9
Basic frame spacing (m) 1.22

SPUD CARRIAGE:
Length (m) 10
Width (m): 8.23
Depth (m) 1.83
Spud Travel (m): 4.5

PUMP:
Ellicott Centrifugal Pump with the following minimum characteristics:
Suction diameter: 356 mm
Discharge Diameter: 356 mm
Diameter impeller: 940 mm
Particle clearance: 178mm

BUCKET WHEEL CUTTER
Shaft horsepower (kw): 250
Bucket outside diameter, excluding teeth (mm): 2387
Bucket Wheel Cutter Width (mm): 2116
Number of motors: 1

SWING WINCH: (Two) with the following minimum characteristics:
Shaft horsepower (kw): 45
Line speed - (m/min): 27
Line pull – Kg: 9525
Wire size - (mm): 19
Drum capacities - (m) 137.2

LADDER HOIST WINCH with the following minimum characteristics:
Shaft horsepower (kw) 76
Line speed - (m/min) 30.5
Line pull - (Kg) 11,566
Wire size - (mm) 22

SPUD WINCHES: (Two) with the following minimum characteristics:
Shaft horsepower (kw) 22.4
Line speed - (m/min) 7.9
Line pull - (Kg) 13,600
Wire size (mm) 25.4

GENERAL:

The above specifications are preliminary and subject to modification due to improvements in the design, modifications required during design and construction or addition of equipment not described in these specifications.

1. STRUCTURAL COMPONENTS

HULL:

The hull is made up of rectangular welded steel pontoons which are rigidly connected to provide stability and ample freeboard. The hull components are generally transversely framed, but also have longitudinal stiffeners. Foundations are provided under all machinery and the hull structure is reinforced in the way of these foundations.

The removable, watertight side pontoons are compartmented and attached to the center section by special watertight connections that are accessible from the exterior of the hull.

The assembled hull provides for a ladder-well at the forward end to accommodate the assembled ladder and to insure proper flotation and trim.

Each of the side pontoons has built-in water ballast tanks provided with limbers and vents to prevent formation of air pockets.

Suitable manholes with vertical ladders are provided in the side pontoon, water or oil tight as required. Deck cleats are suitably located on the hull.

The hull shell plating thickness and stiffener sizes meet or exceed the requirements of the American Bureau of Shipping Rules for Rivers and Intracoastal Waterways.

DECKHOUSE AND CONTROL CENTER

The deckhouse side panels are fabricated from 5/16 inch thick steel and the overhead panels and control center are fabricated from 12 gauge steel. Steel hatches in the overhead panels are provided for equipment access. Full head room and adequate, safe and weatherproof working space around all machinery is provided to facilitate maintenance. The deckhouse has sliding windows for light, a side entrance doorway for access and two (2) ventilating fans.

A control center is mounted forward of the deckhouse. The low profile design includes windows on all four sides for full view of the dredging operation, ventilation and lighting. The front windows are sloped to minimize reflections and all windows are tinted to minimize daytime glare. The control room is fabricated in one piece with disconnect fittings on all piping and controls and can be removed intact for shipping. A door on each side is provided for access from the control room to the machinery space. Functional design and construction provides comfort and conditions favorable to increased operator efficiency.

3. DREDGING COMPONENTS

DUAL WHEEL EXCAVATOR MODULE AND DRIVE:

The dual wheel excavating module consists of two (2) rotating wheels, a roller bearing supported drive shaft, a fabricated steel receiving hopper, a suction connection and the necessary structural

fittings for bolted attachment to the ladder structure. The dual wheel module is designed for dredging service with special consideration given to provide ease of maintenance and replacement of wearing parts.

The dual wheel is driven by one hydraulic motor through a gearbox. Speed and reversing of the motors is accomplished by fingertip controls at the operator's console.

The hydraulic motor drives the excavator wheel in both directions through a gearbox. The entire drive assembly is totally enclosed. To minimize the possibility of water entrance, a lubricating oil system with head tank is provided to maintain a positive internal pressure.

The rotating dual wheels mounted on the output shaft, each consist of eight (8) cast steel blades with fabricated steel rims welded together to form integral units. The blades are of weldable A.S.T.M. A-27 cast steel and provided with replaceable teeth. The teeth are of abrasion resistant cast steel.

The receiving hopper is a stationary unit, mounted between the rotating wheels and is of welded steel construction with replaceable abrasion resistant steel liners.

PIPE AND ACCESSORIES:

The suction pipe is connected to the dual-wheel receiving hopper at one end and the ladder supported suction pipe at the other end.

The suction pipe is equipped with a cast steel cleanout just ahead of the dredge pump to allow for removal of oversized material obstructing the pump.

An enclosed cast steel flap valve is included for installation in the discharge pipeline immediately aft of the discharge elbow. When the pump is stopped, the flap valve acts as a retaining valve and obstructs the slurry in the discharge pipe from returning to the pump. Additionally, the flap valve assists in the pump priming operation by effectively obstructing the discharge line.

LADDER AND SUPPORTS:

The ladder has been designed to meet the strength requirements of dredging service and to provide reliability and durability under rugged and severe conditions. The ladder is fabricated from A.S.T.M. A-36 structural steel. Bending and torsional strength is provided to insure the necessary rigidity for stabilizing the cutting action so as to be able to exert full dual wheel force on the material being dredged.

A bow gantry of A.S.T.M. A-500 steel tubing with rigid backstays and pin connections is provided at the forward end of the hull, which in conjunction with the ladder hoist winch provides for hoisting, lowering and holding the dredging ladder. The ladder winch is actuated by means of fingertip controls on the control console.

Steel safety straps for fixing the ladder in a raised position for towing or maintenance are included.

Fabricated steel trunnions with replaceable bushings are fitted to the aft end of the ladder. A connection for the ladder is provided by pins through the steel trunnions and trunnion bearing brackets on the main deck.

Balanced type swing sheaves with sealed, oil lubricated sheave bearings are of steel construction. These swing sheaves are mounted on the ladder just aft of the dual wheel module and are so designed as to reduce wear and jamming of the swing wires and provide a direct fairlead to the swing ropes onto the drums.

DREDGE PUMP:

The dredge pump shall be located on the main pontoon of the dredge. The pump shall be an Ellicott centrifugal pump with the following minimum characteristics:

Minimum Diameter: 14" (356 mm) suction and 14" (356 mm) discharge

Minimum Power: 375 kW

Minimum 37" (940 mm) diameter high efficiency impeller with minimum 7” (178 mm) particle clearance and patented recessed expeller vanes on both suction and engine sides - thread mounted.

Alloy cast iron (Ni-Hard 4) wearing parts - pump case, impeller and head liners - 500 BHN minimum.

Steel side heads, front head is adjustable to suit liner and impeller wear.

Packed stuffing box with flushing water connection and replaceable 316 stainless steel heavy duty shaft sleeve for sea and fresh water service.

Heavy duty alloy steel pump shaft with high capacity anti-friction roller bearings for thrust and radial loads with internal stainless-steel oil cooler and dual grease purged seals on water end. Shaft equipped with wrench flats to facilitate impeller removal.

Bearing housing internally sandblasted to white metal and coated with oil proof crankcase sealer.

Pump compartment sized to allow dredge to remain afloat when pump compartment is flooded to the main deck.

SPUDS, SPUD WINCHES AND SPUD CARRIAGE:

Two (2) spuds shall be supplied, one (1) mounted in a traveling spud carriage for working and one (1) mounted on the aft end of the hull for holding.

The spuds shall be of steel round tubular design with round steel points for penetrating the hard salt. Cross pins shall be provided at the top of each spud and also at a lower position to allow stowage of the spuds in a fully raised position.

Four (4) spud keepers, two (2) for the working spud mounted at the aft end of the traveling spud carriage and two (2) for the holding spud, mounted on the hull are provided. Gates with pin connections are provided for each spud keeper to facilitate insertion and removal of spuds.

Each spud shall be handled by a winch operated single part wire rope hoist allowing controlled raising and lowering along with freefall for good penetration into the bottom.

The spud winches are individual units each driven by a hydraulic motor through totally enclosed planetary reduction gearing. Each winch has an automatic, hydraulically operated, totally enclosed, disc type brake for holding the load and, in addition, a totally enclosed, disc type, freefall clutch.

Each winch is arranged for control by fingertip levers at the operator's console. Provision is made to prevent swinging the dredge when both spuds are lowered.

The traveling carriage operates in a central well at the aft portion of the dredge hull and consists of a heavy structural steel carriage operating on guide tubes through high capacity bronze bushings. The carriage is powered by a hydraulic cylinder of appropriate stroke with fingertip control at the console. An indicator board within full view of the operator continually monitors the position of the working spud. An interlock system with override will be provided to prevent swinging of the dredge in the following conditions:

- holding and working spuds both in down position
- holding spud in down position

The spuds, spud carriage and associated structure shall be fabricated of A.S.T.M. A-36 steel or better.

WINCHES: (SWING AND LADDER HOIST)

The Ellicott designed direct line winches for swinging of the dredge and raising the ladder are arranged for efficient power transmission. The winch units are in full view of the operator and readily accessible for maintenance.

Two (2) independent single drum swing winches are supplied, one (1) port and one (1) starboard and one (1) independent single drum ladder winch is supplied.

All winch drums are of cast steel and are equipped with self-aligning anti-friction bearings supported by fixed drum shafts.

Each drum is driven by an independent slow-speed high-torque hydraulic motor through open steel gearing with cut teeth. The drum gear is bolted directly to each drum and engages the motor pinion which is mounted in self-aligning anti-friction bearings.

The hydraulic system is arranged to provide for dynamic hydraulic braking of the swing winches by actuating independent lever operated pilot relief valves at the control center and also to provide for "power up" and "power down" of the dredging ladder by single lever operation.

The ladder hoist, in addition, is equipped with a manually operated mechanical pawl which engages the gear teeth for added safety when the ladder is in the stowed position.

All necessary sheaves, of cast steel with bronze bushings and oversized pins are provided for ladder hoisting and for guiding the swing wires to the ladder mounted swing sheaves.

4. HYDRAULIC POWER SYSTEM

Agitation and feed to the suction inlet in a wide range of materials (soft to compact) is obtained with Ellicott's variable control wheel excavator and swing winches. Excavator speed can be increased or decreased and at the same time the swing winch line speed can be increased or decreased, thus insuring maximum power balance and power utilization for the widest range of materials to be dredged.

The hydraulic system is made up of two (2) independent closed loop circuits: and one open loop circuit. The wheel excavator is powered by one of the closed loop circuits and the two (2) swing winches are powered by the other closed loop circuit. The ladder hoist winch, spud winches and spud carriage cylinder are powered by the open loop circuit.

The swing winch circuit has a variable displacement axial-piston hydraulic pump driving low-speed high-torque radial-piston motors. Speed control over the entire speed range of the swing winches is attainable with maximum line pull at all speeds. One single lever speed control and two (2) forward, neutral, reverse, lever operated switches, one for each winch, are provided in the control console. The switches control solenoid operated 4-way valves which provide for independent control of each swing winch. Pilot operated relief valves controlled at the operators console allow hydraulic braking of the swing winches.

Gear type pumps, built integral with the variable displacement hydraulic pumps, provide for displacement servo control and for make up oil for both closed loops. These gear pumps draw their oil directly from the hydraulic reservoirs through heavy duty suction strainers. Fine filtration is also provided on the discharge side of the gear pumps.

The closed loop circuits are equipped with relief valves for overload protection, accumulators for shock absorption, air to oil type heat exchangers for heat dissipation, and fine filtration for system clean-up purposes. The closed loop systems for the continuous duty excavating and swinging functions offer flexibility and efficiency. Motor output is controlled by actual system demand which minimizes power consumption.

Each hydraulic circuit shall have an auxiliary pump identical to the main pump. The auxiliary pump for each circuit will be able to be operated in place of the main pump. In the case of multiple pumps in a circuit, the auxiliary pump shall be able to replace any of the main pumps, one at a time. Each pump can be added to/removed from the circuit via manually operated valves and coupling.

All hydraulic pumps shall be sized per Ellicott Standards.

The open loop circuit consists of a heavy duty positive displacement gear pump driving the low-speed high-torque motor on the ladder hoist winch, the vane type motors for the spud winches and the spud carriage cylinder. The ladder hoist and spud functions are controlled by individual lever-type switches at the control console which actuate solenoid operated 4-way valves. The circuit is equipped with a flow control valve operable from the control console for varying speed and a counterbalance valve to control ladder lowering. The pump draws its oil from the hydraulic reservoir through a heavy duty suction strainer and fine filtration is provided on the return side of the open loop. Relief valves for overload protection and air to oil type heat exchangers for heat dissipation are provided.

Each of the three (3) hydraulic circuits is provided with an independent reservoir to minimize the probability of contamination between circuits. Low level switches on the reservoirs and low make-up pressure switches in the closed loop circuits are arranged for electric motor shutdown and alarms, Electric heaters and air to oil coolers are designed to maintain an oil temperature of 45 degrees C to 65 degrees C.

The two (2) variable displacement excavator pumps are directly connected with flexible couplings to an independent double shaft squirrel cage induction motor.

The variable displacement swing winch pump and the fixed displacement ladder winch and spud system pump are also directly connected with flexible couplings to an independent double shaft squirrel cage induction motor.

Each motor and pump unit is assembled on a rigid structural steel base and mounted on the main deck within the deckhouse,

5. ELECTRICAL SYSTEM

The electrical system is designed for incoming 11Kv High voltage line, Frequency 50Hz.

Incoming shore power cable to be supplied by the Purchaser.

6. CONTROL CENTER AND OPERATING CONTROLS

For safety in operations, flexibility and efficiency, the controls have been designed and mounted on the Ellicott console in the control center to provide for one-man operation of the dredging sequence.

The planned built-in comfort features of the control center with air conditioners to combat operator fatigue and prolong working efficiency.

The following specific controls are provided:

a) Single lever control for ladder raise and lower.
b) Ladder friction brake air control lever.
c) Ladder/spud circuit speed control lever.
d) Swing winch speed control lever.
e) Port swing hydraulic brake control lever.
f) Starboard swing hydraulic brake control lever.
g) Port swing friction brake air control lever.
h) Starboard swing friction brake air control lever.
i) Port swing winch forward, neutral, reverse lever.
j) Starboard swing winch forward, neutral, reverse lever.
k) Wheel excavator speed and direction control lever.

l) Port spud hoist-lower – drop control lever.

m) Starboard spud hoist-lower – drop control lever.

n) Spud carriage travel control lever.

o) Dredge pump motor speed control.

p) Controls and indicating instruments/lights.

q) Ladder/Spud circuit hydraulic pressure gauge.

r) Excavator hydraulic pressure gauge.

s) Swing winch hydraulic pressure gauge.

t) Dredge pump motor ammeter.

u) Dredge pump motor tach.

v) Control air pressure gauge.

w) Dredge pump vacuum gauge.

x) Dredge pump discharge pressure gauge.

A dredging depth indicator and spud carriage position indicator visible from the control center are mounted on or near the bow gantry.

Appropriate starting and shutdown controls are adjacent to all motors in accordance with standard safety practices.

7. MISCELLANEOUS EQUIPMENT

The dredge shall have auxiliary support equipment aboard as follows:

a) Service water pump complete with electric motor to provide water pressure for washdown hoses.

b) Impeller lifting hook

c) Stern jib crane

d) Air conditioner and inlet air filters for the control house and electric equipment room

e) Safety rails

f) Tool kit

g) Nameboards

h) Portable fire and bilge submersible pump – electric with suction and discharge hoses

i) One (1) motor driven fresh water pump with pressure tank, piping, two (2) deck hose stations and one (1) sink with faucet in lever room (Supplied from hull tank)

j) Wire rope for ladder, swing and spuds

k) Zinc anodes on hull and ladder for cathodic protection – bolted attachment

l) Alarm panel mounted in lever room including alarms and shutdown indications

8. INSTRUCTION MANUALS

The following manuals in the English language are provided with the dredge:

Four (4) copies of illustrated booklets for the field assembly, maintenance and operation of the dredge, including schematic drawings for the electric circuits, hydraulic circuits, service water piping, etc.

Four (4) copies of the illustrated repair parts ordering booklets applying to the dredging equipment manufactured by Ellicott.

Four (4) copies of operating instructions, maintenance manuals, bulletins, etc., applying to the commercial machinery and equipment supplied by Ellicott's subcontractors.

Four (4) sets of launching procedure and field assembly recommendations.

9. PAINTING

The dredge shall be painted according to Ellicott Dredges, LLC's standard schedule.

The hull (consisting of the center tank and all side tanks) shall be sandblasted before painting. The hull shall be blasted internally and externally to a commercial grade (SSPC-SP-6). All other steel work shall be wire brushed and thoroughly cleaned of loose mill scale, rust, oil, or other foreign matter before painting.

The hull shall be given one (1) coat of Carbomastic 15 or equal on the interior and exterior of 5 mils thickness and an additional coat of Carboline D890 or equal on the exterior of 5 mils thickness.

All other surfaces shall receive a primer coat of five (5) mils thickness of Carbomastic 15 or equal and a finish coat of five (5) mils thickness of Carboline D890 or equal. The primer coat will be allowed to dry thoroughly and harden before application of the finish coat.

10. SUMMARY

All the machinery described in these specifications is coordinated to form a balanced operating unit.

All materials and machinery components will be new and the workmanship shall be of high order.

If any component, part, material or fabrication process requirements is not explicitly specified by the Purchaser, or is in conflict with the Purchaser's specifications, the Ellicott specification and standard practice will prevail.

It is the policy of Ellicott to make continual improvements in the design and manufacture of our products; therefore, the right is reserved to modify these specifications to provide for the use of any such improvements, which may have been developed prior to the time of actual manufacture.