Ministry of Water and Energy

Ethiopia Flood Management Project (P-176327)

Environmental and Social Impact Assessment (ESIA) for Amibara Right Bank Flood Risk Reduction (Embankment) Project – Awash Basin ESIA Sub Section

(Revised Draft ESIA Report, ESIA-AW-01)

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EXECUTIVE SUMMARY

General Background

The Awash Basin is highly vulnerable to recurrent flooding, particularly in the Middle and Lower Awash floodplains. These floods have repeatedly damaged agricultural land, irrigation infrastructure, roads, and community assets, adversely affecting livelihoods and local economies. Existing flood protection structures have been constrained by several challenges, including sedimentation, ageing, inadequate structural quality, changes in land use, and weak coordination among responsible institutions. In this context, flood management along the Awash River combines structural measures, including dike/embankment construction and non-structural measures such as land use planning, flood mapping, early warning systems, and community preparedness to strengthen basin-wide resilience and mitigate recurrent flooding. Amibara Woreda, situated along the Awash River in the Afar Region, has a long and painful history with flooding. The Awash River, while it remains essential for the livelihoods of agro-pastoralist communities, has also transformed into a destructive force during periods of heavy rain.

The ESIA Study Methodology/Process

A comprehensive desk assessment was conducted to understand the occurrence and experiences of flooding, the capacity of local institutions to respond, and the social implications of the proposed flood protection structures. The insights gathered are intended to be used to verify and to ensure that planned interventions should not only be technically sound but also socially responsive and culturally appropriate. This study process has been designed to be a rigorous, evidence-based, and participatory exercise. It employed a phased, risk-informed approach, technical investigation and understanding, commencing with an intensive desk study phase to establish the regulatory context and baseline (socioeconomic and biophysical environment) considerations. This has been complemented by comprehensive field investigations to collect primary biophysical and socio-economic data across the sub-project's area of influence, and the engagement of relevant stakeholders, ensuring meaningful consultation with all relevant parties, from federal and regional authorities to directly affected communities, including vulnerable groups.

Sub-project Location and Description

The sub-project is located in Afar Regional State, Ethiopia, primarily within Amibara Woreda (Administrative Zone 3) and portions of Haruka Woreda. The Sub project Area of Influence (PAI) includes **a** 200 m buffer zone along the alignment for direct construction impacts, with broader indirect effects on nearby kebeles and agricultural areas dependent on flood protection. The sub-project is a strategic flood protection intervention led by the Ministry of Water and Energy (MoWE) with World Bank support, aimed at replacing old flood protection infrastructure in the Middle Awash Basin. The sub-project combines core infrastructure, consisting of a 60 km compacted earth dike with a reasonably wide crest width (4 meters) that serves as an access road for inspections and maintenance. The sub-project progresses through four phases: pre-construction preparation, construction of the dike/embankment, operation and maintenance, and eventual decommissioning and land rehabilitation.

Physicochemical Baseline Conditions

The project area lies within a semi-arid section of the Main Ethiopian Rift at elevations of 700–1,000 m, marked by high temperatures (reaching up to 37.4 °C) and low, highly variable rainfall. From the project intervention perspective, particular attention is required due to its classification within Seismic

Zone 3, indicating a significant level of seismic hazard. This necessitates rigorous geotechnical investigations and earthquake-resilient design measures to mitigate potential risks to infrastructure and communities.

The geology is characterized by Fluvisols and expansive Vertisols, with the latter posing additional challenges for construction due to pronounced shrink–swell characteristics, which can exacerbate structural vulnerability under seismic loading conditions. Baseline environmental conditions are generally clean but naturally harsh: ambient air quality is relatively good in terms of anthropogenic pollutants, though elevated dust levels arise from strong winds and sparse vegetation cover. Noise levels remain low and typical of a rural-pastoral environment.

A key environmental and public health concern is groundwater quality, with fluoride concentrations ranging from 7.3 to 9.5 mg/L—well above recommended limits—requiring targeted mitigation measures within the ESIA framework. Overall, the combination of seismic risk, problematic soil conditions, and water quality constraints underscores the need for integrated risk management and design adaptation strategies.

Biological Baseline Conditions

Overall, the sub project area's ecosystem, once rich in riverine forests and Acacia-Commiphora shrublands, is now highly degraded due to water diversion, overgrazing, and invasive species. The spread of *Prosopis juliflora* and *Parthenium hysterophorus* has displaced native plants and reduced grazing and agricultural productivity, while aquatic weeds clog irrigation systems, highlighting the need for consideration of environmental management and addressing issues that may exacerbate environmental degradation at all stages of the project..

Socioeconomic Conditions and Sensitivities

This report presents the socioeconomic baseline conditions of communities within and adjacent to the proposed flood protection intervention (right bank embankment) in Amibara Woreda, considering field observation, KII, community consultation and a household survey across eight kebeles of the woreda. Men-headed households make up 89.4% of the sample households and carry the weight of managing livestock when flood risks rise. The remaining10.6% of the HHs are women-headed. Moreover, 30.2% of the households in the area are vulnerable to various social and natural shocks.

The major livelihoods constitute livestock herding (35.8%), irrigated farming (24.5%), and day labour (22.6%), linked with agricultural activities. Thus, 81.1% of households directly depend on the river for their livelihood. This means that any disruption plunges them into an immediate livelihood crisis. Women also bear extraordinary burdens and risks, as they are taking the role of constructing and moving mobile homes, caring for families, and during crises face increased risks of early marriage, rape, and unwanted pregnancies. People with disabilities, the elderly, and patients are harder to evacuate and slower to recover. Cultural heritage sites, including worship places and graveyards, lie along the proposed alignment, and communities demand "due consideration and care" for all cultural assets, mainly holy sites and graveyards. Local stakeholders and community leaders call for strengthened institutional coordination, PSEA protections, and livelihood support during and after construction.

Sub-project Alternative Considerations and Analysis

A Multi-Criteria Analysis (MCA) was used to compare the sub project alternatives based on five key sustainability pillars. In this report, a multicriteria analysis was conducted using a score-based system, where each option was rated on a scale from 1 to 5. the *Approach with Setback Alignment* is selected as the best option. It provides robust flood protection, minimizes environmental impacts, supports local communities, and ensures long-term climate resilience for the Amibara Right Bank.

The Key Considerations and Way Forward

This site-specific ESIA will provide a robust analytical foundation and project management frameworks required to guide responsible construction and ultimately ensure that the ET-FMP contributes to the long-term resilience and sustainable development of the Awash Basin communities and ecosystems. The intervention envisaged both positive and negative impacts on the environment and socioeconomic settings. The enhancement measures are proposed for the key positive impacts identified, which include Local Employment and Income Generation, Skill Transfer and Capacity Building, Agricultural Protection and Flood Resilience, Ecosystem Recovery and Reforestation, Improved Community Access and Safety and Local Market Stimulation. The desired mitigation measures are also suggested for the identified negative impacts at all stages, which include loss of flora and fauna, erosion and turbidity, soil salinity, water and air pollution, hydrological changes, climate change sensitivity, occupational and EHS risks, resource-based conflict and gender based violence, among others. Ultimately, the sub-project's key performance indicator has been determined to be put into practice by utilizing the environmental and social management and monitoring plan, along with the suggested actions to appraise and evaluate the efficacy of the mitigation measures and creating an environmental checklist for auditing purposes.

The successful implementation of the sub-project depends on the capacity of institutions at all levels to carry out the environmental and social management plan (ESMP) prepared in this ESIA report. Sufficient resources should be allocated for training and capacity building. The estimated budget for the environmental management plan is estimated approximately **168,100,000.00** ETB, the environmental and social monitoring plan estimated cost is **12,785,000.00** ETB and capacity building is estimated at approximately **2,500,000.00** ETB.

In summary, the proposed sub-project holds substantial promise in enhancing the safety and well-being of the community and socioeconomic improvements in the Awash Basin in general and in Amibara District in particular. The potential positive impacts significantly outweigh the adverse impacts, which can be effectively mitigated through diligent adherence to the proposed Environmental and Social Management Plan (ESMP)

LIST OF ACRONYMS

Acronym	Full Form / Meaning
ABA	Awash Basin Administration Office
CSA	Central Statistics Authority
DEM	Digital Elevation Model
DRM	Disaster Risk Management
EPA	Environmental Protection Authority
ESIA	Environmental and Social Impact Assessment
ESF	Environmental and Social Framework
ESMP	Environment and Social Management (Monitoring Plan) Plan
EES	Environmental and Social Standard
ESF	Environmental and Social Framework
ET-FMP	Ethiopia Flood Management Project
EDRMC	Ethiopian Disaster Risk Management Commission
FPIC	Free, Prior, Informed Consent
FRR	Flood Risk Reduction
GBV	Gender Based Violence
GDP	Growth Development Program
GRM	Grievance Redressal Mechanism
GTP	Growth and Transformation Plan
Ha	Hectare
IWRM	Integrated Water Resource Management
M&E	Monitoring and Evaluation
MoH	Ministry of Health
MoWE	Ministry of Water and Energy
EMI	Ethiopian Meteorology Institute
RAB	Regional Agricultural bureaus
RP	Resettlement Plan
RWB	Regional Water Bureau
SEP	Stakeholder Engagement Plan
SRAMP	Security Risk Assessment and Management Plan

1. INTRODUCTION

1.1. Background

The Environmental and Social Impact Assessment (ESIA) for the Awash River Basin was launched at a pivotal moment for Ethiopia's development. The nation faces increasingly severe and escalating flood events that critically threaten human security, economic stability, and ecological health. As a core component of the World Bank-funded Ethiopian Flood Management Project (ET-FMP), this study is a foundational tool for responsible and sustainable investment in one of the country's most critical and vulnerable regions.

The mandate of ESIA will extend beyond meeting formal requirements, such as national Proclamation No. 299/2002 and the World Bank's Environmental and Social Framework (ESF). It functions as the primary analytical tool to ensure that major investments in flood protection infrastructure achieve their goals without creating new environmental problems or worsening existing social vulnerabilities. Guided by a philosophy of integrated water resource management, the study seeks to harmonize engineering solutions with the complex dynamics of the Awash River ecosystem and the communities that depend on it. Consequently, this ESIA is designed to embed principles of resilience and equity into every stage of the sub-project's lifecycle, from planning to operation.

The ET-FMP itself is a strategic, paradigm-shifting response to a chronic national issue, aiming to catalyze a systemic shift from costly post-disaster emergency response to proactive, integrated risk management. Hence, the ESIA is about the proposed flood risk reduction (embankment) sub-project in the Amibara district specifically.

1.2. Highlights on Flood Hazard Management Practices in Ethiopia

The strategic design of ESIA is grounded in a necessary shift away from Ethiopia's historical approach to flood hazard management. Past interventions have often been reactive, fragmented, and spatially isolated, focusing on localized structural measures without sufficient basin-wide analysis or comprehensive and careful consideration of long-term environmental and social consequences. This legacy approach has, in documented instances, led to adverse outcomes including inadequate community resettlement, disruption of natural hydrological regimes, and the fragmentation of critical habitats.

The Ethiopia Flood Management Project (ET-FMP), through its explicit mandate for full-scale, basin-level ESIAs, represents a decisive departure from this paradigm. It embodies a modern, holistic understanding of flood risk that recognizes a river basin as a dynamic socio-ecological entity. Consequently, effective flood protection must be conceived as a strategic intervention within a complex watershed system. Hence, the ESIA process serves as the primary analytical framework for navigating this complexity in the Awash Basin. By establishing rigorous baselines, conducting meaningful stakeholder engagement, and analyzing cumulative impacts, the study will generate the foundation necessary to guide sustainable design, encouraging the avoidance of sensitive areas and the proactive mitigation of adverse impacts. In this way, the ESIA ensures the ET-FMP aligns with national commitments, transforming flood protection into an instrument that advances sustainable development, poverty reduction, and ecological stewardship.

1.3. The Flood Management Project (ET-FMP) and the Role of the ESIA

The Ethiopian Flood Management Project (ET-FMP) is supported by a loan from the World Bank/International Development Association (IDA) and will span five years (2023-2028). The project aims to reduce flood risks through structural and non-structural measures in the three target basins. The overall project's Development Objective (PDO) is to strengthen Ethiopia's institutional capacity for disaster risk management (DRM) and flood risk management in selected basins.

The project has a core objective of building institutional capacity and making strategic investments to reduce the severe social and economic costs of flooding. This ESIA study is a fundamental part of the project's second component, "Accelerating Flood Risk Management Investments." The specific assignment is to conduct a comprehensive ESIA for flood protection infrastructure in the Awash River Basin, ensuring proposed structures are technically sound, environmentally sustainable, and socially inclusive.

The consultancy will produce a basin-wide ESIA report and develop an actionable, site-specific Environmental and Social Impact Assessment (ESIA). A critical and urgent deliverable is the expedited ESIA for the high-priority Amibara area, identified for fast-track implementation. Success is contingent upon continuous, iterative collaboration with the separate engineering design teams to ensure environmental and social safeguards, including findings on gender, vulnerability, and ecological findings, are integrated into final sub-project designs from the outset.

Critical Safeguard Condition: It is unequivocally stated that no construction or ground-breaking work on any sub-project, including fast-tracked works, will commence before three conditions are met: (i) completion of the necessary environmental and social screening for the specific site; (ii) meaningful stakeholder engagement and disclosure of draft management plans; and (iii) the formal approval of the corresponding site-specific ESIA. This condition is a non-negotiable control gate embedded in the sub-project schedule.

Furthermore, recognizing climate change as a key driver of increasing hydrological volatility, the ESIA will systematically integrate climate risk analysis. This involves assessing infrastructure resilience against future climate projections and embedding concrete adaptation measures into the ESIA, ensuring the long-term effectiveness and cost-efficiency of investments in a changing climate.

1.4. Objectives

The primary objective of the consultancy service is to conduct an ESIA study for the Awash river basin. This assessment will identify potential environmental and social impacts and risks associated with the construction of the Amibara Embankment /flood protection structures and operational activities, while developing a site-specific ESIAs that includes the environmental monitoring plan to mitigate the adverse impacts and enhance the initial consideration of the desired socioeconomic and biophysical environment elements before the construction of the flood risk reduction works for the benefits of the ET-FMP.

The specific objectives of the assignment are to:

- To establish robust biophysical and socio-economic baseline conditions for each basin and specific sub-project site.
- To identify, predict, and evaluate all significant positive and negative environmental and social impacts associated with the design, construction, operation, and decommissioning of flood protection structures.
- To develop detailed Environmental and Social Impact Assessments (ESIAs) for priority sites, including urgent plans for the Amibara district flood protection structures.
- To analyze and develop concrete measures to avoid, minimize, or compensate for unavoidable adverse impacts, while maximizing project benefits

- To ensure full compliance with Ethiopian environmental laws and the World Bank's Environmental and Social Standards (ESS) listed in the Environmental and Social Frameworks (ESF) for sub-project interventions of this nature and scope.
- To conduct meaningful, inclusive, and gender-sensitive stakeholder consultations and integrate feedback into sub-project design and mitigation.
- To assess alternatives (including the "without sub-project" scenario) and propose design optimizations.
- To provide indicative data on potential displacement and assets affected to inform whether Resettlement and Land Acquisition Issues are important and need desired actions.
- To propose training curricula to build the capacity of relevant institutions in the ESMP and basin-wide ESIA implementation, monitoring, and flood risk management.

1.5. Scope of the Consulting Engagement Activities in line with the ET-FMP Project

The ET-FMP project considers the following four main components aimed at enhancing disaster risk management (DRM) and climate resilience:

1. **Strengthening Institutional and Coordination Capacity for Disaster Risk Management:** Enhancing coordination among federal and regional agencies.
2. **Accelerating Flood Risk Management:** Implementing physical investments and providing technical assistance to mitigate flood risks. This includes structural interventions like constructing flood protection structures as well as non-structural measures.
3. **Contingent Emergency Response:** Supporting emergency response and reconstruction efforts.
4. **Project Management and Implementation Support:** Strengthening institutional capacities and covering operational costs.

In this context, in order to increase basin-wide resilience and reduce recurrent flooding, flood management along the Awash River combines non-structural measures like land use planning, flood mapping, early warning systems, and community preparedness with structural measures like dike/embankment construction, river channel widening, and bed dredging with reservoir improvements.

The specific assignment described in this report is to conduct a focused and comprehensive Environmental and Social Impact Assessment (ESIA) for the flood protection infrastructure planned within the Awash River Basin. The scope is specifically designed to address the basin's unique combination of high economic value and acute environmental sensitivity.

Two core output components are expected: a comprehensive basin-level ESIA report and the development of site-specific Environmental and Social Impact Assessments (ESIAs) for priority intervention areas. We envisage and prioritize an immediate engagement for the preparation of ESIAs for the Amibara area to facilitate the timely commencement of critical works in accordance with MoWE's (ET-FMP) guidance.

Key deliverables for the Awash Basin component include the ESIA Report, the site-specific ESIAs as per the recent feedback and comments of the WB and the complemented and approved guidance of the MoWE team. Besides, indicative baseline information for future Resettlement and/or land acquisition issues that may arise (if there are any) and all supporting baseline datasets could also be considered and provided. These outputs are designed to systematically identify and mitigate risks specific to the Awash basin context, integrate climate resilience into design, and ensure full compliance with national regulations and World Bank standards.

2. THE SUB-PROJECT DESCRIPTION

2.1 Introduction

2.1.1. Location and Sub-project Area Overview

The Awash River Basin is the fourth largest catchment in Ethiopia, after the Wabi Shebele, Abbay, and Genale-Dawa basins. It lies between 7°53′42″–12°07′20″ N and 37°56′56″–43°17′ 04″E, bordered by several basins and Djibouti. The river rises near Ginchi in the central highlands, flows northeast through the Rift Valley, and empties into Lake Abbe after about 1,200 km. The basin covers roughly 116,000 km². The location map of the total Awash basin and Afar regional administrative woredas is displayed in Figure 2.1 below.

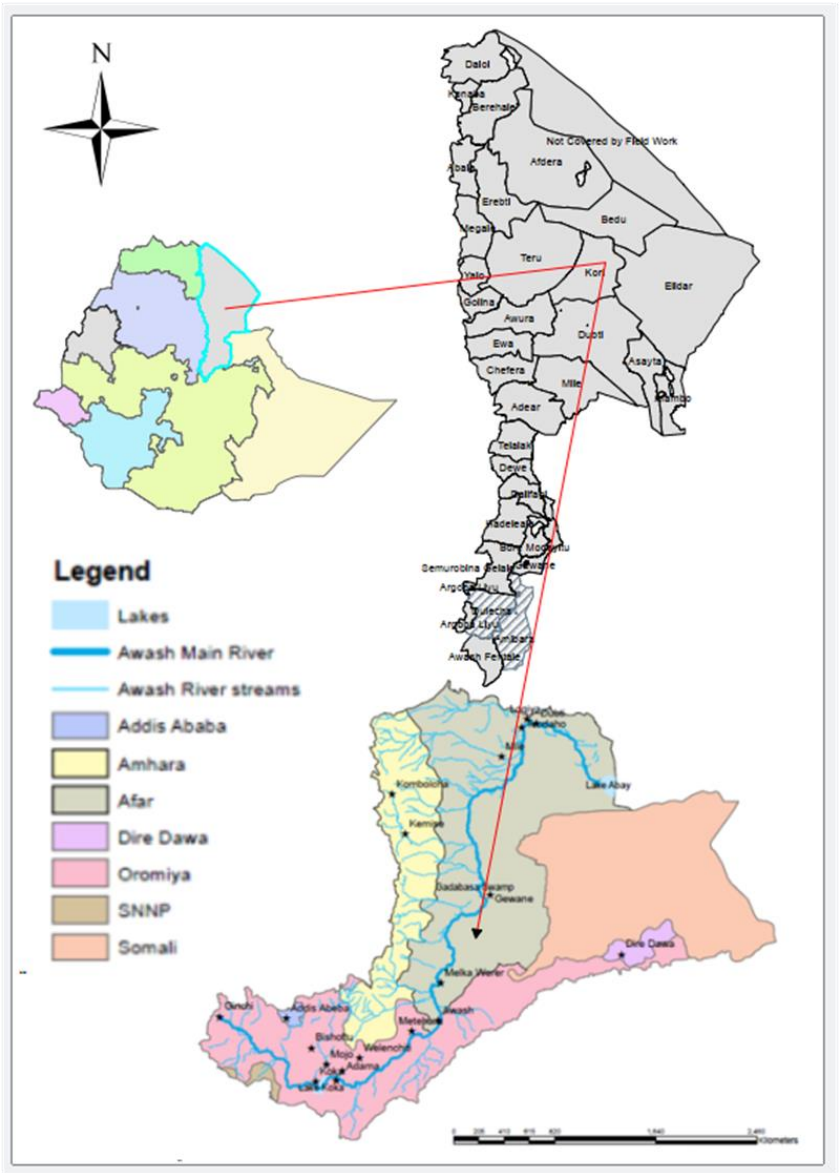

Figure 2.1: Location map of the Awash Basin

The current sub-project area is focused on the middle awash sub-basin that include Amibara, Haruka, Dulecha, Gewane, and Gelealo Woredas. Specifically, Amibara wereda zone three, Afar regional state. The specific sub-project is located in Amibara woreda in Afar Region, Ethiopia. Part of the Administrative Zone 3. Amibara is bordered on the south by Awash Fentale, on the west by the Awash River, which separates it from Dulecha, on the northwest by the Administrative Zone 5, on the north by Gewane, on the east by the Somali Region, and on the southeast by Oromia Region. Towns in Amibara include Awash Arba, Awash Sheleko, Melka Sedi and Melka Werer.

The Amibara Right Bank Flood Risk Reduction Sub-project is a strategic initiative led by Ethiopia's Ministry of Water and Energy (MoWE) in partnership with the World Bank. The sub-project is designed to address the severe seasonal flooding that characterizes the Middle Awash Basin, threatening both local livelihoods and regional economic stability. This specific ESIA is strictly limited to the Amibara Right Bank intervention area.

The sub-project focuses on the construction and rehabilitation of a 60-kilometre embankment stretching from the Melka-Sedi (weir site, zero-zero) water intake to Haruka downstream. By strengthening flood risk management, the intervention seeks to enhance climate resilience for the communities in the flood-prone areas of the Afar Region. Beyond the primary embankment, the sub-project incorporates supporting infrastructure designed to integrate with the local way of life. This includes pedestrian crossing bridges, irrigation intake structures, livestock watering facilities, and comprehensive riverbank protection works.

The key objectives of the sub-project are as follows:

- **Flood Risk Reduction:** The primary goal is to minimize the destructive impacts of seasonal flooding on human settlements, agricultural lands, and critical local infrastructure along the Awash River.
- **Agricultural Protection:** The sub-project aims to shield productive lands, specifically those cultivating cotton, maize, onion, and tomato, from the dual threats of flood inundation and heavy sediment deposition.
- **Infrastructure Safeguarding:** A major focus is placed on protecting essential public assets, including irrigation facilities, schools, health centres, and rural road networks.
- **Livelihood and Mobility Improvement:** By providing safe river crossing structures and improved water management infrastructure, the subproject enhances access to markets, essential social services, and vital grazing areas for pastoralist populations.

Therefore, this environmental and social impact assessment is specifically tailored to the geographic and operational boundaries of the Amibara Right Bank sub-project, ensuring that mitigation measures are directly aligned with the unique needs of the Middle Awash Basin.

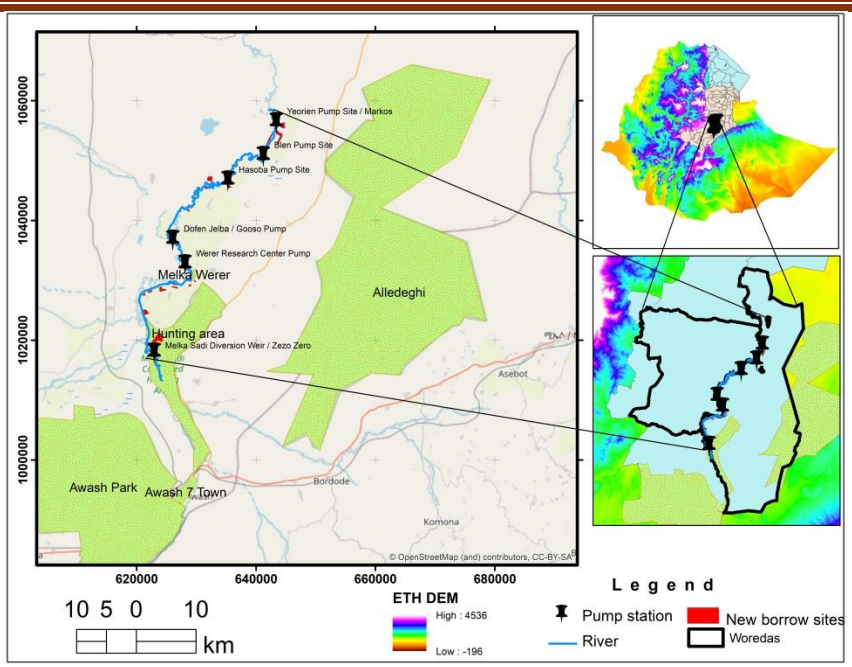

Figure 2.2: Location map of the Amibara Site Specific Embankment Sub Project

2.2 Description of the Existing Flood Protection Works

2.2.1 Existing Flood Protection Infrastructure

The existing **60-km dike system**, constructed more than **45 years ago**, has reached an advanced state of deterioration. Field observations indicate that the structure is largely ineffective in protecting against current flood risks, leaving adjacent communities and agricultural lands highly vulnerable to inundation.

1. **Physical and Engineering Constraints**

Material and Structural Integrity: The dike is primarily composed of permeable river sand, which lacks sufficient cohesion to withstand high hydraulic pressure during flood events. Prolonged environmental exposure over several decades has resulted in significant erosion and multiple structural breaches. As illustrated in Figure 2.3 below, the Awash River has already bypassed the primary structure at several locations along the right bank. Moreover, the side slopes exhibit geotechnical instability, further compromising the structural integrity and reliability of the flood defence system.

2. **Geometric and Operational Limitations**

The geometric characteristics of the dike do not meet modern engineering standards. The crest width is highly inconsistent, varying between 1.5 m and 4 m along different sections of the structure. Severe surface degradation and uneven topography have rendered the crest impassable for heavy maintenance vehicles and unsafe even for motorcycles. Consequently, routine inspection, monitoring, and emergency maintenance operations are significantly constrained.

3. **Biological Interference**

The entire 60-km stretch of the dike is heavily infested with the invasive species *Prosopis juliflora* (locally known as Weyane). Although the local community harvests the plant for charcoal production, its presence introduces significant engineering risks:

- **Piping and Seepage:** The species develops deep taproots that create preferential flow paths within the dike body, increasing the likelihood of internal erosion and piping.
- **Physical Obstruction:** Dense vegetation forms a biological barrier that limits accessibility and visibility, hindering effective inspection and maintenance activities.

Overall, the existing flood protection structure is under significant stress due to dynamic river channel shifts. Active channel migration has triggered substantial bank erosion, directly compromising structural stability. Furthermore, the proliferation of invasive vegetation, coupled with a narrowing crest width, has obstructed access to large sections, effectively preventing routine monitoring and essential maintenance (Figure 2.3).

Figure 2.3: Observed threats to dike integrity: (a) Bank erosion triggered by shifting river dynamics; (b) View of the narrowed crest, slope side and dense Prosopis juliflora

4. Environmental and Social Impacts Incidences Associated with the Existing Deteriorated Flood Protection

The deteriorating existing dike, combined with the absence of crossing bridges, has had serious social impacts, acting as a barrier that cuts off connectivity between Dulecha and Amibara Woredas, and blocks traditional livestock routes and pedestrian access to the river, disrupting essential social and economic interactions. Meanwhile, vulnerable communities in these areas, such as female-headed households, remain stranded in the high-risk areas, leaving them exposed to recurring floods and limited access to safe escape routes.

Environmental impacts are also significant. Chronic seepage through the sandy dike and along Prosopis root channels has led to waterlogging in nearby agricultural fields, increasing soil salinity and reducing crop productivity. Overall, these combined physical, social, and environmental challenges underscore the urgent need to rehabilitate or replace the existing dike.

2.2.2. Proposed Flood Protection Infrastructure

The primary flood protection measure proposed under the sub-project is an earthen embankment (dike) constructed using compacted soil sourced from designated borrow areas. To ensure long-term stability during high flood events, the embankment will incorporate targeted erosion protection measures at vulnerable sections.

Key structural components of the proposed dike and associated activities include:

- **Compacted Earth Embankment:** The main body of the dike will be constructed from well-compacted soil to provide strength and resilience against flood pressures. The proposed embankment (Dike) will extend approximately 60 kilometres along the right bank of the Awash River, beginning near the Melka-Sedi water intake and extending downstream (Haruka) through flood-prone areas within Amibara and Haruka Woredas of the Afar region
- **Crest Functionality:** The crest will be designed to serve as an access side berm and an access road, facilitating routine inspections and repairs.
- **Slope Protection:** Vulnerable slopes will be reinforced using riprap, gabions, or Reno mattresses to reduce erosion and enhance structural stability.
- **Toe Protection:** The base of the embankment will include measures to prevent erosion and undermining of the structure.
- **Drainage Provisions:** Adequate drainage systems will be incorporated to manage seepage and prevent internal erosion (piping), ensuring the embankment's integrity during prolonged high-water conditions.

The Dike is expected to have a 4 m crest width and 0.9 m freeboard, using loose fill. Steel through-truss bridges (up to 2 m wide, 3 m high) support livestock movement with non-slip grating. Reinforced concrete troughs (12 m × 0.6 m) include soak-away aprons, while irrigation intakes are built into the dikes for controlled water use. Erosion is managed with riprap, gabions, and Reno mattresses, and silt fencing protects water quality during construction.

The alignment of the embankment was selected based on hydrological analysis, topographic surveys, flood risk assessments, and environmental considerations to maximize protection while minimizing potential impacts. All construction must be completed before the rainy season (June-September) to avoid catastrophic failure. Further details on project alternatives are provided in this chapter under section

2.2.3 Description of the Sub-project Area of Influence

The Sub project Area of Influence (PAI) encompasses the geographical areas and communities that may be directly or indirectly affected by the construction and operation of the Amibara Right Bank Flood Risk Reduction Sub project(flood protection infrastructure), as well as all ancillary areas. This includes the primary construction footprint, ancillary facilities, and logistical corridors, as well as areas within a recommended 200-meter buffer zone surrounding the sub-project site. The primary sub-project influence area is shown in Figure 2.4 below.

The PAI is divided into the following key components:

- ⇨ Primary Infrastructure Footprint: Includes the main embankment (dike) alignment, extending approximately 60 kilometres along the right bank of the Awash River and Left bank risk reduction intervention at the hotspot areas. The alignment starts near the Melka-Sedi water intake and continues downstream through high-risk flood-prone zones in the Amibara and Haruka (formerly Dulecha) Woredas of the Afar Region.
- ⇨ Access and Logistics Corridors: Permanent and temporary roads required for transporting heavy machinery, construction materials, and personnel to active construction areas.
- ⇨ Material Source Areas: Dedicated zones for resource extraction, including borrow pits for earthfill material and quarries for rock armor and aggregate.
- ⇨ Support Facilities: Construction camps, equipment yards, and fuel storage sites strategically located to support sub-project management and operations.
- ⇨ Ecological Impact Zones: The ecological impact zone of the sub-project activities is expected to be limited. Vegetation clearing and habitat alteration will be kept to a minimum through the strict application of environmental management and mitigation measures.

2.2.3.1 Site Footprint (Primary Impact Zone)

The site footprint and primary impact zone for the Amibara sub-project and related infrastructure are defined by the physical extent of the proposed structural interventions and the immediate surrounding environment. Based on the preliminary feasibility reports, the primary impact zone includes:

- **Embankment and Dyke Footprint:**
  - The primary sub-project footprint consists of the 60-km flood protection embankment(dyke) extending from the Melka-Sedi intake downstream through other areas of Amibara woreda and reaching Haruka Woreda.
  - The primary physical footprint consists of the areas designated for new dyke construction and side berm construction for the access road.
  - This zone includes a crest width of approximately 4 meters for maintenance access and the area covered by engineered side slopes.
  - Where feasible, the embankment will be expected to be located at a significant (approximately 50–100 meters) distance from the riverbank to maintain a functional floodplain and reduce direct bank erosion.

- The zone of impact also includes the temporary construction area for "loose fill" dyke work.
- The sub-project footprint directly affects agricultural lands (specifically cotton, maize, onion, and tomato and vital infrastructure in about 14 high-priority kebeles of Amibara. Haruka and Dulocha Woreda, which are the most vulnerable.
- Dike Dimensions: The planned dike covers a 60-kilometer stretch of the Awash River, starting from the Melka-Sedi water intake. The new design specifies a 4-meter crest width with side access and wider turnout bays at every 1-kilometer interval.
- Temporary Loose Fill (Old Borrow Areas): The spatial extent of specific "temporary loose fill" areas, "old borrow" sites. These sites range in size from approximately 28,312 m^2 to 78,498 m^2. The design recommends refilling these borrow areas with construction spoil material to prevent pond formation or integrating them into the floodplain to expand wetland habitats.

- **Biological and Ecological Footprint:**
  - Vegetation Impacts: The primary biological footprint involves the clearing of Prosopis juliflora, which currently forms impenetrable thickets along the entire 60km alignment. The sub-project proposes mechanical removal of these trees, including uprooting rootstocks to prevent re-sprouting.
  - Ecological Mitigation: To stabilize the new embankment, the design shall include covering it with Vetiver grass (*Chrysopogon zizanioides*). This grass is chosen for its deep roots (up to 3–4 meters) and its ability to survive prolonged waterlogging or a mix of biological (by making use of the invasive species in the area) and structural reinforcements as proposed in the design.
  - Wildlife and Aquatic Species: The sub-project area supports populations of warthogs, baboons, and monkeys, as well as aquatic species like tilapia, catfish, crocodiles, and hippopotamuses in the Awash River. The ecological footprint includes potential issues from blocking floods to natural floodplains, which could reduce silt and nutrient provision. To counter this, the sub-project plans to integrate old borrow areas into the river floodplain to enhance wetland habitats by complementing the natural floodplain.
  - The primary impact zone includes a construction footprint where mechanical removal of the invasive *Prosopis juliflora* is permitted.
  - The zone strictly protects native trees, such as *Acacia spp*., and establishes a buffer zone along the riverbank for a 1:5 reforestation protocol.

- **Socio-Economic Primary Zone:**
  - The sub project zone of influence includes households and seasonal pastoralists in high flood-risk areas between the dike and the riverbank, who can be directly or indirectly, positively or negatively influenced.

2.2.4 Existing Agricultural Infrastructure

The proposed 60 km dike alignment traverses a highly developed irrigation landscape. Key infrastructure, ranging from gravity-fed diversion weirs to mechanically operated pumping stations, is located either directly along the riverbank or within the footprint of the existing legacy dike. Consequently, construction of the proposed embankment will directly or indirectly affect these assets, necessitating either relocation or the implementation of significant structural protection measures..The

following Table 2.1 provides the geospatial coordinates and baseline characterization for the primary irrigation infrastructure located along the sub-project corridor.

Table 2.1: Existing Irrigation Infrastructure and GPS Locations

No	Easting (X)	Northing (Y)	Elevation (m)	Ownership	Existing Conditions and Construction Impact
1	3.626754	39.830504	752	Govt / Institutional	Functional/relocation is required
2	3.626937	39.832389	743	Private	Functional/relocation is required
3	3.627837	39.833239	739	Research / Govt	Functional/relocation is required
4	3.628577	39.83419	725	Private	Functional/relocation is required
5	3.629505	39.834916	725	Private	Functional/relocation is required.
6	3.630761	39.835196	727	Private	Functional/relocation is required
7	3.631424	39.836004	731	Private	Functional/relocation is required
8	3.631537	39.836837	732	Private	Functional/relocation is required
9	3.631787	39.837171	731	Private	Functional/relocation is required.
10	3.632717	39.837206	728	Private	Functional/relocation is required
11	3.633621	39.83763	728	Private	Functional/relocation is required
12	3.634611	39.83996	727	Private	Functional/relocation is required

2.2.4.1 Environmental and Social Due Diligence(ESDD) Findings

The ESDD confirms that all twelve identified facilities are fully functional and constitute the primary water source for agricultural production within the project area. Lack of mitigation by means of the execution of civil works for the dike construction will trigger the following material environmental and social risks:

- **Economic Displacement and Livelihood Degradation:** Any temporary or prolonged interruption of irrigation services will directly reduce crop yields, impairing household incomes and regional food security. Smallholders and commercial out-growers dependent on these facilities face significant vulnerability to income shocks during the asset relocation and reconstruction phases. However, stakeholder consultations reveal a highly collaborative environment: all private pump owners have formally expressed their willingness and consent to relocate their structures, provided that operational continuity is preserved and replacement infrastructure is verified.

- **Physical Displacement of Critical Assets:** Because existing pumps and diversion intake structures lie within the active civil works footprint, unmitigated construction will result in the catastrophic destruction of assets and long-term utility outages. Timely, pre-construction relocation is legally and operationally mandatory.

- **Hydrological and Water Resource Management Risks:** Civil works, excavation, and re-channelling along the riverbank risk causing localized sedimentation, altering river morphology, and temporarily blocking abstraction points. If replacement infrastructure is

poorly engineered, it may permanently degrade gravity-fed or pump-assisted irrigation efficiency.

- **Institutional, Research, and Operational Disruptions:** Interruption of the Werer Research Center pump station threatens ongoing, multi-year national agricultural research trials, data continuity, and extension services, creating institutional impacts that extend beyond the immediate woreda.

2.2.4.2 Recommended Mitigation and Management Measures

To ensure compliance with national environmental legislation and international safeguards, the Project Proponent shall enforce the following mitigation hierarchy:

- **Engineering Assessments and Relocation Planning:** Prior to any site clearing or mobilization, the engineering procurement contractor (EPC) shall conduct a joint site verification with the environmental and social specialists, clan/community leaders/elders, and Woreda and Kebele Administrators to draft a site-specific *Irrigation Infrastructure Relocation and Engineering Plan.* Leveraging the expressed willingness of the asset owners, this plan must be co-signed by the private owners to align civil works with their idle time or non-agricultural calendars.

- **Guaranteed Continuity of Service (Zero-Downtime Objective):** The contractor must utilize a phased construction approach. Temporary bypass channels, flexible intake lines, or auxiliary mobile pumping units must be fully operational before existing infrastructure is decommissioned or disturbed.

- **Inclusive Stakeholder Engagement & Formal Agreements:** Capitalizing on the proactive consensus of the private owners, the project shall establish a continuous consultation mechanism involving private pump owners, water user associations (WUAs), Werer Research Center administrators, and local agricultural bureaus. Formal Memorandums of Understanding (MoUs) shall be signed with each willing owner to legally document agreed-upon relocation sites, technical design updates, and schedules to minimize irrigation downtime during critical cropping cycles.

- **Livelihood Restoration:** Any unavoidable relocation/restoration activities must be systematically planned and implemented.

- **Verification and Sign-Off:** Implement a strict verification protocol requiring written sign-off from the supervising engineer and the asset owner, confirming that the replaced or protected infrastructure meets or exceeds baseline performance criteria prior to legacy asset decommissioning.

2.2.4.3 Due Diligence Conclusion and Integration

The agricultural infrastructure identified along the 60 km alignment represents a highly sensitive socio-economic receptor. The environmental and social impacts associated with their displacement are legally significant and severe at the localized level, yet entirely mitigable through proactive engineering and social management.

The baseline social risk profile is greatly optimized by the fact that all private owners are willing to relocate their structures. Accordingly, these due diligence findings, positive consultation consensus, structural risks, and mitigation protocols are hereby formally integrated into the project's overarching Environmental and Social Management Plan (ESMP).

2.2.5. Access Roads and Logistical Corridors

The sub-project integrates the dike crest and side berm as a primary access route.

- **Existing Access**: The existing dike is highly eroded and too narrow for vehicle movement, even limiting bike movement.
- **Sub-project Access**: The design integrates the dike as the primary access route with a side berm as an access route for maintenance and emergency repairs.
- **Social Connectivity**: The sub-project influence includes the formalization of ramps and designated watering points to restore traditional paths for livestock and people that are currently blocked by the deteriorating infrastructure.

2.2.6. Borrow Pits and Material Sourcing

Materials will be sourced from designated borrow pits providing high-quality, seepage-proof soils. These are located in non-cultivable/non-grazing areas to minimize social disruption and associated issues. The specific sites of the burrow sites (both for the existing and new burrow sites) and proximities from the embankment intervention area are indicated in Figure 2.4 below.

2.2.7. Contractor Camp Locations and Ancillary Facilities

Temporary worker camps and equipment yards will be situated away from sensitive riverine environments, equipped with standardized waste and sanitation management systems.

- **Siting Criteria**: Camps for workers and equipment storage must be located away from sensitive environments and situated on land that does not conflict with local agricultural or pastoral activities and Community and social infrastructures such as schools.
- **Infrastructure Requirements**: Camps will include temporary housing, sanitation facilities, waste management systems, and workshops for equipment maintenance.
- **Buffer Zones**: Camps and workshops must be managed to prevent runoff (oils, solvents, sewage) from impacting the near sensitive environment of the Awash River.

2.2.8. Linear Extent and Operational Footprint Zones

The area of influence includes the entire 60-km stretch heavily infested with Prosopis. Therefor the large sections of the embankment corridor are heavily infested with Prosopis juliflora (locally known as Weyane), an invasive plant species affecting grazing lands and ecosystems.

The sub project will undertake mechanical clearing and uprooting of Prosopis root systems along the embankment corridor. Where feasible, removed biomass may be transported for potential use as industrial biomass fuel.

- **Linear Extent:** The zone covers the entire 60 km stretch of the right bank embankment alignment, starting near the Melka-Sedi intake and extending through Amibara and Haruka Woredas ends at Yeorien pumping station.

- **Operational Footprint**: The management zone is defined by the primary physical footprint required for new dike construction. This includes:
    - The 4-meter crest width of the dike by 60 km stretch/length.
    - Temporary construction areas for "loose fill" dike work.

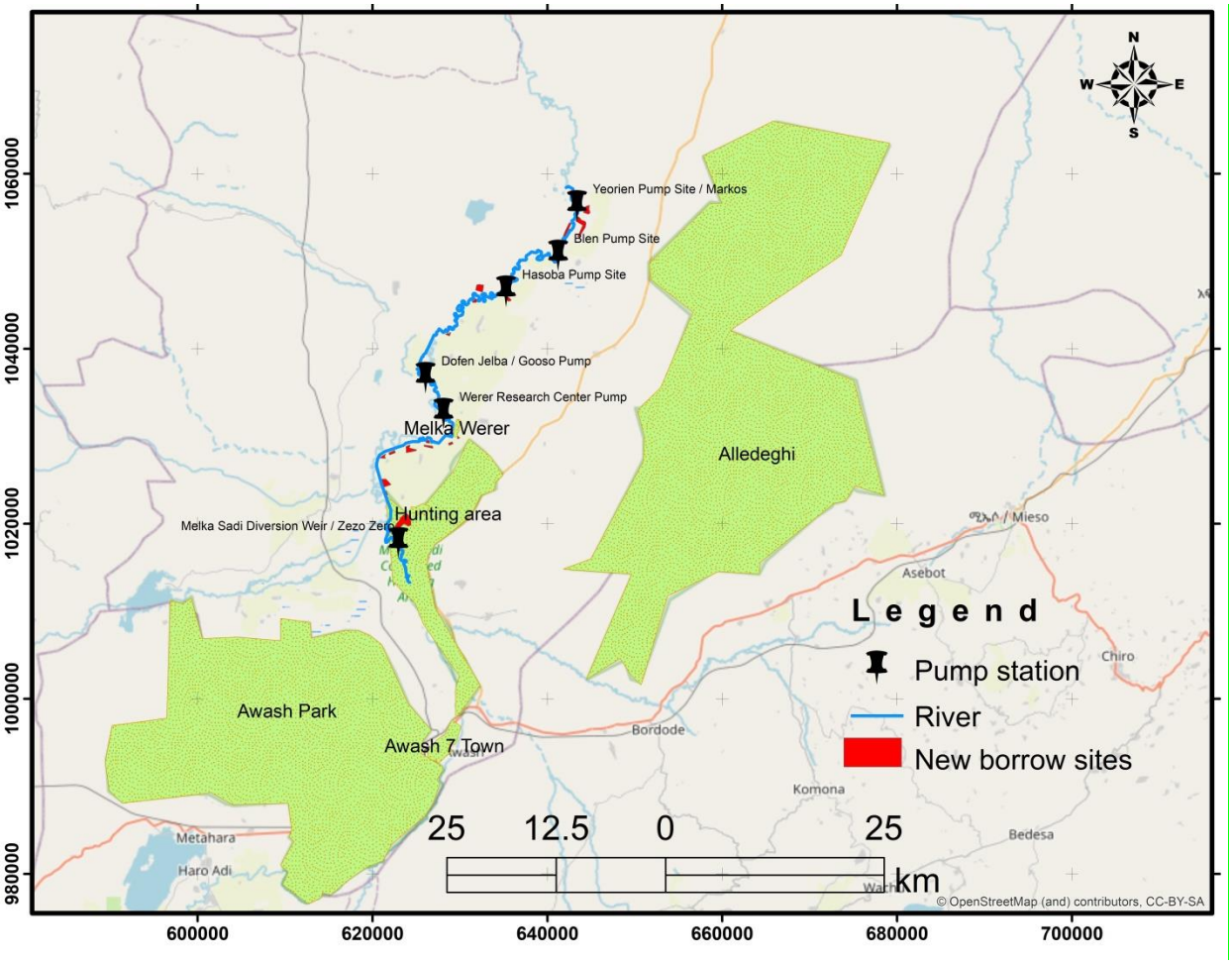

Figure 2.4: The primary sub-project influence area in Amibara woreda and the surrounding areas

2.2.9. Left Bank and Downstream Impact Zones (Hotspots)

The proposed work will alter floodplain dynamics within the project footprint based on the preliminary hydraulic analysis and existing design input/measures. The design consultant's modelling predicts that peak flows will be concentrated within the main channel and the left-hand floodplain by removing or isolating the right-hand bank floodplain until the design event. This flow redistribution is predicted to raise flood water levels and increase the area of flooding on the left-hand floodplain at Amibara, where the floodplain narrows. It is anticipated that the right-hand floodplain will become hydraulically reconnected during higher-order flood occurrences that surpass the design threshold. Flood depths will rebalance as a result of floodwaters redistributing throughout both floodplains. As a result, both the left-hand bank and downstream locations within the project footprint will be impacted by the project's influence on flood behavior, which will mostly show up during bigger magnitude events.

Although confirmation will require more extensive hydraulic modelling outside of the current study area, downstream implications are expected to be rather low. Overall discharge through the Amibara reach will not vary, according to preliminary assessments. Increased storage in swamp areas on the left-hand bank is anticipated to somewhat counterbalance the decrease in flood storage (attenuation) linked to the protected right-hand floodplain.

The project is anticipated to produce manageable increases in flood levels along the left-hand bank during extreme flood events similar to the 2020 scenario, with minimal downstream effects. Detailed modelling shall be used in later stages of design to confirm these predictions. It has been observed that the project footprint may increase the current flood risk exposures in the Dofen and Balahamo areas (see Figure X). To control and lower outstanding flood risks to these communities, engineering design improvements as well as site-specific mitigation measures shall be considered.

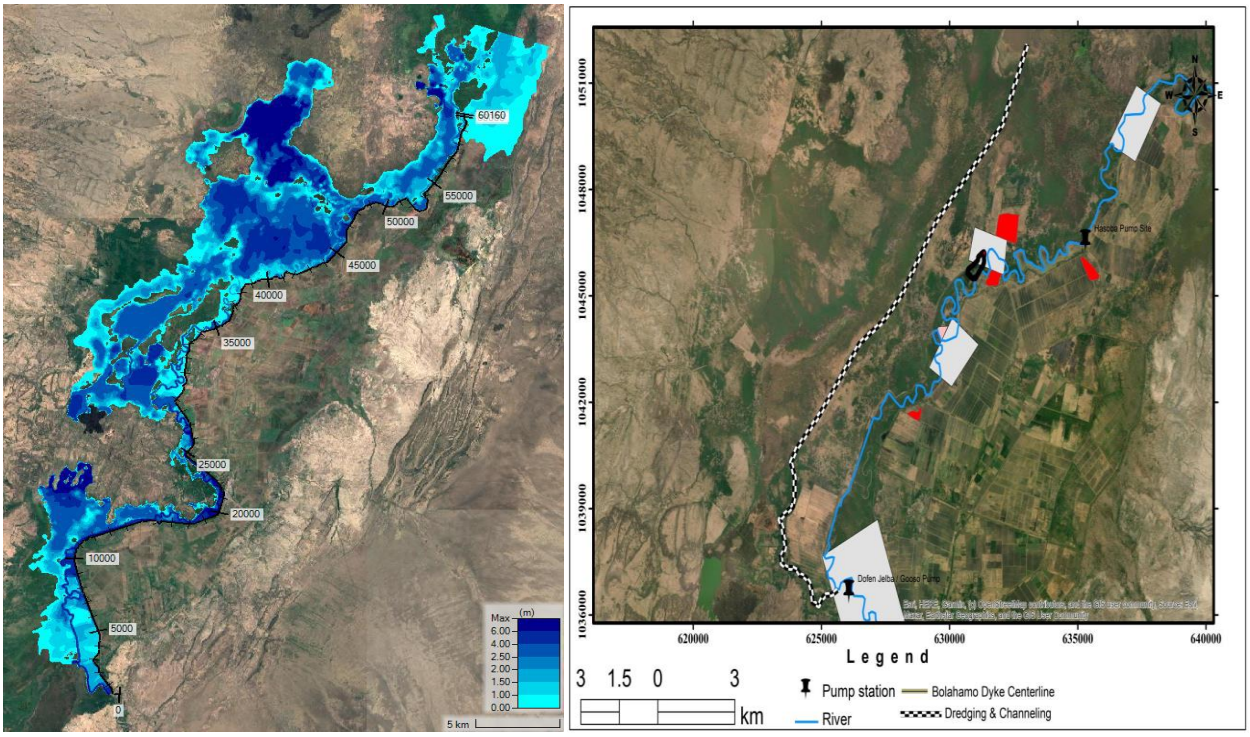

Figure 2.5: Predicted post-scheme flood extents and Location of the hotspot areas (Dofen and Bolahamo)

The ESIA follows a typical sub-project life cycle for infrastructure development, encompassing four key phases: pre-construction, construction, operation and maintenance, and decommissioning. Each phase involves specific activities, as well as associated materials, equipment, and workforce requirements, which are detailed below.

i. Pre-Construction Phase

The pre-construction phase involves preparatory activities required to set the groundwork for the main construction works. Key activities include:

- Conduct targeted consultations and information disclosure sessions with project-affected parties, particularly local communities and vulnerable groups, regarding the project timeline,

labour requirements, potential impacts, and the established Grievance Redress Mechanism (GRM)
- Land acquisition and/or RP and site preparation
- Mechanical clearing of the invasive *Prosopis juliflora* before any earthworks.
- Identification of borrow pits and construction camp locations
- Contractor mobilization and establishment of logistics

ii. Construction Phase

The construction phase encompasses the main civil works required to develop the infrastructure. Major activities include:

- Develop and implement a comprehensive training program for all project workers on the Code of Conduct (CoC), occupational health and safety (OHS), and community engagement protocols.
- Enforce the project's Code of Conduct (CoC) for all staff and contractors to prevent and address issues such as gender-based violence (GBV), sexual exploitation and abuse (SEA), and other forms of misconduct.
- Maintain continuous and meaningful engagement with local communities and project-affected persons throughout the construction phase to provide project updates, address concerns, and manage grievances effectively, as outlined in the SEP
- Topsoil stripping
- Excavation and transport of fill materials from borrow pits
- Embankment construction and compaction
- Installation of erosion protection measures
- Construction of bridges, irrigation structures, and livestock watering facilities via water pump stations and accessible locations compatible with the design alignment
- Establishment of construction camps and access roads

Construction Materials, Equipment, and Workforce

Construction activities will require a range of materials, machinery, and personnel:

a) **Materials:**
- ✓ Earth fill materials
- ✓ Rock and aggregates
- ✓ Cement and reinforcement bars

b) **Equipment:**
- ✓ Excavators and bulldozers
- ✓ Dump trucks and compactors
- ✓ Cranes and concrete mixers

c) **Workforce:**
- ✓ Both skilled and unskilled labour will be employed
- ✓ Priority will be given to hiring local workers wherever possible

iii. Operation and Maintenance Phase

During the operation phase, activities focus on maintaining the functionality and integrity of the infrastructure. Key activities include:

- Routine inspection of embankments
- Maintenance of erosion protection structures
- Vegetation management along embankments
- Monitoring for structural damage, animal burrowing, or unauthorized dike cutting
- Control of the invasive plant *Prosopis juliflora* along embankments to prevent water percolation along roots, which may lead to waterlogging or seepage in adjacent farmland or grazing areas.

iv. Decommissioning Phase

Although the infrastructure is designed for long-term use, eventual decommissioning may involve:

- Removal or stabilization of deteriorated structures
- Disposal or recycling of construction materials
- Rehabilitation and restoration of affected land, including temporary access routes, quarry, or borrow sites
- Develop and implement a site restoration plan in consultation with local communities to ensure the land is returned to a safe and usable state. Besides, conduct continuous and regular consultations with affected communities to confirm that all social and environmental obligations, including compensation and livelihood restoration, have been met if applicable.

2.3. Sub-project Resource Requirements and Sources

The implementation of the Amibara Right Bank Flood Risk Reduction Sub-project necessitates the mobilization of specific water, energy, and human resources. The following sections outline the requirements and sourcing strategies:

- Water Requirements (Construction and Potable):
  - Potable Water: While the Awash River is the primary regional source for domestic and livestock use, its water quality is compromised by high fluoride concentrations (7.3–9.5 mg/L), which exceed safe potable limits. Consequently, the sub-project will provide dedicated safe water supply facilities and appropriate sanitation at all worker camps to protect personnel's health.
- The safe water/potable water can be pumped from low-fluoride groundwater boreholes via dedicated water-tanker trucks. Or provide from elevated polyethylene storage tanks fitted with defluorination filtering media / Reverse Osmosis micro-purification units.
  - Construction Water: Water for technical construction activities (compaction, dust suppression, etc.) will be sourced from the Awash River and existing irrigation canals within the sub-project area. While specific volumes are not yet quantified, these surface water sources are considered sufficient for the sub-project's needs.
- Energy Requirements and Sources:
  - Fuel and Lubricants: The operation of mechanical equipment and heavy machinery (e.g., excavators, dump trucks) will rely on petroleum-based fuels, lubricants, and hydraulic fluids.
  - Efficiency and Sustainability: In alignment with climate change mitigation strategies, the sub-project prioritizes energy efficiency and the use of renewable energy sources where technically feasible, such as the use of a hydroelectric grid or solar camp power, and deploys a fleet less than 10 years old.
  - Contractors are required to maintain rigorous energy and fuel efficiency records throughout the construction phase.
- **Construction Manpower:**
  - **Labour Sourcing:** The sub-project mandates a "local-first" hiring policy, specifically targeting local labour and involving area youth for specialized roles such as traffic assistance and safety monitoring.
  - **Identification:** All sub-project personnel will be issued mandatory uniforms and identification cards to ensure security and site access control.
  - Workforce could range from about 1,200-2,000 workers during mobilization, increasing to roughly 4,000-7,000 workers at peak construction when multiple sections are executed in parallel, and then decreasing to around 800-1,500 workers during

demobilization for final works, inspections, and site restoration, giving an overall estimated workforce requirement in the range of approximately 6,000-10,000 personnel across all phases (not concurrent).

- **Labor Influx and Working Conditions Management:** This high volume of worker concentration introduces significant potential labour influx, occupational health and safety (OHS), and community safety risks. To address these issues systematically, all labour and working condition risks under World Bank Environmental and Social Standard 2 (ESS2) will be strictly managed through the project's formalized Labor Management Procedures (LMP).

2.4. ANALYSIS OF SUB-PROJECT ALTERNATIVES

2.4.1. The "Without Sub project" (No-Action) Alternative

This alternative considers maintaining the current situation without any flood protection (engineering or management) intervention.

- ***Infrastructure Condition:*** The existing flood protection structures in Amibara are over 45 years old and in an advanced state of deterioration, characterized by frequent breaches, severe piping, and bank erosion.
- ***Socio-Economic Consequences:*** Without the sub-project, recurrent flooding will continue to damage crops, livestock, and community infrastructure. The majority of household**s** in the sub-project area depend directly on the Awash River for irrigation and livelihoods; inaction would lead to permanent food insecurity, increased poverty, and extreme vulnerability to climate change.

In conclusion, the No-Action alternative is rejected as it fails to protect the community or support the regional development goals of the Awash Basin.

2.4.2. Design and Technology Alternatives

To ensure the long-term effectiveness of the physical works, specific technological improvements were selected over traditional methods:

- **Material Selection:** The sub-project replaces the use of permeable river sand (which contributed to past failures) with **well-compacted clay soil**. This significantly reduces seepage and improves the overall structural integrity of the embankment.
- **Reducing "Barrier Effects":** To ensure the dike does not disrupt local socio-economic life, the design incorporates "Multi-functional" features such as maintaining water supply to agricultural activities, cattle watering by making use of the spillways and ponds created.

2.4.3. Alignment and Site Selection Alternatives

Two primary routing options were assessed for the 60 km flood embankment:

Option 1: Existing Alignment: This option follows the footprint of the old dike. While it requires minimal additional new land, it is highly exposed to scouring and riverbank instability due to its proximity to the active river channel.

Option 2: Setback Alignment (Selected): This alignment is located at a distance from the current dike and riverbank.

- **Technical Advantage:** Reduces erosive pressure and allows for natural river channel migration.
- **Safety:** Better suited to the geologically active conditions of Seismic Zone 3.
- **Environmental Protection:** Maintains a critical 200m buffer zone to preserve riverine vegetation.

A Multi-Criteria Analysis (MCA) was used to compare the sub-project alternatives based on five key sustainability pillars. In this report, a multicriteria analysis was conducted using a score-based system, where each option was rated on a scale from 1 to 5 (1 = Poor, 2 = Fair, 3 = Good, 4 = Very Good, 5 = Excellent). Each criterion was assigned a weight (ranging from 1% to 100%) based on its priority and relevance to the context of the Amibara Right Bank sub-project, as presented in Table 2:2 below.

Table 2.2:A Multi-Criteria Analysis and Comparison of the Sub-project

Criterion	Weight (%)	Reason	Score: Option 1 (Existing)	Score: Option 2 (Setback)
Technical Effectiveness	20%	Ability to withstand hydraulic pressure and scouring.	2	5
Cost & Maintenance	20%	Construction cost vs. long-term repair frequency.	3	4
Environmental Impact	20%	Preservation of riverine forests and natural buffers.	2	5
Social Impact	20%	Protection of livelihoods and cultural/religious site avoidance.	4	4
Climate & Seismic Resilience	20%	Performance in Seismic Zone 3 and climate adaptation.	2	5
Total Weighted Score	100%	Overall sustainability and safety performance.	2.60	4.60

Key Findings

- **Safety and Reliability:** Option 2(setback alignment) performs significantly higher due to its distance from the active erosion zone and its resilience against seismic activity.
- **Socio-Environmental Balance:** The setback alignment minimizes the ecological footprint, and watering points ensure that the needs of women and vulnerable pastoralist groups are met. Option 2 involves moving inland, which necessitates temporary land-use adjustments and intersecting seasonal agropastoral migratory routes. However, this does *not* result in permanent social setbacks or physical displacement because no permanent structures or settlers exist within this setback zone. Any temporary disruption to local pastoralists is actively managed and offset by the design's related benefit components. These features directly support women and vulnerable pastoralist groups who bear the brunt of tracking livestock and managing household moves during times of flood distress.

In conclusion, the *Approach with Setback Alignment* is selected as the best option. It provides robust flood protection, minimizes environmental impacts, supports local communities, and ensures long-term climate resilience for the Amibara Right Bank.

3. APPLICABLE LEGAL AND POLICY FRAMEWORK

The legal and policy framework that governs the flood management project (ET-FMP) described below facilitates the alignment of ET-FMP with Ethiopia's national laws, therefore, promoting coherence between both the natural and social/economic systems. The ET-FMP is implemented under an Established Legal Framework, which ensures that the protection of the Environment, Public Health, and Social Equity is upheld. This legal framework allows for Environmental Monitoring and Accountability during all phases of this sub-project's implementation.

In the context of this ESIA for flood-protection structures in the Awash basin, a thorough review of relevant policy, legal, and institutional frameworks has been crucial. These frameworks provide the foundation for integrating environmental and social considerations into sub-project planning and implementation. Ethiopia's national policies emphasize sustainable development, environmental stewardship, and public participation. At the same time, international standards, particularly those required by financing institutions such as the World Bank, set benchmarks for environmental and social performance that must be met.

Given the potential environmental and socio-economic impacts of large-scale flood protection infrastructure, this assessment review applies national laws, regional regulations, and international standards to ensure compliance and promote responsible sub-project implementation. The review also identifies key institutions responsible for enforcement and oversight, thereby aligning sub-project activities with both national priorities and donor requirements. The following section outlines the most relevant legal and policy instruments that will guide the ESIA consideration and the overall ESIA process.

I. National Legal Frameworks:

- Constitution of the Federal Democratic Republic of Ethiopia
- Environmental Policy of Ethiopia (EPE)
- Forestry and Environmental Policy
- Environmental Legislation:
    - Proclamation for the Establishment of Environmental Protection Organs (Procl. No. 295/2002)
    - Environmental Impact Assessment Proclamation (Procl. No. 1371/2025)
    - National Proclamation on Water Resources Management (Proclamation No. 197/2000)
    - Environmental Pollution Control Proclamation (Proc. No. 300/2002)
    - Proclamation on Solid Waste Management (Procl. No. 513/2007)
    - Policies on Land Tenure and Compensation
    - Civil Code of Ethiopia
    - etc.

Table 3.1: Main Policy and Strategic Frameworks and Related Guidelines

Framework/Guideline	Brief Description & Relevance
FDRE Constitution (1995)	Enshrines rights to a clean environment, development, and equitable resource use.
Environmental Impact Assessment Proclamation (No. 1371/2025)	Mandates ESIA for this sub-project category.
Environmental Pollution Control Proclamation	Sets standards for water, air, and soil quality.

(No. 300/2002)	
Water Resources Management Proclamation (No. 197/2000)	Governs water use and hydraulic structures.
Proclamation on Expropriation (No. 1161/2019)	Governs land acquisition and compensation; critical for identifying Resettlement/Land Acquisition-related issues.
Biodiversity & Forestry Policies	Relevant for impacts on riparian and terrestrial ecosystems.
National Policy on Disaster Risk Management	Suggests establishing a comprehensive and coordinated disaster risk management system in the context of sustainable development. Aligns with the sub-project's core objective.
The Ethiopia Flood Management Project (ET-FMP) (P176327) envisages specific guidelines/ procedures that include: ▪ Labor Management Procedure (IMP) ▪ Resettlement Framework ▪ Environmental and Social Commitment Plan (ESCP) ▪ Stakeholder Engagement Plan (SEP) ▪ Environmental, Health and Safety (EHS) Guideline These guidelines and procedures are aligned with the national and World Bank policies and regulations.	ET-FMP will be implemented in accordance with the Ethiopian Labour Proclamation No. 1156/2019 and the World Bank's ESS2 Proclamation on Expropriation of Landholding for Public Purposes, Payment of Compensation and Resettlement of Displaced People (Proclamation No 1161/2019 repeals and replaces Proclamation No. 455/2005. The ET-FMP considers the implementation of the Ethiopian Environmental and Social Impact Assessment Proclamation (1371/2025) and the World Bank's ESS1. In case of variations between national legislation, regulations, and the World Bank Environment and Social Standards, the more stringent provision will prevail.

Table 3.2: Relevant World Bank Environmental and Social Standards Considered under the Environmental and Social Framework (ESF)

ESS	Title	Relevance to Flood Protection Structures
ESS 1	Assessment and Management of Environmental and Social Risks and Impacts	Requires the entire ESIA process, and accordingly, this ESIA is prepared in compliance to the requirements and standards.
ESS 2	Labor and Working Conditions	Applies to construction worker health, safety, and terms. Accordingly, Labour Management Procedure (LMP) is suggested to be developed and used as part of the management plans to address Occupational Health and Safety (OHS) and national labour law compliance.
ESS 3	Resource Efficiency and Pollution Prevention	Addresses erosion, sediment control, and waste from construction. A sustainable resource use and pollution management plan is proposed to be integrated, implemented and monitored in the different phases of the sub-project.
ESS 4	Community Health and Safety	Critical for risks of construction accidents, dam safety, and downstream flooding, as well as the project-related labour influx associated risks. Hence, a detailed management plan for community health and safety and labour-related risk management is integrated into the ESIA.
ESS 5	Land Acquisition and Involuntary Resettlement	Will guide the collection of indicative data for potential resettlement and land acquisition-related issues. In this regard, no work before RP and compensation-related issues is proposed as part of the ESIA's management plan.
ESS 6	Biodiversity Conservation and Sustainable	Applies to impacts on rivers, wetlands, and

	Management of Living Natural Resources	associated flora/fauna. Key recommendations provided as design input: biodiversity management plans within site-specific ESIAs. The specific project shall consider a management plan to protect the indigenous trees and habitats during site preparation and throughout the project phases.
ESS 7	Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	For areas in pastoralist communities in the Awash basin and requires free, prior and informed consent (FPIC). Hence, Consultations and consent agreements with the community and involving indigenous people shall be considered, aligned and mainstreamed in the ESIA documentation.
ESS 8	Cultural Heritage	Protection of archaeological or cultural sites affected by excavation/construction. In this regard, consideration of the desired chance of finding procedures and measures to be integrated in the management plan has been suggested, and its detail procedure is annexed.
ESS 10	Stakeholder Engagement and Information Disclosure	Mandates the SEP, consultations, and information disclosure. Report and communication of the consultation records conducted with the public, community and stakeholders; Final ESIA public disclosure; and operational GRM have been proposed to be strictly followed, communicated and implemented.

Additional Safeguards:

- **World Bank Dam Safety Guidelines:** Covers technical safety and emergency planning considerations. The standard also requires strengthened monitoring, periodic safety inspections, and contingency planning to ensure that flood control structures reliably protect downstream communities and align with both national regulations and international best practice.
- **World Bank Gender Strategy:** Ensures gender-inclusive benefits in line with WB and IFC EHS guidelines and ensures benefits to the vulnerable communities in line with the WB directive for addressing risks and impacts on disadvantaged or vulnerable individuals or groups. Ethiopia's legal framework (notably the Constitution, Labour Proclamation, and gender policies) establishes formal equality and prohibits discrimination, but gaps remain relative to World Bank (WB) Environmental and Social Framework standards, particularly ESS1 and ESS10 in systematic gender analysis, proactive inclusion measures, and enforceable project-level benefit-sharing. While national laws emphasize equal treatment, they are generally less explicit on targeted actions (e.g., gender-responsive quotas in employment, tailored livelihood restoration, GBV risk mitigation, and participatory engagement of women and vulnerable groups) that WB standards require as part of project design and monitoring. In practice, this creates a gap in implementation depth: WB projects must go beyond compliance with Ethiopian law to include disaggregated data collection, gender action plans, accessible grievance mechanisms, and measurable outcomes to ensure women and marginalized groups equitably benefit from project interventions.

II. International Conventions:

Ethiopia is a party to various international conventions related to environmental, cultural, labour, and occupational issues. As a result of Article 9(4) of the Federal Constitution, all international treaties ratified by the Ethiopian government are automatically considered part of the national legal framework.

Consequently, these global frameworks provide a basis for climate resiliency, biodiversity preservation, and labour standards for Ethiopia's Integrated Disaster Risk Management Project (ET-FMP). These include, but are not limited to:

- The United Nations Framework Convention on Climate Change (UNFCCC): This framework was ratified in 1994 and coordinates global efforts to stabilize greenhouse gas concentrations in the atmosphere and address cross-border impacts of climate change.
- The Paris Agreement: Ethiopia is a signatory to this legally binding agreement, ratified in 2017, which aims to limit the global average rise in temperature by no more than 1.5°C to 2°C above pre-industrial levels (the focal point of this treaty is encouraging countries to develop their own adaptation strategies).
- The United Nations Convention to Combat Desertification (UNCCD): The UNCCD is one of the key missions of the ET-FMP as it focuses on mitigating the impacts of extreme drought and land degradation, particularly in the African region.
- Convention on Biological Diversity (CBD): The CBD aims to conserve biodiversity and promote sustainable development through equitable benefit-sharing related to genetic material.
- Cartagena Protocol on Biosafety: The Cartagena Protocol supplements the CBD by focusing on the safe handling, shipment and use of living modified organisms developed through biotechnological processes, in order to avoid potential threats to both global biodiversity and human health.
- Convention for the Protection of the World Cultural and Natural Heritage: Under this convention, the state has the responsibility to identify, conserve, and safeguard Ethiopia's cultural and natural heritage for the benefit of future generations.
- The ET-FMP is governed by the core conventions of the International Labour Organization (ILO) to ensure the safety and dignity of the project workforce.

4. BASELINE CONDITIONS

4.1. Physical Environment Setting

4.1.1. Topography

The sub-project area is located on the right bank of the Awash River within the Amibara and Haruka Woredas of the Afar region. The terrain is characterized by broad alluvial floodplains and widening valleys typical of the Middle Awash sub-basin. The landscape predominantly consists of relatively flat alluvial and lacustrine deposits. The river corridor is highly dynamic, with active riverbank erosion and sedimentation evident in many sections. In certain areas downstream of water inlets, the river has recently altered its course, moving significantly closer to existing flood protection structures. Elevations within the site range between 720 and 1,000 meters above sea level, consistent with the broader basin profile. The slope gradients are very low, predominantly between 1% and 2%. The topographic map of the Awash River basin is displayed in Figure 4.1.

Figure 4.1: The Topographic Map of Awash River Basin

The area is a hot-to-warm, arid plain within the Main Ethiopian Rift. It is generally flat (700-1000 m asl), acting as a natural sink for highland runoff. The river exhibits high morphological activity and has established new channels(course) very close to the existing dike alignment in some sections downstream from the water inlet.

The topography of Amibara and Melka Werer in the Afar Region of Ethiopia is generally characterized by flat to gently sloping lowland plains within the Afar Depression, which is part of the East African Rift System. The area lies at an elevation of approximately 700–800 meters above sea level and is dominated by the wide floodplain of the Awash River, which flows from south to north through the region. The landscape is mainly composed of alluvial plains, river terraces, and irrigated agricultural fields, with very gentle slopes that facilitate irrigation farming. Near the river, the land is slightly lower and forms floodplain areas where sediments are deposited during seasonal flooding. In contrast, slightly elevated terraces and flat plains occur farther from the river, supporting settlements and farmland. The surrounding region also includes scattered volcanic landforms and low ridges associated with the rift valley geology. Overall, the topography of the Amibara area is mostly flat and low-lying, which makes it suitable for large-scale irrigation agriculture but also increases the risk of flooding and soil salinity due to poor natural drainage. The location map of the sub project area is displayed in Figure 4.1 above.

4.1.2. Climate

The climate of the Amibara area is semi-arid to arid, marked by high thermal stress and seasonal water scarcity. Average maximum temperatures reach 34.4°C, with peak temperatures rising to 37.4°C, generating strong evaporative demand. Daytime temperatures consistently exceed 32°C throughout the Middle Awash Basin. Rainfall is extremely low, averaging only 47.1 mm annually, and is highly erratic. Precipitation is concentrated mainly in two seasons: the primary Kiremt season from June to September and the secondary Belg season from February to May. Given the insufficiency of local rainfall to sustain agriculture or consistent river flow, the region relies almost entirely on water originating from

upstream highlands, making the Amibara stretch particularly vulnerable to both upstream flood pulses and prolonged dry spells between October and January.

In recent years, the climate variability in Amibara and surrounding areas observed with seasonal and spatial variations. The spatial trend of seasonal maximum temperature increased for the past three decades except in the southwest and northeastern parts of the Amibara district. In the southwest and northeast parts of Amibara district during the winter season, maximum temperature exhibited reduction. Hence, the lowest and pick spring season maximum temperature increment was observed in the southern part of Awash Fentale and the northern part of Amibara district, respectively (Aytenfisu *et al*., 2024).

4.1.3. Geology and Seismicity

The region is dominated by quaternary volcanic rocks, alluvial and lacustrine deposits/sediments, high groundwater levels, and active geomorphological processes. Being part of the Main Ethiopian Rift and the Afar Depression, the area is geologically active with potential for tremors and land subsidence as well as a potential for encountering unidentified paleontological or anthropological resources due to its long history of habitation.

The area around Amibara and Melka Werer in the Afar Region of Ethiopia lies within the geologically active Afar Depression, which is part of the East African Rift System. The geology of this area is mainly characterized by young volcanic rocks and recent alluvial deposits. The rifting process that formed the Afar Depression caused extensive volcanic activity, resulting in widespread basaltic lava flows that form the underlying bedrock of the region. These volcanic rocks were later covered by sediments transported and deposited by the Awash River, especially in the floodplain around Amibara. As a result, the surface geology consists mainly of Quaternary alluvial sediments, including sand, silt, clay, and gravel derived from surrounding highlands and volcanic formations. In some places, lacustrine (lake) deposits and evaporite minerals may also occur due to the arid climate and evaporation in low-lying areas. The flat topography and sediment accumulation in the Awash Valley create fertile floodplain environments that support irrigation agriculture.

Overall, the geology of the Amibara area reflects the combined effects of rift tectonics, volcanic activity, and river sedimentation, which have shaped the present landscape and soil formation in the region. Based on the seismic hazard map of Ethiopia, the Amibara area is located in the high seismic risk zone (Zone 3), which must be considered in all phases of the sub project, in particular during sub project design, implementation and maintenance.

4.1.4. Soil

The soils of Amibara are fundamentally shaped by the hydrology of the Awash River. The Woreda is characterized by two primary soil types (Fluvisols and Vertisols) that dictate agricultural potential and natural vegetation.

The Amibara and Melka Werer area are in the Afar Region of Ethiopia, along the floodplain of the Awash River. The dominant soil types in this area are mainly Fluvisols and Vertisols, which developed from alluvial sediments deposited by the river.

Fluvisols/Alluvial Soils occur mostly along the riverbanks and floodplains and are generally fertile, with textures ranging from silt loam to clay loam, making them suitable for irrigated agriculture such as cotton, maize, vegetables, and sugarcane (Figure 4.1 a).

Vertisols are heavy clay soils commonly found in the flat plains surrounding Amibara; they contain a high percentage of clay and exhibit strong shrink-swell behaviour, forming deep cracks during dry seasons and becoming sticky when wet (Figure 4.1 b). These soils have high natural fertility and good water-holding capacity but often suffer from poor drainage and are difficult to cultivate without proper management.

In addition, some parts of the irrigated land are affected by saline and sodic soils (Solonchaks) (Figure 4.2 c) due to high evaporation and inadequate drainage, which causes salt accumulation in the soil. Minor soil types such as Cambisols may also occur on slightly elevated areas. Overall, the soils in the Amibara area are productive under irrigation from the Awash River, but they require proper soil and water management to control salinity and improve drainage.

Figure 4.2: Typical soil type (a) Fluvisol /Alluvial Soils(Sandy soil)at the flood plain of the river(b) Vertisols in the Ambara area(c) Typical Sodic soil with poor drainage area

4.1.4.1 Soil Erosion and Land Stability

The Sub project Area of Influence (PAI) is dominated by **Alluvial Fluvisols** (along the riverbanks) and **Vertisols** (in the inland plains). The existing dike is currently in a state of "advanced deterioration" primarily due to internal and external erosion and poor material selection.

4.1.4.1.1. Erosion Vulnerability and Mechanical Clearing

The removal of the dense *Prosopis juliflora* thickets during the site preparation phase will expose loose, sandy alluvial soils to high-velocity winds and surface runoff. Without immediate protection, the 60km alignment is at high risk of significant soil loss before the new embankment is consolidated.

4.1.5. Land use and Land cover

Based on 2019 baseline data obtained from the Woreda Agriculture Office, the landscape of Amibara Woreda is heavily dominated by vast open spaces and shrub-related vegetation, covering a total area of 399,440 hectares (Table 4.1).

However, the current land use and land cover of the Amibara dike area in the Awash River basin is predominantly characterized by extensive irrigated agriculture, reflecting the region's role as one of Ethiopia's primary agro-industrial zones. Large-scale commercial farms and smallholder irrigation schemes dominate the landscape, primarily cultivating water-intensive crops such as cotton, sugarcane, and maize.

The surrounding landscape consists of patches of shrubland, representing the natural semi-arid vegetation typical of the Afar lowlands. However, portions of the alignment are characterized by bare land, specifically in areas degraded by soil salinity, wind erosion, or seasonal flood-scouring. The Awash River and its complex network of associated irrigation and drainage canals form the primary water bodies, supporting both agricultural production and localized wetland environments.

Scattered rural settlements and farm infrastructure are interspersed within the agricultural matrix, indicating human activity that is closely tethered to irrigation development. Overall, the LULC pattern reflects a historical transition from natural rangeland to intensively managed agricultural land. This shift has critical implications for water management, soil sustainability, and the long-term geotechnical stability of the 60 km embankment.

Table 4.1: Baseline Land Use and Land Cover of Amibara Woreda

Land Cover Group	**Area (ha)**	**Percentage (%)**
Open Grassland	133,958	33.54
Exposed Sand/Shrub	118,531	29.69
Dense Shrubland	117,422	29.40
Agricultural land and all Other Land Covers Combined	29,529	7.37
Total	**399,440**	**100.00**

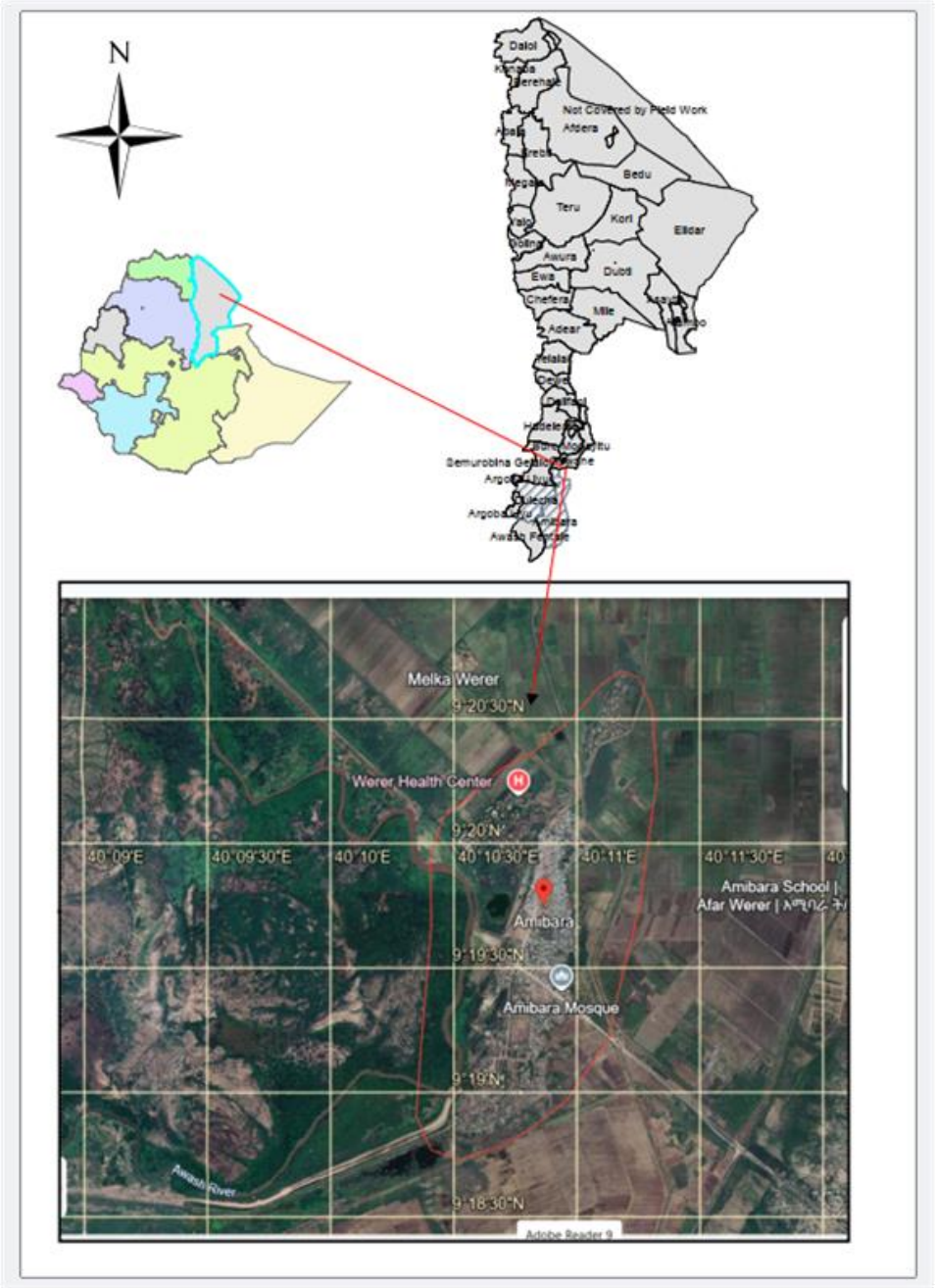

Figure 4.3: Land use of the sub-project area

4.1.6. Hydrology and Water Resources

The Awash River is the primary surface water resource. The groundwater table in the area is shallow, often less than 2 meters in irrigated fields, and is prone to seasonal fluctuations centered on the Awash River. Significant seepage occurs through the current dike, creating artificial ponds and contributing to waterlogging and soil salinity in adjacent farm fields.

The hydrology and water resources of Amibara and Melka Werer in Ethiopia's Afar Region are largely shaped by the Awash River, the primary surface water source in the area. The Awash River flows

through the Awash River Basin, providing vital water for irrigation, livestock, and domestic use. Originating from the Ethiopian highlands, the river flows into the Afar lowlands, creating a broad floodplain around Amibara, where irrigation agriculture is common. Several irrigation canals and water diversion systems have been developed to channel water from the Awash River to large-scale farms and smallholder fields in the Middle Awash Valley. Alongside surface water, groundwater sources also exist, stored in alluvial and volcanic aquifers formed by sediments and basaltic rocks. Groundwater is typically accessed via wells and boreholes for drinking and supplementary irrigation. However, the hot and arid climate of the Afar region results in high evaporation rates and poor drainage, which can cause waterlogging and soil salinity in irrigated lands. Seasonal rainfall adds some surface runoff, but it tends to be limited due to the region's generally low annual rainfall. Overall, the hydrology of the Amibara area is dominated by the Awash River system, which plays a vital role in supporting agriculture, local livelihoods, and water supply in this semi-arid environment.

4.1.7. Water Quality Baseline Conditions

The water quality within the Middle Awash River Basin is a product of complex interactions between natural hydrogeological processes and anthropogenic pressures. Primary stressors include industrial effluents, urban wastewater, and agricultural runoff laden with fertilizers and pesticides. Furthermore, irrigation return flows and significant sediment loads from soil erosion impact the river's physical and chemical integrity. Notably, natural saline inflows, particularly from Lake Beseka, contribute to heightened salinity levels, altering the chemical composition of both surface and groundwater systems.

Baseline data for the sub project area were established through systematic in situ measurements and laboratory analyses (Figure 4.4). The spatial coverage of this dataset is sufficiently robust to provide a comprehensive and representative characterization of the river's existing water quality conditions.

Physical parameters were measured directly in the field at multiple sampling sites (Table 4.1). These in situ field measurements indicate relatively stable alkaline pH values across the sub-project affected portion of the river (7.28-7.69), reflecting the influence of the region's basaltic geology. Elevated electrical conductivity (EC) observed at the Red Ash seepage site (7.1 mS/cm) and the End of Dike (Yeorien pump site) river water sample (5.7 mS/cm) suggests localized zones of high mineralization, likely resulting from a combination of poor drainage, high evaporation rates, and the intrusion of saline groundwater.

Figure 4.4: Water sampling and in situ water quality measurement at Awash River

Table 4.1: In Situ Water Quality Measurements

River and Seepage Water Sampling Site	GPS Point			pH	Eh (mV)	EC (mS/cm)	Temp (°C)
	Elevation (m)	Easting (X)	Northing (Y)				
Zezo Zero (Weir site)	752	0622973	1017808	7.63	-31.9	1.0	23.4
Dofen Jelba / Gooso Pump	743	0626071	1036661	7.28	-149.0	1.2	26.5
Werer Research Center Pump	739	0628126	1032551	7.55	-32.0	1.3	26.9
Amibara (Red Ash)	738	0625416	1029267	7.69	-42.1	7.1	26.1
Awash Basin Office	734	0629020	1030038	7.48	-28.0	1.6	28.3
End of Dike / Markos Pump	727	06434006	1056290	7.53	-30.5	5.7	25.5
Hasoba Pump Site	725	0635294	1046540	7.55	-32.7	1.5	24.6
Blen Site	725	06412366	1050643	7.46	-26.3	1.5	25.3

In addition to *in situ* measurements, laboratory-based analyses were conducted to support a comprehensive baseline assessment of water quality. The laboratory results (Tables 4.2 -4.4) illustrate the spatial variation of physicochemical water quality parameters in the Awash River and selected seepage sites within the proposed sub project's area of influence. For clarity, the analysed parameters were grouped into general water quality indicators, nutrients and major ions, and heavy metals.

a. General Water Quality Parameters

The laboratory results (Table 4.2) confirm field observations, indicating an elevated mineralization across the study area. The seepage (Red Ash sampling site), in particular, shows extremely high total dissolved solids (TDS: 4542.6 mg/L) and electrical conductivity (EC: 6780 µS/cm), both of which exceed recommended drinking water limits. Turbidity levels are consistently high across all sampling locations (111-363 NTU), reflecting substantial sediment transport likely driven by upstream erosion processes as well as the stagnation effect, which facilitates the concentration of dissolved minerals over time.

Table 4.2: General water quality parameters result

No	River and Seepage Water Sampling Site	EC (µS/cm)	TDS (mg/L)	Salinity (mg/L)	Turbidity (NTU)	Alk. (mg/L)	HCO_3^- (mg/L)	CO_3^{2-} (mg/L)	Hardness (mg/L)
1	Werer Research Center	1375	921.25	0.7	189	430	530	260	80
2	Jelba / Dofen	1386	928.62	0.7	255	460	560	270	100
3	Weir Site (Zero Zero)	1056	707.52	0.5	111	340	410	200	60
4	Red Ash	6780	4542.6	3.8	115	290	355	175	165
5	Awash basin office	1402	939.34	0.7	169	650	750	400	75
6	Hasoba Pump Site	1401	938.67	0.7	363	480	590	290	80
7	Billen Pump Site	1415	948.05	0.7	306	520	640	310	75
8	Yeorien Pump Site	1413	946.71	0.7	321	530	640	-	-
	Status with WHO Drinking Water Guideline (mg/L)	~1500 mg/L	1000 mg/L		5 NTU	200 mg/L			

b. Nutrient and Major Anionic Concentrations

Nutrients and major anions were analysed (Table 4.5) to evaluate the impacts of existing agricultural activities. Nitrate and phosphate concentrations generally remain within safe limits, indicating that agricultural nutrient loading has not yet led to chronic eutrophication at the studied sites. However, elevated ammonia levels in seepage water at the Red Ash sampling site (0.87 mg/L) and in river water near the Awash Basin Office (0.85 mg/L) may suggest localized organic pollution or recent fertilizer application.

In addition, fluoride concentrations are critically high (7.3–9.5 mg/L), exceeding the WHO drinking water guideline value of 1.5 mg/L. This is a well-documented regional issue associated with geothermal activity in the Rift Valley. Chloride concentrations in seepage water at Red Ash are also elevated, further supporting concerns about salinity in the area.

Table 4.3: Nutrient Concentrations (mg/L)

No	River and	NO_3	N–	NH_3	NH_4	N–	NO_2	N–	PO_4	P–	SO_4^{2-}	Cl^{1-}	H_2S	SO_4^{2-}	F^{1-}	S^{2-}

	Seepage water Sampling Site		NO_3			NH_3		NO_2		PO_4^{3-}						
1	Werer Research Center	7.26	1.64	0.13	0.14	0.11	0.234	0.071	0.37	0.12	82	86	0.04	82	7.8	0.04
2	Jelba / Dofen	6.30	1.42	0.29	0.31	0.24	0.188	0.057	0.52	0.17	85	105	0.04	85	8.0	0.04
3	Weir Site	7.00	1.58	0.34	0.36	0.28	0.168	0.051	0.24	0.08	80	46	0.06	80	7.3	0.06
4	Red Ash	2.56	0.58	0.87	0.93	0.72	0.010	0.003	0.50	0.17	190	375	0.01	190	9.5	0.01
5	Awash basin office	1.24	0.28	0.85	0.90	0.70	0.204	0.062	0.78	0.26	88	88	0.02	88	7.4	0.02
6	Hasoba	0.26	0.06	0.16	0.17	0.13	0.161	0.049	0.36	0.12	85	82	0.06	85	7.4	0.06
7	Billen	0.88	0.20	0.19	0.21	0.16	0.099	0.030	0.87	0.29	87	82	0.10	87	7.3	0.09
8	Yeorien Pump Site	4.34	0.98	0.19	0.21	0.16	0.145	-	-	-	86	100	-	86	7.4	-
Status with WHO Drinking Water Guideline (mg/L)		50	11.3	1.5*	1.5*	1.2*	3	0.9	—	—	250*	250*	0.05*	250*	1.5	—

c. Metals

Table 4.4 presents the baseline concentrations of selected heavy metals (Fe, Cu, Zn, Cr, and Mn) in surface water samples collected from the Awash River and associated seepage sites within the sub project area. The baseline assessment of surface water quality within the sub project area focused on key heavy metals to establish a reference point for future monitoring. The following Table 4.4 analysis summarize the findings against international standards. The observed some higher baseline values may be influenced by upstream activities in the Upper Awash, including industrial discharges and agricultural runoff.

Table 4.4: Heavy Metals (mg/L)

No	Sampling Site	Fe	Cu	Zn	Cr	Mn
1	Werer Research Center	0.04	0.04	0.01	0.06*	0.001
2	Jelba / Dofen	0.02	0.10	0.01	0.06*	0.001
3	Weir Site	0.02	0.02	0.04	0.02	0.001
4	Red Ash	0.07	0.10	0.06	0.04	0.001
5	Awash basin office	0.03	0.08	0.03	0.05	0.001
6	Hasoba	0.05	0.34	0.11	0.07*	0.001
7	Billen	0.04	0.24	0.14	0.07*	0.001
8	Yeorien Pump Site	0.11	0.01	0.05	0.05	0.001
Status with WHO Drinking Water Guideline (mg/L)		0.3	2.0	3.0	0.05	0.1
		Acceptable	Acceptable	Acceptable	*exceedance	Acceptable

The overall baseline water quality in the Amibara area (Middle Awash Basin) is characterized by high salinity, elevated fluoride, and extreme turbidity. Most sampled sites exceed WHO and EPA guideline limits for electrical conductivity (EC ~1500 µS/cm), total dissolved solids (TDS 1000 mg/L), turbidity (5 NTU), alkalinity (200 mg/L), and fluoride (1.5 mg/L). In particular, Red Ash exhibits significant exceedances of EC, TDS, and chloride (250 mg/L), rendering it less suitable for domestic use and sensitive agricultural practices. Nutrient concentrations (e.g., nitrate ~50 mg/L) and trace metals(except Chromium) generally remain within acceptable limits. These baseline conditions should be carefully considered in future sub project planning to minimize further environmental degradation.

4.1.8. Ambient Air Quality Conditions

Baseline ambient air quality was determined through on-site measurements carried out at selected locations within the Sub project Area of Influence (PAI). This assessment considers key air pollutants, including particulate matter PM2.5, PM10, and Total Particulate Matter (TPM) as well as gaseous emissions such as Nitrogen Dioxide (NO_2) and Sulfur Dioxide (SO_2). The recorded pollutant concentrations were subsequently compared with the World Health Organization (WHO) Air Quality Guidelines to evaluate baseline compliance and identify potential environmental and public health risks.

The results indicate that the sub-project area currently experiences very good ambient air quality, with pollutant concentrations generally well below both national and international guideline values (see Annex Table J-1). Gaseous pollutants (NO_2 and SO_2) were measured at 0 ppm across all monitoring sites. PM_{10} concentrations (6.6-26.1 μg/m³) remained well below the WHO 24-hour guideline of 45 μg/m³. Most $PM_{2.5}$ measurements complied with the WHO 24-hour guideline of 15 μg/m³, except at the Awash Basin Office, where a localized slight exceedance of 17.9 μg/m³ was recorded. Given the currently favourable air quality conditions, dust suppression measures and vehicle emission controls are recommended during flood protection embankment construction to prevent deterioration of local air quality and minimize impacts on nearby communities. The area is predominantly rural, characterized by low population density, limited vehicular traffic, and the absence of major industrial emission sources. As a result, existing air quality conditions are largely influenced by natural processes and traditional land-use practices rather than industrial or urban activities.

Local air quality stressors are relatively minor and include small-scale charcoal production from burning the invasive shrub *Prosopis juliflora*, the clearing and burning of *Prosopis juliflora* from agricultural lands, which produces intermittent smoke emissions, and diesel-powered irrigation pumps that generate occasional exhaust emissions(Figure 4.5 below). Elevated Total Particulate Matter (TPM) concentrations observed at some monitoring locations, particularly at Dofen Jelba sampling point, are likely associated with biological particulates such as pollen, plant debris, and organic particles originating from dense *Prosopis juliflora* stands and surrounding wetland vegetation.

The gaseous pollutants nitrogen dioxide (NO_2) and Sulfur dioxide (SO_2) were recorded at 0.00 ppm at the selected sites. This result indicates the absence of significant combustion-related emission sources such as heavy vehicular traffic, industrial operations, or large-scale fuel combustion within the sub-project area. Overall, the monitoring results demonstrate that ambient particulate and gaseous pollutant concentrations remain within acceptable environmental thresholds.

Figure 4.5: Smoke observed from the charring activity of *Prospis julioflora*

To ensure contractors effectively manage cleared *Prosopis* during dike construction, Contractors are required to implement a "zero-burn" policy to reduce greenhouse gas emissions and fire risk hazard, instead segregating biomass into high-value timber for construction, small branches for community firewood or charcoal, and brush for conversion into soil-enriching biochar.

4.1.9. Noise and Vibration

The noise level of the sub-project area (Table 4.6 below), the 60 km sub project corridor from Melka-Sedi through Amibara and Haruka Woredas, is a predominantly quiet rural and pastoral area. The existing acoustic environment is mainly influenced by natural sounds such as wind and the flow of the Awash River. Human-generated noise is limited and intermittent, primarily from:

- Agricultural machinery: Irrigation pumps at sites such as the Yeoren pump.
- Transportation: Occasional light vehicles such as three-wheeled Bajaj and motorcycles using the narrow and degraded dike road. As well as tracks to load agriculture and irrigation products, charcoal is observed near agricultural lands.

Noise level based on the field measurements shows that most rural locations remain within acceptable limits. However, areas near irrigation pumps and administrative centres sometimes approach or exceed daytime standards due to localized mechanical activity.

Table 4.6: Noise Level Measurement along the Embankment Corridor

Sampling Site	**GPS Point**			**Time**	**Noise Level (dB)**	WHO Guidelines (Daytime Limit)
	Elevation (m)	**Easting (X)**	**Northing (Y)**			
Zezo Zero (Weir site)	752	0622973	1017808	Day time	60.0	55 dB
Dofen Jelba / Gooso Pump	743	0626071	1036661	Day time	48.5	55 dB
Werer Agricultural Research Center Pump	739	0628126	1032551	Day time	64.0	55 dB
Amibara Red Ash/ Seepage	738	0625416	1029267	Day time	58.0	55 dB
Awash Basin Office	734	0629020	1030038	Day time	58.0	55 dB
End of Dike / Yeorien Markos Pump	727	06434006	1056290	Day time	43.0	55 dB
Hasoba Pump Site	725	0635294	1046540	Day time	57.0	55 dB
Blen Site	725	06412366	1050643	Day time	41.7	55 dB
Algata Pump Site				Day time	43.0	55 dB
N.B. According to the *Ambient Environment Standards for Ethiopia*, noise levels at sensitive residential locations must be maintained within: **Daytime (6:00 AM – 9:00 PM):** 55 dB (A); **Nighttime (9:00 PM – 6:00 AM):** 45 dB (A)						

The sensitive receptors for noise and vibration primarily include households in approximately 14 high-priority kebeles, representing a significant population residing along the right bank. These households may be exposed to increased noise from heavy machinery, such as excavators and dump trucks, as well as vibrations resulting from compaction activities.

Moreover, currently, there are no notable sources of anthropogenic vibration in the sub-project area. However, the area's sandy alluvial soils efficiently transmit vibrations. As a result, construction activities such as dike compaction using heavy rollers and potential piling for pedestrian bridges may generate perceptible vibrations that could affect nearby informal or masonry structures in adjacent kebeles.

Figure 4.6: Ambient air and noise measurement

4.1.10. Waste Generation and Management

The community in the Ambira rural sub project area utilizes a traditional waste management system typical of pastoralist settings. There is currently no formal infrastructure for waste collection, transportation, or disposal along the 60 km sub project alignment. Waste generation is relatively low, estimated at approximately 0.2 kg per capita per day.

The waste stream is predominantly organic (over 85%), consisting mainly of agricultural residues and animal manure that naturally decompose. Limited quantities of non-biodegradable waste, primarily plastics, are managed through informal methods such as open burning. Despite these practices, the area remains largely undisturbed due to the very low population density and minimal waste generation.

This relatively pristine environmental condition makes the ecosystem highly sensitive to external pollutants. Even small increases in non-biodegradable or hazardous waste could disrupt soil quality, water sources, and grazing land, which are critical to local livelihoods.

The introduction of construction activities and worker camps will alter the existing waste profile by introducing non-organic and potentially hazardous materials such as hydrocarbons, lubricants, packaging waste, and wastewater. To ensure the surrounding environment remains undisturbed, the Environmental and Social Management Plan (ESMP) will adopt a strict "Leave No Trace" approach.

4.2. Biological Environment Baseline

4.2.1. Ecosystem Overview and Ecological Integrity

The Amibara Woreda, situated within the Middle Awash Sub-Basin of the Afar Region, is a high-biodiversity mosaic of riverine forests and arid savannahs. Naturally dominated by *Acacia-Commiphora* shrublands, this landscape serves as a critical biological lifeline for dryland fauna and provides essential grazing resources for local pastoralist communities.

Currently, the ecological integrity of the Sub project Area of Influence (PAI) is heavily compromised by several primary drivers:

- **Habitat Destruction and Water Diversion:** Commercial irrigation schemes have diverted critical water flows, altering the moisture balance of the riverine woodlands and leading to a decline in indigenous forest cover.
- **Invasive Species Encroachment:** The aggressive spread of *Prosopis juliflora* (locally known as "Weyane") has fundamentally altered the landscape. This invasion outcompetes native flora, obstructs irrigation canals, and undermines the pastoral grazing capacity of the region.
- **Anthropogenic Pressures:** Increasing population and overgrazing have shifted the environment toward a degraded bushland state, necessitating urgent management to preserve remaining ecological value.

4.2.2. Flora

The sub project site, located outside formally designated national parks, has experienced significant ecological degradation due to both natural processes and human activity. Along the 60-km flood protection dike, the botanical landscape is currently dominated by dense, invasive thickets of *Prosopis juliflora*. This deep-rooted species not only suppresses native vegetation but also poses a structural risk to the dike by creating conduits for water seepage.

Scattered remnants of indigenous woodland that comprise <0.4% of the area persist throughout the Sub project Area of Influence, including species such as *Acacia tortilis* (Umbrella Thorn), *Acacia senegal* (Gum Arabic Tree), and *Acacia nilotica* (Figure 4.6). In riverine zones, *Salvadora persica* (Adaito) and *Cordia sinensis* (Mederto) are frequently observed (Figure 4.6). The highly invasive weed *Parthenium hysterophorus* is common in disturbed soils and farmlands, where it reduces crop yields and causes health irritations.

A comprehensive list of representative terrestrial plant species in the sub-project area and its surroundings is presented in Table 4.7. None of these native species is classified as vulnerable or threatened under the IUCN Red List, nor do they hold formal protected status under local legislation.

Aquatic flora also exhibits aggressive growth within the sub-project's irrigation networks, including pump stations, canals, and seepage areas. Species such as *Typha* (cattails), *Nymphaea lotus* (water lily), and *Lemna* spp. (duckweed) frequently colonize slow-moving water bodies and irrigation channels. Their proliferation disrupts local hydrological flow and obstructs irrigation systems; in particular, duckweed often forms dense surface mats at pump sites. The presence of these species necessitates active management to prevent blockage of irrigation infrastructure and to ensure consistent water distribution across the floodplains. Typical aquatic flora observed are displayed in Figure 4.7.

Figure 4.7: Typical observed terrestrial and riverine plant species dominated by Prosopis juliflora.

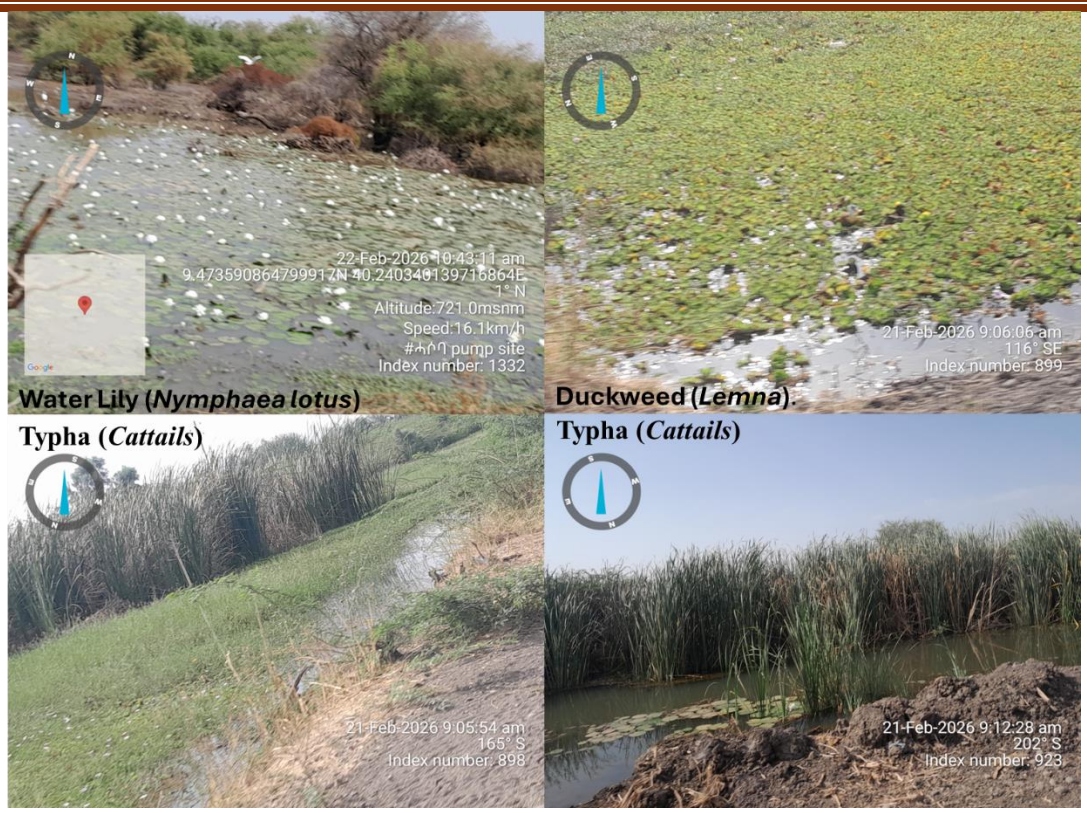

Figure 4.8: Observed aquatic plants, Water hyacinth and Typha in the seepage area/water logging area and irrigation canals

Table 4.7: Plant Species Observed in the Sub-project Area and Surroundings

Local Name (Afar)	Scientific Name	Abundance	IUCN Status
Weyane	*Prosopis juliflora*	Dominant (Invasive)	Not Evaluated (Invasives)
E'ebto	*Acacia tortilis*	Dominant (Native)	Least Concern
Merka'ato	*Senegalia mellifera*	Highly Abundant	Least Concern
Ada-ado	*Acacia senegal*	Widespread	Least Concern
Mederto	*Cordia sinensis*	Common	Least Concern
Adaito	*Salvadora persica*	Frequent	Least Concern
Kasalto	*Acacia nilotica*	Moderate	Least Concern
Gerssa	*Dobera glabra*	Scattered	Least Concern

4.2.3 Fauna

Despite significant ecological degradation caused by the invasive *Prosopis juliflora*, the sub project area remains a vital biological corridor due to its proximity to the Awash River. The fauna within the Sub project Area of Influence consists of a diverse assemblage of terrestrial mammals, aquatic reptiles, and avian species that utilize the riverine ecosystem for water, forage, and transit. Among the terrestrial and aquatic mammals observed during the field visit are displayed in Figure 4.8 and presented in **Table 4.9** below.

4.2.3.1 Terrestrial and Aquatic Mammals

The open grasslands and farm fringes support modest populations of mammals, including Common Warthogs (*Phacochoerus africanus*), Olive Baboons (*Papio anubis*), and various monkey species. These mammals are frequently observed near human settlements and agricultural interfaces.

The perennial flow of the Awash River supports charismatic megafauna essential to the regional ecosystem, and includes mainly the following, but not limited to:

- Nile Crocodiles (*Crocodylus niloticus*): Commonly sighted along riverbanks and near water intake structures, such as Melka-Sedi.
- Fish Species: The river hosts Tilapia and Catfish, though high silt loads during seasonal floods generally limit the commercial fishery potential.
- Hippopotamuses (*Hippopotamus amphibius*): Inhabit deeper river pools and rely on adjacent floodplains for nocturnal grazing.

Figure 4.9: Observed Terrestrial and Aquatic Mammals -Warthog(a), Ape(b), Baboon(c), Nile crocodile(d)

4.2.3.2 Avian Diversity

The wetlands, drainage canals and seasonal floodplains support a rich diversity of bird species. Notable species observed during field surveys are presented in Figure 4.9 and Table 4.8 include:

- African Sacred Ibis (*Threskiornis aethiopicus*): Distinguished by white plumage and a decurved black bill.
- White-faced Whistling Ducks (*Dendrocygna viduata*): Found in large groups near stagnant water and irrigation canals.
- Great Egret (*Ardea alba*) and Cattle Egret (*Bubulcus ibis*): Often seen in shallow waters or following livestock.
- Marabou Stork (*Leptoptilos crumenifer*): Locally known as "Aba Koda," these scavengers are prevalent near riverine areas.
- Abyssinian Roller (*Coracias abyssinicus*) and Northern Carmine Bee-eater (*Merops nubicus*): Frequently observed in shrublands and grasslands.

According to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, all wildlife species identified within the immediate sub project site are currently classified as **Least Concern (LC)**. However, population trends vary among these species. For example, the Marabou Stork shows an increasing population trend, while species such as the Northern Carmine Bee-eater and the Common Warthog exhibit decreasing trends at the global level.

Table 4.8: IUCN Red List Status for Identified Wildlife Species

Common Name	Scientific Name	IUCN Status
Abyssinian Roller	*Coracias abyssinicus*	Least Concern
Northern Carmine Bee-eater	*Merops nubicus*	Least Concern
Marabou Stork	*Leptoptilos crumenifer*	Least Concern
Great Egret	*Ardea alba*	Least Concern
White-faced Whistling Duck	*Dendrocygna viduata*	Least Concern
Common Warthog	*Phacochoerus africanus*	Least Concern
Olive Baboon	*Papio anubis*	Least Concern
Nile Crocodile	*Crocodylus niloticus*	Least Concern

Figure 4.10: Typical birds observed standing in the shallow water, shrubland, and grassland

4.2.4 Ecological Sensitivity and Protected Areas

4.2.4.1 Sensitive Habitats

While the sub-project alignment does not fall within formal national park boundaries, the Awash riverine corridor functions as a "biological lifeline" in an arid landscape. Sensitive habitats within the PAI include riverine woodlands and seasonal wetlands. These areas provide critical nesting sites for birds and maintain bank stabilization. Mechanical clearing during the construction of the 60-km dike and other infrastructures must be managed to avoid disrupting the migratory paths of mammals moving toward the river.

4.2.4.2 Proximity to Protected Areas

The subproject is situated between two major conservation areas, though both are at a significant distance from the site:

1) **Awash National Park (~60 km South):** Spanning 756 km², this park includes the Alledeghi Wildlife Reserve. It is home to endangered species such as the **Beisa Oryx** (*Oryx beisa*) and vulnerable species like **Soemmerring's Gazelle** and **Lion**. It is a critical bird area with over 350

recorded species. The overview of Awash National Park along the Ethio- Djibouti main roadside as displayed in Figure 4.11.

2) **Yangudi Rassa National Park (~100 km Northeast):** This 4,730 km² park consists of sandy semi-desert and wooded grasslands. It provides habitat for the endangered **Grevy's Zebra** and **East African Oryx**, as well as the vulnerable **Cheetah** and **Leopard**.
3) **Alledeghi Wildlife Reserve:** The reserve is a nationally important biodiversity area supporting populations of globally threatened species, including Grévy's zebra (*Equus grevyi* – Endangered), Somali wild ass (*Equus africanus somaliensis* Critically Endangered), and Beisa oryx (*Oryx beisa* -Endangered). It also provides habitat for other arid and semi-arid-adapted wildlife. The Alledeghi Wildlife Reserve is located approximately 8 km from the proposed 60-km dike alignment and associated ancillary facilities, generally at a significant distance from the sub-project area. This wildlife reserve does not fall under the direct influence of the proposed sub-project.
4) **Gewane Wildlife Reserve:** Gewane Wildlife Reserve lies approximately 80 km downstream of the sub project influence area. It forms an important wetland and riverine ecosystem associated with the Awash River, supporting diverse birdlife and terrestrial species such as the lesser kudu (*Tragelaphus imberbis*). An ecological corridor links Gewane with Alledeghi, enabling seasonal migration and maintaining regional ecosystem connectivity.

Although these parks and wildlife reserve are distant from the sub project site, the Awash River connects these ecosystems, underscoring the importance of maintaining water quality and flow within the sub project zone to protect downstream biodiversity.

Figure 4.11: Overview of Awash National Park along the Ethio- Djibouti main roadside

4.3. Socioeconomic Setting

This section explains basics of demography and tries to paint a picture of what life looks like for communities living next to where the dike might go up in Amibara Woreda. It draws from two main places—a household survey that covered 53 families across different kebeles like Badhamo, Eeble, Hasoba, Koma Gidaro, Halay Sumale, Keleat, Bonta, and Werer, and conversations with people in focus groups. Those groups included community members themselves, woreda officials, and folks from various sector offices dealing with agriculture, water, health, and education. The study team also made a walk-through along the proposed alignment, just to see with their own eyes how people use this space daily.

4.3.1 Demography and Community Features

The CSA's sub-projected population of Amibara Woreda in 2025 is 127,166. A socioeconomic survey in Amibara Woreda was conducted in February 2026 in 8 sample kebeles, and it was found that Men-headed households make up 89.4% of the households surveyed. Men in these households usually have more freedom to move around and make decisions, but they also carry the weight of managing livestock when floodwaters rise. The survey caught about 9% of women-headed households (also addressed in section 4.3.4.1). The previous flood incidence has been impacting about 30.2% of the households in the area, which are vulnerable to various social and natural shocks. The impact has been severe with those associated with the displacement of people due to flood incidence. The families with chronic sickness, females and children, households with many dependents and those unable to work, which include the elderly and people with disability/ies, have been among the main vulnerable groups. When floods come, they can't evacuate as easily, can't reach services easily, but are assisted by clan members and extended family structure, and can't rebuild the same way.

The area where this sub-project is going to be implemented stretches across several kebele administrations, alongside the Awash River. Field observation and assessment indicated a mix (in terms of economic base) of people living along the Awash River. These people include pastoralists and agro-pastoralists; others work or depend on farming (either farming their own land or working for investors in commercial farms). The way people have arranged themselves along the river tells you something about how they've learned to live with flood risk. The team noticed three main patterns:

In Badhamo Kebele, the survey team counted five places where farming is the main source of livelihood, and people live near the existing dike. People live on both sides of the riverbank. While in Bonta Kebele, there are three more farming centers with established communities in agriculture and livestock. Out in the floodplain, between the river and the current barrier/dike, there are temporary settlements. People move into these areas during the dry months when the flood risk is low, then pack up and head for higher altitude areas when the rain threatens. It's a smart way to live with the river's rhythms, but it also means living with uncertainty that never quite goes away. In Aeble, Komagidero, and Worer Kebeles, people and animals use the water right alongside the existing dike. This isn't occasional use; it's a daily activity. People use the water for bathing, cooking, washing, and drinking by humans and livestock, including small-scale irrigation at spots they've used for a long period of time. Based on survey findings, landless pastoralists' households account for about 24.5%. Moreover, the survey found that 64.2% of households use direct access points to reach the river and highlighted that these access points are "critical."

More than half of households 54.7% use the dike paths for Grazing Animals to get their livestock down to riverine pastures, and 55.2% call these routes "Critical." They indicated that this is not about convenience; livestock can't survive without regular access to river water, and there aren't any other places to take them. They also depend on footpath routes along the existing dike to reach their farming plots. For about 58.6% of them, these paths are "Critical." The plots might be some distance from home, but the paths connect them.

In spots like near the Haji Ahmed pump station, the river doesn't connect its blocks. People cross using rope and homemade boats that look like they could flip at any second. They make use of it to reach farming fields on the other side, markets, and services. Community members brought this up themselves, saying they desperately need proper crossings that work even when the river rises, especially when they need to evacuate.

People in focus groups highlighted a state of chronic insecurity that settles in as the rainy season approaches and has been a persistent psychological toll. This isn't an abstract fear; it's living with the knowledge that displacement could come, that assets could wash away, that family members or livestock could die, that the work of putting things back together will be exhausting. Again and again, people asked and reminded *when* specifically and whether construction could start before the next rains. Their message was raw fact, and it was about urgency; without action now, lives and livelihoods will remain at risk.

4.3. 2. Land Use and Livelihoods

The economic base is a mix of livestock, irrigation farming, and daily labour work, among others. The people depend on resources even while flooding threatens. The household survey and collected data in the sample kebeles indicated the livelihood and land use conditions, which include:

i. **Livestock Herding (35.8%):** This is more than a job; it's the foundation of Afar identity. Herders need access to grazing land and to the river, especially in dry months. Due to the previous flood incidents, vast grazing areas were damaged. Soil salinity intensified what's left of the soil and made it less fertile. Animals forced to move too soon are crowded into temporary spots where disease spreads.

ii. **Irrigated Farming (24.5%):** A substantial number (about 85%) of households farm with water pumped straight from the Awash River. From the 24.5% who own irrigated plots, 42.9% of those use them in both main and dry seasons year-round. They grow maize, vegetables like tomatoes and onions, and cotton, some for their livelihood and income source. Farmers were absolutely clear that construction shouldn't t block their access to the river water. Although there are considerations of seasonality, communal and private land use, HHs considered in the interview reflected that they consider irrigation farming from 0.5 to 2 ha, excluding those considered as investors and associations. Even missing one season could put a family in debt and in hunger. It has also been noted that people also seek to herd small ruminants and chickens or own livestock with other Shepherds.

iii. **Daily Labour (22.6%):** Another substantial group of people work for wages, mostly on commercial farms. These folks are especially vulnerable to any disruption of flood incidents as their livelihood depends on their daily engagement with no savings to cushion the disruption. When floods hit commercial farms, as in 2021, daily labourers are the first to lose immediate income and are vulnerable.

iv. **Rain-fed Farming or Recession (Dasse) Agriculture (3.8%):** You don't see much of this in such a dry season, and only practiced where enough moisture is available on the land. The fact that it's so rare just shows how everything depends on the river. It should be noted that people seek additional sources of livelihood, like the rearing of small ruminants and chickens. It has been indicated that about 68.4% of them could be impacted if the river access is restricted or changed.

4.3.3. Effects of Floods and Social Impact Risks

The 2021 flood incident still lives in people's memories. From the then 13 kebeles, eight were badly hit, and two kebeles were destroyed and wiped out. An estimated 20,000 hectares of farmland were destroyed, including maize, vegetables, and cotton at different stages. Whether the land belonged to big investors or the local community, the economic pain was shared everywhere. Sector office representatives even characterized the incident as something cruel since floods tend to hit the area when

crops are almost ready to harvest. All that season's work, all that investment, all those resources people were counting on were gone.

The KI interview with the Disaster Risk Management representatives explained that investors (big and small) have become scared of the flood risks. They don't want to risk commercial farming anymore. So the scale of farming keeps shrinking. Fewer farms mean fewer jobs for daily labourers, who constitute up 22.6% of the households. Less income means families can't meet basic needs or invest in their kids. People in focus groups expressed their worry that if this keeps up, the community will lose its ability to use the natural resources that have always been its wealth. A cycle of poverty, pulling people down deeper each time.

The land isn't producing as it used to because salt is building up. People said this isn't really from floodwater, it's from factory chemicals released into the Beska River, which flows into the Awash. When that contaminated water floods into the fields or gets used for irrigation, it leaves salt and chemicals behind. Over time, the soil degrades.

4.3.3.1. Community Assets and Infrastructure

The sub project area holds things people depend on for public and private use. Past floods have shown how easily these can be damaged.

The survey indicated that 56.6% of households rely on community water points, wells, boreholes, and piped systems. And 73.3% of these call them "Critical." This dependence makes sense in such a dry area with few clean water alternatives. In this regard;

- Physical Destruction: The survey, KI, FGD, and field observation all indicate that flooding results in significant physical damage, including washed-away pipes, flooded and submerged pump buildings, and damaged or swept-off storage tanks. Additionally, KI and observation verified that health centers were damaged, and most kebeles had ruined water structures from schools, research facilities, and health centers.
- Contamination: Even intact infrastructure frequently becomes contaminated, according to the survey and KI results. According to KI and field observations, flooding also makes hand-dug wells unusable by burying them in mud and debris.
- Health Fallout: According to the survey, KI, FGD, and observation, major health centers have sustained damage, which has disrupted regular services like emergency care, vaccines, and prenatal care. Participants in the FGD emphasized that populations turn to drinking directly from rivers tainted with industrial effluents, agricultural chemicals, dead animals, and human waste when water systems fail. Waterborne illness outbreaks, including cholera, can sometimes cause more damage than the flood itself, as seen and documented by KI. Furthermore, FGD and observation verified that stagnant floodwater increased the risk of malaria, with cases significantly increasing following floods and further burdening already impacted populations.
- Economic Restrictions on Recovery Measures: According to the survey, KI, and FGD, the lack of tools, supplies, and technical know-how needed to fix damaged water infrastructure and medical facilities severely restricts recovery. Because of this, communities frequently lack access to clean water and medical care for long stretches of time.
- Schools: Floods destroy school buildings, obstruct roads, and uproot families, according to the survey, FGD, and observation. As households prioritize survival and reconstruction, many

children drop out during this time, and some never return, according to FGD conversations. This has long-term effects on schooling and the community.

4.3.4. Women's roles and cultural values, and social vulnerabilities

4.3.4.1 Women's roles and vulnerabilities

Some people face more risk than others due to flooding and the sub-project. These vulnerabilities run deep in social structures, cultural practices, and physical realities.

- Building and Moving Homes**:** Women put up the mobile huts that define pastoralist life. They build them, renovate them every two weeks, take them apart, load them on camels, and move to new grazing spots. This is physical work that demands strength and skill, and it happens no matter the weather, no matter how they're feeling.
- Caring for Everyone: Women look after all family members. Feeding children, nurturing them, caring for the sick, managing household property. Making sure kids are fed, clean and healthy. Looking after sick family members without formal health services. Keeping household goods together.
- Bringing in Income**:** Women do small-scale trade, process dairy products, and engage in other activities that bring in cash. These contributions keep families going but often get missed in formal economic counts.
- When a flood comes, this load gets heavier in ways hard to imagine:
- Women try to salvage the mobile home, cooking stuff, bedding, food stores—while keeping children and elderly relatives safe.
- They figure out how to feed everyone with markets cut off and food stores destroyed.
- They do all this while maybe pregnant, nursing, caring for infants.
- After the flood, they rebuild the home and re-establish routines, usually with no help from outside.
- The toll on body and spirit is enormous. And yet, women's voices are often missing from sub-project planning.

4.3.5 Gender Based Violence and Abuse Against Women and Girls

Focus group discussion findings indicated that during flooding and displacement, early marriage, rape, and unwanted pregnancies increase. Normal social structures break down. Shelters get crowded. People end up in unfamiliar places. Chaos provides cover for abusers and leaves victims with less protection. Girls are especially at risk. Families under extreme stress sometimes marry off daughters early, fewer mouths to feed, and bride wealth to help survival.

Sexual and Reproductive Health: HIV and other STIs increased during and after flood incidents. People in focus groups linked this to several things:

- Displacement puts people in contact with new partners
- Survival means will cause a breaking of social customs and bring health risks
- Health services, family planning information, and protection (like condoms) become harder to access
- Normal social networks and protections crumble

Flooding inhibits mobility; there's no way to reach a health center, even to a central location. Respondents talked about this with real fear, as such incidents complicate the overall access to any kind of services (medication, technical and sanitation), which mainly result in mortality incidents.

- **Elderly and Sick People.** They also face critical challenges and vulnerabilities due to flood incidents. Chronic conditions requiring medication and dietary needs are not possible when incidents of flood occur.
- **People with Chronic disease:** Those who require regular check-ups for HIV, TB, diabetes, and high blood pressure, their situations worsen fast due to the restricted access to medication, clean water, health facilities, and treatment interruption, while stress makes everything worse.
- **Female-Headed Households:** Women heading households handle every part of crisis response while caring for children. More vulnerable to exploitation. Fewer resources for recovery.

4.3.6. Cultural Heritage/Religious Tie Sites

Due attention and consideration shall be given while constructing the dike and related infrastructures since graveyards/Burial grounds of ancestors are observed near the proposed dike at Dofen Jelba site, although the proposed embankment is not aligned as the primary impact area. In this regard, engagement and regular consultation with the community members, important clan/community leaders and figures during site preparation and construction is vital and will address any risks that may arise in advance.

4.3.7. What The Local Communities Want Sub-Project Planners to Know/Consider

- Make sure the embankment has accessible routes to the river. The clearest, most consistent message: construction must not block access to the river for water, irrigation, livestock, or movement. From the community's view, this isn't negotiable. The river is life.
- Put in formal crossings where paths get disrupted
- Mark and protect spots where livestock water
- Make sure irrigation pumps keep running through construction
- Keep footpaths open on both banks
- Early warning committees exist on paper but lack training, resources, and real authority
- Last-minute fixes like dumping sand on banks don't help against intense floods
- Fast recovery interventions and plans help the victims to get emergency relief
- Institutional coordination to monitor and share information
- Community members and officials both want a **real coordination mechanism** that brings sub-project people, government offices, and community reps together regularly, with actual follow-through.
- Engage and work with Werer Agricultural Research Centre to plant indigenous and valuable trees during the construction period, to ensure local farming and ecology are sustainable and harmonized, and manage soil salinity through research and extension works.

4.3.8. Indicative Information and Desired Actions for Resettlement/Restoration Needs

Approximately 128 seasonal pastoralist households were identified along the existing Amibara embankment between 5 km and 25 km downstream of the weir site (zero-zero) during the ESIA field assessment conducted in February 2026. A subsequent field verification undertaken in June 2026 identified approximately 96 seasonal pastoralist households within the same section. The variation in

household numbers reflects the seasonal and mobile nature of pastoral settlements, which fluctuate over time in response to grazing conditions, water availability, and livestock management practices.

Suggested Action Points for Consideration (Compliant with World Bank ESF) shall include:

1) Planning and Social Assessment

- To account for seasonal migration and confirm the 96 households, conduct a thorough socioeconomic survey and census update prior to implementation.
- Set a deadline/cut-off day for eligibility that takes seasonal pastoral migration into account.
- In accordance with ESS5 (Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement), design and implement a Resettlement Plan (RP).
- Incorporate livelihood restoration techniques specific to pastoral systems, taking into account shared land use and movement patterns.

2) Involvement of Stakeholders

- Hold ongoing, culturally sensitive engagements with local institutions, clan leaders/elders, and pastoralist groups.
- To consider pastoral migration patterns, use mobile and seasonal consultation and engagement approaches.
- Make sure information is disclosed in the local language and in accessible forms.

3) Measures for Restoring Livelihoods

- Offer help and remuneration based on livestock, such as negotiated grazing corridors or substitute grazing access, Water access points and veterinary services.
- Encourage alternative sources of income diversification, such as small-scale trade, the cultivation of fodder, or livelihoods that can withstand drought.
- Through negotiated agreements, improve access to community rangeland resources.

The desired resettlement plan shall consider the following major activities, but not limited to:

i. Planning for Settlement and Site Selection
   - Locate appropriate, voluntary resettlement locations near grazing corridors, water sources (boreholes, rivers), access routes, etc.
   - Adopt flexible or semi-settled arrangements rather than permanent sedentary structures.
   - Assure land tenure security in accordance with ESS5 and customary rights.

ii. Assistance for Relocation and Re-establishment at a comparable site.
   - Assist with (enclosures, temporary shelters, livelihood implications), transitional assistance (food, transportation, supplies for a temporary shelter)
   - Acknowledge the utilization of communal and traditional resources rather than just personal holdings.

iii. Consider Mobility-Sensitive Resettlement
   - Use seasonal or cluster-based relocation strategies that permit ongoing mobility.
   - Preserve access to transhumance corridors, which are traditional migration routes.
   - Refrain from interfering with established pastoral coping strategies.

iv. Provision of Basic Services
- Make sure provision of access to water supply (piped systems and/or boreholes), watering stations for animals, health outreach programs, such as mobile clinics, education, and others as appropriate.

v. Measures of Vulnerability and Inclusion
- Determine and offer specialized assistance to households led by women, people with disabilities and the elderly, pastoralists who lack resources or are pro-poor,
- Make sure benefit-sharing and consultation are gender-sensitive.

vi. Mechanism for Grievance Redress (GRM)
- Create a GRM that is both culturally relevant and accessible locally, and include community leaders and elders.
- Design and consider complaints to be submitted orally because of low literacy levels
- Ensure prompt documentation and resolution.

vii. Adhere to the Key Principles of Environmental and Social Frameworks of the Project and World Bank
- When feasible, reduce or avoid displacement.
- Make sure the consultation is free, prior, and informed.
- Improve or restore livelihoods rather than merely relocation alone
- Honour traditional systems and pastoral mobility.
- Offer fair and comprehensive assistance

4.4. Grievance Redress Mechanism Integration

4.4.1 Project Plan of GRM Use

Through the creation and execution of a thorough Resettlement Plan (RP), the initiative will lessen the expected negative effects on impacted households. Before displacement takes place, this strategy will guarantee that all impacted parties get prompt, equitable, and transparent relocation at full replacement support for land and assets of temporary use. To assist households in restoring or raising their pre-project living standards, specific livelihood restoration measures such as agricultural assistance, skill development, and income-generating opportunities will also be offered. To guarantee that impacted communities are properly aware of their rights and that compensation procedures are conducted in a participatory and responsible way, ongoing stakeholder engagement through consultations, such as KIIs and FGDs, will be maintained.

The project will create a strong and easily accessible Grievance Redress Mechanism (GRM) to supplement these measures, enabling communities to voice concerns and seek prompt resolution. To guarantee accessibility and inclusivity, the GRM will incorporate a variety of uptake channels, including community focal points, phone hotlines, and private reporting options. Crucially, the GRM will include secure, private, and survivor-focused channels created especially to receive and manage complaints about Sexual Exploitation and Abuse and Sexual Harassment (SEA/SH). These channels will include anonymous reporting and referral pathways to relevant support services. In order to ensure responsibility and reinforce the zero-tolerance policy for misconduct, all contractors will also need to

establish and execute a strong Code of Conduct, complete SEA/SH training, and promptly report any events through both internal procedures and the project GRM.

4.4.2. Objective of Grievance Redressing Mechanisms

An effective and locally responsive Grievance Redress Mechanism (GRM) is a critical component of the Amibara Right Bank Embankment sub-project. It provides a structured process for addressing concerns raised by Sub-project Affected Persons (PAPs) and other stakeholders. In line with the WB ESF, GRM is designed to be accessible, culturally appropriate, and responsive to the local population's needs. Its primary goal is to resolve complaints fairly and efficiently, minimizing the necessity for formal legal proceedings unless absolutely required.

The GRM for the flood risk reduction infrastructure will be tailored to reflect the local social context, incorporating the participation of respected community figures and institutions. By emphasizing amicable resolution, the mechanism will conserve time and resources while fostering trust between the community and sub-project implementers.

The core objectives of the GRM are threefold: first, to provide PAPs with a transparent and inclusive platform to express concerns related to environmental and social impacts, compensation, construction activities, and service delivery; second, to ensure timely and fair resolution of grievances, thereby preventing delays in sub-project implementation; and third, to promote community ownership and trust through participatory grievance handling.

To operationalize the GRM, a local-level Grievance Redress Committee (GRC) will be established. This committee will include representatives from the Amibara District Administration, the Sub-project Office, elected PAP representatives, respected community elders, and clan and religious leaders, as well as local civil society organizations. To ensure the committee functions effectively and remains responsive to community needs, the sub-project owner will facilitate capacity-building and awareness training for all GRC members.

4.4.3. Grievance Handling Procedure

To facilitate timely and culturally appropriate resolution of concerns raised by Sub project-Affected Persons (PAPs) and other stakeholders, the Amibara site-specific right bank embankment sub-sub project will implement a structured Grievance Redress Mechanism (GRM). This mechanism is designed to resolve complaints efficiently, minimizing the need for formal legal proceedings unless necessary.

Complaints may be submitted through various channels, including written forms, verbal reports, phone calls, SMS, or other locally preferred methods. Public awareness of the GRM will be promoted through community meetings and local institutions to ensure accessibility.

Each complaint will be documented by the Grievance Redress Committee (GRC) secretary using a standardized form, which will include the complainant's name, contact details, the nature of the grievance, and any suggested remedies. Proper documentation ensures consistency, traceability, and accountability.

Upon receipt, the GRC will conduct an initial review to verify whether the grievance is sub-project-related. Valid complaints will be forwarded to the full committee for deliberation. The GRC will communicate its decision to the complainant within seven working days. If the grievance remains unresolved, it will be escalated to the municipal or regional grievance body.

Should amicable resolution fail, PAPs retain the right to pursue formal legal recourse in accordance with national laws. The GRM will adhere to core principles, including fairness, simplicity, accessibility, timely responsiveness, and transparency. It will be inclusive of vulnerable groups and adapted to local social norms.

Beyond compensation issues, the GRM will also address broader sub-project-related concerns such as environmental nuisances, construction disruptions, and service delivery failures. This comprehensive approach aims to build community trust, encourage participatory engagement, and contribute to the successful implementation of the Amibara Right Bank Embankment sub-project, as part of the flood risk reduction intervention along the Awash Basin.

5. POTENTIAL IMPACTS AND MITIGATION MEASURES

5.1 Impact Analysis Steps and Evaluation Criteria

The environmental and social impact analysis followed a three-step process:

I. **Impact Identification:** Baseline research, stakeholder consultation, and surveys were used to identify potential impact receptors and the current state of the environment and socioeconomic conditions.
II. **Impact Description:** The features of a sub-project's effect were characterized by whether they are positive or negative, direct or indirect, short, medium, or long-term, and permanent. This step also considers if effects reach local, regional, or global scales, cross borders, or are cumulative.
III. **Impact Evaluation:** Professionals used their opinion to assign criteria for significant impacts based on effect strength, size, duration, and intensity on the biophysical and sociocultural environment. Evaluation involved comparing findings against national and international laws, consulting decision-makers, referencing government policy objectives, and considering community concerns.

5.2 Impact Evaluation Methodology

To ensure a rigorous and transparent assessment of the environmental and social consequences of the Amibara embankment sub-project, each identified impact is subjected to a standardized evaluation process. This systematic approach allows for the prioritization of mitigation efforts and helps decision-makers understand the magnitude of the sub-project's footprint. Significance is calculated by combining the scores of **Consequence** (Extent + Duration + Intensity) and **Likelihood** (Terrapon-Pfaff et al., 2017; Tagliani & Walter, 2018; **Morgan, 1999; Petts, 1999)**.

Table 5.1: Summary of Impact Evaluation Description

Category	Description	Elaboration / Example
Extent	*Area of influence of the impact: The* area across which the influence will be manifested is referred to as its extent. Since an impact's importance and severity typically have distinct scales, bracketing ranges are frequently needed. This helps clarify the determined relevance or severity of an influence during	- **On Site:** Inside the sub-project site. - **Local:** Two kilometres around the sub-project site. - **Regional:** Effects on the provincial level and nearby provinces. - **National:** Impacts with overall national

	the sub-project's evaluation phase.	influence. - On Site (1), Local (2), Regional (3), National (4) (Terrapon-Pfaff et al., 2017; Tagliani & Walter, 2018; Morgan, 1999; Petts, 1999).
Duration	Estimated lifetime of the impact / Level of damage or disruption	- **Temporary:** Less than one year. - **Short term:** Under five years. - **Medium-term:** Five to ten years. - **Long-term:** Ten to thirty years. - **Permanent:** More than 30 years; long-lasting and irreversible changes. - Temporary (1), Short-term (2), Medium-term (3), Long-term (4), Permanent (5) (Terrapon-Pfaff et al., 2017; Tagliani & Walter, 2018; Morgan, 1999; Petts, 1999).
Intensity	Determines whether an impact is damaging or not.	- **Low:** Affects the environment without interfering with natural, cultural, or social processes. - **Moderate:** Changes occur, but processes continue in a different form. - **High:** Processes undergo drastic changes, temporarily stopping. - **Extremely High:** Functions and processes are permanently altered or ended. - Low (1), Moderate (2), High (3), Extremely High (4) (Terrapon-Pfaff et al., 2017; Tagliani & Walter, 2018; Morgan, 1999; Petts, 1999).
Probability of Occurrence	Expresses the likelihood that an impact will occur	- **Improbable:** Extremely low chance of occurrence. - **Likely:** May happen. - **Certain:** Impact will definitely occur. - Improbable (1), Likely (2), Certain (3) (Terrapon-Pfaff et al., 2017; Tagliani & Walter, 2018; Morgan, 1999; Petts, 1999).
Type	Refers to whether the impact is adverse or beneficial.	- **Adverse:** Negative impact. - **Beneficial:** Positive impact.
Significance	Measures the impact's relevance in temporal and physical scope; determines mitigation priority./ Overall relevance and priority for mitigation	- **Negative:** Very High, High, Moderate, Low. - **Neutral:** No significant effect. - **Positive:** Very High, High, Moderate, Low - **Low: Score 1-5** - **Medium: Score 6-10** - **High: Score 11-14** - **Very High: Score 15+** (Terrapon-Pfaff et al., 2017; Tagliani & Walter, 2018; Morgan, 1999; Petts, 1999).

5.3. Identified Environmental and Social Impacts of the Sub-project

Based on an extensive desk review, investigation of the Preliminary Report for Awash Infrastructure Study and Design, stakeholder and community consultation and issue identification, socioeconomic survey, biophysical data collection and analysis and comprehensive field assessment and observation, the environmental and social impacts for the sub project are identified, and categorized across the sub project phases of development, which envisage pre-construction, construction, operational and decommissioning phases. Accordingly, the Amibara Right Bank Flood Risk Reduction Sub project's potential environmental and social impacts are listed and described across the sub-project's life cycle (phases) as follows:

5.3.1. Pre-Construction and Mobilization Phase

This phase focuses on design, site selection, and preparatory activities that establish the sub-project's social and environmental footprint. The pre-construction phase involves preparatory activities such as land acquisition, site preparation, and contractor mobilization. Key impacts include:

- **Positive Impacts:**
  - **Design-Based Mitigation**: Positive impact from integrating community feedback (via Elders' Councils) into engineering designs to protect seasonal grazing routes before construction begins.

- **Negative Impacts**:

Displacement of Seasonal Migratory Pastoralists: The Amibara area community is predominantly pastoralist, practicing seasonal migration, particularly toward the Awash River during the dry season in search of water and grazing land. During this period, pastoralist households establish temporary settlements, often constructing temporary shelters along the existing embankment and within designated buffer zones, which are recognized as government-owned land. The prior site assessment and subsequent verification visits indicated that there are about 96 households residing along the embankment within 25km from the weir site, and categorized as temporary/migratory settlers.

With the planned strengthening and upgrading of the embankment, the consideration of the resettlement of these seasonal settlers will be necessary. Although these settlements are not permanent, the movement of pastoralist groups requires careful coordination to minimize disruption to their livelihoods and seasonal mobility patterns.

In addition, land acquisition will be required for sub-project related activities, including the establishment of borrow pits and temporary camp sites for construction purposes. In this regard, local community leaders and the Woreda administration have expressed their commitment to facilitating the sub-project by voluntarily providing land for quarry sites and temporary camps. This collaborative approach is expected to reduce potential social impacts and ensure that sub-project implementation proceeds smoothly while respecting the traditional practices and needs of the pastoralist communities.

- **Social Disruption:** If these borrow pits and camps are sited without community consultation, they risk interrupting traditional migratory grazing routes or interfering with sensitive community assets.

- **Archaeological Sensitivity**: Risk of impacting unidentified paleontological or anthropological resources during initial site clearing in the fossil-rich Afar region (requiring "Chance Find" procedures).
- **Social Disruption and Conflict**: Initial site selection for infrastructure like dykes or grazing route diversions can interrupt long-standing migratory routes and traditional livelihoods if not coordinated with local "Elders' Councils". Preparatory activities and the presence of survey teams can cause anxiety or conflict regarding land use, especially if they interfere with seasonal grazing routes or sensitive community assets.
- **Resource Extraction Planning**: Constructing the dike requires "large amounts of construction materials from borrow and quarry areas," which the report admits can "harm farm and grazing land, as well as affect the landscape and scenic value". The selection of borrow pits must be carefully managed to avoid high-value agricultural or grazing lands and to minimize initial social and economic disruption. The newly selected and former usable borrow pits are enough to provide the needed quantity of materials (2.4million m3 required Vs >31 million m3 available). **Mitigation for Extraction:** To manage extraction risks, the document mandates that borrow sites be located on **high ground** away from farms and settlements. Furthermore, contractors are required to **reinstate** these sites by refilling them with stockpiled spoil material or integrating them into the floodplain to expand wetland habitats.
- The Right Bank (RHB) embankment and related interventions would change the hydraulics of the floodplain by:

  - ✓ Increasing the left floodplain and restricting flows inside the river channel
  - ✓ In some situations, the Left Hand Bank (LHB) experiences an increase in flood depth and inundation extent.
  - ✓ Engaging with LHB structures that are already weak and failing (overtopping, breaches, seepage, bifurcation implications).
  - ✓ This results in site-specific impacts at Dofen and Bolahamo hot spot areas, necessitating focused action.

- **Key Concerns and Impact Areas (Hotspots)**

1. **Dofen Area (Bifurcation/Breaching Zones & Pump Station)**

- ✓ A higher risk of flooding and overtopping: There is erosion and overtopping at the pump station and downstream areas.
- ✓ A split/breaching river channel that increases flow to LHB, exacerbating erosion and flood loads
- ✓ The instability of morphology
- ✓ Erosion and active channel shifting at breaching sites
- ✓ Possible deepening or widening as a result of dredging and flow concentration
- ✓ Weak dike sections' failure: The presence of sandbag emergency protection indicates a structural deficiency.
- ✓ Infrastructure and livelihood effects
- ✓ Abandoned irrigation systems and flooding of agricultural land
- ✓ Risks to local mobility and access routes

2. Bolahamo Area (Upstream & Downstream of the Existing Steel Bridge)

a) Upstream of the Bridge

- ✓ Groundwater emergence and ponding
- ✓ Farmland and settlements are impacted by ongoing flooding.
- ✓ Crest depressions and dike overtopping
- ✓ Water availability may be disrupted by channelization or diversion

b). Downstream of the Bridge

- ✓ Failure of flood defence and overtopping
- ✓ Recurrent flooding is indicated by several areas with sandbag protection.
- ✓ Risk to access infrastructure
- ✓ Increased flow from dredging or channelized portions may overflow bridges and access roads.
- ✓ The impacts of flood concentration
- ✓ Channelization may result in higher downstream flood intensity and flow velocity.

c) Impacts on Public Utilities/Services

- ✓ Risk of flooding on health facilities, schools, and settlements in the Bolahamo area, on the left side of the steel bridge
- ✓ Social susceptibility to frequent exposure to floods, the loss of goods and livestock
- ✓ Possible land loss because of the left-side dike alignments and channelization routes

3. Downstream (Youren Area Included)

- ✓ A generally small downstream impact is anticipated, associated with the open dike end, which allows floods to enter Youren village, reducing grazing areas and changing the hydrology of wetlands to a certain extent.

- **Biodiversity and Ecosystem Impacts are partly addressed through the following:**
  - **Invasive Species Bias:** While the assessment focuses heavily on the clearing of invasive *Prosopis juliflora* (Weyane tree), it does recognize the presence of **riparian woodland** and aquatic species such as tilapia, catfish, crocodiles, and hippopotamuses.
  - **Habitat Disruption:** The report admits that "blocking floods from reaching into natural flood plains may cause ecological issues and also reduce silt and nutrient provision". To counter this, it suggests including former borrow areas and riverside wetlands inside the new dike alignment to preserve wetland habitats (based on the design report, a setback of 50 to 100 m behind the new dike, which could be used for borrow pits, will be left for wetland).
  - **Riparian Clearing:** Mechanical clearing of *Prosopis* is required to restore the dike corridor, but the report advises replanting **indigenous grasses** to prevent re-infestation and encourage native species growth.
- **Groundwater and Community Safety**
  - **Groundwater Recharge:** The document identifies a shallow water table (<2m in some areas). While it doesn't explicitly model the *reduction* in recharge from channel smoothing, it

notes that the current dike already causes **seepage-induced waterlogging and salinity** on the landward side. To mitigate this, a dedicated **drainage line** is proposed to return seepage to the river.

- **Embankment Breach Risks:** The report highlights that the original dike failed due to "permeable river sand with inadequate mechanical compaction". The new design addresses this through **laboratory-verified compaction** and high-quality materials.
- **Community Safety and Crossing Points:** To address safety and access, the design must incorporate **formal crossings and watering points** for livestock and residents, as the current structure forces people to use dangerous traditional boat and rope systems.

- **Downstream and Cumulative Impacts**
  - **Downstream Flooding:** The assessment acknowledges that the dike "can worsen downstream flooding due to increased river volume". The proposed mitigation is to **extend dike construction** into at-risk downstream areas as identified by design activities.
  - **Cumulative Impacts:** While the assessment identifies individual sub-project risks, it lacks a consolidated assessment of the **cumulative effect** of multiple sub-subprojects within the broader Awash Basin, focusing primarily on the 60km Amibara stretch.

5.3.2. Construction Phase Impacts

This phase involves major civil works, including vegetation clearing, excavation, and the construction of the 60-km embankment and supporting infrastructure, which involve the most significant physical disturbances.

- **Positive Impacts**:

- **Local Employment**: Prioritization of local youth for labour-intensive tasks like trench digging. An employment letter in which the employment period is clearly specified has to be given to avoid a project phase-out-related job loss awareness.
- **Knowledge Transfer**: Training local workers in global occupational health and safety (OHS) standards.
- **Invasive Species Removal**: Funding and equipment provided for the mechanical removal of the aggressive invasive shrub *Prosopis juliflora.*

- **Negative Impacts**:

- **Temporary disruption of irrigation water supply:** Modification works at pump stations may require partial or full shutdown, temporarily interrupting water delivery to downstream users.
- **Increased turbidity and sedimentation at intake points:** Excavation and earth-moving near intake structures can increase suspended solids in water, potentially clogging pumps and reducing water quality.
- **Local soil erosion and instability around pump stations:** Excavated areas and disturbed soil near pump stations may become vulnerable to erosion, particularly during rainfall events, affecting site stability.
- **Risk of water contamination from fuel and lubricants:** Construction machinery can leak oil, fuel, or lubricants, potentially contaminating nearby irrigation water if not carefully managed.
- **Hydrological Impacts**
  - **Natural Flow Changes:** Embankments may alter the natural floodplains, potentially increasing flow velocity within the channel.
  - **Waterlogging:** Risk of trapped surface runoff behind the dike during heavy rains.

- **Riverbank Erosion and Siltation**: Earthworks for bridge abutments and irrigation pipes can loosen soil, leading to increased river turbidity and the clogging of downstream off takes.
- **Water Pollution**: Risks of fuel spills, lubricants, or chemical runoff from steel corrosion protection treatments entering the Awash River, which serves as a primary water source for over 76,000 people.
- **Physical Disturbance:** The actual clearing and excavation for bridge abutments, dykes, and irrigation pipes physically removes land from its previous agricultural or communal use.
- **Temporary Land Use:** The operation of borrow pits and machinery yards consumes land temporarily, often rendering it unusable for grazing or farming for the duration of the works.
- **Access Restrictions:** Construction activities may block traditional access routes to the river or between kebeles, causing temporary economic displacement as farmers and pastoralists are forced to take longer routes.
- **Water Quality**: Siltation from disturbed riverbanks during construction (e.g., during bridge or intake work) can temporarily increase the already high turbidity of the Awash River.
- **Air Quality**: Mechanical clearing and earthworks (excavation and transport) are expected to temporarily increase particulate matter (PM10) concentrations by **200–500%**. This is a high risk due to the area's loose sandy soils.
- **Noise and Vibration**: Heavy machinery (excavators, dump trucks) and compaction activities will increase noise and vibration levels. Approximately ***232* households** located in the floodplain near the construction alignment are particularly vulnerable to these disturbances.
- **Social and Labor Risks**:
    - **Labour Influx**: The arrival of outside workers increases the risk of social conflict, Gender-Based Violence (GBV), and Sexual Exploitation and Abuse (SEA). Code of conduct training has to be held, and an employment letter in which the employment period is clearly specified has to be given to avoid decommissioning phase job loss mess.
    - **Occupational Health**: Workers face high risks of heat stress (temperatures exceeding 40°C) and injuries during high-risk tasks like welding or trenching, and potential waterborne diseases due to poor sanitation management at camps that could lead to the transmission of waterborne diseases to downstream populations.
    - **Delayed in Community Grievances**
    - **Water diversion, unequal water access and conflict**
- **Waste Generation**:
    - **Solid Waste**: Mechanical clearing of the 60-km alignment will generate "massive amounts of green waste" from uprooting invasive Prosopis juliflora.
    - **Excavated Material**: Surplus or unsuitable soil and rock from dike foundations and borrow pits will be transported to designated, managed disposal sites to prevent unauthorized dumping.
    - **Domestic Waste:** Worker camps will generate daily food waste, plastics, and paper. Management protocols (e.g., secured bins and regular removal) will be enforced to prevent attracting local wildlife (e.g., baboons) and to protect riverbank ecosystems.
    - **Sanitary Wastewater (Sewage):** To prevent the discharge of untreated effluent into the floodplains and the Awash River, worker camps must be equipped with self-contained sanitation facilities, such as septic systems or mobile toilets. This is critical to preventing the spread of waterborne diseases (e.g., cholera, typhoid) to downstream communities.
    - **Construction Runoff:** During earthworks, silt fences and sediment traps will be deployed to mitigate erosion and prevent increased turbidity in the Awash River.

- **Hazardous/Liquid Waste**: Maintenance of heavy equipment at worker camps poses a risk of soil and water contamination from fuel, oils, and lubricants.To prevent soil and groundwater contamination:
  - Materials must be stored on impermeable surfaces.
  - Material Safety Data Sheets (MSDS) must be prominently displayed at all storage and handling points

- **Ecological Disturbance**: Mechanical clearing could disrupt the migratory paths of mammals moving toward the river. However, clearing is targeted primarily at the invasive *Prosopis juliflora* while strictly protecting native trees like *Acacia nilotica.*
- **Embankment and Roadway Erosion:** The design specifies a **4-meter crest width** to serve as an access track for maintenance vehicles. To mitigate erosion from both river velocity and traffic, the project proposes covering the embankment with **Vetiver grass** (*Chrysopogon zizanioides*), which has a root system 3–4 meters deep, designed specifically for soil stabilization.
- The Right Bank (RHB) embankment and related interventions would change the hydraulics of the floodplain by:

  - ✓ Increasing the left floodplain and restricting flows inside the river channel
  - ✓ In some situations, the Left Hand Bank (LHB) experiences an increase in flood depth and inundation extent.
  - ✓ Engaging with LHB structures that are already weak and failing (overtopping, breaches, seepage, bifurcation implications).
  - ✓ This results in site-specific impacts on the left bank, particularly at Dofen and Bolahamo hot spots, necessitating focused action.

- **Key Concerns and Impact Areas (Hotspots)**

➢ **Dofen Area (Bifurcation/Breaching Zones & Pump Station)**

- ✓ A higher risk of flooding and overtopping: There is erosion and overtopping at the pump station and downstream areas.
- ✓ A split/breaching river channel that increases flow to LHB, exacerbating erosion and flood loads
- ✓ The instability of morphology
- ✓ Erosion and active channel shifting at breaching sites
- ✓ Possible deepening or widening as a result of dredging and flow concentration
- ✓ Weak dike sections' failure: The presence of sandbag emergency protection (indicates structural deficiency).
- ✓ Infrastructure and livelihood effects
- ✓ Abandoned irrigation systems and flooding of agricultural land
- ✓ Risks to local mobility and access routes

➢ **Bolahamo Area (Upstream & Downstream of the Existing Steel Bridge)**

a) Upstream of the Bridge

- ✓ Groundwater emergence and ponding
- ✓ Farmland and settlements are impacted by ongoing flooding.
- ✓ Crest depressions and dike overtopping
- ✓ Water availability may be disrupted by channelization or diversion

b). Downstream of the Bridge

- ✓ Failure of flood defence and overtopping
- ✓ Recurrent flooding is indicated by several areas with sandbag protection.
- ✓ Risk to access infrastructure
- ✓ Increased flow from dredging or channelized portions may overflow bridges and access roads.
- ✓ The impacts of flood concentration
- ✓ Channelization may result in higher downstream flood intensity and flow velocity.

c) Issues on Public Utility/Services

- ✓ Risk of flooding on Health facilities, schools, and settlements, Irrigation infrastructure and agricultural land
- ✓ Social susceptibility to frequent exposure to floods, the loss of goods and livestock
- ✓ Possible land loss because of Extra dike alignments, Construction material extraction

➢ **Downstream (Youren Area Included)**

- A generally small downstream impact is anticipated, associated with the open dike end, which allows floods to enter Youren village, reducing grazing areas and changing the hydrology of wetlands to a certain extent.

- **Biodiversity and Ecosystem Impacts are partly addressed through the following:**
  - **Invasive Species Bias:** While clearing of invasive *Prosopis juliflora* (Weyane tree), we should recognize also the presence of **riparian woodland** and aquatic species such as tilapia, catfish, crocodiles, and hippopotamuses.
  - **Habitat Disruption:** The report admits that "blocking floods from reaching into natural flood plains may cause ecological issues and also reduce silt and nutrient provision". To counter this, it suggests including former borrow areas and riverside wetlands inside the new dike alignment to preserve wetland habitats.
  - **Riparian Clearing:** Mechanical clearing of *Prosopis* is required to restore the dike corridor, but the assessment result advises replanting **indigenous grasses** to prevent re-infestation and encourage native species growth.
- **Groundwater and Community Safety**
  - **Groundwater Recharge:** The document identifies a shallow water table (<2m in some areas). While it doesn't explicitly model the *reduction* in recharge from channel smoothing, it notes that the current dike already causes **seepage-induced waterlogging and salinity** on the landward side. To mitigate this, a dedicated **drainage line** is proposed to return seepage to the river.

- **Embankment Breach Risks:** The report highlights that the original dike failed due to "permeable river sand with inadequate mechanical compaction". The new design addresses this through **laboratory-verified compaction** and high-quality materials.
- **Community Safety and Crossing Points:** To address safety and access, the design must incorporate **formal crossings and watering points** for livestock and residents, as the current structure forces people to use dangerous traditional boat and rope systems.**Hydrological and Flooding Concerns:** The Middle Awash Basin is a high-risk flood zone. The current infrastructure is insufficient, often causing artificial floods due to breaches and high seepage rates that waterlog adjacent agricultural fields. Risks During the Construction Phase:

  - Diversion Failures: Construction work on crossings and embankment reinforcements may require temporary water diversions. These are highly vulnerable to sudden flash floods originating from the Ethiopian highlands, which can overwhelm construction sites, wash away equipment, and cause significant downstream sedimentation.
  - Increased Turbidity: Heavy excavation and earth-moving near the riverbank will temporarily increase the sediment load (turbidity) of the Awash River, potentially affecting the water intakes and downstream irrigation facilities.

- **Downstream Impacts**
  - **Downstream Flooding:** The assessment acknowledges that the embankment will have an impact on the downstream flooding risk due to increased river volume. However, the impact is predicted to be minimal due to the presence of a floodplain that can stabilize the flow. Besides, the consideration of the proposed mitigation is to **extend dike construction** into at-risk downstream areas as identified by design activities.

5.3.3. Operational Phase Impacts

Once the infrastructure is built, the impacts shift toward long-term land use changes that relate to the functionality and sustainability of the infrastructure.

- **Positive Impacts**:
- **Resilient Infrastructure**: Use of corrosion-resistant HDPE pipe systems to prevent leaks in saline soils.
- **Sustainable Agriculture**: Implementation of precision irrigation based on soil leaching capacity to prevent long-term salinization.
- **Enhanced Connectivity**: Restored social and economic links through safe pedestrian and livestock crossings.
- **Climate Resilience**: Improved water access for agriculture and livestock during dry seasons, supporting local livelihoods.
- **Positive Land Impact:** Conversely, the protection provided by the dyke is intended to prevent the seasonal loss of vast tracts of agricultural land to flooding, effectively "saving" land for productive use in the long term.
- **Improved irrigation efficiency and water control**: Upgraded or optimized pump stations can deliver water more reliably and efficiently, benefiting downstream agriculture.
- **Reduced flood damage to pump stations**: Structural improvements and integration with flood protection measures reduce risk of water damage to pump infrastructure.

- **Negative Impacts**:
- **Reduced pumping efficiency due to improper intake modification (if poorly aligned)**: Altered intake structures may affect flow dynamics, reducing pump performance if not carefully designed and installed.
- **Seepage and piping affecting structural stability**: Water may escape along or under pump station foundations or pipelines, weakening soil support and potentially undermining structures.
- **Damage from shrink–swell behavior of Vertisols (cracking, misalignment)**: Expansive soils may expand when wet and shrink when dry, causing stress on pipelines and pump station foundations.
- **Localized waterlogging and soil salinity**: Inefficient drainage around modified pump stations may lead to water accumulation, affecting soil health and nearby crops.
- **Increased maintenance and operational failures**
- Structural and hydraulic modifications may require more frequent inspection and repairs to maintain performance.
- **Hydrological Impacts**
  - River Flow Alteration/ **Natural Flow Changes:** Embankments may alter the natural floodplains, potentially increasing flow velocity within the channel.
  - Downstream Flood Risk: Embankments may alter the natural floodplains, potentially increasing flow velocity within the channel and increasing the possibility of bank breaching at the downstream.
  - **Waterlogging:** Risk of trapped surface runoff behind the dike during heavy rains.
- **Resource Competition**: Formalized water offtakes may lead to upstream users capturing water at the expense of downstream pastoralists, potentially sparking inter-clan conflict.
- **Soil Salinization**: Improper drainage or over-irrigation in the arid Middle and Lower Awash can lead to medium-level risks of soil salinization.
- "Build-and-Neglect" Risk: A risk that remote infrastructure may fall into disrepair without proper community ownership and technical training for local Water User Associations (WUAs).
- **Dismantling/Decommissioning**: At the end of temporary facility use (such as worker camps or material extraction sites), there is a requirement to extract materials properly and restore the site to prevent residual pollution.
- **Land Restoration**: A key impact is the requirement to rehabilitate and restore all borrow pits and quarry sites used during construction to their original or a safe state.
- **Waste Removal**: The removal of temporary worker camps, equipment yards, and fuel storage sites must be managed to ensure no residual hazardous waste (like oil-contaminated soil) remains.
- **Ecological Recovery**: Following the removal of temporary access roads and camps, these areas must be stabilized and potentially reforested (e.g., the 1:5 reforestation protocol for native trees) to restore the biological corridor.
- **Resource and Water Conflict**: New irrigation offtakes may lead to upstream users capturing water at the expense of downstream pastoralists, necessitating traditional "Mada'a" water-sharing rotas to avoid inter-clan conflict.
- **Structural Risks**: Potential for structural failure or damage to bridges from extreme flash floods or heavy flood debris accumulation.

- **Permanent Land Conversion:** Areas under the footprint of the dykes, bridges, and permanent drainage structures are permanently converted from their original state, potentially reducing the total available acreage for traditional farming in those specific spots.
- **Embankment and Roadway Erosion:** The design specifies a **4-meter crest width** to serve as an access track for maintenance vehicles. To mitigate erosion from both river velocity and traffic, the sub project proposes covering the embankment with **Vetiver grass** (*Chrysopogon zizanioides*), which has a root system 3–4 meters deep designed specifically for soil stabilization. **4.1.6.1.**
- **Hydrological and Flooding Concerns**
    - The Middle Awash Basin is a high-risk flood zone. The current infrastructure is insufficient, often causing artificial floods due to breaches and high seepage rates that waterlog adjacent agricultural fields.
    - **Hydraulic Pressure and Velocity:** By confining the Awash River within a rehabilitated 60km stretch, the water velocity and depth may increase during peak flows. The ESIA ensures the design accounts for this increased hydraulic pressure to prevent overtopping in downstream areas.
    - **Seepage and Salinity Management:** A major operational concern of the past was waterlogging caused by seepage. The new design includes a **dedicated drainage line on the landward side** to collect seepage water. This is essential to prevent soil salinity and waterlogging in the cotton and maize fields that the sub-project is intended to protect.
    - **Social Access to Water:** Historically, the dike blocked access to the river. If the new operation does not maintain the proposed formal watering points and ramps, informal crossings created by the community and livestock will lead to localized erosion and eventual dike failure.

5.3.4. Decommissioning Phase

Decommissioning primarily concerns the restoration of temporary sites used during construction and also the implementation of a labour management plan.

- **Site Rehabilitation/ Land Restoration**: Requirement to stabilize and rehabilitate all borrow pits and quarry sites to prevent long-term safety hazards or erosion. If not properly decommissioned, these sites remain as "scars" on the landscape, representing a permanent loss of land utility and a safety hazard for livestock and residents.
- **Restoration of Temporary Lands /Site Handover**: Removal of all temporary worker camps and equipment yards, followed by soil stabilization and reforestation and returning the land to the community for grazing or agricultural use.
- **Waste Management**: Proper disposal of residual construction waste, such as metal scraps and hazardous materials, to prevent localized pollution.
- **Site restoration plan:** Prepare, notify and implement the site restoration plan in consultation with local stakeholders to ensure beneficial post-project land use.
- **Labour management plan:** Prepare, notify and implement the Labour management plan in consultation with local stakeholders and provide advance notice of project closure to the workforce and community

5.4. Prediction and Significance of Impacts

The identification of impacts is a critical component of the Environmental and Social Impact Assessment (ESIA) for the Amibara sub-project. While traditional assessments focus heavily on risk mitigation, this section highlights the issues that consider enhancements of the positive impacts and mitigation of the negative impacts and ecological gains that the sub-project is designed to deliver. By systematically identifying these opportunities, the sub-project moves beyond a "do-no-harm" approach toward active value creation for the communities in the Awash basin.

Positive impacts are identified and categorized across the entire sub-project lifecycle from the early planning and design stages to the long-term operation of the flood protection infrastructure. These benefits generally fall into three key pillars:

- **Socioeconomic Resilience:** Including local job creation, skill enhancement, and the protection of high-value agricultural lands (maize, cotton, and onion).
- **Infrastructure & Safety:** Enhancing community mobility through steel bridges and providing secure livestock watering points that prevent drowning and conflict.
- **Ecological Restoration:** Leveraging the sub-project to restore native riparian corridors and manage invasive *Prosopis juliflora* through community-led nursery programs.

The significance of the impact is determined by the cumulative characteristics of these impacts, which include their nature, duration, and probability, ensuring that enhancement measures are targeted where they provide the greatest regional benefit.

5.4.1. Pre-Construction and Mobilization Phase

During this initial stage, the primary benefit is derived from enhanced community awareness and stakeholder engagement. As the sub-project team conducts consultations with the residents of the 14 high-priority kebeles, local communities gain a transparent understanding of the flood protection infrastructure and their rights regarding the Resettlement Action Plan (RAP). This impact is Beneficial with a Local Extent and Short-term Duration. Its Intensity is Low, as it primarily facilitates information flow, and the Probability of occurrence is Certain due to mandatory regulatory requirements. Consequently, the Significance is Low Positive

5.4.2. Construction Phase: Socioeconomic and Ecological Benefits

i. Local Employment and Income Generation

- Evaluation:
  - Nature: Beneficial (+)
  - Extent: Local (Immediate kebeles in the Amibara Woreda)
  - Duration: Short-term (Construction duration)
  - Intensity: High (Provides critical cash flow to households in a drought-prone region)
  - Probability: Certain (Mandated by contract)
  - Significance: High Positive

ii. **Skill Transfer and Capacity Building**

- Evaluation:
  - Nature: Beneficial (+)
  - Extent: Regional (Workers carry skills to future infrastructure sub-projects)

- Duration: Long-term (Permanent improvement in human capital)
- Intensity: Moderate (Enhances employability in technical sectors)
- Probability: High
- Significance: Medium to High Positive

i. **Local Market Stimulation**

- Evaluation:
- Nature: Beneficial (+)
- Extent: Local (Boosts local vendors, cooperatives, and service providers)
- Duration: Short-term (Construction duration)
- Intensity: Moderate
- Probability: High
- Significance: Medium Positive

ii. **Ecosystem Recovery (Nursery Development)**

- Evaluation:
- Nature: Beneficial (+)
- Extent: Local/Regional (Restores native riparian and savanna corridors)
- Duration: Long-term (Ecological succession)
- Intensity: Moderate (Reverses degradation from invasive *Prosopis*)
- Probability: Medium (Depends on seedling survival rates)
- Significance: Medium Positive

5.4.3. Operation Phase: Infrastructure and Agricultural Benefits

- **Reduced Flood Damage to Pump Stations:**
  - Evaluation:
  - Nature: Beneficial
  - Extent: Local
  - Duration: Long-term
  - Intensity: High
  - Likelihood: Certain
  - Significance: High Positive
- **Agricultural Protection and Food Resilience**
  - Evaluation:
  - Nature: Beneficial (+)
  - Extent: Regional (Protects large-scale cotton, maize, and onion production)
  - Duration: Long-term (Life of the dike)
  - Intensity: High (Prevents catastrophic crop loss and soil waterlogging)
  - Probability: High (Assuming regular maintenance)
  - Significance: High Positive
- **Community Safety from Flood Risk**
  - Evaluation:
  - Nature: Beneficial (+)
  - Extent: Local/Regional
  - Duration: Long-term
  - Intensity: High (Fundamental change in the risk profile of the floodplain)
  - Probability: High
  - Significance: High Positive

- **Improved Community Access and Livestock Safety.** The integration of steel pedestrian bridges and livestock watering points (cattle troughs) prevents the "barrier effect" of the dike.
  - Evaluation:
  - Nature: Beneficial (+)
  - Extent: Local (Serves the pastoralist and farming communities along the 60km alignment)
  - Duration: Long-term (Life of the steel structures)
  - Intensity: Moderate to High (Reduces drowning risks and social conflicts)
  - Probability: High
  - Significance: High Positive

5.4.4. Decommissioning Phase

- Enhancing Ecosystem Restoration:
  - Transform stabilised borrow pits into community livestock watering points or "micro-wetlands" where technically feasible, instead of simple backfilling.
  - Engage local youth groups in the long-term monitoring of the re-vegetated sites to ensure a survival rate of native species above 80%.

5.5 Potential Adverse Impacts and Evaluation Matrix

While the Amibara Flood Protection Sub project is intended to deliver long-term regional benefits, the scale of the construction activities and the ecological sensitivity of the Awash Basin necessitate a thorough identification of potential adverse impacts. This section outlines the possible negative environmental and social consequences that could arise in the absence of appropriate mitigation measures. These adverse impacts are evaluated based on their Nature, Extent, Duration, and Intensity, Type, and Significance.

5.5.1. Pre-Construction and Mobilization Phase

1. **Socioeconomic disruption of seasonal migratory pastoralists**
   - Evaluation: This is an Adverse impact. Its Extent is Local, occurring within the high-risk floodplain of the sub project area. The Duration is Reversible as it involves the mobility and limiting access to grazing of seasonal migratory pastoralists. The Intensity is High, as it drastically alters the social and cultural functions of the affected pastoralist households. The Probability of occurrence is Certain. Significance: Very High - Negative. Mitigation:
     - Establishing a co-management agreement with pastoralist communities for rangelands and water resources; supporting a livelihood diversification program; empowering communities to monitor project impacts and mitigation effectiveness; and creating a contingency fund for unforeseen losses?
     - Implement a GRM tailored to local customs, utilising elders and traditional leaders for rapid mediation
     - Maintain open-access buffers to ensure livestock are not trapped and retain access to vital water points during construction.
     - Systematically integrate pastoralist expertise regarding seasonal timing and land-use rights into the sub-project master schedule.
     - Provide supplemental fodder to mitigate the loss of primary grazing resources.
2. **Additional land and resource requirements for dike/embankment and other structural measures on the left bank:** The report recommends that designers specifically identify flood-

susceptible hot spots such as Dofen, Balahamo and Youren areas on the left bank and downstream of the intervention, and design a prevention dike for those areas that may pose additional land requirement burden on the area for dike construction and resource extraction.

- Evaluation: This is an Adverse impact. Its Extent is Regional, as an additional dike would affect the community. The Duration is Short-term to Temporary. The Intensity is High. The Probability of occurrence is likely. Significance: Medium Negative. Mitigation: Structural reinforcement using riprap and gabions; maintaining a 50–100m environmental setback from the riverbank.

3. **Technical Failure due to Seismic Activity and River Dynamics**

- Evaluation: This is an Adverse impact. Its Extent is Regional, as a dike breach would affect downstream Woredas. The Duration is Long-term to Permanent. The Intensity is Extremely High, as a failure would cause natural and social processes in the basin to end or suffer catastrophic damage. The Probability of occurrence is likely given the active channel migration observed in the baseline. Significance: High Negative. Mitigation: Structural reinforcement using riprap and gabions; maintaining a 50–100m environmental setback from the riverbank.

4. **Geotechnical and Structural Impact:** Soil Instability, Piping, and Seepage from Prosopis Clearing

- Evaluation: The mechanical clearing and "surgical" uprooting of Prosopis juliflora root systems along the alignment will temporarily destabilize the alluvial soil structure. Extent: On-site (along the entire 60 km alignment). Duration: Short-term (construction phase until stabilization). Intensity: Moderate; while the soil structure is physically altered, ecological and structural functions are restored post-stabilization. Probability: Certain. Significance: Moderate Negative. Mitigation and Biotic Stabilization: Mechanical Uprooting: Root systems must be completely removed to prevent internal decay, which leads to "piping" (internal erosion tunnels). Nature-Based Solutions: Cleared areas must be immediately stabilized using Vetiver grass (Chrysopogon zizanioides). Unlike native grasses, Vetiver's deep, vertical root system (reaching up to 3 meters) acts as "living nails," binding the loose alluvial soil layers of the 4-meter crest and slopes.

5.5.2. Construction Phase

5. **Water Pumping Stations Disruption:** Irrigation water supply disruption, increased turbidity at intake points, soil erosion and localized disturbance

- **Evaluation:** Adverse, Extent: Local, Duration: Short-term, Intensity: High, Likelihood: Certain, Significance: High – Adverse
- **Mitigation:** Implement **temporary bypass pumping systems** to maintain continuous water delivery to downstream users during construction. **Schedule construction works** during periods of low irrigation demand to reduce disruption. Communicate planned shutdowns with local farmers to allow advance water management.

6. **Natural Flow Changes:** Embankments may alter the natural floodplains, potentially increasing flow velocity within the channel.

- Evaluation: This is an Adverse impact. The Extent is on-site along the 60km alignment. The Duration is long-term. The Intensity is Moderate. The Probability of occurrence is Certain.
- Significance: Moderate Negative.
- Mitigation: Provide outlets to the community water service points through pipe and extend treatment to the downstream part.

7. **Downstream Flood Risk:** Embankments may alter the natural floodplains, potentially increasing flow velocity within the channel and increasing the possibility of bank breaching at the downstream by the local community for domestic use.
   - Evaluation: This is an Adverse impact. The Extent is off-site downstreams. The Duration is long-term. The Intensity is high. The Probability of occurrence is Certain.
   - Significance: High Negative.
   - Mitigation: Provide a water supply system to the community water service points to avoid bank breaching activities for domestic use.
8. **Waterlogging:** Risk of trapped surface runoff behind the dike during heavy rains.
   - Evaluation: This is an Adverse impact. The Extent is on-site along the 60km alignment. The Duration is long-term. The Intensity is Moderate. The Probability of occurrence is Certain.
   - Significance: Moderate Negative.
   - Mitigation: Provide a drainage system.
9. **Geotechnical and Structural Impact**

A. Soil Instability, Piping, and Seepage from Prosopis Clearing

Sub project Phase: Construction Phase (Pre-construction clearing and earthworks)

- **Impact Evaluation:** The mechanical clearing and "surgical" uprooting of *Prosopis juliflora* root systems along the alignment will temporarily destabilize the alluvial soil structure.
  - Extent: On-site (along the entire 60 km alignment).
  - Duration: Short-term (construction phase until stabilization).
  - Intensity: Moderate; while the soil structure is physically altered, ecological and structural functions are restored post-stabilization.
  - Probability: Certain.
  - Significance: Moderate Negative.
- **Mitigation and Biotic Stabilization:**
  - **Mechanical Uprooting:** Root systems must be completely removed to prevent internal decay, which leads to "piping" (internal erosion tunnels).
  - **Nature-Based Solutions:** Cleared areas must be immediately stabilized using **Vetiver grass (*Chrysopogon zizanioides*)**. Unlike native grasses, Vetiver's deep, vertical root system (reaching up to 3 meters) acts as **"living nails,"** binding the loose alluvial soil layers of the 4-meter crest and slopes.

B. Structural Deformation due to Shrink-Swell Pressure (Stability of Steel Bridge Crossings and Irrigation Infrastructure)

- **Sub project Phase: Construction and Operational Phases** (Impact begins during backfilling and persists through the infrastructure lifecycle).
- **Evaluation:**
  - Extent: Localized (specific to the footprint of the bridges and pipe crossings).
  - Duration: Long-term (permanent structural risk).
  - Intensity: High; Vertisol expansion can exert enough upward or lateral pressure to crack concrete foundations or displace steel truss supports.
  - Probability: Certain (given the presence of Black Cotton Soils in Amibara).
  - Significance: Major Negative (if unmitigated).
- **Mitigation:** Mandatory use of non-expansive, laboratory-verified select backfill around all foundations and buried pipes to act as a buffer zone.

C. Embankment Failure via Piping and Seepage at Interfaces

- **Sub-project Phase: Operational Phase** (Triggered during the first high-flow or flood event).
- **Evaluation:**
  - Extent: On-site (along the interface between the dike and the buried infrastructure).
  - Duration: Short-term to Permanent (can lead to sudden localized breach).

- Intensity: Moderate to High; small initial "tunneling" can escalate into a full embankment breach.
- Probability: Likely (due to high soil permeability and the smooth surface of pipes/conduits).
- Significance: Negative
- **Mitigation:** Installation of anti-seepage collars (cutoff walls) and the application of puddled clay around all conduits to break the hydraulic path of seepage.

10. **Loss of Native Biodiversity (Dense and Riparian Woodland)**

- **Evaluation:** This is an **Adverse** impact. The **Extent** is **Local**. The **Duration** is **Long-term**, as native trees take years to mature. The **Intensity** is **High**, as these woodlands comprise <0.4% of the area and provide critical habitat. The **Probability of occurrence** is **Certain**.
- **Significance:** High Negative.
- **Mitigation:** Demarcate construction limits to avoid riparian trees; plant 10 indigenous seedlings for every native tree removed and maintain until they reach 1.5m height.

11. **Temporary Displacement of Fauna and Safety Risks**

- Evaluation: This is an Adverse impact. The Extent is Local. The Duration is Temporary, coinciding with active construction. The Intensity is Moderate, as wildlife/livestock movement is altered but not permanently stopped. The Probability of occurrence is Likely.
- Significance: Moderate Negative.
- Mitigation: Schedule clearing in segments to allow fauna relocation; fence or erect obstacles in all ditches and trenches to prevent accidents involving domestic and wild animals.

12. **Deterioration of Water Quality and Increased Turbidity**

- Evaluation: This is an Adverse impact. The Extent is Regional, affecting downstream water users and aquatic habitats. The Duration is Temporary, occurring only during active riverbank works. The Intensity is Moderate, as the river environment is changed by sediment, but natural processes continue. The Probability of occurrence is Certain.
- Significance: Moderate Negative.
- Mitigation: Install silt fences and sediment traps; schedule heavy earthworks during the dry season (Oct–Jan); establish buffer zones to prevent camp runoff from reaching the river.

13. **Damage to Infrastructure from Expansive Vertisols (Black Cotton Soils)**

- Evaluation: This is an Adverse impact. The Extent is on-site. The Duration is Permanent if structural cracking occurs. The Intensity is High, as it can cause drainage and bridge functions to stop or fail. The Probability of occurrence is Certain due to the dominant soil types.
- Significance: High Negative.
- Mitigation: Replacing expansive clay with laboratory-verified, non-expansive backfill for all underground structures and bridge foundations.

14. **Occupational Health and Safety Risks**

- The sub project entails significant occupational risks due to the scale of civil works including a 60km compacted earth dike and the harsh semi-arid environment of the Middle Awash Basin. The primary risks identified include heat stress, physical injuries from heavy machinery, and biological hazards related to working near water bodies.

a) Key Occupational Risks

- **Heavy Machinery Operations:** The use of excavators, dump trucks, and compaction equipment for the 60km dike construction presents risks of collisions, equipment roll-overs, and noise-induced hearing loss.
- **Large-Scale Earthworks:** Deep excavation for foundations and borrow pit operations pose risks of trench collapses and dust-related respiratory issues.
    - The environment within the sub project area can be considered environmentally sensitive, primarily because existing pollutant concentrations are currently very low.

Under such baseline conditions, even moderate increases in particulate emissions during sub project construction may be noticeable.

- Construction activities associated with the proposed sub project, particularly earthworks, embankment construction, excavation at borrow pits, and transportation of construction materials, may temporarily increase PM_{10} concentrations by approximately 200-500% as well as gaseous pollutants if adequate dust control measures are not implemented. This risk is heightened by the presence of loose sandy soils, dry surface sediments, and riverine deposits that are easily mobilized by wind and vehicle movement.

- **Work Near Water Bodies:** Activities near the Awash River, such as bridge construction and intake installation, involve risks of drowning and exposure to water-borne diseases or hazardous aquatic fauna, specifically **Nile crocodiles**.
- **Heat Stress:** Workers face extreme temperatures in the Main Ethiopian Rift, which consistently exceed 32°C and can peak at **37.4°C**, leading to dehydration and heat-related illnesses.

- **Evaluation**: This is an Adverse impact. The Extent is On Site. The Duration is short-term (construction period). The Intensity is High, as extreme thermal stress (peak temperatures >37.4°C) can cause physical processes to stop. The Probability of occurrence is Certain.
- Significance: High Negative.
- Mitigation: Provide mandatory OHS training and PPE; establish water stations; enforce a Worker Code of Conduct regarding community interactions and GBV/SEAH prevention.

15. Impact of Construction on Waste and Sanitation

- The introduction of large-scale construction activities and the establishment of worker camps will significantly alter the existing waste profile. The transition from a traditional organic-based waste stream to a modern construction-based stream, combined with the concentration of labor, presents several environmental risks.

a) Anticipated Waste and Wastewater Streams

- Non-Organic Waste: Packaging materials, plastics, metal scraps, and geotextile remnants.
- Hazardous Materials: Spent lubricants, hydrocarbons (fuel/oil), hydraulic fluids, and contaminated soils.
- Domestic Wastewater: Significant volumes of greywater (showers/laundry) and blackwater (sewage) from worker camps.
- Construction Debris: Large volumes of "green waste" from the clearing of invasive *Prosopis juliflora*.

b) Evaluation of Waste and Sanitation Impacts

- Water Source Contamination:
- High: Risk of untreated sewage or chemicals leaching into the Awash River.
- Short-term: During construction phase
- Likely: If sanitation is not strictly managed.
- High Negative
- Soil & Land Degradation:
- Moderate: Potential for "non-traceable" litter and hydrocarbon spills.
- Long-term: If hazardous materials are not remediated.
- Certain: Due to high machinery density.
- Medium Negative

c) Mitigation and "Leave No Trace" Strategy: The sub project shall adopt a strict **"Leave No Trace"** approach through the following waste and sanitation management measures:

- Sanitation Facility Requirements:
  - Self-Contained Systems: Worker camps must be equipped with self-contained sewage management systems (e.g., lined septic tanks or mobile chemical toilets) to prevent soil and groundwater infiltration.
  - Buffer Zones: No sanitation facility or latrine shall be constructed within 50 meters of the Awash River or any known local water point.
  - Maintenance: A professional service provider must be contracted for the regular desludging and off-site treatment of sewage at an approved municipal facility.
  - Gender-Segregated Facilities: Camps must provide clean, lockable, and well-lit sanitation blocks separated by gender, following World Bank ESS 2 requirements.
- **Waste Segregation and Storage:**
  - Mandatory color-coded bins at all construction sites for the separation of organic, recyclable, and hazardous waste.
  - Contracts with authorized waste management companies for the collection and appropriate disposal (or recycling where possible) of waste
  - Solid Waste: Mechanical clearing of the 60-km alignment will generate "massive amounts of green waste" from uprooting invasive Prosopis juliflora.
  - Excavated Material: Surplus or unsuitable soil and rock from dike foundations and borrow pits will be transported to designated, managed disposal sites to prevent unauthorized dumping.
  - Domestic Waste: Worker camps will generate daily food waste, plastics, and paper. Management protocols (e.g., secured bins and regular removal) will be enforced to prevent attracting local wildlife (e.g., baboons) and to protect riverbank ecosystems.
  - Sanitary Wastewater (Sewage): To prevent the discharge of untreated effluent into the floodplains and the Awash River, worker camps must be equipped with self-contained sanitation facilities, such as septic systems or mobile toilets. This is critical to preventing the spread of waterborne diseases (e.g., cholera, typhoid) to downstream communities.
  - Construction Runoff: During earthworks, silt fences and sediment traps will be deployed to mitigate erosion and prevent increased turbidity in the Awash River.
  - Hazardous/Liquid Waste: Maintenance of heavy equipment at worker camps poses a risk of soil and water contamination from fuel, oils, and lubricants.To prevent soil and groundwater contamination:
- **Prohibitions:**
  - Strictly prohibit the discharge of untreated wastewater or sewage into the Awash River or irrigation canals.
  - Strictly prohibit open defecation and the open burning of plastics/synthetic materials.

16. Soil Compaction & Topsoil Loss due to quarry site activity

- Evaluation: This Adverse type of impact.
- Extent: Local (Impacts extend to the quarry footprint and immediate access roads within the Amibara area).
- Duration: Medium-term (Compaction persists beyond construction until active ripping/rehabilitation occurs).

- Intensity: Moderate to High. While the land is "low-value," the high ambient temperatures in the Awash basin accelerate the hardening (crusting) of compacted soils, making natural recovery nearly impossible without intervention.
- Probability: Certain.
- Significance: Medium to High Negative.
- Mitigation: Strip and Stockpile: Even in arid Amibara soils, the top 15–30 cm contains the seed bank and organic matter; stockpile this in heights not exceeding 2m to maintain aerobic activity.
- Controlled Movement: Strictly limit heavy machinery to designated "Low-Value" corridors.
- Rehabilitation: Post-quarrying, perform deep ripping (sub-soiling) to break compaction layers before spreading the stockpiled topsoil.

17. **Dust & Air Pollution:-** Heavy vehicle movement and crushing activities near Amibara settlements or sensitive ecological zones.

➢ Evaluation:
- Type: Adverse.
- Extent: Local to Regional (Dust in the Awash valley can be carried significantly by wind, affecting visibility and health beyond the site).
- Duration: Short-term (Limited to the duration of active quarrying and hauling).
- Intensity: High. High temperatures (>37.4°C) and low humidity in the region increase the friability of the soil, leading to rapid dust suspension.
- Probability: Certain.
- Significance: High Negative.

➢ Mitigation:
- Water Suppression: Implement regular water spraying using water bowsers on haul roads. *Note: Given water scarcity in some sub project areas, consider using non-toxic chemical dust suppressants to reduce water consumption.*
- Speed Limits: Enforce a strict speed limit (e.g., 20-30 km/h) for all sub project vehicles on unpaved surfaces to minimize dust "kick-up.
- Containment: Ensure all trucks hauling quarry materials to the Amibara site are fully covered with tarpaulins.
- Buffer Zones: Maintain a minimum 500m dust buffer between the quarry/crusher and the nearest residential cluster or irrigation canal.

18. **Structural Deformation due to Shrink-Swell Pressure** (Stability of Irrigation Infrastructure) (Impact begins during backfilling and persists through the infrastructure lifecycle).

➢ Evaluation:
- Extent: Localized (specific to the footprint of the bridges and pipe crossings).
- Duration: Long-term (permanent structural risk).
- Intensity: High; Vertisol expansion can exert enough upward or lateral pressure to crack concrete foundations or displace steel truss supports.
- Probability: Certain (given the presence of Black Cotton Soils in Amibara).
- Significance: Major Negative (if unmitigated).

➢ Mitigation: Mandatory use of non-expansive, laboratory-verified select backfill around all foundations and buried pipes to act as a buffer zone.

19. vibrations resulting from compaction activities.

- To mitigate these impacts, the contractor will implement a strict daytime-only schedule (7:00 AM to 6:00 PM) for all heavy equipment operations near residential areas. Additionally, all machinery will be equipped with well-maintained mufflers, temporary noise barriers will be utilized near dense clusters of households, and baseline structural surveys will be conducted for homes closest to the construction footprint to monitor vibration thresholds.

5.5.3. Operation and Maintenance Phase

20. Water Pumping Stations Efficiency and Related Disruption: Reduced pump efficiency (if poorly aligned), seepage and piping risks, shrink-swell soil damage, water logging and salinity risks

- Evaluation: Adverse, Extent: Local, Duration: Long-term, Intensity: Moderate, Likelihood: Likely, Significance: Medium – Adverse
- Mitigation: Ensure proper hydraulic design and alignment of intake structures to maintain flow efficiency. Conduct post-installation calibration and testing to verify pump performance. Schedule **regular maintenance and inspection** to detect and correct alignment issues early

21. **Natural Flow Changes:** Embankments may alter the natural floodplains, potentially increasing flow velocity within the channel.

- Evaluation: This is an Adverse impact. The Extent is on-site along the 60km alignment. The Duration is long-term. The Intensity is Moderate. The Probability of occurrence is Certain.
- Significance: Moderate Negative.
- Mitigation: Provide outlets to the community water service points through pipe and extend treatment to the downstream part.

22. **Downstream Flood Risk:** Embankments may alter the natural floodplains, potentially increasing flow velocity within the channel and increasing the possibility of bank breaching at the downstream

- Evaluation: This is an Adverse impact. The Extent is off-site downstream. The Duration is long-term. The Intensity is high. The Probability of occurrence is Certain.
- Significance: High Negative.
- Mitigation: Provide outlets to the community water service points through pipe and extend treatment to the downstream part.

23. **Waterlogging:** Risk of trapped surface runoff behind the dike during heavy rains.

- Evaluation: This is an Adverse impact. The Extent is off-site downstream of the site. The Duration is long-term. The Intensity is Moderate. The Probability of occurrence is Certain.
- Significance: High Negative.
- Mitigation: Provide outlets to the community water service points through pipe and extend treatment to the downstream part.

24. Soil Salinization (Solonchaks) and Waterlogging in Agricultural Land

- Evaluation: This is an Adverse impact. The Extent is Local, affecting the 14 high-priority kebeles. The Duration is Long-term. The Intensity is Moderate to High, as salt accumulation can drastically change crop productivity. The Probability of occurrence is Likely due to high evaporation.
- Significance: Moderate Negative.
- Mitigation: Regularly monitor and maintain irrigation return-flow drainage lines; ensure the dike remains "seepage-proof" by checking for animal burrowing.

25. Dike Piping due to *Prosopis* Re-infestation

- Evaluation: This is an Adverse impact. The Extent is on-site. The Duration is Medium-term if not maintained. The Intensity is Moderate initially, becoming High if roots create major flow paths. The Probability of occurrence is Certain given the invasive nature of the species.
- Significance: Moderate Negative.
- Mitigation: Implement a biannual maintenance program to manually or mechanically remove invasive seedlings from the dike body to prevent structural compromise.

26. Community Safety Risks at River Crossings and due to vehicles mobility

- Evaluation: This is an Adverse impact. The Extent is Local. The Duration is Long-term. The Intensity is Moderate, as it affects the safety of community and livestock movement. The Probability of occurrence is Likely.
- Significance: Moderate Negative.
- Mitigation: Conduct quarterly inspections of steel pedestrian bridges and livestock watering facilities to ensure safe community access.

27. **Structural Deformation due to Shrink-Swell Pressure (Stability of Steel Bridge Crossings and Irrigation Infrastructure)** (Impact begins during backfilling and persists through the infrastructure lifecycle).

➢ Evaluation:
- Extent: Localized (specific to the footprint of the bridges and pipe crossings).
- Duration: Long-term (permanent structural risk).
- Intensity: High; Vertisol expansion can exert enough upward or lateral pressure to crack concrete foundations or displace steel truss supports.
- Probability: Certain (given the presence of Black Cotton Soils in Amibara).
- Significance: Major Negative (if unmitigated).

➢ Mitigation: Mandatory use of non-expansive, laboratory-verified select backfill around all foundations and buried pipes to act as a buffer zone.

28. Embankment Failure via Piping and Seepage at Interfaces (Triggered during the first high-flow or flood event).

➢ Evaluation:
- Extent: On-site (along the interface between the dike and the buried infrastructure).
- Duration: Short-term to Permanent (can lead to sudden localized breach).
- Intensity: Moderate to High; small initial "tunneling" can escalate into a full embankment breach.
- Probability: Likely (due to high soil permeability and the smooth surface of pipes/conduits).
- Significance: Moderate Negative

➢ Mitigation: Installation of anti-seepage collars (cutoff walls) and the application of puddled clay around all conduits to break the hydraulic path of seepage.

5.5.4. Decommissioning Phase

29. Land Degradation and "Scarring" at Borrow Pits and Camp Sites

- **Site restoration plan:** Prepare, notify and implement the site restoration plan in consultation with local stakeholders to ensure beneficial post-project land use.
- Evaluation: This is an Adverse impact. The Extent is Local. The Duration is Permanent if not rehabilitated. The Intensity is Moderate, as the natural landscape is altered. The Probability of occurrence is Certain.
- Significance: Moderate Negative.
- Mitigation: Executing a restoration plan involving backfilling borrow pits, ripping soil for aeration, and native re-vegetation.

30. Soil and Water Contamination from Hazardous Waste

- **Waste Management**: Proper disposal of residual construction waste, such as metal scraps and hazardous materials, to prevent localized pollution.
- Evaluation: This is an Adverse impact. The Extent is on-site. The Duration is Short-term but potentially harmful. The Intensity is High, as pollutants (fuels/lubricants) can stop natural soil/water functions. The Probability of occurrence is Likely.
- Significance: High Negative.

- Mitigation: Collect and dispose of all hazardous materials at approved regional facilities; conduct a final soil audit at camp and workshop locations to ensure no residual pollutants remain.

31. Job loss

- Labour management plan: Prepare, notify and implement the Labour management plan in consultation with local stakeholders and provide advance notice of project closure to the workforce and community
- Evaluation: This is an Adverse impact. The Extent is on-site. The Duration is Short-term but potentially harmful. The Intensity is High, as socio-economic functions. The Probability of occurrence is Likely.
- Significance: High Negative.
- Mitigation: Prepare, notify and implement the Labor management plan in consultation with local stakeholders and provide advance notice of project closure to the workforce and community.

5.6. Mitigation Measures for Adverse Environmental and Social Impacts

The primary objective of the mitigation strategy for the Amibara sub-project is to follow the Mitigation Hierarchy: prioritizing the avoidance of impacts at the source, followed by minimization, and finally, restoration or compensation for residual effects. A key pillar of this approach is the strategic selection of sub-project sites; specifically, land with the lowest value characterized as non-cultivable and not utilized for grazing, is prioritized for the establishment of contractor camps and quarry sites. This ensures that the sub-project's physical footprint does not compromise the high-value agricultural zones or essential pastoral resources of the Awash basin.

The measures detailed in the following sections provide technical and operational instructions for the contractor to manage unavoidable disturbances. These include specific protocols for soil conservation, such as the systematic stripping and stockpiling of topsoil, and air quality controls to manage dust in the high-temperature, arid environment of the sub-project area. By integrating these mitigations into the construction and operation phases, the sub-project aims to stabilize the environmental and social baseline while ensuring the structural integrity of the flood protection infrastructure.

Hydraulic modelling and flood risk screening indicate that the proposed flood protection scheme is expected to have only limited impacts during larger flood events. The incorporation of spillways within the right-bank embankment design provides an important adaptive feature that controls flood levels once the scheme's standard of protection is exceeded, thereby reducing the need for significant modifications to the current design. Consequently, no major revisions to the left-bank flood protection concept are anticipated. However, the preliminary assessment identified the Dofen (Bolahamo) settlement as the only location likely to experience direct adverse impacts resulting from increased flood levels associated with the scheme. Provision has therefore been made within the construction contract to implement targeted mitigation measures following completion of detailed hydraulic modelling during the subsequent design phase.

To address potential impacts at Bolahamo, a package of mitigation measures has been proposed, focusing on the protection of the most vulnerable areas of the settlement and strengthening community resilience to flood hazards. Preliminary assessment indicates that the right-bank embankment may increase peak flood levels along the left bank by approximately 1 m for events up to the 1-in-20-year flood. The redesign of local flood protection around Bolahamo therefore incorporates this additional

flood level while recognizing that excessively high embankments could create unacceptable residual risks in the event of structural failure. Accordingly, the preferred approach is to provide localized protection around the settlement core rather than extending defences to low-lying areas where the consequences of breach, groundwater inundation, and emergency evacuation challenges would be significantly greater. Owing to local topography, existing defence conditions, and groundwater management requirements, a revised alignment using a ring-defence configuration is considered the most appropriate solution.

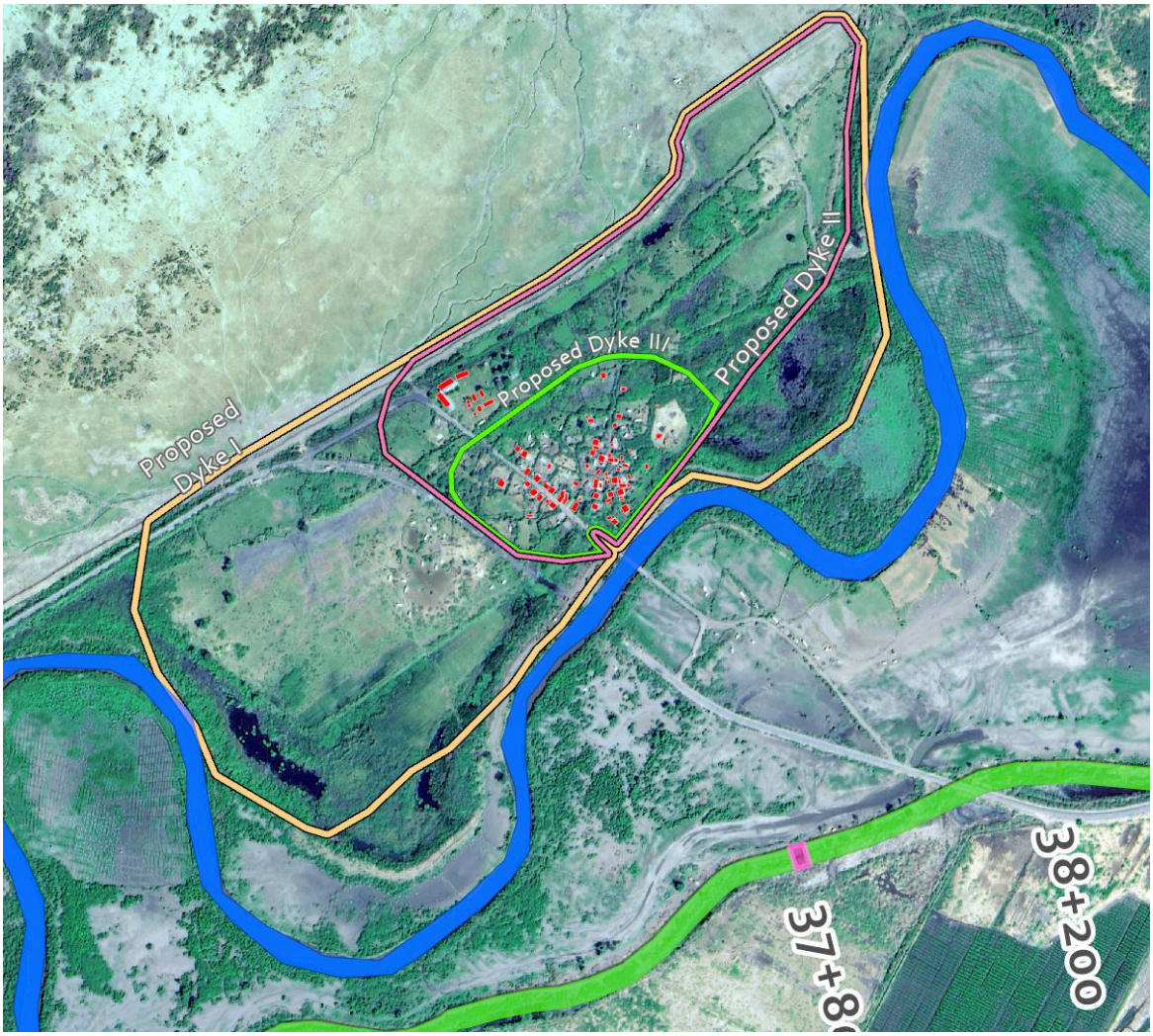

Figure 5.1: Layout of Options considered at Bolahamo (Amibara Design Report)

Proposed Mitigation Measures for Bolahamo Settlement (Option II)

- Consideration of localized flood protection embankments around the core settlement area.
- Envisage selected lower-elevation areas within the protected zone where groundwater ingress can be effectively managed.
- Upgrade and realign existing flood defences based on detailed hydraulic and groundwater assessments.
- Establish a flood forecasting and early warning system linked to flood thresholds and spillway overtopping conditions.

- Develop evacuation procedures and trigger levels to enable timely relocation of residents across the Awash River during major flood events.
- Regular stakeholder engagement and adaptive flood risk management through implementation of the Environmental and Social Management Plan (ESMP).
- Consider limited resettlement of households located in low-lying areas where flood and groundwater risks cannot be adequately mitigated.
- Maintain seasonal settlement management practices whereby pastoralist communities avoid occupying the floodplain during the rainy season.

At the downstream end of the scheme near the pastoral settlement of Youren, additional mitigation measures are required to ensure continuity of flood protection and prevent backdoor flooding of right-bank agricultural land. Topographic analysis confirms that floodwaters could bypass the proposed embankment through low-lying areas unless a cross-bank closure structure is constructed to connect the new embankment with existing flood protection infrastructure protecting adjacent plantations and pumping facilities. Although this arrangement may displace some floodplain storage and increase flooding within parts of the left-bank floodplain during events up to the 1-in-20-year return period, no permanent settlements have been identified within the affected downstream areas, and the extensive wetland floodplain is expected to absorb these flows. Given the absence of a detailed hydraulic model at the current stage, the project has included a robust allowance for downstream mitigation works, including: (i) upgrading existing plantation defences and cross-bank structures with a higher closure embankment; (ii) incorporating a controlled spillway within the closure embankment to safely manage overtopping flows; (iii) providing multiple drainage outfalls equipped with flap gates to facilitate floodplain drainage and prevent backflow; and (iv) integrating drainage arrangements for the stream channel surrounding the plantation. These measures will be refined during detailed design and are illustrated in the proposed downstream protection layout.

In this context, the consolidated mitigation measures for the Amibara Embankment project intervention are summarized in Table 5.2 below.

Table 5.2: Consolidated Mitigation Measures for Adverse Environmental and Social Impacts

Mitigation Measures Schedule	Category of Impact	Potential Impacts	Proposed Mitigation Measures
Pre-Construction Phase	**Socioeconomic**	Disruption of seasonal migratory pastoralist settlers of about 96 HHs (although their number could vary at the time of implementation due to seasonal mobility) currently residing around existing embankments and their mobility (Required land along the existing embankments to ensure structural integrity and safety buffers)	○ Establishing a co-management agreement with pastoralist communities for rangelands and water resources; supporting a livelihood diversification program; empowering communities to monitor project impacts and mitigation effectiveness; and creating a contingency fund for unforeseen losses ○ Implement a Livelihood Restoration/Resettlement Plan (specifically tailored to seasonal migratory patterns to ensure grazing and livelihoods are not adversely affected) and consult traditional leaders and Elders' Council to coordinate the issue." ○ Seasonal Construction Scheduling - Align the pre-construction activities (clearing, surveying, fencing) with the seasonal absence of the pastoralist groups to minimize direct physical confrontation and displacement
		Temporary Land Use Change (Seasonal loss of	○ Ensure priority access for PAPs regarding sub-project-related job opportunities and livelihood support.

		access to grazing land and traditional migratory corridors). -Impact on Seasonal Pastoralists (Temporary displacement of Sub project Affected Persons (PAPs) who utilize the land seasonally for grazing (no permanent structures or settlers identified)).	○ Provide or direct alternative grazing access to maintain the community's pastoral viability in consultation with the local elders. ○ Develop a Grievance Redress Mechanism to allow PAPs to report disruptions to migratory patterns issues during the transition. ○ Establishing a community-based committee (involving elders, clan leaders, kebele/district officials, and local household representatives) to manage the voluntary land management issues together with the client and contractor
		Archaeological Heritage	○ Implement "Chance Find" procedures during initial site clearing in fossil-rich areas.
	Technical & Design Completeness	Risk of structural failure due to seismic activity or dynamic river channel shifts. Flood risk to the identified left bank areas (Dofen and Bolahamo) and downstream	○ Finalize designs with structural reinforcements (riprap/gabions) and ensure a 50–100 m environmental setback from the riverbank to maintain a functional floodplain. At Dofen: ○ Consideration of engineering measures such as increasing and fortifying the dike crest in breach-prone areas and at pump stations ○ Bank protection at erosion hotspots using bioengineering, riprap, or revetment ○ Bifurcated channel training under control to minimise diversion toward LHB hydraulic measures ○ To lessen excessive flow transfer to LHB, add spillways upstream on RHB ○ When possible, maintain a buffer of 50–100 meters to permit floodplain function. ○ Targeted Defence work and strengthening as localised protection for irrigation remnants and vital infrastructure At Bolahamo: ○ Structural measures (optimizing and ensuring the multi-criteria-based and selected design option II to be implemented): to prevent areas that are prone to flooding, the current dike (ring defence strategy) should be strengthened and realigned and shall ensure the protection of the estimated 50 HHs that have permanent structure houses near the left side of the river bank. Besides, raising crest heights to account for higher flood levels. ○ Increasing the hydraulic capacity of the bridge (raising the deck or enlarging holes) or aligning with the ongoing new bridge construction is necessary, and to avoid excessive concentration, design flow dispersal structures. Consider access routes that are safe during floods. ○ Channelisation and Dredging Management: Make sure bifurcation and reconnection are controlled to prevent community water access from being turned off. ○ Management of Drainage and Groundwater: Determining the cause of ponding by conducting hydrogeological investigations and installing relief wells, drainage channels, or pumping systems. ○ Community Awareness and Early Warning System establishment for Flood Risk Reduction, and flood

			protection locally for HHs, Schools, Clinics, and Communities o Social Countermeasures: Alternative analysis and planning, establishing and undertaking ongoing communication with local authorities and communities.
Construction Phase	**Water Pumping Stations Disruption**	Irrigation water supply disruption, increased turbidity at intake points, soil erosion and localized disturbance and contamination	o Implement temporary bypass pumping systems to maintain continuous water delivery to downstream users during construction. o Schedule construction works during periods of low irrigation demand to reduce disruption. o Communicate planned shutdowns with local farmers to allow advance water management.
	Hydrology	River flow alteration (reduced/increased flow, seasonal variability changes)	o Conduct regular hydrological monitoring o Maintain environmental flow requirements. o Establish adaptive water management plans
	Hydrology	Flood risk changes downstream	o Develop and implement flood risk modelling o Establish early warning systems for downstream communities o Maintain buffer zones along riverbanks o Prepare a local water supply system through a pipe to protect the bank from breaching
	Flora (Invasive Species)	Soil instability and piping risks due to mechanical clearing of dense *Prosopis juliflora* thickets along the 60km alignment.	o Perform mechanical uprooting of root systems; immediately stabilize cleared areas with native vegetation or Vetiver grass to bind the loose alluvial soil.
	Flora (Invasive)	Severe soil erosion and **piping risks** following the mechanical uprooting of dense *Prosopis juliflora* thickets along the 60km alignment.	o Use non-mechanized clearing where possible; immediately stabilize exposed sandy soils using **Vetiver grass** (*Chrysopogon zizanioides*) to act as "living nails."
	Flora (Native Biodiversity)	Loss of scarce "Woodland" and "Riparian Woodland" (comprising <0.4% of the area) during site clearing.	o Demarcate construction limits to avoid riparian trees; for every native tree removed, plant 10 indigenous seedlings and maintain them until they reach 1.5m height.
	Fauna (Habitat & Safety)	Temporary displacement of local wildlife/livestock; risk of animals falling into open excavation trenches.	o Schedule clearing in segments to allow fauna relocation; fence or erect obstacles in all ditches and trenches to prevent accidents involving domestic and wild animals. o Like other sections of the nation, the habitat for wildlife has already been converted to agricultural land and populated areas. As a result, just a few common bird species were found in the sub project area. o Conduct pre-construction surveys to identify and avoid active nests or burrows. o Schedule noisy construction activities outside of key breeding seasons for local birds.

			○ If any protected species are unexpectedly encountered, work with the relevant environmental authority to develop a protection plan. Information provided by the locals also confirmed the presence of only a few kinds of animals in the region. ○ Besides, the sub project's impact on its surroundings does not include any parks or other protected areas. ○ o Consequently, there will be relatively little effect of the planned sub project on the local natural animals.
	Biophysical (Soil & Water)	Severe soil erosion and increased turbidity in the Awash River are affecting aquatic habitats and downstream users.	○ Use Vetiver grass for biotic stabilization; install silt fences and sediment traps; schedule heavy earthworks during the dry season (Oct–Jan). ○ Develop and use a strategy for managing the excavated soil before beginning any building work. The construction should be done during the dry season to prevent runoff-enhanced sediment movement. ○ Use sandbags, diversion berms, culverts, or other physical means to prevent sheet and rill erosion of soil; ○ Carefully remove and properly stockpile the topsoil removed from the site and re-use it for site restoration when construction works are finished; ○ Oil exchange should only take place in the pre-prepared workshop area; ○ Vehicle and machinery washing should only be done in the workshop area and never on open soil. ○ Avoid using old (> 10 years) and properly unmaintained machinery as this can most likely result in oil, grease, and fuel leaks; ○ Drive on existing roads wherever feasible; avoid driving on unpaved ground. ○ After construction is finished, immediately restore the area by distributing heaped topsoil. ○ o Create temporary drainage channels or holding ponds to reduce soil erosion;
	Biophysical (Water)	Increased turbidity and sediment load in the **Awash River** during bank stabilization and river training works.	○ Install silt fences and sediment traps; schedule heavy earthworks during the dry season (Oct–Jan); establish buffer zones to prevent camp runoff (oils/sewage) from reaching the river.
	Biophysical (Water)	Water pollution due to leakages from machinery and garages	○ All chemicals and hazardous substances must be stored on an impermeable surface in a designated bounded area that can contain 10% more than the total volume of materials stored at any given time; ○ Material safety data sheets (MSDSs) are to be displayed for all hazardous materials in the workshop; ○ Regular inspections of the impermeable surface and maintenance reports are required; ○ Develop and display an emergency response plan for accidental oil and chemical spills. ○ It is imperative to prevent construction materials and waste, such as aggregate, cement, and fresh concrete, from infiltrating the current drainage system and infrastructure. ○ Make sure the environment of the water body is protected by managing construction materials properly when doing civil works.

	Biophysical (Air)	Dust and air pollution	○ Water should be sprayed on construction sites and transportation routes up to three times a day; ○ All cars and construction equipment should be operated following applicable vehicle emission standards and should undergo routine maintenance to minimize air pollution; ○ Personal protective masks, safety goggles, earplugs, and helmets should be worn by workers near dust and loud noise areas, and their working hours should be limited to maximize time spent in the noisy environment. ○ Manual trench digging for trunk lines should be done to avoid having too many trucks and machinery in the area. ○ Piled up in the open air should be reduced as much as possible, or ensure the piled-up material's moisture rate during the construction stage. ○ Particulate Matter (PM) monitoring should be undertaken by using the Dust Track Monitor to set mitigation measures.
	Biophysical (Climate)	Impact on climate change and resilience	○ Implement measures to minimise disturbance on the ecological and social systems ○ Control dust and missions from construction vehicles/equipment ○ Plan and consider an appropriate waste management plan to minimize waste generation and ensure proper disposal ○ Implement energy efficiency measures and use of renewable energy and climate emergency plans
	Socio-economic Impact (Noise)	Noise and vibration	○ Use a sound level meter to assess the primary sensitive receptors' exposure status regularly. ○ Steer clear of heavy machinery building sub-projects throughout the night, close to residential areas. It is recommended to avoid using noisy machinery within 50 meters of residential areas or near institutions like schools and hospitals. ○ Additionally, construction machinery should be properly maintained and operated to minimize noise generation. ○ Transport routes should be chosen to minimize noise pollution in sensitive areas. ○ Whenever possible, non-mechanised construction machinery should be used, and a local labour force should be used during trench excavation. ○ Workers in construction will be informed about the acceptable noise levels in the surrounding area and at work. ○ The recommended noise levels for construction sites are 70 dBA at night and 75 dBA during the day, respectively. ○ When it is not in use, equipment will be turned off; well-maintained and functioning equipment will be used; ○ Personnel will be given the required personal protective equipment (PPE), such as ear muffs, if needed and as deemed appropriate;

	Socio-economic Impact (Traffic)	Traffic congestion and accidents	○ Create and carry out a traffic management plan while collaborating closely with the local traffic police; ○ Educate workers and the community about traffic accident prevention; ○ Provide protective gear for workers and place temporary signs or notices to indicate construction sites; ○ Ensure that only qualified drivers operate vehicles on the site and park in designated areas; ○ Hire young people to assist with traffic management activities on both sides of the construction site; ○ Fence or erect obstacles in ditches and trenches to prevent interference and accidents involving children and domestic and wild animals; ○ The resident engineer and the contractor should plan to avoid peak traffic periods; ○ The resident engineer must make sure that construction vehicles are operated during off-peak hours; ○ To avoid traffic accidents in the area, the Resident Engineer and Contractor should agree on traffic routes.
	Socio-economic Impact (OHS)	Occupational health and safety	○ Put into effect globally recognized standards and OHS guidelines before commencement of the sub-project construction, and ensure safe work practices and guidelines and adhere to safe work practices; ○ Create a site-specific Health and Safety Management Plan (including training on safe work practices, risk reduction, and work-related accidents); Identify and designate a competent health and occupational safety officer to supervise OHS concerns daily; ○ Keep an eye on construction workers' adherence to safe work practices and guidelines (OHS); ○ First aid kits should be available in workshops, construction sites, and inside cars. ○ Workers should also be provided with the proper personal protective equipment (PPE). ○ The campsite should be kept fenced and hygienic, with enough facilities for firefighting and waste disposal. ○ All incidents of injuries and accidents should be meticulously recorded, including the date, time, and location of the occurrence, the extent of the injuries, the damage to resources, and the number of people hurt or killed and reported to the project management as per the requirements of the ESCP. ○ Assign a health and safety officer for the duration of the construction period; ○ Train the sub-project workforce on the basic use of emergency first aid. ○ Provide workers with appropriate personal protective equipment (PPE); ○ Use signage to warn staff and/or visitors about the construction activities of dangerous places and activities; ○ Plan to properly handle construction waste and dispose it on a site designated for this purpose; ○ Put signs on open trenches to avoid the risk of falls; ○ Refill open trenches within a maximum of seven days;

	Socio-economic Impact (Heat)	Occupational health risks (heat stress >37°C) and social conflicts from labor influx.	o Mandatory hydration intervals; SPF 30+ sun protection; and worker rotation during peak heat (12 pm – 3 pm). o o Provide mandatory OHS training and PPE; establish water stations; enforce a Worker Code of Conduct regarding community interactions and GBV/SEAH prevention.
	Socio-economic Impact (STD and WBCD)	Exposure to STDs, including HIV/AIDS, unwanted pregnancies, water-borne and communicable diseases	o It is recommended to raise awareness among employees and the community about HIV/AIDS, unwanted pregnancy prevention, communicable disease prevention and management through staff training, awareness campaigns, multimedia workshops, and community meetings. Additionally, town health and HIV/AIDS Prevention and Control offices should collaborate to bring about significant changes in attitudes and behaviors. o Hand washing facilities with enough running water and soap should be installed, as well as sanitizing areas around catering and sanitation areas. o Provide free distribution and provision of condoms to construction workers by the Contractor to avoid the spread of STDs and HIV/AIDS; o Put educational posters and flyers on HIV/AIDS, using local languages to minimize the spread of HIV/AIDS;
	Socio-economic Impact (VSC)	Violations of Social Custom	o Reinforce and strictly follow traditional and cultural rules and orient staff and workers to respect culture and people always. o To minimize the number of laborers entering the community, efforts should be made to hire both skilled and unskilled labour from within the community when available. o Good communication and teamwork are essential in addressing the opportunities and challenges brought about by a labour influx. o New employees shall sign a code of conduct, and the contractor should provide proper identification and uniforms so that workers can quickly identify those with social difficulties.
	Socio-economic Impact (GBV and SEAH)	Gender-Based Violence and SEAH/ Social Conflict	o A separate restroom for women should be available at the construction site. Women-friendly safety supplies and equipment should also be provided. Women should be assigned to jobs that do not negatively impact their biological condition. o A code of conduct that strictly prohibits sexual harassment and gender-based violence should be prepared and implemented, and all workers should sign it. o Ensure equitable distribution of employment opportunities between men and women and practice affirmative action if competent women are scarce. o Equal pay for equal work should be guaranteed. o Employees who experience GBV should also be given access to counseling, medical attention, and legal assistance. o Organize women's workforce to prevent gender-based violence by forming different sub-committees that will have a strong linkage with women's affairs offices at

			Woreda and Town administration levels o Provide technical support and make functional of Community Engagement, Accountability and Complaint o Provide mandatory GBV/SEAH regular awareness training
	Socio-economic Impact (PS)	Impact on public services	o When possible, efforts should be made to engage both skilled and unskilled labor from within the community to reduce the number of laborers entering the area. o To handle the potential problems brought about by a workforce surge, effective communication and cooperation are crucial. o To enable workers to promptly identify individuals with social challenges, the contractor should furnish appropriate identification and uniforms, and new hires will be required to sign a code of conduct.
	Socio-economic Impact (Heritages)	Potential Disturbance to Physical Cultural Resources As the Afar Region is globally recognized for its richness in fossils and burial sites, there is a high risk of loss or damage to unidentified archaeological artefacts, paleontological remains or graveyards during earthworks and embankment construction).	o Chance Find Protocol is important even though there are no observable heritage sites identified along the current embankment alignment. If any artefacts are discovered, the contractor must immediately cease excavation, secure the area, and promptly notify the Culture and Tourism Office
	Socio-economic Impact (Left bank)	Risks related to the newly planned dyke, dredging and channelization works: The assessment identifies several risks associated with dredging and channelization activities with additional dike works to protect the Bolahamo community and the farm land and the Pumpstation and Overtopping at Dofen: Loss of access road, Loss of water access and Additional land requirement for additional dike and other structural measures	o Establishing a community-based committee (involving household representatives, elders, clan leaders, women, youth representatives and kebele and district officials) to manage the voluntary land management processes together with the client and contractor o Establishing a co-management agreement with pastoralist communities for rangelands and water resources; supporting a livelihood diversification program; empowering communities to monitor project impacts and mitigation effectiveness; and establishing and securing a contingency fund for unforeseen losses
Operation & Maintenance	**Physical (Infrastructure)**	Damage to steel bridges and drainage lines from expansive Vertisols (Black Cotton Soils).	o Replace expansive clay with laboratory-verified, non-expansive backfill material for all underground structures and bridge foundations.

	Physical Infrastructure and Socioeconomic	Reduced Water Pumping Stations Efficiency if poorly aligned	○ Ensure proper hydraulic design and alignment of intake structures to maintain flow efficiency. ○ Conduct post-installation calibration and testing to verify pump performance. ○ Schedule regular maintenance and inspection to detect and correct alignment issues early.
	Hydrology	River flow alteration (reduced/increased flow, seasonal variability changes)	○ Conduct regular hydrological monitoring ○ Maintain environmental flow requirements. ○ Establish adaptive water management plans
	Hydrology	Flood risk changes downstream	○ Develop and implement flood risk modelling ○ Establish early warning systems for downstream communities ○ Maintain buffer zones along riverbanks ○ Prepare a local water supply system through a pipe to protect the bank from breaching
	Biophysical (Soil/Land)	Soil salinization (Solonchaks) and potential waterlogging of agricultural lands (cotton, maize, onion).	○ Regularly monitor and maintain irrigation return-flow drainage lines; ensure the dike remains "seepage-proof" by checking for animal burrowing.
	Biophysical (Soil/Water)	Impact on Soil and water due to breaching and overflows	○ Make sure the dyke has enough hydraulic capacity to handle peak flows; ○ Implement a breach detection program to identify where the sensitive portion of the site. ○ A sustainable watershed-based solution has to be sought in addition to structural dyke solutions ○ A community-based water supply system has to be there so as to prevent local people from breaking the bank for utility
	Physical (Design)	Structural Failure	○ Conduct annual regulatory audits for structural resilience against flood debris; use real-time upstream gauging for flood alerts and consider regular structural maintenance.
	Biophysical (fauna)	Impact on Fauna	○ The quality must meet the national and international standards to comply with environmental safety.
	Ecological (Maintenance)	Internal piping and seepage caused by *Prosopis* re-infestation on the embankment.	○ Implement a biannual maintenance program to manually/mechanically remove invasive seedlings from the dike to prevent deep taproots from compromising structural integrity.
	Ecological	Re-infestation of the dike by *Prosopis juliflora*, leading to root-induced seepage and waterlogging in adjacent farmlands.	○ Implement a biannual maintenance schedule for the mechanical uprooting of seedlings from the dike crest and slopes.
	Socioeconomic	Potential conflicts or accidents at river crossing points if bridges and cattle troughs are not maintained.	○ Conduct quarterly inspections of steel pedestrian bridges and livestock watering facilities to ensure safe community access.
	Socio-economic Impact	Resource & Water Conflict	○ Implement traditional "Mada'a" water-sharing quotas via Clan Elders to ensure equitable irrigation access.
	Biophysical (Land)	Environmental	○ Execute a site restoration plan: backfill and level

Decommissioning Phase		degradation at borrow pits, quarries, and temporary worker camp sites. Or Permanent land degradation and "scarring" at borrow pits and abandoned camp sites.	borrow pits, remove all construction waste, and re-vegetate with native savanna species to restore the ecosystem.
	Waste Management	Soil and water contamination from hazardous construction waste (fuel, lubricants, cement wash).	○ Collection and disposal of all hazardous materials at approved regional facilities; conduct a final soil audit at camp and workshop locations to ensure no residual pollutants remain.
	Biophysical Environment	Land Degradation	○ Stabilize and rehabilitate all borrow pits; decommission temporary camps and return land to the community.
		Riparian Restoration	○ Follow a 1:5 reforestation protocol (planting 5 indigenous seedlings for every native tree cleared).
		Impact on Climate Change and Resilience	○ Restore the site to its original condition or to a better beneficial use ○ Dispose of any waste materials properly and at a designated site to protect scars
	Socio-economic Impacts	Job loss	○ Develop a severance and transition plan for affected employees, which may include career counselling, job placement services, and severance packages in accordance with national labour laws. ○ Provide advance notice of decommissioning to all staff to allow them time to seek new employment. ○ Prepare, notify and implement the Labour management plan that includes an official employment and hiring with a definite timespan in consultation with local stakeholders and provide advance notice of project closure to the workforce and community

5.7. Environmental and Social Management and Monitoring Plan (ESMP)

5.7.1 Overview of Environmental and Social Management Plan

The Environmental Social Management and Monitoring Plan (ESMP) has been carefully crafted to address the sub-project's negative environmental and social impacts; suggest mitigation measures, roles and responsibilities of different bodies involved in the different phases of the sub-project; set the implementation schedule, indicators, monitoring, and evaluation approaches, and the indicative budget needed to carry out the mitigation measures.

An ESMP's main goal is to make sure that any potential dangers to the environment and society that might be brought on by a sub-project or activity are recognized, evaluated, and skillfully handled. To promote good social and economic results and reduce or eliminate negative impacts on the environment and local populations, the ESMP creates a thorough framework outlining the procedures and activities that will be done.

Below, the suggested mitigating actions for each of the corresponding negative effects noted in the previous chapter are covered. The goal of the suggested mitigation strategies is to reduce or completely eradicate any effects brought on by the site-specific Amibara Right Bank Embankment/Dyke construction sub-project. By incorporating consequences that would develop during mobilization and construction, operation, and decommissioning phases, as well as the suggested mitigation methods, the detailed ESMP (Table 5.2).

In particular, ESMP offers a detailed description of the institutional setup for implementing mitigation and monitoring measures in addition to identifying and summarizing the major adverse environmental and social consequences. The ESMP needs to follow the fundamentals of well-designed environmental performance that include:

- Appropriate facility management;
- Thorough knowledge of environmental laws, policies, and priorities;
- Being aware of legal obligations and maintaining current operating data; and
- Establishing proper coordination and alignment with the different stakeholders and key role players of the sub-project.

This section details the Environmental and Social Management Plan (ESMP) specifically tailored for the Amibara Right Bank flood protection works. The plan will serve as a binding operational framework to ensure that all construction and operational activities along the right bank alignment are executed in a manner that protects the fragile alluvial ecosystem and the livelihoods of the surrounding pastoralist and farming communities.

The ESMP for the Right Bank prioritizes the Mitigation Hierarchy, with a heavy emphasis on "Impact Avoidance" by situating contractor facilities and quarry sites on low-value, non-cultivable land. It integrates technical engineering solutions such as reinforced dike embankments and expansive soil replacement with social safeguards, including the maintenance of community cattle watering points and pedestrian bridges. By defining clear mitigation actions, institutional responsibilities, and dedicated budgets, Table 5.2 ensures that the sub project remains environmentally sustainable and socially inclusive throughout its lifecycle.

5.7.2. Institutional Arrangements for the Implementation of Environmental and Social Safeguards

MoWE has developed expertise in creating safeguarding tools, such as Environmental and Social Impact Assessments (ESIA) and Resettlement Action Plans (RAP), to identify and mitigate potential environmental and social risks associated with various infrastructure sub projects funded by the World Bank.

Currently, the Awash Basin Authority (ABA) is responsible for implementing the ongoing Amibara Right Bank Embankment sub project, collaborating with the Ministry of Water and Energy at the federal level through Project Management Units (PMUs) staffed with environmental safety professionals. Within the PMU, the Ministry has employed safeguard experts, one specializing in environmental issues and another in social safeguards, who are dedicated to the successful continuation of the Amibara Site-Specific Sub project.

The successful implementation and long-term sustainability of the ESMPs for the Awash Basin are contingent upon a clear and collaborative institutional framework. This framework engages all key stakeholders across multiple administrative levels with specific, complementary roles relevant to the Awash ESIA study context. The ESIA study process requires consideration of the consent of the key stakeholders and working with them.

The key institutions and stakeholders at the local, regional, and federal levels that will be directly involved in the sub-project are outlined below.

1) At the federal level, the **Ministry of Water and Energy (MoWE)** provides the overarching policy direction and technical standards for water resource management and flood control infrastructure. And specifically, the ET-FMP project team of MoWE provide overall guidance, support and facilitation of this particular engagement and ensures compliance standards of the Ministry and the World Bank across all deliverables and stages of our service engagement.

Serve as the primary project proponent, overseeing the technical delivery of flood risk reduction, irrigation and livestock infrastructure, among others.

2) The **Awash Basin Authority (ABA)** holds the pivotal cross-regional mandate for integrated water resource management within the basin. Its role is central to the ESIA process, providing critical basin-level data, facilitating inter-regional coordination, and it will be the primary long-term institution responsible for overseeing the implementation of the ESMPs and monitoring cumulative impacts.
3) The **Environmental Protection Authority (EPA)** is responsible for enforcing national environmental standards, reviewing the ESIA, and issuing the mandatory environmental permit. The Federal Disaster Risk Management Commission (FDRMC) contributes national strategies for disaster prevention and response, ensuring the sub-project aligns with broader risk reduction goals.
4) At the regional level, the relevant **Regional States' Bureaus of Water and Energy, Agriculture, and Environmental Protection (Oromia and Afar)** are key partners. They are responsible for adapting federal guidelines to the local context, issuing regional permits, supervising sub-project activities within their jurisdictions, and nominating staff for capacity-building programs. Their on-the-ground knowledge is indispensable for effective stakeholder engagement and monitoring.
5) At the woreda and kebele levels, local administrations are the primary interface for implementation. **Woreda Relevant Sector Offices** (including Woreda Grievance Redressal Committee) will be tasked with local enforcement of mitigation measures and routine monitoring, while kebele administrations and community leaders are essential for mobilizing local stakeholders, providing context on land use and social structures, and serving as the first point of contact for grievance redress. Engaging established youths and women's offices, investors, business associations, and pastoralist community committees will be crucial for managing local resources and ensuring the plans are socially grounded. They have been actively engaged and consulted throughout the Environmental and Social Impact Assessment (ESIA) study to ensure their participation.
6) Traditional Clan Leaders: These leaders play a vital role in the institutional framework by managing the social rotation of water use at troughs and resolving localized land or water disputes through traditional mediation.
7) In the construction, operation, and decommissioning phases, personnel from the district administration and the kebele administration will monitor adherence to the ESMP closely. Before commencing construction sub projects, various entities, including the Agricultural Bureau, Awash Basin Authority, environmental oversight offices, the Amibara town administrations where the sub project is situated, representatives of affected parties, and community elders, will collaborate to address compensation and land acquisition matters. The compensation panels will include representatives of impacted parties to ensure fairness.
8) Working hand-in-hand with the communities, local government representatives, and relevant offices will facilitate land replacement arrangements when necessary and oversee population counts and compensation disbursements. Regional offices responsible for the Environment, Health, and Water Supply and Sanitation will collaborate to oversee environmental considerations. The sub-project details, proposed mitigation measures, responsible institutions, and budgetary needs for implementing the ESMP are outlined for effective execution.
9) The **World Bank**, as the key development partner, performs a vital role in providing funding, ensuring safeguard compliance, and offering international best practice guidance throughout the

ESIA process and project cycle. The reports to be submitted also needed to be approved by the World Bank.

10) The design consultant is in charge of making sure the design is made in an environmentally friendly manner by accounting for key issues included in the ESIA document. The task of designing the Right Bank Embankment in detail has been given to a consultant, who will also be in charge of integrating the site investigation inputs suggested by the ESIA study team into the technical requirements of the primary sub project report
11) The contractors responsible for the construction of the sub-project are tasked with executing the construction process while ensuring strict adherence to the Environmental and Social Management Plan (ESMP) and environmental regulations. The Contractor will assign a dedicated Environmental, Health and Social (EHS) staff to prepare and implement C-ESMP and this ESMP, and as well to supervise the implementation and maintenance of the ESMPs, overseeing essential environmental and social monitoring activities. This team will be stationed on-site throughout the construction sub-project's duration, serving as the primary contact for any environmental and social concerns raised by the contractor. Moreover, the team is responsible for regularly confirming that mitigation measures are effectively implemented and that construction activities align with the criteria outlined in the ESMP.
12) The Supervision Consultant plays a crucial role in ensuring that the contractor complies with the environmental construction guidelines established by the consultant. This oversight is essential for maintaining environmental standards throughout the construction process. Sub-project implications, recommended mitigation strategies, responsible entities, and the financial requirements for implementing the Environmental and Social Management Plan (ESMP) are consolidated in Table 5.4. This comprehensive approach helps streamline the execution of the ESMP and ensures that the sub-project aligns with environmental regulations and best practices. Accordingly, the supervising consultant shall deploy at least one EHS staff member for the follow-up and reporting of E&S pertinent issues.
13) The Regional Environmental Protection Authority is responsible for reviewing and approving Environmental and Social Screening (ESS) and Environmental Significance Assessment (ESI) documents, as well as the safeguard components of sub-projects. They conduct spot inspections to ensure effective implementation of ESMPs and environmental and social screening. Additionally, they offer guidance to sub-project implementing organizations on addressing sub-project implications beyond general issues, assessing the need for sub-project redesign or suitable mitigation measures. Serves as the primary regulatory auditor, reviewing the ESSP and conducting field inspections to ensure contractors adhere to waste management and erosion control protocols.

Table 5.3: Environmental and Social Management Plans for Amibara Right Bank Embankment Sub project

Phase	Category / Impact	Proposed Mitigation Measures	In charge of accountability for:		Estimated Budget (ETB)
			Implement ation	**Supervision & Timeframe**	
Pre-Constructi on	Disruption of seasonal migratory pastoralists' mobility along with existing embankments.	Implement a Livelihood Restoration/Resettlement Plan (specifically tailored to the seasonal migratory of settlers *of about 96 HHs (although their number could vary at the time of*	The sub-project owner (Awash Basin Office) and Local	Sub project Owner, before handover	Regional Government / Town Administration and/or WB. (This is to be done based on

	Temporary Land Use Change (Seasonal loss of access to grazing land and traditional migratory corridors).	*implementation due to seasonal mobility) currently residing around the existing embankment and their mobility* to ensure grazing and livelihoods are not adversely affected), and consult traditional and clan leaders and the Elders' Council to coordinate the issue	District Administration and GRM Committee		the detailed RP report and compensation procedure, and in accordance with applicable law/guideline, following the RP report. 20,000,000.00
	Technical & Design Consideration Limitations: Structural failure and Flood risk / Seismic risk	Use riprap/gabions; ensure 50–100m environmental setback from riverbank. At Dofen: Consideration of engineering measures, such as increasing and fortifying the dike crest in breach-prone areas and at pump stations Bank protection at erosion hotspots using bioengineering, riprap, or revetment Bifurcated channel training under control to minimise diversion toward LHB hydraulic measures To lessen excessive flow transfer to LHB, add spillways upstream on RHB. At Bolahamo: Consider and implement the proposed structural measures (by optimizing and ensuring the multi-criteria-based and selected design option II to be implemented): to prevent areas that are prone to flooding, the current dike (ring defence strategy) should be strengthened and realigned and shall ensure the protection of the estimated 50 HHs that have permanent structure houses near the left side of the river bank. Besides, raising crest heights to account for higher flood levels. Increasing the hydraulic capacity of the bridge (raising the deck or enlarging holes) or aligning with the ongoing new bridge construction is necessary,	Design Engineers	Resident Engineer; Design stage	Design and related estimated cost, 25,000,000

		and to avoid excessive concentration, design flow dispersal structures. Consider access routes that are safe during floods, Channelization, and Dredging Management: Make sure bifurcation and reconnection are controlled to prevent community water access from being turned off.			
	Archaeological: Site clearing in fossil-rich areas	Implement "Chance Find" procedures during initial clearing.	Contractor	Culture & Tourism Office	50,000
Construction	**Hydrology:** River flow alteration (reduced/increased flow, seasonal variability changes)	Conduct regular hydrological monitoring Maintain environmental flow requirements Establish adaptive water management plans	Contractor	Sub project Owner; before handover	500,000
	Water Pumping Stations Disruption	Implement temporary bypass pumping systems to maintain continuous water delivery to downstream users during construction. Schedule construction works during periods of low irrigation demand to reduce disruption. Communicate planned shutdowns with local farmers to allow advance water management.	Contractor	Sub project Owner, Contractor	1,000,000
	Hydrology: Flood risk changes downstream	Establish early warning systems for downstream communities Maintain buffer zones along riverbanks Prepare a local water supply system through pipe so as to protect the bank from breaching	Contractor	Sub project Owner; before handover	14,000,000
	Flora (Invasive): Soil instability from *Prosopis* clearing	Mechanical uprooting; immediate stabilization with native vegetation or Vetiver grass.	Contractor	Environmental Officer; Construction	450,000
	Flora (Native): Loss of Riparian Woodland	Demarcate limits; 1:10 reforestation ratio (plant 10 indigenous seedlings for every 1 removed).	Contractor	Environmental Officer; Construction	300,000

	Fauna: Habitat & animal safety	Segmented clearing; fence trenches; avoid noisy work during bird breeding seasons.	Contractor	Environmental Officer; Construction	150,000
	Soil & Water: Erosion and Turbidity (Awash River)	Silt fences; sediment traps; earthworks only in dry season (Oct–Jan); manage excavated soil strategy.	Contractor	Resident Engineer; Oct–Jan	400,000
	Water Pollution: Chemical/Oil leaks	Store hazards on impermeable surfaces (110% volume); display MSDS; emergency spill plan.	Contractor	Environmental Officer; Daily	200,000
	Air Quality: Dust and emissions	Water spray 3x daily; maintain vehicle emission standards; particulate matter (PM) monitoring.	Contractor	Environmental Officer; Daily	350,000
	Climate Change: System resilience	Energy efficiency; renewable energy use; climate emergency plans; minimize ecological disturbance.	Contractor	Sub project Owner; Construction	100,000
	Noise & Vibration: Sensitive receptors	No night work near residences; 50m buffer from schools/hospitals; use sound level meters.	Contractor	OHS Officer; Daily	100,000
	Traffic: Congestion and accidents	Traffic management plan; hire local youth for assistance; use signage and off-peak hauling.	Contractor	Local Traffic Police; Construction	200,000
	OHS: Occupational Health & Safety	Site-specific H&S Plan; OHS officer; first aid kits; PPE; signage on open trenches.	Contractor	OHS Officer; Daily	400,000
	Heat Stress: Health risks (>37°C)	Hydration intervals; SPF 30+ protection; worker rotation (12 pm – 3 pm).	Contractor	OHS Officer; Peak Summer	100,000
	Social: STDs, HIV/AIDS, & Communicable Diseases	Awareness campaigns; free condom distribution; hand washing facilities; local language posters.	Contractor	Town Health Office; Monthly	750,000
	Social: Customs, GBV, & SEAH	Mandatory Code of Conduct; GBV training; separate restrooms for women; equal pay for equal work.	Contractor	Woreda Women's Affairs; Monthly	500,000

	Infrastructure: Expansive Vertisols	Replace expansive clay with non-expansive backfill for foundations/bridges.	Contractor	Resident Engineer; Foundation stage	700,000
	Left Bank and Downstream Structural Measures Implementation	At Dofen: Consider and implement measures to strengthen the dike and raise the crest by installing revetment and riprap in areas of erosion and overtopping To prevent excessive flow diversion, control channel and dredging operations, and in case of disruptions, provide temporary spillways. Enforce environmental and health, and safety measures. At Bolahamo: Strictly consider and adhere to increasing and adjusting the height of the dike Implement and align drainage systems, including pumps, channels, and relief wells Align the design and implementation with the ongoing bridge construction to accommodate more traffic, congestion and flood risks. Ensure regulated channelization and reconnecting and/or discharge to the downstream waterbody receptions (lakes, flood plain) At Youren (Downstream): Consider and implement the work on the dike closure and extension, and the installation of controlled outlets to reduce disturbance to the protected wetlands	Contractor,	Supervision Consultant, Awash Basin Office	100,000,000
	Socio-economic Impact (Left bank)	Establishing a community-based committee to manage the land use management and consideration together with the client and contractor Establishing a co-management agreement with pastoralist communities for	Awash Basin Office and Local Livelihood and GRM Committee	MOWE and ESIA Consultants and Sub project Owner, before handover	3.000.000

		rangelands and water resources; supporting a livelihood diversification program; empowering communities to monitor project impacts and mitigation effectiveness; and creating a contingency fund for unforeseen losses			
Operation	**Hydrology:** River flow alteration (reduced/increased flow, seasonal variability changes)	Conduct regular hydrological monitoring Maintain environmental flow requirements Establish adaptive water management plans	Awash Basin Office and Contractor	Sub project Owner, before handover	550,000
	Reduced Water Pumping Efficiency (if poorly aligned)	Ensure proper hydraulic design and alignment of intake structures to maintain flow efficiency. Conduct post-installation calibration and testing to verify pump performance. Schedule regular maintenance and inspection to detect and correct alignment issues early	Contractor	Sub project Owner, Contractor	150,000
	Hydrology: Flood risk changes downstream	Establish early warning systems for downstream communities Maintain buffer zones along riverbanks Prepare a local water supply system through a pipe to protect the bank from breaching	Contractor	Sub project Owner; before handover	650,000
	Soil/Land: Salinization & Waterlogging	Maintain irrigation return-flow lines; ensure dike is "seepage-proof" against animal burrows.	Sub project Owner	Operations Team; Annual	150,000
	Structural: Dike breaching/overflow	Breach detection program; annual regulatory audits for flood resilience; real-time gauging.	Sub project Owner	Regulatory Authority; Annual	200,000
	Maintenance: *Prosopis* re-infestation	Biannual manual/mechanical removal of seedlings from dike to prevent root-induced seepage.	Sub project Owner	Maintenance Crew; Biannual	100,000
	Socioeconomic: Resource/Water Conflict	Implement traditional "Mada'a" water-sharing rotas via Clan Elders.	Community /Elders	Sub project Owner; Continuous	150,000

	Left Bank and Downstream Measures Sustainability Risks	At Dofen: Maintain the integrity of the dike crest and related structures for bank protection. To manage surplus flows, operate spillways upstream. Encourage local flood preparedness initiatives At Bolahamo: Regularly operate the pumping and drainage systems. Follow up and inspect ring dikes and flood barriers During floods, make sure there are always accessible paths. Assist regional flood control establishments. At Youren (Downstream): Follow up and operate for the regulated outlets, and downstream defence systems in place, and protect from flooding, grazing, and ecological requirements	Awash Basin Office	Regional/Local Government (Amibara District) and Afar and/or Amibara District EPA	500,000
Decommissioning	**Land:** Degradation of borrow pits/camps	Backfill/level pits; remove all waste; re-vegetate with native savanna species.	Contractor	Environmental Officer; End of Life	200,000
	Waste: Hazardous waste contamination	Final soil audit: dispose of all fuel/lubricants at approved regional facilities.	Contractor	Environmental Officer; End of Life	100,000
	Socioeconomic: Job loss	Severance/transition plan; career counselling; advance notice per national labour laws. Prepare, notify and implement the Labour management plan that includes employment with a definite timespan in consultation with local stakeholders and provide advance notice of project closure to the workforce and community.	Contractor	Labour/Social Affairs and committee, and ESIA Consultants	100,000
TOTAL					**168,100,000**

Table 5.4: Enhancement Measures for Beneficial Environmental and Social Impacts

Beneficial Impact	Enhancement Measure	In charge of accountability for: Implementation	In charge of accountability for: Supervision and Time Frame	Estimated Budget (ETB)
Local Employment and Income Generation	Mandate that at least 60% of unskilled and semi-skilled labour is recruited from local kebeles; provide mandatory OHS and technical training before work commencement.	Contractor / Local Labor Office	**Awash Basin Office** (Continuous)	Included in Contract
Skill Transfer and Capacity Building	Implement a formal on-the-job training program and issue recognized "Skills Certificates" to local workers upon completion of their contracts to improve future employability.	Contractor / Vocational Training Centre	**Awash Basin Office** (Continuous)	150,000
Agricultural Protection and Flood Resilience	Establish and train community-led "Dike Maintenance Committees" to monitor seepage and animal burrows, ensuring long-term protection of maize, cotton, and onion farms.	Woreda Agriculture Office / Sub project PIU	**Awash Basin Office** (Continuous)	200,000
Ecosystem Recovery and Reforestation	Award contracts to local women and youth groups to establish nurseries for native savanna and riparian seedlings required for the 1:10 compensatory planting scheme.	Contractor / Woreda Environmental Office	**Awash Basin Office** (Continuous)	300,000
Improved Community Access, Safety, Water Pumping Stations Efficiency	Optimize pump operation and intake alignment to maximize water delivery, use an automated control system, and train operational efficiency	Woreda Water & Energy Office / PIU	**Awash Basin Office** (Continuous)	250,000
Local Market Stimulation	Encourage the procurement of non-technical supplies (e.g., food for camps, sustainable construction materials) from local Amibara vendors to boost the regional economy.	Contractor / Local Administration	**Awash Basin Office** (Continuous)	Included in Contract
	Note: RE: Resident Engineer, **ESSO:** Environmental and Social Safeguard Officer, **PIU:** Sub project Implementation Unit, **OHS:** Occupational Health and Safety			

5.8. Environmental And Social Monitoring Plan

Establishing and maintaining an environmental and social monitoring system is essential for evaluating the effectiveness of various mitigation strategies, identifying potential environmental concerns, and promptly detecting unforeseen effects. Monitoring social and environmental factors will help identify possible issues early on and enable the quick application of efficient corrective actions.

Environmental and social monitoring shall be carried out during the pre-construction, construction, operation, and maintenance, as well as decommissioning of the sub-project to ensure that the identified mitigation measures are implemented in accordance with the preset schedule, and involving the indicated/proposed responsible body for implementation to ensure environmental and social sustainability of the sub-project under consideration.

A framework for keeping an eye on the social and environmental circumstances at the Amibara Right Bank subsub project is outlined in this Environmental and Social Monitoring Plan (EMP). The subsub project's monitoring program has been established, and it includes information on the parameters, frequency, and accountability for supervision and monitoring in addition to the initial charges. Monthly and quarterly environmental monitoring reports will be generated, and the sub-project implementation office and the site operators will all keep thorough records. The regional/Afar EPA will receive the environmental monitoring reports every quarter, or more frequently if necessary.

In general, the specific objectives of the environmental monitoring plan upon executing activities are to:

- Monitor the effective implementation during the construction and operation phases of proposed mitigation measures.
- Confirm compliance with environmental, public health, and safety legislation/regulations during construction, and control the risks and ecological/social impacts.
- Ensure best practices management as a commitment to continuous environmental performance improvement.
- Provide environmental information to the community/stakeholders, which includes early warning signals on potential environmental degradation for appropriate actions to prevent or minimize environmental consequences. The sub project's impact on climate change risks and opportunities should also be monitored and evaluated.

The contractors (responsible for the day-to-day implementation of the proposed mitigation measures), PIM/PMU (responsible for the overall project and mitigation measures implementation oversight and guidance), and ABA (responsible for the sustainability and smooth operation of the project as a mandated project intervention owner) will carry out the environmental monitoring plan that will be adhered to during the construction, operation, and decommissioning stages, possibly with the aid of an external body. Consultants will provide training to employees from various offices so that they can carry out social and environmental monitoring tasks during the construction, operation, and decommissioning phases. During these times, a consultant is being hired to provide training on a few of the topics. To guarantee the effective execution of the suggested ESMP, two primary forms of monitoring will be included in the monitoring activities:

- Compliance Monitoring: It is the process of keeping an eye on constructing and operating sites and activities for general environmental compliance.

- Impact Monitoring: It involves keeping an eye on the quality of construction of the embankment, as well as the air quality, dust, and socioeconomic improvements due to the sub project implementation.

Table 5.5: Environmental and Social Monitoring Plan (ESMP) for Amibara Embankment Project

Sub project Phase	Adverse Environmental / Social Impacts	Mitigation Measures	Monitoring Indicators	Method of Monitoring	Responsible Institution	Monitoring Schedule	Budget (ETB)
Pre-Construction	Disruption of the seasonal migratory pastoralists' mobility	Implement livelihood restoration/resettlement plan (RP) where applicable and address grievances as encountered, making use of the GRM committee.	The number or percentage of HHs' livelihoods is supported by the report. Number and type of grievances received and resolved	Review of RP and GRM records and site inspections.	Regional Gov't / Woreda administration/ Sub project Owner, Resettlement Committee	Monthly until completion	200,000
	Land Use Change (Grazing/Farmland)	Coordinate with the "Elders' Council" to protect grazing routes.	Number of access routes maintained; Elder Council approval.	Stakeholder meetings and site mapping.	Sub project Owner / Elders	Quarterly	150,000
	Archaeological Heritage	Implement "Chance Find" procedures during site clearing.	Documented "Chance Find" incidents; training logs.	On-site supervision during clearing.	Culture & Tourism Office	Continuous during clearing	50,000
	Risk of structural failure	Finalize designs with reinforcements and 50–100m setbacks.	Verified setback distance; approved structural plans.	Engineering audit of final designs.	Resident Engineer	Once (Pre-Commencement)	50,000
	Left Bank and Morphological Risks	Setback of 50 to 100 meters from the riverbank to allow for a "functional floodplain" and "floodplain ecosystem" and also identify flood-susceptible "hot spots" on the left bank, and design and implement prevention structures for those areas. Baseline data collection at Dofen (existing dike crest levels and erosion points, flow breaching, access routes, and livelihoods) At Bolahamo, collect baseline (groundwater levels, flood-prone zones and infrastructure risk,	Verified setback distance; approved structural plans. Baseline rrecords for each hotspot area and category of impacts	Engineering audit of final designs.	Resident Engineer	Once (Pre-Commencement)	50,000

		map sensitive receptors such as schools, clinics and farms, existing service and access conditions)					
	Seepage-induced waterlogging and salinity on the landward side Community Safety and Crossing Points: Embankment Breach Risks	Drainage line is proposed to return seepage to the river. Laboratory-verified compaction and high-quality materials. The design must incorporate watering points for livestock and residents.	Verified drainage line, crossings and watering points; approved structural plans.	Engineering audit of final designs.	Resident Engineer	Once (Pre-Commencement)	50,000
Construction	Hydrology: River flow alteration (reduced/increased flow, seasonal variability changes). changes)	Conduct regular hydrological monitoring Maintain environmental flow requirements Establish adaptive water management plans	Water management plan executed Prepared an outlet for drainage water	Plan revision and visual audits.	Environmental Officer	Quarterly	550,000
	Water Pumping Stations Disruption	Ensure the use of aligned design and implement efficiency measures	Water pumping station management plan executed	Plan revision and visual audits of implementation evidence	Sub project owner, environmental and agricultural office	Weekly	25,000
	Hydrology: Flood risk changes downstream	Develop and implement flood risk modelling Establish early warning systems for downstream communities Maintain buffer zones along riverbanks Prepare local water supply system through pipe so as to protect the bank from breaching	Flood risk model prepared Early warning system developed Number of pipe supply to the local community	Plan revision and visual audits.	Environmental Officer	Quarterly	850,000

	Flora: Invasive Species (*Prosopis*)	Mechanical uprooting; stabilize with Vetiver grass.	% of cleared area successfully stabilized; Vetiver survival rate.	Visual inspection and survival counts.	Environmental Officer	Weekly	120,000
	Flora: Native Biodiversity Loss	Demarcate limits; 1:10 reforestation ratio (native seedlings).	Count of native trees saved vs. removed; seedling survival.	Inventory log and field inspection.	Environmental Officer	Quarterly	100,000
	Fauna: Habitat & Safety	Segmented clearing; fence trenches; avoid bird breeding seasons.	Integrity of trench fencing; no wildlife/livestock casualties.	Daily site walkthroughs.	OHS Officer	Daily	120,000
	Soil Erosion & Water Turbidity	Silt fences; sediment traps; dry season earthworks (Oct–Jan).	Turbidity levels (NTU); presence of rill/sheet erosion.	Water sampling; visual soil audits.	Resident Engineer	Weekly	250,000
	Water Pollution (Oil/Chemicals)	Impermeable storage (110% bunding); MSDS display; spill plan.	Condition of bunded areas; availability of spill kits. Water quality parameters test results	Weekly facility inspection.	Environmental Officer	Weekly/ Monthly	620,000
	Air & Dust Pollution	Water spraying 3x daily; vehicle emission standards; PM monitoring.	Dust levels (PM10/PM2.5); vehicle maintenance logs.	Air quality monitoring (Dust Track).	Environmental Officer	Bi-weekly	280,000
	Climate Change Impact	Energy efficiency; waste management; renewable energy use.	Volume of waste recycled; fuel efficiency records.	Review of waste/energy logs.	Sub project Owner	Monthly	300,000
	Noise and Vibration	Use sound meters; avoid night work near residences; 50m buffers.	Noise levels (dBA); resident grievance records.	Sound level meter testing.	OHS Officer	Bi-weekly	120,000
	Traffic Congestion & Accidents	Traffic management plan; signals; hire youth traffic assistants.	Traffic incident reports; status of signage.	Road safety audits.	Local Traffic Police	Daily	110,000
	Occupational Health & Safety (OHS)	Site-specific H&S Plan; PPE; first aid kits; signage on trenches.	PPE compliance rate; accident/injury frequency rate. Incident records	Daily safety inspections.	OHS Officer	Daily	300,000
	Occupational Heat Stress	Hydration intervals (camp sites, temporary hydration locations, and mobile hydration services established by the contractor); SPF 30+; rotation (12 pm – 3 pm).	Health records (heat exhaustion); number of water station logs.	Temperature monitoring; shift logs.	OHS Officer	Daily (during heat)	100,000

	STDs, HIV/AIDS, & Diseases	Awareness campaigns; condom distribution; handwashing stations.	Number of condoms distributed; training attendance.	Monthly health report reviews.	Town Health Office	Monthly	150,000
	Social Customs & Gender (GBV)	Sign Code of Conduct; GBV training; women-friendly facilities.	Number of workers trained on the Code of Conduct and OHS; % of workers signed CoC; Incidents of social conflict or non-compliance with the CoC grievance logs (GBV). Number and type of grievances received and resolved;	Interviews and record audits.	Woreda Women's Affairs	Monthly	100,000
	Impact on Public Services	Hire local labor; identify workers via uniforms/ID.	% of local employees; verified ID/uniform usage. Number of community consultation meetings held;	Employment records; site checks.	Contractor	Monthly	30,000
	Damage to Infrastructure (Vertisols)	Replace expansive clay with non-expansive backfill.	Lab test results for backfill; structural stability checks.	Geotechnical report review.	Resident Engineer	During backfilling	50,000
	Socio-economic Impact (Left bank)	Establishing the GRM committee to manage the land use and management processes together with the client and contractor Establishing a co-management agreement with pastoralist communities for rangelands and water resources; supporting a livelihood diversification program; empowering communities to monitor project impacts and mitigation effectiveness; and creating a contingency fund for unforeseen losses	Committee reports prepared for the unforeseen impacts	Interviews and record audits.	ESIA Consultants	Monthly	1,285,000

	Left Bank and Downstream Structural Measures Implementation	At Dofen: Consider and implement measures to strengthen the dike and raise the crest by installing revetment and riprap in areas of erosion and overtopping To prevent excessive flow diversion, control channel and dredging operations, and in case of disruptions, provide temporary spillways. Enforce environmental and health, and safety measures. At Bolahamo: Strictly consider and adhere to increasing and adjusting the height of the dike Implement and align drainage systems, including pumps, channels, and relief wells Align the design and implementation with the ongoing bridge construction to accommodate more traffic, congestion and flood risks. Ensure regulated channelization and reconnecting and/or discharge to the downstream waterbody receptions (lakes, flood plain) At Youren (Downstream): Consider and implement the work on the dike closure and extension, and the installation of controlled outlets to reduce disturbance to the protected wetlands	Inspection of dike construction quality and bank stablization works Track community complaints and access (water, route, grazing, farm, etc) disruptions Monitor ground water fluctuations Follow up Bridge performance during high flows Monitor water flow pattern downstream and its impacts on wetlands	Awash Basin Office, Regional/ District EPA	Regional/local government Regulatory Authority	Monthly and incident-based	1,500,000

Operation	Hydrology: River flow alteration (reduced/increased flow, seasonal variability changes). changes)	Conduct regular hydrological monitoring Maintain environmental flow requirements Establish adaptive water management plans	Prepared outlet for drainage water	Plan revision and visual audits.	Environmental Officer	Quarterly	550,000
	Reduced Water Pumping Stations	Ensure the use of aligned design and implement efficiency measures	Water pumping station management plan executed Post-installation calibration and testing to verify pump performance evidence	Test conducted, plan revision and visual audits of implementation evidence	Sub project owner, environmental and agricultural office	Weekly	25,000
	Hydrology: Flood risk changes downstream	Establish early warning systems for downstream communities Maintain buffer zones along riverbanks Prepare local water supply system	Early warning system developed Number of pipe supply to the local community	Plan revision and visual audits.	Environmental Officer	Quarterly	850,000
	Soil Salinization & Waterlogging	Monitor return-flow drainage; dike "seepage-proof" checks.	Soil salinity levels; presence of standing water.	Soil testing; visual dike inspection.	Operations Team	Bi-annual	170,000
	Dike Breach & Overflow	Breach detection program; annual resilience audits.	Upstream gauge data; dike structural condition.	Real-time monitoring; annual audit.	Regulatory Authority	Annual	600,000
	Prosopis Re-infestation	Biannual manual/mechanical removal of seedlings from dike.	Presence/density of seedlings on dike slopes.	Walkover surveys.	Maintenance Crew	Bi-annual	180,000
	Resource & Water Conflict	Implement traditional "Mada'a" water-sharing rotas.	Number of water-sharing disputes resolved.	Village Elder consultation.	Clan Elders and ESIA Consultants	Quarterly	350,000
	Left Bank and Downstream Structural Measures Sustainability	At Dofen: Consider and implement measures to strengthen the dike and raise the crest by installing revetment and riprap in areas of erosion and overtopping To prevent excessive	Inspection of dike performance and pump station stability during floods Track community based flood reporting system	Awash Basin Office, Regional/ District EPA	Regional/local government Regulatory Authority	Monthly and incident based	500,000

		flow diversion, control channel and dredging operations, and in case of disruptions, provide temporary spillways. Enforce environmental, health, and safety measures. At Bolahamo: Strictly consider and adhere to increasing and adjusting the height of the dike Implement and align drainage systems, including pumps, channels, and relief wells Align the design and implementation with the ongoing bridge construction to accommodate more traffic, congestion and flood risks. Ensure regulated channelization and reconnecting and/or discharge to the downstream waterbody receptions (lakes, flood plain) At Youren (Downstream): Consider and implement the work on the dike closure and extension, and the installation of controlled outlets to reduce disturbance to the protected wetlands	Monitor channel migration using remote sensing/GIS Follow up on flood depth and duration, groundwater levels and ponding extent and frequency Monitor dike crest integrity and seepage Monitor the downstream condition and biodiversity, grazing productivity and water availability				
Decommissioning	Land Degradation (Borrow Pits)	Backfill pits; remove waste; re-vegetate with native species.	% of rehabilitated area; waste clearance certification.	Final site audit.	Environmental Officer	Post-Construction	800,000
	Waste Contamination	Hazardous waste disposal; final soil audit at camp locations.	Soil pollutant levels; waste disposal manifests.	Laboratory soil analysis.	Environmental Officer	Post-Construction	600,000

	Job Loss	Severance plan; career counseling; advance notice.	% of staff receiving severance; counseling logs.	Payroll and HR record review.	Labour/Social Affairs and ESIA Consultants	Post-Construction	650,000
TOTAL							**12,785,000**

6. TRAINING AND CAPACITY-BUILDING REQUIREMENT AND ESTIMATED BUDGET

Based on the site-specific baseline and institutional responsibilities and readiness requirements for the Amibara Right Bank sub-project, here are the suggested Training and Capacity Building Requirements and Estimated Budget proposed for consideration.

Table 6.1: Training and Capacity-building Requirements and Estimated Budget

S/N	Training Topic	Relevant Participants	Time	Responsible Body	Cost Estimation (ETB)
1	**Environmental and Social Impact Mitigation, Monitoring, and Reporting** Focusing on: Engineering controls for sandy and expansive soils, riverbank stabilization, and integrated monitoring protocols.	**MoWE** Safeguards Team **Awash Basin Office** Technical Staff **Federal, Regional, and Woreda EPAs** **Contractor's** Environmental & Social Officers Sub-project Technical Specialists (Soil, Biology, and Social)	Post-commencement and quarterly during implementation	MoWE, Awash Basin Office, and WB	**750,000**
2	**Invasive Species Management and Nature-Based Solutions** Focusing on: Mechanical clearing of *Prosopis juliflora*, slope stabilization using Vetiver grass, and riparian woodland restoration.	**Contractor's** Site Crews & Engineers **Woreda and Regional EPA** Inspectors **Awash Basin Office** Water Resource Experts Local Agricultural Office technicians	During site preparation (Mechanical clearing phase)	Regional EPA & Agriculture Office	**750,000**

3	**Occupational Health, Safety, and Social Safeguards** Focusing on: Heat stress prevention (>37.4°C), GBV/SEAH protocols, and community Grievance Redress Mechanisms (GRM).	**Contractor's** Safety Officers and Site Supervisors **MoWE** Social Development Officers **Woreda** Labor and Social Affairs representatives **Awash Basin Office** Community Liaison Officers	Prior to commencement of civil works	MoWE & Social Development Unit	**500,000**
4	**Post-Construction Restoration and Maintenance** Focusing on: Borrow pit rehabilitation, structural integrity of the 60km dike, and long-term erosion monitoring.	**Awash Basin Office** O&M Team **Woreda and Regional EPA** (for restoration sign-off) **MoWE** Sub-project Management Team **Contractor's** Demobilization Lead	During the handover and transition to operation	Awash Basin Office & MoWE	**500,000**
	TOTAL ESTIMATED BUDGET				**2,500,000**

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

The existing flood protection infrastructure is in a severe state of deterioration and no longer provides adequate defence against current flood risks. The proposed 60 km dike represents a multi-functional solution, offering not only effective flood mitigation but also improved social connectivity through the inclusion of bridges, watering points, and controlled access features addressing the barrier effects created by the failing structure.

The baseline findings and assessments indicate that the project area is geologically active (Seismic Zone 3) and presents biological challenges, notably the spread of invasive Prosopis**,** both of which pose considerable risks. At the same time, the area's pristine air quality and low noise levels highlight the need for careful mitigation of construction-related disturbances.

This comprehensive Environmental and Social Impact Assessment (ESIA) has demonstrated that the sub-project offers substantial socioeconomic benefits that far exceed any minor adverse effects. Through meticulous engineering design, adherence to best construction practices, and the implementation of effective mitigation measures, the sub-project is well-positioned to minimize or eliminate negative environmental and social impacts. If environmental and social impacts are systematically managed as indicated in this report, the sub-project has the potential to deliver significant socio-economic benefits, particularly by safeguarding extensive agricultural land and supporting local livelihoods.

Successful and timely implementation is expected to yield numerous positive outcomes, including improved well-being for residents and local communities through the reduction of unprecedented flood

risks and related issues. Additionally, the sub-project is expected to create both short and long-term employment opportunities and promote socioeconomic stability and well-being.

The ESIA has also identified negative environmental impacts associated with the sub-project that can be mitigated while highlighting its substantial socioeconomic advantages. By following a carefully designed engineering framework and adhering to the mitigation measures outlined in the Environmental and Social Management and Monitoring Plan (ESMP), the sub-project can effectively address concerns such as loss of productive farmland, deterioration of air quality, soil erosion, improper solid waste disposal, and clearance of indigenous vegetation. Conversely, expected positive outcomes include job creation, increased agricultural expansion and productivity through salinity minimization and expansion of agricultural activity and investments, improved human and animal well-being, and the establishment of well-designed embankments along the Awash River of the Amibara site-specific intervention site, which envisages a 60 km dyke construction with complementary crossing structures for humans and animals.

To maximize positive effects and effectively address identified adverse impacts, a detailed ESMP has been developed with allocated budgets for various sub-project phases of the construction, operation, and decommissioning activities. The responsibilities of stakeholders involved in implementing these plans have been clearly defined. Adhering to the ESMP is crucial to prevent major adverse impacts, making strict compliance essential for the sub-project's success.

In summary, the effective implementation of this sub-project is expected to mitigate anticipated impacts to non-harmful levels. Timely and adequate execution is vital, with the overall positive impacts anticipated to significantly outweigh any negative consequences. The sub-project is prepared to address the flood risks (on the right and left banks, including downstream) and to improve the well-being of the community where the Awash River is perceived as a threat to their livelihoods and socioeconomic activities. Furthermore, it is expected to create job opportunities, foster agricultural expansion and productivity (due to the reduction of flood risk and associated soil salinity and wetland formations), among others. Ultimately, the sub-project aims to promote a more ecologically, socio-culturally, and economically sustainable environment in intervention areas. Therefore, it is strongly recommended that the sub-project proceed in accordance with the proposed ESMP.

7.2. Recommendations

To ensure the successful implementation of the sub-project, strict adherence to the Environmental and Social Impact Management and Monitoring Plans (ESMP) is essential. The sub-project supervision consultant should develop a Construction Supervision Plan before construction begins, integrating this plan into the contract. Additionally, the contractor's documents must include the environmental management plans to ensure compliance with ESMP. All responsible parties should adhere to best monitoring practices throughout the construction, implementation, and decommissioning phases.

In light of the identified adverse impacts and findings from the baseline survey, the following recommendations are proposed:

- Soil Engineering Integration: In areas dominated by Vertisols (Black Cotton Soils), utilize non expansive backfill materials for all structural foundations (e.g., bridges and intake structures) to mitigate risks of seasonal shrink-swell cracking.

- Biological Slope Stabilization: Implement Vetiver grass planting along dike slopes. Its deep root system (up to 3 meters) acts as natural reinforcement, effectively controlling surface erosion and enhancing slope stability.
- Invasive Species Management: Ensure complete mechanical removal of Prosopis root systems to prevent regrowth and reduce the risk of internal piping and seepage within the dike structure.
- Dust and Noise Control: Apply regular water spraying on access roads and construction areas to suppress dust levels. Restrict heavy machinery operations to daytime hours to preserve the existing low-noise rural environment.
- Construction Scheduling: Complete all major earthworks before the rainy season to minimize the risk of washouts caused by highland flood surges.
- Community Access Management: Provide and maintain designated watering points and pedestrian/livestock crossings to discourage informal access routes that could lead to erosion and structural weakening.
- Ensure the sub-project is executed accurately and promptly: By strictly following the design documents provided by the design consultant, maintaining high-quality standards during construction and operation of the FSTP.
- Rigorously apply the mitigation and management measures outlined in the ESMP: To address potential negative impacts, preserve job opportunities, and promote local employment while managing workplace health and safety, noise, dust, and traffic concerns.
- Conduct ongoing environmental audits and monitoring: To ensure compliance with health, safety, and environmental standards.
- Create awareness and enhance community engagement: By exploring opportunities to amplify the sub-project's benefits and encourage community participation to address concerns and promote participation at all sub project stages, while fostering a sense of ownership and responsibility towards flood risk reduction activities and environmental conservation.
- Address GRM timely and effectively: Community requests regarding compensation and livelihood restoration promptly, while adhering to the proposed design to manage flood risk and related issues.
- Consider a robust plan and restore: The site, including the quarry, shall be restored immediately to its beneficial state or repurposed for beneficial uses, minimizing environmental and social impact.

List of Annexes As Part of the Amibara Right Bank Embankment Sub Project ESIA

Annex A: List of Site-Specific Stakeholder Meetings

Annex B: Community Consultation Meeting Minutes

Annex C: Chance Find Procedure

Annex D: Contractors E & S Guidelines (Environmental and Social Requirements for Contractors)

Annex E. Photographs of Baseline Conditions at the Site

Annex F: Legal Documents of the Consultant

Annex G: Pictures Demonstrating Socioeconomic Survey, Community Consultation and KII in Amibara Woreda Regarding the Right Bank Embankment Sub-project

Annex H: Example Of Voluntary Land Donation (Or Land Lease) Consent Form

Annex I: Summary Of Impact Prediction And Significance Rating

Annex J: Amibara Site-Specific Embankment Area Ambient Air Quality Data Baseline

Annex I: Maps Produced by the ESIA Team Regarding the Amibara Embankment Project Intervention

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(Note: This bibliography includes a mix of specific studies cited and representative examples of the types of institutional reports that would be consulted. The final report would include a complete list of all documents actually reviewed.