

8. ANALYSIS ALTERNATIVES TO THE PROPOSED PROJECT

A number of project alternatives are considered based on submissions from stakeholders and also from the clients. Apart from the sugar cane production, the development of eco-tourism was mentioned by an appreciable number of local and overseas stakeholders. Initially, TARDA was interested in the development of 12,000ha of rice. They tried to get business partners through advertisement but there seems to be no much interest in that direction.

8.1 Assessment of Alternatives to Projects

8.1.1 Alternative 1: Without Project Scenario

The 'without project scenario' from a socioeconomic perspective would mean that the use of the site continues in a marginal manner with substantial underutilization of resources. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. Without the proposed integrated sugar cane development project, the site would continue to be in the status quo with the prevailing economic marginalization of the area, high poverty (76%)^b and unemployment levels, insecurity, food insecurity and continuous dependence on relief food, high illiteracy, poor health facilities, poor access roads and improper infrastructure, no improvement on livestock production due to lack of market for animal products, and continuation to import sugar from foreign countries leading to more loss of foreign exchange. Additionally, potential for over 20,000 employment opportunities during and after construction of the proposed development would also be lost. The illegal use of the site for commercial purposes like charcoal burning would continue and the resources will finally be degraded to an irreversible state. The area will also be occupied by *Mathege* in the long-term. The current Kenyan and regional economy cannot afford these losses while the rest of the country is on a tremendous economic growth. This alternative was the least favourable.

8.1.2 Alternative 2: Sugar Cane Production and Enhanced Habitat Conservation

Another alternative use of the site would be mixed-development: sugar cane production and enhanced habitat conservation. Sugar cane production was identified scientifically suitable for the project area by 1969. This is due to favorable soils, climatic and agronomical conditions (like altitude/ humidity) that favors fast maturity of 8 months as compared to 18-24 months in western Kenya and high yields (over 100 tonnes per Ha compared to as low as 35 tonnes per Ha elsewhere in the country). There is also availability of enough land and water for large scale irrigation in Lower Tana. The COMESA tariffs arrangements in favor of Kenya will also end by 2008 and may lead to a collapse of the sugar industry in the country due to outdated and inefficient existing production and processing technologies. The country is also currently faced with serious sugar deficit (250,000 tonnes per year) compared to current production of 400,000 tonnes per year. Continued importation of sugar has drained foreign exchange and exported jobs. Through the planned utilization of sugar bagasse for co-generation, the project will further assist in gap filling the energy needs of the country using cheaply produced plantation cane to obtain 40MWs of electricity. The project also will generate about 25million liters of power alcohol for the Kenyan economy. The major challenge for the sugar component is the appropriate management of agro-chemicals and water abstraction and usage.

Habitat conservation is essential for mitigating decline in biodiversity due to sugar cane development. The establishment of conservation areas within Lower Tana River project area is an important mechanism for achieving this aim. In addition to protecting biodiversity, conservation areas hold economic value: supporting local livelihoods,

protecting watersheds from erosion, harboring flora and fauna, supporting thriving recreation and tourism industries, providing for science and education. These benefits will continue to grow in importance as more and more green area is developed with time from time to time. The cane farms; sugar, ethanol and co-generation plants; and other associated facilities will be an attractive educational facility of the primary, secondary, college and university students in the coast province. It will be a major teaching facility for agriculture, engineering and environmental sciences in the recently established Pwani University.

When considering that the Delta area is about 200,000ha, habitat conservation plans should be developed at ratios ranging from 1:1 to 3:1(Conserved Area: Developed Area) because of the ecological sensitivity and the presence of endangered species of the Tana delta. This has also taken into consideration the previous scientific studies that have indicated that 100,000ha of the Delta has high potential for agricultural crop production. These ratios can be used as general guidelines when the Tana Delta Development Master Plan will be formulated to allocate space/ land to other viable developments. Some of the negative impacts resulting from the proposed sugar cane development can be minimized by restricting the total area to only 20,000ha, in favor of expanding the forest conservation area to facilitate the creation of unique ecotourism attraction. This is consistent with habitat conservation criteria or ratios set above. Eliminating cane development closest to the proposed forest conservation areas would increase the ecological buffer zone between the development and the existing important forest patches within the project area. Other advantages include the maintenance of woodlands by the creation of forest conservation areas and wetland reserves to continue supporting local livelihoods like fishing, livestock keeping, etc. This alternative is the most acceptable, recommendable and favorable to the project area because it will reduce the current 75% poverty level, create employment, ensure food security, enhance livestock activities, and control the current environmental degradation.

8.1.3 Alternative 3: Creation of Nature Reserve

The most environmentally friendly alternative to the current proposal would be to fence and declare the area a Nature Reserve to be used primarily for eco-tourism (wildlife and bird-watching), research and education. The extent of infrastructure near the site would be limited to sanitation, garbage disposal, and off-site parking facilities. Access to the Nature reserve would be fee-based and would be restricted to pedestrian traffic only. Car access to the reserve would not be permitted. Revenues generated through entrance fees would support the Reserve maintenance crew as well as environmental wardens to monitor the conservation area. This scenario would protect the current state of the aquatic and terrestrial ecology and offer long-term protection from future development initiatives. The present extensive and uncontrolled conversion of forested lands to pasture or agricultural use would also be curtailed by this alternative while maintaining the integrity of the site for use by endemic resident and migrant species of avifauna. This alternative does not provide for agricultural development, or for the level of economic benefits attendant on Alternatives 2. This alternative although attractive is not the most recommended.

8.2 Analysis of alternative technologies: furrow vis-à-vis sprinkler irrigation

8.2.1 Alternative 1: Sprinkler (spray) irrigation

Sprinkler (spray) irrigation applies water to the entire irrigated area via a pressurized pipe through single or multiple nozzles. Sprinkler irrigation is a flexible system that can be used to supply adequate moisture for plant growth, as well as for frost control or crop cooling during dry months. The system can be used for the application of pesticides and

fertilizers. The growth in adoption of sprinkler technology depends primarily on the economic and environmental benefits of the system in comparison to other irrigation methods. In terms of benefits, sprinkler irrigation, with its flexibility and efficient control of water application permits a wide range of soils and terrain to be irrigated. It has also the following advantages:-

- Suitable for most soil types when application rates are matched to soil infiltration capacity.
- Can be used on marginal soils such as those with low infiltration or low water holding capacity.
- Provides good control of water application, which can reduce vegetative growth and improve the product quality.
- Reduces effects of wind-blown sandy soils on young crops.
- Provides a high degree of flexibility in design and operation, and can be automated to save labour and energy expenditure.
- Nutrients can be applied through the irrigation system (fertigation).
- Can be used to cool the crop during extreme dry seasons, and to manage cane plant health
- Has the ability to keep soil soft for emerging seedlings with frequent short irrigations.
- With proper drainage, sprinklers can be used efficiently to flush accumulated salts down the profile.
- Promotes rapid germination and crop establishment.

Some of the disadvantages of sprinkler irrigation are:-

- High capital cost.
- Distribution uniformity can deteriorate over time.
- Prone to wind effects on uniformity of water distribution.
- May create a humid environment in the crop canopy which, can lead to disease.
- Can cause surface crusting in some soils and inefficiency where application rate exceeds infiltration capacity.

Kenya being a developing country, the starting capital cost overrides other factors. Hence, this alternative is not favourable for the proposed project.

8.2.2 Alternative 2: Furrow Irrigation (recommended also by KESREF)

A furrow is a small, evenly spaced, shallow channel installed down or across the slope of the field to be irrigated parallel to row direction. Furrow irrigation is one of the oldest controlled irrigation methods known and one of the few methods that has changed the least. It is an efficient system if properly managed and a most inefficient one if improperly managed. Two major advantages for furrow irrigation are (1) developed gradually as labor or economics allow, and (2) developed at a relatively low cost after necessary land-forming costs for drainage are deducted.

Disadvantages to surface irrigation include these: high labour requirements, inefficiency, high water requirements, and potential over irrigation and resulting yield reduction and versatility. Otherwise, the best success from a furrow irrigation program is the result of hard work and good management. When using properly designed row slopes, row lengths, set times, stream sizes, and a re-use system, furrow efficiencies have been shown by research to be as high as 90%. Hence, with proper adherence to the Environmental Management and Monitoring Plans at the end of this report, this method is the most preferable and recommendable due to availability of water and low capital cost requirements.

8.3 Analysis of alternative factory sites location

To select the factory site, the 4 steps below were followed:-

5. Demarcation of cane production area.
6. Determination of the geographical centre of production.
7. Within the rough centre an area was sought with suitable acceptable soil conditions for construction.
8. Availability of a water source nearby.

In the case of TISP there was that typical point of an area free from flooding. With these criteria in mind, four (4) locations were initially recommended. These are the following and the coordinates:-

- 5 The area between Tarasaa and Ngao (40 0 11' E -20 26' S)
- 6 North of Somiti Singwaya Swamp (40 0 12' E -20 22' S)
- 7 Near the Center of the Project area (40 0 14' E -20 22' S)
- 8 South of the Rice Project office (40 0 11' E -20 16' S)

Site No. 1 (Between Tarasaa and Ngao) is far from the centre of the plantation, hence the cost of hauling sugar cane from the field to the factory will be higher. This site is also located in the opposite side of the Tana River; hence there is a need to construct bridge for cane hauling. Another disadvantage of this site is that the direction of the prevailing wind is 10 0 SE to 10 0 NW which is directly towards Tarasaa or Ngao villages. This posts some pollution concern regarding fly ash and bagacillo from the boilers. This alternative was, therefore, rejected.

Site No. 2 (Near the Centre of the Project area) is a low land (El = + 12 m) and therefore prone to flooding. The soils are also not very stable. This is not recommended for factory site.

Site No. 3 (South of the Rice Project office) is already a developed area because of the existing rice mill project. However, this site being in the northern most part of the project site is very far from the centre of the plantation making cane hauling cost more expensive. The site is also a low land with elevation of only El. = 14 m. and also subject to flooding during rainy seasons. This is also not recommended for factory site.

Site No. 4 (North of the currently dry former Somiti Singwaya Swamp) is the recommended site for the factory because it's nearer to the centre of the cane plantation. This site is of higher elevation (El. = + 16 m) and therefore not prone to flooding. The prevailing wind direction is 10⁰ SE to 10⁰ NW. with wind velocity of about 25 miles / hr. (40 kms/hr). The prevailing soil type has higher load bearing capacity than the other four sites hence reduces the cost of civil works. There are no recorded seismic activities in the area. There are some native houses in the proposed factory site made from local materials: i.e. roof made from palm leaves and walls from bamboo and clay. Vegetations are mostly palm trees and other small trees averaging three meters high. There are also some domesticated animals such as chicken, goat and cattle but no wild animals. In terms of the land tenure, the proposed factory site is a public land owned by the Government of Kenya through Tana River County Council. The site is about 4 km from Ngao Village/ market. The main source of livelihood is farming, fishing in the Tana River and raising domesticated animals like chicken, goat and cattle. Majority of the people around the factory site are Christians and small percentage of Muslims.

8.4 Analysis of alternative construction materials and technology

The proposed project will be constructed using modern, locally and internationally accepted materials to achieve public health, safety, security and environmental aesthetic requirements. Equipment that saves energy and water will be given first priority without compromising on cost or availability factors. The concrete pillars and walls will be made using locally sourced stones, cement, sand (washed and clean), metal bars and fittings that meet the Kenya Bureau of Standards requirements. Heavy use of timber during construction is discouraged because of destruction of forests. The exotic species would be preferred to indigenous species in the construction where need will arise.

8.5 Waste water management alternatives

Three most suitable technologies are discussed below:

8.5.1 Alternative 1: Connection sewer system

Connection to a main sewer line after prescribed pre-treatment will solve the waste water management issue at a very minimal cost and in an environmental efficient manner. Currently this option is not possible since no sewer line exists within or near the project area.

8.5.2 Alternative 2: Use of septic tanks

This involves the construction of underground concrete-made tanks to store the sludge with soak pits. It is expensive to construct and regular emptying required which is also expensive and time consuming. However, in the absence of a sewer line in the project site, this remains the most appropriate option for the developer for some residential/workers housing estates.

8.5.3 Alternative 3: The anaerobic biomethanation system

The anaerobic biomethanation system uses bio-digesters to convert organic matter into useful energy in the form of biogas. The methane gas produced is piped to a methane gas tank from where once it accumulates enough, it is pumped to the boilers. The bio-digesters use obligate anaerobic bacteria. These digest the waste from the separation of alcohol and the mash. This sludge produced is potential manure because it can be dried and be used on farms. Effluent flows by gravity from the second aeration pond into the algae pond from where it goes into a series of ponds. The final effluent from the treatment process will leave last pond into a pipeline, where it is mixed with river water at a point to help in diluting it. The discharge will have to meet the NEMA and WHO environmental standards of discharging into a water body. Since enough land is available for construction of the stabilization ponds. This has always proved the most environmentally friendly and cost-effective method of treating the factory waste. Hence, it one of the technologies recommended.

8.6 Solid waste management alternatives

The proposed project will generate some quantities of solid wastes from the factory and office premises and residential areas. An integrated solid waste management system is recommendable. First, the proponent will give priority to *Reduction at Source* of the materials. This option will demand a solid waste management awareness programme in the management and the employees. Secondly, *Recycling, Reuse and compositing* of the waste will be the second alternative in priority. This will call for a source separation

programme to be put in place. The recyclables will be sold to waste buyers within the surrounding areas. The third priority in the hierarchy of options is *Combustion* of the waste that is not recyclable in order to produce energy. Finally, *sanitary land-filling* will be the last option for the proponent to consider.

9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

This chapter presents the Environmental and Social Management Plan (ESMP) that will need to be implemented by the proponent to prevent or reduce significant negative impacts to acceptable levels. All the project components (sugar factory; ethanol plant; cane irrigation; drainage or flood control facilities; project support facilities like roads, electricity transmission lines, community CSR amenities, etc) are all considered when this comprehensive ESMP was developed.

Using best practices in other parts of the world, the costs of the mitigation measures and of the institutional and training requirements to implement them will be estimated with a ceiling budget of not more than 2.5% of the total project cost. Compensation to the affected parties for impacts which cannot be mitigated will need to be considered where applicable. A comprehensive work program, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measure will be prepared based on the above budget guideline.

The following ESMP has been structured in such a manner to provide a basis for implementation of the Environmental Management System (EMS) ISO 14001 principles for the life of the proposed development. It should be further noted that the proposed ESMP is not static, as allowance has been made for it to evolve through the life of the project. Such a characteristic is seen to be important to key factors and processes may change through the life of the project. It is therefore necessary to alter proposed mitigation and monitoring methodologies in order to determine best approach to deal with such changes.

This ESMP includes the necessary specialist input to determine, mitigate and manage any environmental impacts that the proposed development may have, relating to bio-physical and socio-economic aspects.

Specific attention has been made to ensure that the ESMP conforms to the following criteria:

It is auditable in that it:

- Identifies specific quantifiable monitoring regimes;
- Delineates key lines of accountability;
- Associates mitigation and monitoring tasks to specific impacts;
- Gives guiding costs of implementation,
- Where practically possible identifies key indicator, which can be utilized for environmental performance monitoring
- Ensures flexibility to enable incorporation of additional monitoring and mitigation techniques as deemed necessary throughout the life of the project
- Conforms to all best practice principles by acknowledging the existence of both long term and immediate impacts and the resulting mitigation measures necessary to deal with such and;
- Identifies key corporate commitments made by Mumias Sugar Company Ltd. with regard to its environmental performance.

9.1 Policy

Mumias Sugar Company Ltd/ TARDA, as the proponents commit themselves to the creation of safe and healthy environment for all its employees and the members of the communities with which they interact.

9.2 Aims

In order to give practical expression to their commitments and to measure their progress, they have the following aims;

9.2.1 Health and Safety

- To prevent or minimize work related injuries or health impairment of employees and contractor
- To contribute to addressing priority community health issues

9.2.2 Environment

- To conserve environmental resources (land, water, forests, air, wildlife, etc);
- To prevent or minimize adverse impacts arising from all operations;
- To demonstrate active stewardship of land and biodiversity;
- To promote good relationship with, and enhance capacities of, the local communities; and
- To respect people's culture and heritage.

9.3 Management Principles

9.3.1 Prevention and Control

The aim of the proponent is to prevent, minimize or control priority risks through planning, design, investment, and management and workplace procedures. Emergency response plans will be in place and tested on regular basis. Corrective action will be taken where accidents or incidents occur and the root causes will be investigated and prompt remedial action will be taken. All necessary action will be taken to prevent recurrences of any accidents.

9.3.2 Performance Indicators

The proponent will set appropriate goals, objectives, targets and performance indicators for all farm and plant operations. They will meet and where applicable surpass all applicable laws and regulations as a minimum and, where appropriate, apply international best practices.

9.3.3 Interested and/or affected Parties

Promote and maintain open and constructive dialogue, intercommunication and good working relationships with employees, local communities, regulatory agencies, business organizations and other interested and/or affected parties.

9.3.4 Management and Training

Institutional factors are often cited as the cause of failure of large-scale public irrigation schemes. Operation of all control facilities from the water source to individual farms requires almost constant management. Careful water management is essential to quality, timing, controllability and predictability of water delivered to the users, all of which will determine the success of the project. Training of a cadre of managers to provide the needed services is required if they are not available or lack necessary technical and managerial skills.

Planning and implementation of an irrigation project must be done with the cooperation and collaboration of engineers, soil scientists, hydrologists, public health specialists, environmental planners, social scientist and economists. An operation plan, outlining the operation rules and water distribution goals, should be developed prior to the design of the physical infrastructure and guide the subsequent project management.

9.3.5 Monitoring Requirements

To ensure that the ESMP is effective, environmental monitoring is mandatory and is described elsewhere in this report. Factors to be monitored should include: climate (wind, temperature, rainfall, etc); stream discharge above the irrigation project and below at various points; nutrient content of discharge water; flow and water levels at critical points in the irrigation system; water table elevations in the project area and downstream; water quality of the project inflows and returns flows; quality of ground water in the project area; water salinity levels in coastal wells; physical and chemical properties of the soil in irrigation area; agricultural acreage in production; cropping intensity; crop yield per unit of land and water; erosion/sedimentation rates in project area; relation between water demand and supply of users(equitability of distribution), conditions of distribution and drainage canals (siltation, presence of weeds, condition of the linings);upstream watershed management (agricultural extent and practices, industrial activity); incidence of diseases and presence of disease vectors; health conditions of project populations; changes in wildlife populations in the project area and on the floodplain downstream; vegetation changes using various indicators, fish population and species and social change (life styles, behaviour, standards of living, human population, human health, education standards, social amenities, etc).

9.3.6 Continual improvement

The proponent supports innovation in the management and performance of its businesses; research and development (R & D) regarding safety, health and environmental issues; and implementation of international “best practices” and technologies where appropriate. This policy will be reviewed regularly to reflect commitment to, and growing understanding of, the principles of sustainable development.

9.4 The Environmental and Social Management Plan (ESMP)

The following table forms the core of this ESMP for the construction and operational phases of the proposed sugar project. The tables provide details of all necessary mitigation measures as well as the person responsible for implementing and monitoring such measures. The tables should be used as checklist on site. Due to the magnitude of the project, compliance with the ESMP must be audited bi-annually during the construction (completion) phase and once immediately following completion of construction as required in EMCA 1999. This must be followed up by annual audits during the operation phase of the project.

Table 9.1: Tana Integrated Sugar Project – Environmental and Social Management Plan for the Planning and Design Phase

Activity/Objective/Impact	Action Required	Responsible Party	Frequency
Objective: To prevent potential increase in vagrancy to adjacent properties			
The accommodation of the construction crew	<ul style="list-style-type: none"> □ For safety reasons, no persons/workers are to be housed on site (within the security area), other than, individuals as deemed necessary by the contractor, which will be on site for security reasons. 	Contractor, ECM	Once-off
Objective: Promotion of social and economic consideration during the initial design phase			
Environmental Considerations and sensitivities of the area	<ul style="list-style-type: none"> □ All road works are to comply with the approved Civil Engineering standards. 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ Footpaths will be furnished with adequate down lighting 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ The site development plan (SDP) and all other construction drawings shall be verified on site prior to the onset of any construction work. Any discrepancies must be brought to the attention of the Environmental Control Manager (ECM) or the relevant Authority. 	Contractor, ECM	
Actions pertaining to the environment	<ul style="list-style-type: none"> □ The contractor must take corrective action to mitigate an incident appropriate to the nature and scale of the incident and must also rehabilitate any residual environmental damage caused by the incident or by the mitigation measures themselves. 	ELO, Contractor ECM,	Continuous
	<ul style="list-style-type: none"> □ The Contractor must also change his/her operating procedures, where applicable, to prevent a recurrence of an accident. 	ELO, ECM	Continuous

Activity/Objective/Impact	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> □ Compile an Incident Report and investigate root cause of the incident. 	ELO, ECM	Continuous
	<ul style="list-style-type: none"> □ No unauthorized movement of vehicles shall take place outside demarcated areas. 	ELO, ECM	Continuous
	<ul style="list-style-type: none"> □ The necessary training mechanisms must be implemented. <ul style="list-style-type: none"> • An information pamphlet is to be distributed by ECM to all contractors and their employees at the cost of the developer, and the contents thereof explain to all contractors and employees. • The objective is to inform all personnel on site of restricted sensitive areas, penalties for hunting or snaring, and must enforce a strict “no littering” policy and encourage environmentally responsible behaviour, • There is to be general training on environmentally responsible behaviour. 	ELO, ECM Developer Contractors	Continuous
Objective: Prevention and mitigation of potential safety risks to surrounding properties			
All operations	<ul style="list-style-type: none"> □ Management must ensure that fire extinguishers are located in strategic and visible places. 	Developer, ECM	Once-off
	<ul style="list-style-type: none"> □ Ensure that all vehicles are under control of competent personnel 	Developer, ECM	Continuous
	<ul style="list-style-type: none"> □ Provide adequate facilities to treat staff emergencies 	Developer, ECM	Continuous
	<ul style="list-style-type: none"> □ Staff need to be informed on the necessary safety procedures and be competent in the work they are employed to do 	Developer, ECM	Continuous

Activity/Objective/Impact	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> □ All necessary safety regulations must be abided by including building codes and fire practice requirements 	Developer, ECM	Continuous
Objective: Prevention and mitigation of potential safety risks to surrounding properties			
Safety and security	<ul style="list-style-type: none"> □ Separate fire flow requirements (100L/s) must be stored in tanks on site. 	ECM	Once-off
	<ul style="list-style-type: none"> □ The security fence should be erected prior to any other factory construction activities on the site 	Developer, ECM	Once-off
	<ul style="list-style-type: none"> □ The Contractor must ensure that fire extinguishers are located in strategic, visible places at the staff quarters and at the Construction camp. 	Developer, ECM	Once-off
Objective: Mitigating the increase in demand on local sewage infrastructure.			
Additional sewage loads (long term and short term)	<ul style="list-style-type: none"> □ The contractor shall provide sufficient chemical toilets and/or toilet with septic tanks for the entire construction crew. The toilets shall be well removed from areas of surface water flow 	Contractor, ECM	Daily
	<ul style="list-style-type: none"> □ Chemical toilets shall be serviced daily to avoid overflowing and unpleasant odours. 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ Storm water management measures to be studied and complied with. 	Contractor, ECM	Continuous
Objective: Reducing and managing the potential increase in storm run-off			

Activity/Objective/Impact	Action Required	Responsible Party	Frequency
Storm water management	<ul style="list-style-type: none"> □ All storm water drainage systems and sewage systems and sewage systems must be watertight 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ Energy dissipaters are to be added to all storm water outflows, including shallow gradients and uneven surfaces 	Contractor, ECM	Once-off
Objective: Reducing Social Impacts Related to Displacement of People Within TISP			
Avoid negative impacts due to dislocation of population and communities.	<ul style="list-style-type: none"> □ All affected villages affected to be mapped and census carried out □ A detailed Re-settlement Plan to be formulated, and negotiated with the affected people and implemented using a participatory approach □ Siting of project to minimize effect. □ Resettlement scheme (eco-villages establishment) ensuring at least equal to or better standard of living. □ Compensation of affected people based on the number of animals owned, land size, property existing on land, or any criteria agreed. 	Developer, Contractor, ECM, ELO	On-going
Increased social problems alcoholism, diseases (HIV/AIDS), changed lifestyles	<ul style="list-style-type: none"> □ Awareness creation and training on business management 	Contractor, ECM ELO	Once-off
Assessment of graves	<ul style="list-style-type: none"> □ Determine the number, GPS points, community value attachments to the dead, transfer, compensation on agreed figures. This is particularly important in the proposed factory site 	Contractor, ECM ELO	Once-off

Activity/Objective/Impact	Action Required	Responsible Party	Frequency
Increased in-migration	<ul style="list-style-type: none"> ▫ Establishment of a moratorium over the host area as soon as possible, to avoid people hoping to acquire land from moving into the area. 	Kenya Government Developer	Once-off
	<ul style="list-style-type: none"> ▫ Development of urban infrastructure: housing, electricity, domestic water supply, water treatment, roads, sanitation, bridges, schools, health facilities, etc to support the population increase 	Kenya Government Developer	Continuous
Loss of business for local folk, e.g. those who were offering river crossing services with their own canoes	<ul style="list-style-type: none"> ▫ Promote safety nets via diversification of enterprises/ livelihoods 	Developer, ECM ELO	Once-off

The following are the objectives, targets and measures that will need to be adhered to in this phase.

Table 9.2: Tana Integrated Sugar Project – ESMP for the Construction (Implementation) Phase

Activity	Action Required	Responsible Party	Frequency
Objective: Compliance with relevant legislations			
Approval of building plans	<ul style="list-style-type: none"> ▫ Building plans should be presented to the local occupational health and safety office for subsequent scrutiny and approval. ▫ Building plans should also be submitted to the Tana River District Physical Planner for approval (Physical planning Act No. 6 of 1996). Also the town planner at Hola town (approval physical planning Act No. 6 of 1996 and existing council by-laws). The Department of public Health at Hola also need to give certification. ▫ Process land ownership documents for the farms and factory site 	Developer	Once-off
Impact: Loss of Flora and Fauna			
To ensure that commonly occurring plants, on site, are not disturbed during the construction phase	<ul style="list-style-type: none"> ▫ The use of herbicides should be limited as far as possible. Herbicides should only be used under strict control and only when no other options are available. Herbicides may not be used near sensitive environments especially wetland areas 	Developer Contractor ECM	Ongoing
	<ul style="list-style-type: none"> ▫ The areas disturbed by the placement of spoil material are to be monitored and kept to minimum. 	Contractor, ECM	Ongoing

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> ▫ Construction vehicles should remain only in the area to be disturbed by the road and other works at all times. ▫ Disturbance should remain only in the area to be disturbed by the road and other works at all times. ▫ Disturbance should be restricted to the actual project areas. 	Contractor, ECM	Ongoing
	<ul style="list-style-type: none"> ▫ If the Contractor finds bird nests that may interfere with construction, he/she must contact the ECM, who will arrange for their movement after consultation with an appropriate expert or government agency like KWS. 	ELO, ECM	When Necessary
Wildlife conservation	<ul style="list-style-type: none"> ▫ Avoid sensitive wildlife areas ▫ Develop protection and management plans for these areas ▫ Use discontinuous maintenance of roads ▫ Utilize appropriate clearing techniques, (e.g. hand clearing versus mechanized clearing in sensitive areas ▫ Maintain indigenous ground cover beneath transmission lines ▫ Replant disturbed sites ▫ Make provisions to avoid interfering with natural fire regimes. ▫ Establishment of compensatory parks or reserved areas for ecotourism community projects ▫ Construction of bridges or special crossing places ▫ Animal rescue and relocation 		
To ensure that invasive alien plant species are not introduced in the area	<ul style="list-style-type: none"> ▫ Materials such as sand and stone should, wherever possible, be sourced from areas which are free of alien plants. 	Contractor, ECM	As necessary

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> ▫ An important aspect of the ongoing maintenance is the monitoring of the rehabilitated sites and access road verges for alien plant species. 	Contractor, ECM	Ongoing
	<ul style="list-style-type: none"> ▫ Should alien species be identified then these should immediately be removed. 	Contractor, ECM	As necessary
The clearing of all vegetation must be undertaken to ensure that, where possible, cleared vegetation, including soils, can be utilized when construction and farm establishment activities are completed	<ul style="list-style-type: none"> ▫ The contractor may not remove, reposition, cut or prune any shrubs or trees without the consent of the ECM. ▫ 30-metre riverine vegetation strip should be preserved along the main channel and Matomba brook. ▫ Establish a TISP tree nursery 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> ▫ No vegetation shall be cleared outside of the demarcated farm and construction areas. 	ELO, ECM	Continuous
	<ul style="list-style-type: none"> ▫ Clearing of vegetation is to be minimized. The clearance must be phased to prevent possible erosion on areas where construction or farming will only start at a later stage. 	ELO, ECM	Continuous
	<ul style="list-style-type: none"> ▫ Alien plants must be removed, and indigenous plants must be utilized once construction activities are completed as far as possible. ▫ Encourage agro-forestry 	Developer, ECM	Once-off
	<ul style="list-style-type: none"> ▫ Vegetation should be removed from the areas of the site that will be affected by construction and farming. Vegetation must be harvested as close to ground level as possible before earthworks machinery is utilized. 	Contractor	Continuous
	<ul style="list-style-type: none"> ▫ The cleared vegetation must be stored on a mulch stockpile for later re-use to re-vegetate disturbed areas. 	Contractor	When necessary

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> □ If there are substantially different vegetation types on the site, the ECM must point this out to the contractor. The contractor must store material from these measures must store material from these different vegetation types in separate mulch stockpiles. 	ECM, ELO	When necessary
Extraction of construction materials from borrow areas and quarries	<ul style="list-style-type: none"> □ Restore/Rehabilitate all the affected borrow pits and quarries immediately after completion of works in the project area as per NEMA requirements. 	Contractor, ECM	On-going
Impact: Soil erosion			
To ensure that soil erosion does not occur as a result of the construction phase of the development	<ul style="list-style-type: none"> □ The contractor must implement erosion control measures to avoid erosion in areas that are prone to erosion, e.g. steep slopes and drainage lines. These measures must include the construction of cross drains and other appropriate measures. 	Contractor	Once-off
	<ul style="list-style-type: none"> □ No topsoil to be utilized during any construction activity 	Contractor, ECM.	Ongoing
	<ul style="list-style-type: none"> □ Construct soil conservation measures at stockpiled sites as well as during construction and road-building activities. 	Contractor, ECM	Ongoing
	<ul style="list-style-type: none"> □ Avoid bare, disturbed surfaces for long periods (e.g. re-vegetation of stockpiled soils). 	Contractor, ECM	Ongoing
	<ul style="list-style-type: none"> □ Avoid undue storm-water concentration (e.g. construct run-off measures according to soil conservation of stockpiled soils). 	Contractor, ECM	Ongoing
	<ul style="list-style-type: none"> □ Areas of localized fill and hill wash are to be avoided. 	Contractor, ECM	Once-off

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> □ Where pipelines have been excavated, the areas must be returned to pre-construction state. □ Subsoil must be returned to trenches after all pipes have been installed. Topsoil must be reinstated and rehabilitated and rehabilitated on top of sub soil. 	Contractor, ECM	Continuous
	<ul style="list-style-type: none"> □ All excavation works must be properly backfilled and compacted. 	Contractor, ECM	Continuous
Impact: Soil compaction			
To ensure that the soil is not compacted during the construction of the development	<ul style="list-style-type: none"> □ Vehicles must be kept on existing roads or tracks where possible 	Contractor	Continuous
	<ul style="list-style-type: none"> □ Minimize compaction during stockpiling by working the soil in the dry state. 	Contractor, ECM	Ongoing
	<ul style="list-style-type: none"> □ Avoid unnecessary trafficking 	Contractor , ECM	Ongoing
	<ul style="list-style-type: none"> □ Rip compacted areas to reduce runoff and improve re-vegetation where required. 	Contractor, ECM	Ongoing
	<ul style="list-style-type: none"> □ All topsoil and other soil profiles must be managed strictly. 	Contractor, ECM	Continuous
Impact: Increased storm water runoff and sedimentation			
To ensure that storm water runoff is correctly managed to avoid increased volume and velocity downstream	<ul style="list-style-type: none"> □ Create diversion channels to ensure that no water flows across rehabilitated area until it is stable □ Minimize reduction of channel length and preserve some meanders of the Tana River. 	Contractor, ECM	As necessary
	<ul style="list-style-type: none"> □ Control surface runoff by: <ul style="list-style-type: none"> • Divert run-off around the work areas • Construction of sedimentation retention ponds (if necessary) 	Contractor, ECM	As necessary

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> □ Should it be deemed necessary by the ECM, storm water deflection berms or stone pitched channels shall be constructed at regular intervals, diagonally across new roads on slopes as directed by the Environmental Control Manager (ECM). 	Contractor, ECM	As necessary
	<ul style="list-style-type: none"> □ In areas which are likely to experience increased runoff as a result of gradient and excessive clearing it will be necessary to construct silt traps. <ul style="list-style-type: none"> • Measures such as the use of hay bales in drainage lines or elsewhere • Use of gravel and geotextile silt • Barriers. □ Such nature as well as necessity of such methodologies will be identified by both the contractor and ECM 	Contractor, ECM	As necessary
	<ul style="list-style-type: none"> □ All exposed areas need to be minimized by: <ul style="list-style-type: none"> • Staging operations • Progressive stabilization of works as completed • Provision of temporary grassing or other treatments to disturbed areas 	Contractor, ECM	As necessary
	<ul style="list-style-type: none"> □ All diverted and pumped water shall be discharged at locations on the surface from which it cannot re-enter the works and in a manner which does not cause erosion, pollution or nuisance. 	Contractor, ECM	As necessary
	<ul style="list-style-type: none"> □ Filters should be added to all storm water inlets, and silt fences established where erosion is predicted. 	Contractor, ECM	Once-off

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> □ Install sediment traps or screens to control runoff and sedimentation □ Minimize use of fill dirt □ Use ample culverts □ Design drainage ditches to avoid affecting nearby lands 	Contractor, ECM	As necessary
Impact: Storm water contamination			
To ensure that surface water and water bodies are protected against contamination	<ul style="list-style-type: none"> □ Fuel storage and machinery maintenance must take place as follows: <ul style="list-style-type: none"> • Bund walls around fuel storage areas within the site shall be maintained. Such walls shall be of a sufficient height to contain 110% of the contents of its fuel storage facilities. • Drainage from fuel storage and machinery maintenance areas shall be treated to remove oil and/fuel. Where the drain passes through or across the bund wall, a means of preventing flow will be provided so that in the event of a leak all spilt fuel and other liquids will be contained by the bund walls; • Soil contaminated by oil fuel or chemical leakage shall be removed and placed in disposal areas as directed by the Environment Control Manager; • Provide adequate facilities for the storage of used oil and contaminated hydrocarbons. Such facilities must be designed and sited with the intention of preventing pollution of the surrounding areas and environment; • Provide for a back up generator and cut-off switches as a contingency measure should a power failure or plant failure occurs. 	Contractor, ECM	Ongoing
Impact: Increase in ground water pollution			

Activity	Action Required	Responsible Party	Frequency
Ensure the strict control of water usage	<ul style="list-style-type: none"> ▫ All water dependent activities need to be monitored regularly. The necessary records need to be kept and made available to the ECM on weekly basis 	ECM, Contractor	Ongoing
Minimize the potential for surface to ground water pollution	<ul style="list-style-type: none"> ▫ All areas where possible spillage could take place are to be bunded. 	Contractor, ECM	Ongoing
	<ul style="list-style-type: none"> ▫ The handling of all petroleum and chemicals substances needs to occur in a bunded area 	Contractor	Ongoing
	<ul style="list-style-type: none"> ▫ Bulk fuel storage containers shall be placed away from areas of intensive movement of machinery to prevent accidental damage to the containers 	Contractor, ECM	When necessary
	<ul style="list-style-type: none"> ▫ All spillages from any potential ground water contaminants such as lubricants, hydrocarbon based fuels, etc. must be safely and immediately removed to an appropriate disposal facility. 	Contractor, ECM	When necessary
Impact: Increase in the concentration of dust			
To ensure that dust concentrations are correctly managed to minimize air pollution during construction	<ul style="list-style-type: none"> ▫ Suitable wet suppression techniques need to be utilized in all exposed areas 	ECM, Contractor	Ongoing
	<ul style="list-style-type: none"> ▫ All unnecessary traffic must be limited 	ECM, Contractor	Ongoing
	<ul style="list-style-type: none"> ▫ Strict on-site speed controls are to be enforced 	ECM, Contractor	Ongoing
To ensure dust deposition is maximized at point of source during the construction phase of the proposed development.	<ul style="list-style-type: none"> ▫ Wet suppression techniques will need to be undertaken, as necessary 	ECM, Contractor	As necessary
	<ul style="list-style-type: none"> ▫ Phasing of all earth moving activities must occur 	ECM, Contractor	Ongoing
	<ul style="list-style-type: none"> ▫ The early paving of all permanent roads must occur 	ECM, Contractor	Ongoing
	<ul style="list-style-type: none"> ▫ Exposed areas not for farming or any other use must be re-vegetated at the earliest possible time 	ECM, Contractor	Ongoing

Activity	Action Required	Responsible Party	Frequency
Impact: Significant deterioration of ambient air quality			
The maintenance of all equipment as well as the monitoring of all emissions.	<ul style="list-style-type: none"> □ NEMA/ WHO environmental air emission standards should always prevail controlling black smoke, suspended particles of matter, Sulphur Dioxide, Nitrogen Dioxide and other parameters 	ECM	Ongoing
Impact: Increase in ambient noise levels			
To ensure that ambient noise levels are kept to acceptable levels	<ul style="list-style-type: none"> □ Ambient noise impact mitigation needs to focus on the following: <ul style="list-style-type: none"> • The planning of construction activities (Construction site) must endeavour to minimize the noise impact on adjacent communities. • In this regard vehicles should idle as little as possible, construction schedule times must be encouraged to keep noise to a minimum on site; • All generators and heavy duty equipment is to be insulated and /or placed within buildings to minimize the ambient noise levels. 	ECM Contractor, ECM	Ongoing Continuous
Impact: Increase in perceived degrading of the visual quality of the immediate vicinity.			
To ensure the minimization of visual clutter and the degrading of the visual quality of the immediate vicinity.	<ul style="list-style-type: none"> □ Indigenous trees must be planted at suitable locations around the site so as to interrupt sight lines (screen planting), between the adjacent residential areas, the road and the development. 	Developer ECM	Once-off
	<ul style="list-style-type: none"> □ No fires or cooking will be allowed on site 	Contractor, ECM	Once-off

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> ▫ All construction material shall be stored in their demarcated area of the construction camp. Under no circumstance may any material be stored outside of the demarcated area on naturally vegetated areas. 	ECM, ELO	When necessary
Impact: Increase hazards / harm to the personnel			
All operations	<ul style="list-style-type: none"> ▫ Management must ensure that fire extinguishers are located in strategic and visible places 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ Ensure that all vehicles are under control of competent personnel 	Developer	Continuous
	<ul style="list-style-type: none"> ▫ Provide adequate facilities to treat staff emergencies. 	Developer	Continuous
	<ul style="list-style-type: none"> ▫ Staff needs to be informed on the necessary safety procedures and be competent in the work they are employed to do 	Developer	Continuous
	<ul style="list-style-type: none"> ▫ All necessary safety regulations must be abided by including building codes and fire practice requirements 	Developer	Continuous
Impact: Increase in the generation of domestic and hazardous waste			
Ensure that all waste generation is minimized and managed in an environmentally sensitive manner	<ul style="list-style-type: none"> ▫ The developer must keep the site in a clean and orderly state at all times. The ELO must supervise a litter patrol twice a week to ensure that the site is free from litter. This litter patrol must be undertaken from the first week that the developer is on site until the last week when he or she leaves the site 	Developer, ELO, ECM	Continuous

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> ▫ Adequate measures to collect, remove and safely dispose of waste must be implemented during each stage of the proposed development from site preparation to final construction. 	Developer, Constructor, ECM, ELO	Continuous
	<ul style="list-style-type: none"> ▫ The ECM must approve the waste disposal arrangement. 	ECM	Once-off
9.4.1 Impact: Loss of floodplain grazing land			
Ensure livestock activities are not negatively affected	<ul style="list-style-type: none"> ▫ Development of the water dams/ pans and other livestock support facilities/ services like cattle dips, diseases control around Galana ADC ranch in the northern part of the proposed sugar project and around the project site ▫ Introduce zero-grazing systems ▫ Introduce small-scale feed-lot systems based on local materials and sugar processing by-products like cane tops, molasses, etc ▫ Production of fodder crops like Napier grass ▫ Develop alternative water sources for animals in the upstream, e.g. sinking of more boreholes/ wells/ pans, dams, etc. ▫ Change sources of livelihoods through awareness creation programmes ▫ Creation of useable land in previously unsuitable areas for livestock to offset losses ▫ Reserve about 5000ha of concession land for livestock ▫ 	Kenya Government Developer, ELO, ECM	Continuous
	<ul style="list-style-type: none"> ▫ Adequate measures to collect, remove and safely dispose of waste must be implemented during each stage of the proposed development from site preparation to final construction. 	Developer, Constructor, ECM, ELO	Continuous

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> ▫ The ECM must approve the waste disposal arrangement. 	ECM	Once-off
	<ul style="list-style-type: none"> ▫ The contractor shall immediately deposit waste in the litter bin. Waste may not be left in any other area temporarily prior to being deposited in a bin. 	ECM ELO	Once-off

Table 9.3: Tana Integrated Sugar Project - ESMP for Operational Phase

Activity	Action Required	Responsible Party	Frequency
Impact: Dissatisfaction of local community with past projects in the TISP area			
To ensure stability through social conflict resolution and improved livelihoods	□ Clear TARDA staff's unpaid salaries/ wages	TARDA	One-off
	□ Fair distribution of job-opportunities among the existing communities/ villages	Developer	Continuous
	□ Existing land ownership and boundary dispute cases to be sorted out of court	Developer ELO	One-off
	□ Ensure good public relations with the locals	Developer, ECM, ELO	Continuous
	□ Develop a well-organized and community-based Corporate Social Responsibility Strategy to provide services/ facilities (e.g. schools, health centres, cattle dips, water supply, etc),	Developer, ECM, ELO	Continuous
	□ Quick rehabilitation of the existing Rice Irrigation Scheme	TARDA	On-going
	□ Harmonization of local sugar cane development initiatives to avoid competition/ conflicts	TARDA Kenya Government	
	□ Negotiation and formulation of an MOU with the local community leaders to ensure the resources are well utilized for the benefit of everybody.	Developer ELO	On-going
	□ Priority in material and service procurement should be considerate to the local entrepreneurs	Developer Contractor	Continuous
	□ Training of local youths in sugar cane production and processing	Developer Contractor	Continuous

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> ▫ Incorporate gender issues in manpower recruitment, management, selection of CSR community-based projects and other relevant decisions that pertain to the project. 	Developer Contractor ELO	Continuous
	<ul style="list-style-type: none"> ▫ Formulate and implement a project village-to-village sensitisation programme 	Developer ELO	Continuous
	<ul style="list-style-type: none"> ▫ Facilitate local land ownership through the adjudication process 	Developer Kenya Government	On-going
Impact: Increased potential loss of flora and fauna			
To ensure that commonly occurring plants on site are not disturbed during the operational phase	<ul style="list-style-type: none"> ▫ The use of herbicides should be limited as far as possible. Herbicides should only be used under strict control and only when other options are not available. Herbicides may not be used near sensitive environments especially wetland areas ▫ Use “best practices” in handling/ using agricultural chemicals 	ELO, ECM	When necessary
Impact: Proliferation of aquatic weeds			
	<ul style="list-style-type: none"> ▫ Clearance of woody vegetation from inundation zone prior to irrigation (nutrient removal) ▫ Use Best Practices in weed control ▫ Harvest of weeds for compost, fodder or biogas ▫ Regulation of water discharge and manipulation of water levels to discourage 		

Activity	Action Required	Responsible Party	Frequency
	weed growth		
To ensure that invasive alien plant species are not introduced to the area.	<ul style="list-style-type: none"> ▫ Should alien species be identified then this should be immediately removed. 	Developer, ECM	As necessary
Impact: Increased soil erosion (furrow, surface)			
To ensure that soil erosion does not occur as a result of the daily activities on the plant, farms, and other areas	<ul style="list-style-type: none"> ▫ The developer must implement erosion control measures to avoid erosion in areas that are prone to erosion e.g. steep slope and drainage lines. These measures must include the construction of crossed drains and berms, design of terraces on hillside minimizing surface erosion hazard. 	Developer, ECM	As necessary
	<ul style="list-style-type: none"> ▫ Avoid undue storm water concentration (e.g. construct runoff measures according to soil conservation measures) ▫ Proper design and layout of furrows or field avoiding too steep a gradient. ▫ Land levelling. 	Developer, ECM	As necessary
Impact: Increased soil compaction			
To ensure that the soil is not compacted	<ul style="list-style-type: none"> ▫ Vehicles must be kept on existing roads of trucks where possible. 	Developer	Continuous
	<ul style="list-style-type: none"> ▫ All topsoil and other soil profiles must be managed with "best management practices" 	Developer, ECM	Continuous
Impact: Increased water logging of soil.			
To prevent water logging of soil through general	<ul style="list-style-type: none"> ▫ Regulation of water application to avoid over watering (including controlled turn-out 		

Activity	Action Required	Responsible Party	Frequency
irrigation/ management	water to allow cutting off water supply to irrigation ditches) <ul style="list-style-type: none"> ▫ Installation and maintenance of adequate drainage system. ▫ Use of lined canals or pipes to prevent seepage where necessary. 	Developer, ECM	Continuous
Impact: Increased salinization of soils.			
To prevent or control salinization of soils to minimal levels	<ul style="list-style-type: none"> ▫ Measures to avoid water logging. ▫ Leaching of salts by flushing soils periodically in cane fields. 	Developer, ECM	Continuous
Impact: Scouring of canals.			
To prevent scouring of canals through change of design	<ul style="list-style-type: none"> ▫ Design of canal system to minimize risk and use of lined canals if possible. 	Contractor Developer	On-going
Impact: Clogging of canals by sedimentation and weeds.			
To prevent clogging of canals by sedimentation and weeds through implementation of soil erosion control measures and engineering design	<ul style="list-style-type: none"> ▫ Measures to minimize erosion on fields. ▫ Design and management of canals to minimize sedimentation. ▫ Provision of access to canals for removal of weeds and sediments. 	Contractor Developer	Continuous On-going
	<ul style="list-style-type: none"> ▫ Design and management of canals to minimize weed growth. ▫ Provision of access to canals for treatment or removal of weeds. 	Contractor Developer	Continuous On-going

Activity	Action Required	Responsible Party	Frequency
Impact: Leaching of nutrients from soils			
	<ul style="list-style-type: none"> ▫ Avoidance of over watering ▫ Replacement of nutrients by fertilizers 	Developer ECM	Continuous
Impact: Algal blooms and weed proliferation			
	<ul style="list-style-type: none"> ▫ Reduction of input to and release of nutrients (nitrogen and phosphorous) from cane fields. ▫ Use of organic instead of chemical fertilizers 	Developer ECM	Continuous
Impact: Increased downstream impacts			
Deterioration of river water quality below irrigation project and contamination of local ground water (higher salinity, nutrients, agrochemicals) affecting fisheries and downstream users.	<ul style="list-style-type: none"> ▫ Improved water management; improved agricultural practices and control of inputs (particularly biocides and chemical fertilizers). ▫ Imposition of water quality criteria. ▫ Water quality monitoring and best practices in pollution control ▫ Installation of fish passageways ▫ Protection of reproductive sites like ox-bow lakes ▫ Incorporation of fishery management , including hatchery and restocking programmes ▫ Introduce fish farms with local people 	Developer ECM	Continuous
Sea water intrusion into downstream freshwater systems (wells, boreholes).	<ul style="list-style-type: none"> ▫ Reduction of takeoff to maintain adequate downstream flow. ▫ Recharge of coastal aquifers through 	Developer ECM	Continuous

Activity	Action Required	Responsible Party	Frequency
	injection wells where possible.		
Reduction of downstream flows affecting flood flow plain use, flood plain ecology, riverine and estuarine fisheries, users of water, dilution of pollutants.	<ul style="list-style-type: none"> ▫ Redesign of project in later phases. ▫ Regulation of takeoff to mitigate effects. ▫ Compensatory measures where possible. 	Developer ECM	Continuous
Encroachment on swamps and other ecologically sensitive areas.	<ul style="list-style-type: none"> ▫ Siting of project fields/ facilities to avoid or minimize encroachment on critical areas like ox-bow lakes and other important wetlands. 	Contractor Developer ECM	Continuous
Alteration or loss of flood plain vegetation and distribution of coastal ecosystems (e.g. mangroves).	<ul style="list-style-type: none"> ▫ Siting of project to less vulnerable area. ▫ Limitation and regulation of water take-off to minimize problems to extent possible. 	Contractor Developer ECM	Continuous
Increased pollution and health hazards from downstream industrial and municipal pollutant caused by decreased flow (decreased dilution) of river water.	<ul style="list-style-type: none"> ▫ Control of waste sources downstream. ▫ Reductions of water take-off. 	Developer ECM	Continuous
Water quality deteriorated or made unusable by upstream land use and pollutants discharge	<ul style="list-style-type: none"> ▫ Control of land use in water shade areas. ▫ Control of pollution sources. ▫ Water treatment prior to use. 	Developer ECM	Continuous
Impact: Alteration or destruction of wild life habitat or impediment to movement of wildlife.			
To ensure wildlife conservation	<ul style="list-style-type: none"> ▫ Establishment of compensatory parks or reserved areas. 	Developer ECM	Continuous

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> ▫ Animal rescue and relocation. ▫ Provision of corridors for movement. ▫ Facilitate establishment of ecotourism projects at the community level 		
Impact: Potential for Structural failure and floodwaters high than capacity of control structures			
	<ul style="list-style-type: none"> ▫ Implementation of non-structural measures to prevent increased flood risk, and of a flood warning system ▫ Create overflow flood basins at strategic points ▫ Flood monitoring and forecasting and predictions 	Contractor Developer ECM	On-going and Continuous
Impact: Impediment to livestock and humans.			
Avoid impediment to livestock and humans.	<ul style="list-style-type: none"> ▫ Provision of passageways ▫ Provision of corridors for animal movement 	Developer ECM	Continuous
Impact: Threat to historic, cultural or aesthetic features.			
Historic, cultural or aesthetic features to be preserved for ecotourism and future generations	<ul style="list-style-type: none"> ▫ Siting of project facilities to prevent loss ▫ Salvage or protection of cultural sites 	Contractor ECM	On-going
Impact: Increase in incidence of water borne or water related diseases			
Control or prevent the introduction or increase in incidence of water borne or	<ul style="list-style-type: none"> ▫ Use of lined canals or pipes to discourage vectors. ▫ Avoid stagnant or slowly moving water. 	Developer ECM	Continuous

Activity	Action Required	Responsible Party	Frequency
water related diseases (schistosomiasis, malaria, etc.).	<ul style="list-style-type: none"> ▫ Use of straight or slightly curving canals. ▫ Installation of gates at canal ends to allow complete flushing. ▫ Filling or draining of borrow pits along canals and roads. ▫ Disease prophylaxis ▫ Disease treatment 		
Disease and health problems from use of waste water in irrigation	<ul style="list-style-type: none"> ▫ Use efficient wastewater treatment (e.g. settling ponds) prior to use. ▫ Establishment and enforcement standards for wastewater use. 	Developer ECM	Continuous
Impact: Increased demand and conflict over water supply and inequalities in water distribution			
Avoid conflict over water supply and inequalities in water distribution throughout service area	<ul style="list-style-type: none"> ▫ Develop means to ensure equitable distribution among users and monitor to assure adherence. 	Developer ECM	Continuous
Avoid over pumping of ground water.	<ul style="list-style-type: none"> ▫ Limitation of withdrawal so that it does not exceed "safe yield" (recharge rate). 	Developer ECM	Continuous
Reduce water demand-related conflicts	<ul style="list-style-type: none"> ▫ Avoid over irrigation ▫ Cancel all water permits not in use for a long time ▫ Avoid water wastage 	Developer ECM	Continuous
Impact: Increased storm water runoff			
To ensure that storm water runoff is correctly managed in order to avoid increased	<ul style="list-style-type: none"> ▫ Maintain diversion channels to ensure that no water flows across the rehabilitated area until it is stable 	Developer, ECM	As necessary

Activity	Action Required	Responsible Party	Frequency
volume and velocity downstream	<input type="checkbox"/> Control surface runoff by: <ul style="list-style-type: none"> • Divert runoff around the working areas • Storm water deflection berms or stone pitched channels shall be maintained. • Measures such as use of hay bales in drainage lines or elsewhere • Use of gravel and geotextile silt barriers 	Developer, ECM	As necessary
		Developer, ECM	As necessary
	<input type="checkbox"/> All exposed area needs to be minimized by: <ul style="list-style-type: none"> • Staging operations • Progressive stabilization of works as completed • Provision of temporary grassing or other treatment to disturbed areas 	Developer, ECM	N/A
	<input type="checkbox"/> All diverted and pumped water shall be discharged at locations on the surface from which it can not re-enter the works and in a manner which does not cause erosion, pollution or nuisance	Developer, ECM	As necessary
	<input type="checkbox"/> Filters should be added to all stormwater inlets, and silt fences established where erosion is predicted	Developer, ECM	Once-off
Impact: Storm water contamination			
Quality of water after treatment	<input type="checkbox"/> Records of the water quality after treatment needs to be kept	Developer, Contractor	Weekly
Water usage monitoring	<input type="checkbox"/> A discharge meter must be fitted to the clean water outlet to determine the total water usage	Developer	Once-off
Monitoring of water quality	<input type="checkbox"/> Install an automatic water sampler in order	Developer	Once-off

Activity	Action Required	Responsible Party	Frequency
<p>To ensure that surface water and water bodies are protected against contamination</p>	<p>to have continual water quality records on site</p> <ul style="list-style-type: none"> ▫ Fuel storage and machinery maintenance must take place as follows ▫ Bund walls around fuel storage areas within the site shall be built and maintained such walls shall be of a sufficient height to contain the entire contents of its fuel storage facility • Drainage from fuel storage and machinery maintenance areas shall be treated to remove oil and/or fuel. Where the drain passes through or across the bund wall a means of preventing flow will be provided so that in the event of a leak all spilt fuel and other liquids will be contained by bund walls • Soil contaminated by oil fuel or chemical leakage shall be removed and placed in disposal areas as directed by the ECM 	<p>Developer, ECM</p>	<p>Ongoing</p>
<p>Impact: Ground water pollution</p>			
<p>Ensure the strict control of water usage</p>	<ul style="list-style-type: none"> ▫ All water dependent activities need to be monitored regularly, the necessary records need to be kept and made available to the ECM on a weekly basis or as per NEMA requirements 	<p>ECM, Contractor</p>	<p>Ongoing</p>

Activity	Action Required	Responsible Party	Frequency
Minimize the potential for surface to ground pollution	<ul style="list-style-type: none"> ▫ Provide for a back up generator and alarms and cut-off switches as a contingency measures, to prevent any spillage of diesel at the storage tank should a power failure or plant failure take place 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ Provide for a backup generator and alarms and cut-off switches as a contingency measures, to prevent any spillage of furnace fuel at the storage tank should a power failure or plant failure take place 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ Provide for a back-up generator and, alarms and cut-off switches as a contingency measures, to prevent any spillage of molasses at the storage tank, should a power failure or plant failure take place 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ All areas where possible spillages could take place are to be bunded. 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ The handling of all petroleum and chemicals substances needs to occur in a bunded area 	Contractor	Ongoing
	<ul style="list-style-type: none"> ▫ Bulk fuel storage containers shall be placed away from areas of intensive movement of machinery to prevent accidental damage to the containers. 	Contractor	When necessary
	<ul style="list-style-type: none"> ▫ All spillages from any potential ground water contaminants such as lubricants, hydrocarbons based fuels, etc. must be safely and immediately removed to an appropriate disposal facility. 	Contractor	When necessary

Activity	Action Required	Responsible Party	Frequency
Impact: Increase in concentration of dust			
To ensure that dust concentrations are correctly managed to minimize air pollution during constrictions	□ All unnecessary movement must be limited	ECM, Contractor	Ongoing
	□ Strict on-site speed controls are to be enforced	ECM, Contractor	Ongoing
Impact: Increased Health and Safety concerns			
Registration of the premises	□ The developer must acquire application forms for the registration of the plant under the Factories and Other Places of Work Act Cap 514, Laws of Kenya. This registration application forms need to be completed and returned to the local occupational health and safety office.	Developer	Once-off
Approval of building plans	□ Building plans should be presented to the local occupational health and safety office for subsequent scrutiny and approval	Developer	Once-off
Providing copies of the Factories and Other Places of Work Act	□ The abstract of the Factories and Other Places of Work Act must be well posted in prominent places in the premises	Developer	Once-off
Dangerous occurrences	□ Provision for reporting dangerous occurrences needs to be in place	Developer	Once-off
Environment, Health and Safety committee	□ Provision must be put in place to for the formation of an Environment, Health and Safety committee, of which the employer and workers are represented	Developer	Once-off
Medical Examination for all employees	□ Arrangements must be in place for the medical examination of all employees,	Developer, ECM	Ongoing

Activity	Action Required	Responsible Party	Frequency
	before employment, during and after termination of employment		
Safety of all persons	<ul style="list-style-type: none"> ▫ All machines and other moving parts of equipments must be enclosed to protect all workers from injury ▫ Provide incineration of medical waste 	Developer, ECM	Ongoing
Examination of plant and equipment	<ul style="list-style-type: none"> ▫ All compressors, lifts (if any), and other lifting machines must be examined by a government or company authorized person. The equipment may only be used if a certificate of examination has been issued 	Developer, ECM	Once-off
Siting facilities for women	<ul style="list-style-type: none"> ▫ Provisions need to be in place to provide adequate and suitable sitting facilities for female workers who work standing 	Developer, ECM	Once-off
Sitting facilities for the physically disabled workers	<ul style="list-style-type: none"> ▫ Provisions need to be in place to provide adequate and suitable sitting facilities for physically disabled workers who work standing. Such people should be employed in areas without machinery movements. 	Developer, ECM	Once-off
First aid and emergency preparedness	<ul style="list-style-type: none"> ▫ Provision must be made for persons to be trained in first aid with a certificate issued by a recognized body. ▫ Three trained first aid personnel are needed for first hundred employees plus one additional person for each extra employees or thereof (Rule No. 7 of the factories (First aid) Rules, 1977 	Developer, ECM	Once-off
Hazards of open pumps	<ul style="list-style-type: none"> ▫ Pumps from the molasses load off to the storage needs to be placed so as not to create a hazard 	Developer, ECM	Once-off
Ventilation	<ul style="list-style-type: none"> ▫ Enough space needs to be left at all facilities to allow for adequate natural 	Developer	Once-off

Activity	Action Required	Responsible Party	Frequency
	ventilation		
Fire emergency plan	□ Emergency plan and evacuation routes should be marked and communicated to staff	Developer, ELO	Ongoing
	□ No fire or cooking will be allowed on factory site and near cane farms	Developer/ ECM	Continuous
Electrical safety	□ Circuits must not be overloaded	Developer, ELO	Once-off
	□ All electrical equipments must be grounded	Developer	Once-off
Emergency Exits	□ ALL the emergency exits should be opened outwards and be marked in RED and aisles should be clear of slip, trip and fall hazards	Developer	Once-off
PPE	□ Provision for suitable overalls, safety footwear, dust masks, respirators, gloves, ear protection	Developer, ECM, ELO	Continuous
Handling of chemicals	□ Chemical safety data sheet of the chemical used at the plant should be kept on record	Developer, ECM	Continuous
	□ Chemicals should be properly labelled with content and hazard warnings.	Developer, ECM	Continuous
	□ There should be no eating or drinking in the chemical use area	Developer, ECM	Continuous
	□ Chemicals should be properly stored and used in accordance with the manufactures direction and good practice	Developer, ECM	Continuous
	□ Containers filled with hazardous substance, not to be used should be labelled and properly closed. These substances must be collected by an approved contractor and disposed off at a licensed disposal site.	Developer, ECM	Continuous
Ventilation at the administration block	□ Air conditioners and overhead fans need to be installed	Developer	Continuous

Activity	Action Required	Responsible Party	Frequency
Painting of administration block	<ul style="list-style-type: none"> ▫ Ceilings must be painted white and walls light colour 	Developer	Continuous
Ergonomics	<ul style="list-style-type: none"> ▫ Must have a proper backrest to provide lower back support 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ Provision for repairing and maintaining of hand tools must be provided 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ Hand tools e.g. cane knives must be of appropriate shape and size for easy and safe use 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ Height of equipment, control surface, positioned to reduce bending posture for standing workers 	Developer	Once-off
	<ul style="list-style-type: none"> ▫ Work table of suitable height must be provided for seated workers to avoid too high or too low hand position 	Developer	Once-off
Impact: Increase in ambient noise levels			
To ensure that ambient noise level are kept to acceptable levels	<ul style="list-style-type: none"> ▫ Ambient noise impact mitigation needs to focus on the following: <ul style="list-style-type: none"> • The planning of construction activities (construction site/ farms) must endeavour to minimize the noise impact on adjacent landowners • In this regard, vehicles should idle as little as possible, construction schedule times must be adhered to ,and all construction workers must be encouraged to keep noise to a minimum on site; • All generators and heavy duty equipment is to be insulated and/or placed within buildings to minimize the ambient noise 	Contractor, ECM	Continuous

Activity	Action Required	Responsible Party	Frequency
	levels		
Impact: Increase in visual clutter and degrading of the genius loci of the area.			
Ensure that all signage and architecture is in character with the surrounding environment	□ All signs must be within the guidelines of the Kenyan legislative framework and as directed by NEMA	Developer	Once-off
	□ All architecture must add value to the character of the surrounding environment.	Developer	Once-off
To ensure the minimization of visual clutter and the degrading of the visual quality of the immediate vicinity	□ Indigenous tree forming a buffer around the plant and cane farms need to be maintained and new trees need to be planted where others have died.	Developer	Continuous
	□ The generators need to be maintained in a good working condition to prevent the occurrence of black smoke.	Developer, ELO	Continuous
Impact: Increase in the generation of domestic waste			
Ensure that all waste generation is minimized and managed in an environmentally safe manner	□ The developer must keep the site in a clean and orderly state at all times. The ECM must supervise a litter patrol twice a week to ensure that the project area is free from litter.	Developer, ELO, ECM	Continuous
	□ Proper waste handling facility must be provided for on-site and emptied daily.	ELO, Contractor, ECM	Continuous
	□ Waste generation must be minimised as first priority. □ Unavoidable wastes should be separated at source, recycled or re-used, combusted, and disposed in sanitary landfills		

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> □ All waste must be removed from site by a registered disposal company and taken to a licensed disposal site. 	ELO, ECM	Continuous
	<ul style="list-style-type: none"> □ Adequate measures to collect, remove and safely dispose of waste must be implemented during each stage of the proposed development. 	Developer, Contractor, ELO, ECM	Continuous
	<ul style="list-style-type: none"> □ The ECM must approve the waste storage, collection, transportation and disposal arrangements. 	ECM	Once-off
	<ul style="list-style-type: none"> □ The contractor shall immediately deposit waste in the litterbins. Waste may not be left in any other area temporarily prior to being deposited in a bin. 	ELO	Once-off
Impact: Increased odour			
To ensure that all odours resulting from the treatment facilities are minimized	<ul style="list-style-type: none"> □ Ensure the correct working condition of Methane (CH4) storage facility. 	Developer	Continuous
To ensure that all odours resulting from the molasses storage areas are minimized	<ul style="list-style-type: none"> □ It is the responsibility of the developer to ensure that molasses storage and load off areas are functioning correctly and that the source of odours is identified and dealt with immediately. 	Developer	Continuous
Impact: Increased loitering			
Ensure that the general safety and security on site is maintained at all times during the development	<ul style="list-style-type: none"> □ Day-Night security guards and adequate lighting are to be provided by the developer. 	Developer	Continuous

Activity	Action Required	Responsible Party	Frequency
operations			
Spirit of ESMP	<ul style="list-style-type: none"> ▫ In the spirit of this ESMP document, the maintenance and the future improvement of the integrity and functioning of the project is fundamental. All the activities mentioned herein, must be carried out in this spirit, with this end-goal in mind. 	Developer	Continuous

9.5 Tana Integrated Sugar Project – Decommissioning and Closure Phase

In addition to the above Tables it is necessary to outline the basic rehabilitation measures that will be required to be undertaken once all operations activities have ceased. To this end Table 4 below outlines basic principles, which need to be adhered to during the rehabilitation process. It should however be noted that such principles should not be viewed in isolation but rather an extension of all actions identified in the above Tables.

Table 9.4: Tana Integrated Sugar Project – ESMP for Decommissioning and Closure Phase

Activity	Action Required	Responsible Party	Frequency
Objective: There is need to rehabilitate the natural and built environment to a state that is equivalent or better than the site' original condition			
Remove all buildings and structures	<ul style="list-style-type: none"> □ All structure and building that will not be used for other purposes must be removed and materials recycled as far as possible or taken to a licensed waste disposal site. 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ All foundation must be removed and taken to licensed disposal site or to used for backfilling at other building or construction sites 	Contractor, ECM	Once-off
Landscaping	<ul style="list-style-type: none"> □ All cleared slopes shall be terraced and re-vegetated 	Contractor, ECM	Continuous
	<ul style="list-style-type: none"> □ Indigenous trees should be preferred in all landscape areas 	Contractor, ECM	Continuous
Re-vegetations	<ul style="list-style-type: none"> □ The effectiveness of re-vegetation and erosion control must be monitored periodically. In the event that rehabilitation is not successful, corrective action must be taken. □ This may include bringing in additional topsoil, reseeding and mulching, depending on the reasons for the failure of the prior vegetation methods. 	ECM, ELO	Weekly
	<ul style="list-style-type: none"> □ The landscape contractor must follow the guidelines of the landscape development action plan or other plans approved by the ECM while landscaping the site 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ Where necessary, brick paving areas might require stabilization of the lower layers, to seal layer works from surface runoff. 	Contractor, ECM	Once-off, monitor monthly

Activity	Action Required	Responsible Party	Frequency
	<ul style="list-style-type: none"> □ Re-vegetation should be completed as soon as possible after construction. 	Contractor, ECM	Continuous
	<ul style="list-style-type: none"> □ Trees should be planted at suitable location so as to interrupt site lines (screen planting), between the adjacent villages/ residential areas and the development 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ Area that are rehabilitated must be demarcated with danger tapes to prevent vehicular access to these areas. 	ELO, ECM	Once-off
Removal of construction materials	<ul style="list-style-type: none"> □ Once construction is complete; all construction materials are to be removed in appropriate manner. 	ELO, ECM	Daily
Replacement of topsoil	<ul style="list-style-type: none"> □ Topsoil is to be replaced strictly according to all principals outlined by ECM. 	Contractor, ECM	Continuous
Restriction of vehicle access	<ul style="list-style-type: none"> □ Vehicles must be kept on existing tracks and no new tracks should be created through rehabilitated areas. 	Contractor, ECM, ELO	Once-off
	<ul style="list-style-type: none"> □ Time permitting, the natural seed bank and vegetative structure retained in the topsoil can be utilized instead of using a seed mixture 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ A seed mix will have to be used to re-vegetate disturbed areas should the time period prior to re-vegetation commencement be excessive. 	Contractor, ECM	
	<ul style="list-style-type: none"> □ Areas identified as potentially subject to erosion (e.g. steep slopes) must be vegetated with indigenous grass species 		
	<ul style="list-style-type: none"> □ The time that the barren areas will be subjected to the agents of erosion should be minimal 		
	<ul style="list-style-type: none"> □ Re-vegetation of clear land must be completed according to landscaping action plans. 	Contractor, ECM	

Activity	Action Required	Responsible Party	Frequency
Ripping of soil	<ul style="list-style-type: none"> □ Soil that has been compacted by the passage of vehicles and pedestrians must be ripped to a depth of 15cm in lines not more than 50cm apart. 	Contractor, ECM	Once-off
	<ul style="list-style-type: none"> □ Ripping should be done in two directions perpendicular to each other 	Contractor, ECM	Once-off

9.6 Environmental and Social Incidents

An environmental and social incident is defined as any unplanned event that results in actual or potential damage to the environment, whether of a serious or non-serious nature. An incident may involve non-conformance with the any of the following:-

1. Legal requirements;
2. Requirements of the ESMP;
3. Requirements of the Record of Decision; and
4. Any verbal or written order given by the ECM on site while discharging his / her duties.

The contractor must take corrective action to mitigate an incident appropriate to the nature and scale of the incident. The contractor must also rehabilitate any residue environmental damage caused by the incident or by mitigation measures themselves. The contractor must change his/her operating procedures, at his/her cost, where applicable to prevent recurrence of the incident.

The ELO must inform the ECM of the serious incidents immediately upon occurrence of the incident. The ECM must complete an Incident Report for all environmental incidents. The ELO shall investigate incidents in collaboration with the ECM. The focus of these investigations will not be to apportion blame, but to determine the root cause of the incident and to prevent a recurrence of similar incident.

The ECM must send Incident Reports to EHS Committee or Chief Executive of the sugar company envisaged on a monthly or regular basis. Such incidents should be captured in periodical environmental audit reports and mitigation measures must be formulated, implemented and evaluated. In the case of a serious incident or an emergency, the Incident Report must be sent to NEMA and other relevant government authorities and as soon as possible after the incident has been reported.

9.7 Conclusions

The measures in this Environmental and Social Management Plan (ESMP) are designed to enable all relevant role players, including the developer, contractor, engineer and Environmental Control Manager to cooperate to prevent adverse environmental impacts and to mitigate unavoidable impacts when they occur. It is expected that the ECM will make this ESMP available to NEMA licensed auditors or inspectors in future both in hard and soft copies for facilitating audit purposes. The ESMP need also to be stored in an electronic EXECEL sheet for future use during the carrying out of the Initial Environmental Auditing (IEA) and subsequent periodical Self Audits (EAs) for easy calculation of the environmental and social compliance levels. Compliance levels should be assessed between 0-4, where 0=Not Compliant and 4=Fully Compliant. Weights in-between 0-4 will be fixed as per field conditions may dictate. This ESMP is flexible for review in the future for purposes of ensuring project sustainability in the long term.

Table 9.5: Environmental and Social Incident Log

Environmental and Social Incident Log			
Date	Environmental & Social Condition/ Complaints	Comments (Include any possible explanations of current condition and possible responsible parties. Include photographs, records, etc. if available)	Corrective Action Taken (Give details and attach documents as far as possible)

10 INSTITUTIONAL ASPECTS FOR THE IMPLEMENTATION OF THE ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

Introduction

After review of at all levels the capability of TARDA and Mumias Sugar Company Ltd because of their expected involvement in the project implementation at initial stages, the following steps are recommended to strengthen or expand the envisaged private sugar company so that the management and monitoring plans in this report can be successful and sustainable. The recommendations focus on laws and regulations, functions, intersectoral arrangements, management procedures and training, staffing, and operations required. It should be emphasised here that the purpose of the EMP is to formulate mitigation measures that will be adhered to by all contractors and/or sub-contractors during the construction phase as well as measures that must be implemented during the operational and decommissioning phases. The EMP pro-active approach is recommended to address potential environmental problems before they occur. This would limit corrective measures needed during the construction and operational phases of the proposed development. Additional mitigation will be included throughout the project's various phases, as required and if necessary.

10.2 Establishment of the Environment Control (EC) Department

Before commencement of the implementation, it is recommended that the developer must establish the EC Department headed by a Manager reporting directly to the Chief Executive Officer of the company. The key role of the Environmental Control Manager (ECM) is to oversee the implementation of the EIA licence conditions during construction and operation of the project to minimize negative environmental impacts and ensure optimization of positive impacts. The current existing Environmental Planner of TARDA and MSC officer in-charge of Environment Health and Safety issues should closely assist in the initial stages of establishing this department. The Department should develop electronic Environmental Performance Indicators based on Monitoring results. The Department's major responsibilities will be in the following six (6) areas:-

a) Environmental issues

- Solid waste management
- Wastewater effluent monitoring and management
- Emissions to air monitoring and control
- Water consumption and management
- Energy consumption monitoring and management

b) Occupational Health and Safety

Occupational health and safety hazards that will require monitoring and control by the EC Department include the following:-

- Physical hazards
- Exposure to dust and biological hazards
- Exposure to chemicals (including gases and vapours)
- Exposure to heat and cold and radiation
- Exposure to noise and vibrations
- Water-borne diseases monitoring

c) Community Health and Safety

The EC department should also monitor and control community health and safety impacts during the construction, operation, and decommissioning of the project.

d) Environmental Monitoring

This proposed Department throughout the project cycle should coordinate environmental monitoring programs. The department is expected to establish a well-equipped monitoring laboratory as outlined in the Monitoring Plan. The Environmental Monitoring Plan outlined in this report should fully be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use. Monitoring frequency should be sufficient to provide representative data for the parameters being monitored. Trained individuals in the department following standard monitoring and record-keeping procedures should conduct monitoring and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

e) Rehabilitation of Damaged Areas

In case of any accidental damage to environmental sensitive habitats, the EC department must quickly develop relevant rehabilitation plans. The rehabilitation of quarries that will be used to extract materials for building and roads construction must be planned and coordinated from this department.

f) Local Environmental Action Plans

Due to the magnitude of the project the EC department will be required in collaboration with contracted environmental experts/ firms to formulate and administer the implementation of the following specific internal environmental action plans. Copies of the action plans should be sent to NEMA office and other government authorities for reference purposes. Environmental Action Plans envisaged are:-

- Ecological and Rehabilitation Management Action Plan
- Water Management Action Plan
- Waste Management Action Plan
- Emissions Management Action Plan
- Transport Management Action Plan
- Quarries Excavation and Rehabilitation Action Plan
- Environmental Monitoring Programme Management Action Plan
- Human Resettlement and Social Management Action Plan
- Operational Health and Safety Management Action Plan
- Emergency Preparedness Management Action Plan
- Ecotourism Project Action Plan

g) Other Environmental Control and Management Duties

The EC department should undertake all other duties as may be directed by various Government Authorities, e.g. NEMA, Water Resources Management Authority, etc.

10.3 Responsibilities of the role players

10.3.1 Developer

The developer (proponent) remains ultimately responsible for ensuring that the development is implemented according to the requirements of the EMP throughout all phases of the project. Although the developer appoints specific role players to perform functions on his/her behalf, this responsibility is delegated. The developer is responsible for ensuring that sufficient resources (time, finances, human, equipment, etc) are available to the other role players (e.g. Environmental Control Manager, Contractor' Environmental Liaison Officer and Contractor) to efficiently perform their tasks in terms of EMP. The developer is liable for restoring the environment to what is deemed by the necessary legislative requirements as an environmentally suitable condition in the event of negligence leading to damage to the environment. The developer must ensure that the EMP is included in tender documentation so that the contractor who is appointed is bound to the conditions of the EMP.

10.3.2 Site Agent

The site agent is usually a site Engineer or project manager who is the developer's most senior representative on site and coordinates activities on site. The site agent must follow the advice of the ECM with regard to environmental management and ensure that the contractor abides by all the requirements stipulated in the EIA licence and addresses all the problems according to the EC departmental recommendations. This may include, in certain circumstances, taking positive action against the contractor for failing to comply with important requirements of the EIA licence.

10.3.3 Contractor

The contractor, as the developer's agent on site, is bound to the EMP and EIA licence conditions through his/her contract with the developer, and is responsible for ensuring that he adheres to all the conditions of the EMP. The contractor must thoroughly familiarize him/herself with the EMP requirements before coming onto site and must request clarification on any aspect of these documents, should they be unclear. The contractor must ensure he/she has provided sufficient budget for complying with all the EMP and EIA licence conditions at the tender stage. The contractor must comply with all orders (whether verbal or written) given by the ECM, project manager or site engineer in terms of the EIA licence conditions.

10.3.4 The Environmental Control Manager (ECM)

The Environmental Control Manager will be appointed by the developer as an independent monitor of the implementation of the EMP. The Environmental Control Manager must be a qualified environmental impact assessment/ auditing Lead Expert registered and licensed by NEMA. He should have a minimum of a Masters degree in Environmental Sciences, preferably in Environmental Planning and Management and with a multi-disciplinary training. He must have good experience in EIA/Auditing procedures followed in Kenya. As such he/she is expected to be well versed with the local conditions and environmental legislation, regulations and policy governing the project. In carrying out internal environmental assessments and audits, the Environmental Control Manager shall comply with all existing national environmental regulations and standards prescribed by

NEMA, and in absence of such environmental regulations and standards shall use such other international standards as shall be prescribed by NEMA, e.g. WHO and ISO standards. The Environmental Control Manager shall indicate in his/her assessment/audit reports the measures that exist under the EMP of the project to bring the project up to acceptable environmental standards and ensure that environmental impacts are addressed and controlled.

He /she must form part of the project team and be involved in all aspects of project planning that can influence environmental conditions on site. The Environmental Control Manager must attend relevant project meetings, conduct inspection to assess compliance with the EIA licence conditions and be responsible for providing feedback on potential environmental problems associated with the development. In addition the Environmental Control Manager is responsible for:-

- Liaison with contractors regarding environmental management; and
- Undertaking routine monitoring and appointing a competent person/institution/consultancy firm to be responsible for specialist environmental monitoring, if necessary.

The Environmental Control Manager has the right to enter the site and do monitoring and assessment/ auditing any time, subject to compliance with safety and health requirements applicable to the site (e.g. wearing of safety boots and protective head gear).

a) Inter-Agency Co-ordination and involvement of Affected Groups and Local NGOs

Inter-agency coordination is critical for effective EIA since environmental issues are often inter-sectoral and regional, and in some cases international. The authority and responsibility to deal with different aspects e.g. collection of information, preparation of plans, approval of designs and environmental permitting, resource allocation, monitoring of progress etc are spread over a number of agencies at different levels of government. The successful implementation of the EIA recommendations will depend on the capabilities of the institutions involved in environmental management. In this regard, the following government agencies will be involved to varying degrees: the National Environment Management Authority (NEMA), Kenya Wildlife Service (KWS), National Museums of Kenya (NMK), Ministry of Water and Irrigation (MoWI), Ministry of Regional Development, Ministry of Agriculture, Ministry of Lands and Housing, Ministry of Agriculture, National Irrigation Board (NIB), Water Resources Management Authority (WARMA), County Councils in the project Area, Kenya Sugar Research Foundation (KESREF), the Coast Development Authority (CDA), Kenya Marine Fisheries Research Institute (KMFRI), Kenya Forest Service (KFS) etc.

Besides the above, the affected communities will need to be involved throughout the EIA process and also in the implementation stage. A number of NGOs working in the area e.g. World Vision, KWAHO etc, associations, conservation groups e.g. Kenya Wetland Forum, East African Wildlife Society, as well as the private sector (tourism, ranches) also need to be involved in the implementation of the ESMP.

b) Liaison with Contractors

The Environmental Control Manager is responsible for informing the contractors of any decisions that are taken concerning environmental management during the construction phase. This would also include informing the contractors of the necessary corrective actions to be taken.

10.3.5 Environmental Liaison Officer (ELO)

The contractor must appoint ELO to assist with day to day monitoring with the construction activities. Any issue raised by the Environmental Control Manager will be routed to the ELO for the contractor's attention. The ELO shall be permanently on site, during the construction (to completion) phase to ensure daily environmental compliance with the EIA licence conditions and should be ideally be a senior and respected member of the construction crew. Past experience has revealed that ELO's that can relate to the work force are the most effective for information transfer and ensuring compliance with the EIA licence conditions. The right candidate for this position must have a first degree background in environmental studies with a bias towards community development.

10.3.6 Community Liaison Officer (CLO)

Should it prove necessary, as a result of increased community awareness or complaints relating to construction activities, directly associated with the proposed development, the contractor must appoint a Community Liaison Officer (CLO) to act as a point of contact between the contracting team and the community that will be affected by such activities. Any complaint from the community about construction activities must be channeled through the CLO, and the CLO should relay feedback from the contractor to the groups of Interested and Affected Parties (I&AP's). It is permissible that the ELO and CLO is the same person.

In light of the above discussions all general roles and responsibilities associated with the different role-players are summarized in the Table below.

Table 10.1: EMP general for institutional needs

Activity/Issue	Action required	Responsible party	Frequency
Appointment and Duties of ECM	1 The Proponent (Developer) must appoint an independent Environmental Control Manager (ECM) who must monitor the contractor's compliance with Environmental Management Plan and NEMA EIA licence conditions.	Developer	Once-off
	2 The developer must provide all the contractors with a copy of the EMP and any other relevant document or supporting documents like EMCA, EIA/EA Regulations of 2003, Waste Management Regulations, Water Act, Forest Act, etc as outlined in the legal framework of this report. A library with such reference materials must be sent up.	Developer	Once-off
	3 The priority of the ECM is to maintain the integrity of the open space	ECM	Continuous
	4 The ECM should identify sensitive habitats or individual environmental sensitive areas that may not be damaged during construction and clearly demarcate these areas with danger tape	ECM	Once-off
	5 The contractor must attend a site inspection and orientation session with the ECM to identify and be informed of the sensitive elements of the site. The ECM must point out any particular site-specific elements of importance.	ECM, Contractor	Once-off
	6 The ECM must form part of the project management team and attend all project meetings.	ECM	Continuous
	7 The contractor must ensure that the construction crew attends an environmental briefing and training session presented by the ECM or a contracted firm of EIA Experts prior to commencing activities on site.	ECM, Contractor	Once-off
	8 The ECM shall keep a record of all communication with external interested and affected parties on the site.	ECM	Continuous
	9 The ECM must monitor the emergence of invasive alien species on a monthly basis. If such species are observed he/she should instruct the contractor to remove them by the most effective mechanical method recommended in the relevant literature.	ELO, ECM	Monthly
Appointment and Duties of ELO	10 The contractor must appoint an ELO. This person will be required to monitor the situation with a direct hand on approach, and ensure compliance and co-operation of all personnel. He should be fluent in the languages (especially Kiswahili) of the employees.	Contractor	Once-off

11. ENVIRONMENTAL MONITORING PLAN

An environmental monitoring plan is vital for any Environmental and Social Management Plan of a development project. The monitoring plan helps in assessing the effectiveness of proposed mitigation measures, in assessing changes in environmental conditions and to provide warning of significant deterioration in environmental quality for further preventive action. The principle elements of a monitoring plan are:

- A clear statement of aims and objectives
- A description of sampling sites
- A description of variables that will be measured
- Proposed frequency and timing of sampling
- An estimate of the resources required to implement the design
- Delineation of responsibility to implement the monitoring plan – see Chapter 11
- A plan for quality control and quality assurance

Environmental monitoring for the TISP will be required both during the construction and operation phases of the project. Timing and responsibility for the implementation of the proposed mitigation measures are given in the Environmental and Social Management Plan (ESMP). The institutional needs for the implementation of the ESMP are outlined in Chapter 10. Key measurements and indicators used in the baseline studies should be continued in the monitoring phase. Construction and Operation phase environmental and social impacts are summarized in Chapters 7 and 9. Thus, in order to meet the objectives of the Environmental Monitoring Plan, key parameters in the following broad areas will need to be monitored:

- a. Habitat and vegetation
- b. Socio-economics and community participation
- c. Demography and settlement
- d. Historical, archaeological monuments and cultural heritage
- e. Physical environment
- f. Wildlife
- g. Fisheries
- h. Livestock
- i. Agriculture, pests and diseases
- j. Forest products and wood energy
- k. Community environmental health

11.1 Habitat and vegetation

Environmental monitoring will comprise the following broad areas::

- a. Although mangrove ecosystem is a significant distance from the project site (ca.30km), due to the high dynamism of aquatic ecosystem, this forest ecosystem needs to be monitored in terms of change in species. Water flowing from the project site is likely to carry increased nutrients and chemicals, which are likely to impact on the forest ecosystem.
- b. The spread of *Prosopis juliflora* in the bushland ecosystem and grazing areas needs to be monitored and controlled due to the likelihood of becoming invasive and should at best removed. Likely benefits of the weed e.g. as source of fuel wood or animal fodder needs to be explored
- c. Due to the young status and poor establishment of vegetation along the riverine areas, the bordering vegetation areas need to be closely monitored in terms of natural regeneration so as to complement the same with enrichment planting. These areas should also be monitored for riverbank erosion and where necessary strengthened with gabions to allow vegetation to establish.
- d. Monitor changes with regard to replenishment of wetlands along the riverine areas, which are used for farming and dry season grazing. There is a likelihood

that implementation of the project will contribute to change in flooding pattern. This maybe a source of great conflict should the wetland currently in use to not accessible to both farmers and pastoralists

- e. Endangered vegetation species
- f. Microclimatic changes in various habitats – radiation, temperature, moisture balance & wind patterns
- g. Types and rates of soil erosion in the project area in general
- h. Changes in composition and condition of vegetation and habitats in the remaining forest patches
- i. Sources of energy and amount consumed by households in the project area
- j. Biodiversity indicators
- k. Fragmentation of forests in the project area

11.2 Socio-economic and community participation

- a. The following parameters will be monitored:
- b. Socio-economic situation in the project area
- c. Participation in the project by different gender
- d. Seasonal labor profiles by gender
- e. Availability of infrastructure in relation to the population – education, health, roads, water and sanitation etc
- f. Land tenure system and land use issues
- g. Enterprise development and associated enabling environment – micro-finance, credit facilities and agro-business training in relation to gender parity
- h. Compensation and resettlement of displaced families
- i. Other measures introduced to alleviate poverty – such as other crops like oil palm, soya beans, jatropha etc
- j. Type and frequency of accidents – in the work place and on the roads
- k. Progress towards development of a data base for “best management” practices in the basin

11.3 Demography and Settlement

Parameters that should be monitored under this subject include the following:

- a. Demographic information – household composition and structure, size, ethnic composition, settlement patterns, migration (in- or out-migration) including seasonality in population movements
- b. Human and animal movements in relation to resource availability
- c. Changes in lifestyles and habits of the different communities in the project area
- d. Incidence and prevalence of diseases – HIV/AIDS, STDs, communicable diseases, water-borne diseases etc

11.4 Historical, archaeological monuments and cultural heritage

No significant sites of historical, archaeological monuments and cultural heritage were identified within the project area. There will be no alteration of old construction or cultural heritage buildings with historical, architectural, or archaeological value within the proposed project site. Also, the consultants do not foresee the deterioration of public meeting places where cultural expressions of the affected people, community, or group take place. However a temporary Christian church (also used as a community nursery school) was found at proposed factory site at Milimani area that might be affected. The presence of graves is also a potentially emotive issue in the project area among the various local communities. Due to the insecure land tenure in the project area, many

households might have opted for burying their dead outside the area. However, some households will have graves on their land.

As part of the monitoring programme during the construction and even implementation phase, a detailed assessment of the number and location of graves per family to be affected, their cultural value, and community preferences will need to be undertaken for both the factory site and farm area both Estate and Out grower lands.

11.5 Physical environment

- a. Physical and chemical characteristics of soils
 - i. Soil texture, bulk density, organic carbon, pH, aggregate stability, hydraulic conductivity, electrical conductivity, SAR
 - ii. Soil fertility through regular sampling and determination of pH, P, N, OC, Mn, Zn, Cu, Mg, EC, Na and Ca; CEC
 - iii. Heavy metals
 - iv. Pesticide residues
- b. Soil Conservation regimes
Soil erosion rates, slope stability, water, sediments load, types and effectiveness of soil conservation measures, changes in soil structure as well.

c. Water Quality and Quantity

Water Quality:

Water quality and public health parameters shall be monitored. Monitoring should be carried out at least two times a year to cover seasonal variations. The parameters for monitoring would be in accordance with the Water Quality Regulations (2006). The monitoring points will cover different segments of the project perimeter and surroundings, Tana River, Matomba and Handarako brooks and ground water from a representative sample of wells/boreholes in the project's sphere of influence. It will also cover the ox-bow lakes, the delta and the marine environment. Important to include also is sedimentation rates of the canals, drains, the Tana River and associated ox-bow lakes.

Water Quantity:

It will important to monitor water quantity in the Tana River and the two brooks of Matomba and Handarako, the ox-bow lakes that are presently being utilized in one way or another, and selected wells/boreholes within the project area.

d. Nutrient cycles and food chains

The proposed project will use fertilizers, herbicides, fungicides, pesticides, ripeners and many other chemicals in the growth of sugar cane and in industrial processing of sugar cane and its by-products. It will be important to assess the way residues from these chemicals will disperse from their areas of application in the environment. Both nutrients and pesticides will end up either in the air, soil or aquatic environments often followed by bioaccumulation. A monitoring programme will therefore need to consider:

- Types and amounts of fertilizers used in the project – urea and PSP
- Types and amounts of pesticides used in the project (Gesapax Combi500 FW, Krismat 75 WG, Lumax 537.5 SC). In this respect, it will be useful to study the Material Safety Data Sheets (MSDS) for each pesticide
- Analysis of soil and water samples from representative sites in the cane fields, drains, river, ox-bow lakes and delta/ocean

e. Air Quality and Noise

This is important particularly at the factory site at Milimani. The parameters initially recommended for monitoring during construction are: NO₂, SO₂, O₃, CO₂, CO, VOC, BENZENE, Hydrocarbons, particulates, noise

f. Solid waste management – sources, types and management

11.6 Wildlife

- a. Monitoring of population and habitat changes of - threatened species (Red Columbus Monkey & Tans River Mangabey) as well as nesting places, breeding grounds and feeding places
- b. Monitoring of population size and movement of large herbivores in and around the project area
- c. Monitoring of endemic biota in the project area

11.7 Fisheries and other aquatic fauna

The aim of a fisheries monitoring program is to assess changes in fish species diversity, composition and catches to avoid collapse of fisheries. It may also help to assess

effectiveness of the management measures in place and, in this case, to assess whether the sugar growing, sugar processing and associated ethanol and energy plants are having adverse impacts on fisheries over time in the project area and associated water bodies.

To achieve this objective, there is need to devise a monitoring plan that captures both temporal and spatial changes. Thus it is necessary to select strategically located water bodies for the study and an appropriate time frame.

It is proposed that the monitoring program covers the Tana River, the ox-bow lakes as well as the marine component. Three sites along the river course will be sampled, one above the project area, in the project area and below. In addition two ox-bow lakes should be sampled, ideally Shakababo and Moa. The delta and open sea adjacent to the delta should be included in the monitoring programme.

A baseline sampling will be conducted using appropriate scientific techniques before the project operation starts. Thereafter, sampling will be done biannually in all the five sites mentioned above. The sampling should target the following variables:

- i) Fish diversity studies
- ii) Fish population structures – Breeding and recruitment patterns, length at maturity, reproductive status, migration patterns etc.
- iii) Food and feeding habits
- iv) Water physico-chemical parameters in relation to fish abundance and distribution.
- v) The implementation of the proposed actions can be achieved in collaboration with KMFRI.

11.8 Livestock

The important livestock aspects that will need to be monitored include the following:

- Herd ownership, size and composition
- Livestock productivity and distribution
- Carrying capacity of the range resources in the project area
- Animal movements in and around the project area in the wet and dry seasons
- Livestock sales (for meat, dairy products, hides & skins)
- Prevalent and new animals diseases
- Conflicts arising due resource deprivation or competition

11.9 Agriculture, pests and diseases

The important parameters for environmental monitoring include:

- Impact of chemicals in relation to soil, water, livestock and human health
- Pesticides used and their fate in the environment
- Types of fertilizers used and their effect on the environment
- Soil fertility conservation measures
- Changes in farm enterprises
- Types of crops and crop yields
- Labour requirements and availability
- Prevalent and new pests and diseases
- Integrated pest management

11.12 Forest products and wood energy – see above under Habitat and Vegetation

- Status of remaining forests in the project area
- Assess degree of afforestation/enrichment planting
- Assess sources of energy and amount consumed by households in the project area
- Assess community status and trends in use of medicinal plants in the project area
- Monitor traditional forest exploitation and management

11.13 Community environmental health

- Availability and accessibility of water and sanitation facilities
- Community health status
- Occupational health and safety in the farm and factories
- Emissions and their health impacts
- Frequency of flooding in relation to water-borne diseases and displacement
- Diseases and disease vectors
- Effects of use of agro-chemicals

11.14 Summary of Environmental Monitoring Programme

The environmental monitoring programs are presented in Table 13. This section briefly highlights the summary of these programs along with parameter and frequency.

Table 11.1: Summary of Environmental Monitoring Programme for the TISP

S. No.	ITEM	PARAMETERS	FREQUENCY	LOCATION
<i>During Project Construction Phase</i>				
1	Erosion and siltation	Soil erosion rates, stability of bank and canal embankments, etc.	Monthly	River banks, canals, sugar farms at Estate & Out grower areas
2	Noise	Noise limits for different working environments	Monthly	At major construction sites
3	Vibration	Vibration exposure & action value limits	Daily	Project area
3	Physical and economic dislocation of affected families	Compensation & resettlement of affected people	End of construction period and monthly thereafter	Concession and Out grower areas in both Taana River and Lamu Districts
4	Accidents & Diseases	HIV/AIDs, STDs and other diseases Accidents; hazardous materials	Quarterly	Project area and environs
5	Vegetation and habitats	Vegetation structure, biodiversity, fuel wood,	Twice a year	Project area and environs
6	Water quantity	Tana River, Matomba & Handarako Brooks, Ox-bow lakes	Monthly	In the specified areas
7	Air pollution	Particulates, especially dust as a result of earthworks and construction machinery	Monthly	In the project area and environs where major works will take place
8	Crime	Registered crimes/disputes; crimes/disputes involving women; crimes/disputes involving vulnerable groups	Monthly	In the project area and environs
9	Demographic and population changes	Total population, in- and out-migration, structure of the population & vital statistics; informal settlements	Annual	In the project area and environs

S. No.	ITEM	PARAMETERS	FREQUENCY	LOCATION
10	Livestock	Ownership, sizes and structure of livestock herds; livestock productivity and distribution; livestock movements particularly in and out of the delta area by season; livestock movement in relation to carrying capacity of the range and effects on the project; livestock and livestock product sales; livestock health & diseases in relation to environmental conditions due to the project; resource conflicts (water & pasture)	Wet and dry seasons	In the project area and environs
11	Wildlife	Types and condition of habitats (nesting places, breeding grounds, feeding places etc); endemic biota	Annual	TISP area and environs
12	Infrastructure	Housing, health facilities, water, transport & communications	Annual	Urban centers in the project area
13	Borrow pits	Location and number; type and status of rehabilitation carried out	At the end of construction period	In the affected areas
14	Surface and ground water quality	As per the Second Schedule of Legal Notice # 120 2006	monthly	River, well/borehole: same locations that were sampled during baseline studies
15	Solid waste generation	Types and sources of solid wastes	monthly	Project area
16	Soil and water pollution	Oils and greases	quarterly	Project area
17	Exhaust emissions	Sulfur and lead concentrations in air	quarterly	Project area
18	Water	Water usage by different operation areas	monthly	Project area
19	Energy	Energy use by type	monthly	Project area
20	Accidents and hazards	Number, causes and actions taken	quarterly	Project area
<i>During Project Operation Phase</i>				

S. No.	ITEM	PARAMETERS	FREQUENCY	LOCATION
1.	Water quality (sources of domestic water)	As per the Second Schedule of Legal Notice # 120 2006	Monthly	River, well/borehole: same locations that were sampled during baseline studies
2	Hydrology	Discharge of Tana River, Matomba and Handarako Brooks & lahes	monthly	Mentioned water bodies
2	Effluent discharge into the environment	As per the Fourth Schedule of Legal Notice # 120 2006	Monthly	River, well/borehole: same locations that were sampled during baseline studies
3	Treated effluent	As per the Sixth Schedule of Legal Notice # 120 2006	Monthly	River, well/borehole: same locations that were sampled during baseline studies
4	Waste water for irrigation	As per the Eighth Schedule of Legal Notice # 120 2006	Monthly	After treatment and polishing in the lagoons
5	Water related diseases	Identification of water related diseases, adequacy of local vector control and curative measure etc.	Three times a year	Labor camps and colonies.
7	Air quality	NO ₂ , SO ₂ , O ₃ , CO ₂ , CO, VOC, Benzene, Hydrocarbons	Monthly	In the factory & down wind of the factory
8	Ecology	Status of Afforestation programmes of green belt development	Annual	Project area
9	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition & diversity; food chain & food webs;	Once a year	Rivers, lakes and delta
10	Soil erosion and siltation	Types and rate of erosion on farmland and banks of rivers and canals	seasonally	Project area
11	Noise	Noise limits for different working environments	Monthly	Factory
12	Vibration	Vibration exposure & action value limits	Daily	Factory

S. No.	ITEM	PARAMETERS	FREQUENCY	LOCATION
13	Accidents & Diseases	HIV/AIDs, STDs and other diseases Accidents; hazardous materials	Quarterly	Project area and environs
14	Vegetation and habitats	Vegetation structure, biodiversity, fuel wood,	Twice a year	Project area and environs
15	Demographic and population changes	Total population, in- and out-migration, structure of the population & vital statistics; informal settlements	Annual	In the project area and environs
16	Livestock	Ownership, sizes and structure of livestock herds; livestock productivity and distribution; livestock movements particularly in and out of the delta area by season; livestock movement in relation to carrying capacity of the range and effects on the project; livestock and livestock product sales; livestock health & diseases in relation to environmental conditions due to the project; resource conflicts (water & pasture)	Wet and dry seasons	In the project area and environs
17	Wildlife	Types and condition of habitats (nesting places, breeding grounds, feeding places etc); endemic biota	Annual	TISP area and environs
18	Infrastructure	Housing, health facilities, water, transport & communications	Annual	Urban centers in the project area
19	Borrow pits	Location and number; type and status of rehabilitation carried out	At the end of construction period	In the affected areas
20	Surface and ground water quality	As per the Second Schedule of Legal Notice # 120 2006	monthly	River, well/borehole: same locations that were sampled during baseline studies
21	Solid waste generation	Types and sources of solid wastes	monthly	Project area
22	Soil and water pollution	Oils and greases	quarterly	Project area

S. No.	ITEM	PARAMETERS	FREQUENCY	LOCATION
23	Exhaust emissions	Sulfur and lead concentrations in air	quarterly	Project area
24	Water	Water usage by different operation areas	monthly	Project area
25	Energy	Energy use by type	monthly	Project area
26	Accidents and hazards	Number, causes and actions taken	quarterly	Project area
27	Crime	Registered crimes/disputes; crimes/disputes involving women; crimes/disputes involving vulnerable groups	Monthly	In the project area and environs

11.15 Resources for a monitoring programme

Implementing a monitoring programme requires access to resources including an equipped laboratory, office space, and equipment for fieldwork, transport and trained personnel in all areas of the monitoring programme. In the initial stages of the monitoring programme, it is recommended to proceed as follows:

- Start slowly with analyses of a few variables in each major component
- Train staff to ensure that proper procedures are followed
- Impose quality assurance on all procedures from the beginning
- Take samples in places where the selected parameters are of relevance to the monitoring programme
- Prepare reports that are factual and acceptable to NEMA and other stakeholders
- Increase the number of variables, the number of sampling stations and the frequency of sampling as the capacities of the sampling and analysis teams increase

11.15.1 *Laboratory facilities*

A number of options are available for conducting analysis of various types of samples. The proponent may have his own laboratory or the facilities of another agency or of a government ministry may be available, or some of the analytical work may be done under contract by a private laboratory. The important thing is that the chosen laboratory is accredited for the purpose of specified analysis by NEMA or conforms to international norms and standards. Some of the analytical work will be done in the field, using either field kits or a mobile laboratory. The option selected will depend on number of variables to be analyzed, sampling frequency and number of sampling stations, existing laboratory facilities, and duration of monitoring.

11.15.2 *Transport*

The type of transport needed depends on ease of access to various sampling stations. It is envisaged that the following type of transport will be needed for the proposed monitoring program: four-wheel drive vehicles, motor-cycles (for one person and a portable kit) and a boat for sampling the rivers, lakes and marine ecosystems.

11.15.3 *Staffing*

Staff on a monitoring programme fall into a number of categories according to the major disciplines represented in Table 31 above. As a minimum, they include: programme management staff (see Chapter 10 above), field staff, laboratory staff and data processors. The personnel required include (excluding their assistants): Ecologist/Forester, Soil scientist, Climatologist, Water engineer, Agriculturalist, Demographer/Population expert, Chemical engineer, Limnologist, Fisheries expert, Socio-economist, Wildlife and range ecologist, Livestock expert, Public health expert, Environmental planner, Environmental technology specialist, Resettlement expert. The period of engagement for each of the experts will be specified as per the monitoring programme.

REFERENCES

- 1) Cheffings Joe 1987. The Tana Delta: An article in SWARA magazine July/Aug Vol 10 No. 4 1987.
- 2) CIEH (1999) Health and safety: First principles. Chartered Institute of environmental health, UK.
- 3) Ecosystems Ltd. 1985 (TARDA): Tana Delta Ecological Impact Study – Final Report
- 4) GoK 1976. District Development Plan. Tana River District 1974 – 1978
- 5) GoK 1980. District Development Plan. Tana River District 1979 – 1983
- 6) GoK. District Development Plan. Tana River District 1984 – 1988 Hughes Francine 1982. On the Lower Tana: An article in SWARA magazine July/Aug Vol 5 No. 4 1982.
- 7) JICA 1984: Land Use Mapping (Topographic Mapping Project) in East Kenya.
- 8) MENR/NES, 1985: Lower Tana River District Environmental Assessment Report.
- 9) Ministry of Planning and National Development. District Development Plan. Tana River District 1989 - 1993
- 10) Ministry of Reclamation and Development of Arid, Semi Arid areas and wastelands 1991: Tana River Delta Wetlands Survey. Coastal ASAL Development Project.
- 11) MOA & LD/National Agricultural Laboratories/Kenya Soil Survey 1973 (Sombroek WG, Mbuvi JP and Okwaro HW). A Preliminary Evaluation of the Irrigation Suitability of the lands in Pre Delta Tana Floodplain (Marengo-Garsen). Report No. P15
- 12) MOA/National Agricultural Laboratories (P J Kanake) 1980: Detailed Soil Survey of Ngao Irrigation Scheme (South Tana Division, Tana River District).
- 13) MOA/National Agricultural Laboratories/Kenya Soil Survey 1976(Wokabi SM, Somboek WG and Mbuvi JP): Preliminary Evaluation of the Soil conditions of the Tana Delta for Irrigation development
- 14) MOA/National Agricultural Laboratories/Kenya Soil Survey Special Task Force on Minor Irrigation Development 1977: Detailed soil survey of Mnazini Irrigation scheme of South Tana Division Report No.D6
- 15) Opala K 1993. National Park or farm for prawns. An article appearing in the Daily Nation in February 1993 and reprinted in SWARA magazine Mar/Apr VOL 16 No. 2 1993.
- 16) Republic of Kenya, Kenya gazette supplement Acts 2000, Environmental Management and Coordination Act Number 8 of 1999. Government printer, Nairobi
- 17) Republic of Kenya, Kenya gazette supplement Acts Building Code, 2000 government printer, Nairobi
- 18) Republic of Kenya, Kenya gazette supplement Acts Electric Power Act, 1998 government printer, Nairobi
- 19) Republic of Kenya, Kenya gazette supplement Acts Physical Planning Act, 1999 government printer, Nairobi
- 20) Republic of Kenya, Kenya gazette supplement Acts Water Act, 2002 government printer, Nairobi
- 21) Republic of Kenya, Kenya gazette supplement number 56. Environmental Impact Assessment and Audit Regulations 2003. Government printer, Nairobi
- 22) Republic of Kenya, The Agriculture Act (Cap 318) Government Printers, Nairobi
- 23) Republic of Kenya, The Crop Production and Livestock Act (Cap 321) Government Printers, Nairobi
- 24) Republic of Kenya, The Forest Act (Cap 386) Government Printers, Nairobi
- 25) Republic of Kenya, The Irrigation Act (Cap 347) Government Printers, Nairobi
- 26) Republic of Kenya, The Lakes and Rivers Act (Cap 409) Government Printers, Nairobi
- 27) Republic of Kenya, The Land Acquisition Act (Cap 295) Government Printers, Nairobi
- 28) Republic of Kenya, The Land Adjudication Act (Cap 284) Government Printers, Nairobi

- 29) Republic of Kenya, The Land Consolidation Act (Cap 283)) Government Printers, Nairobi
- 30) Republic of Kenya, The Land Planning Act (Cap. 303) government printer, Nairobi
- 31) Republic of Kenya, The Land Titles Act (Cap 282), Government Printers, Nairobi
- 32) Republic of Kenya, The Local Authority Act (Cap. 265) government printer, Nairobi
- 33) Republic of Kenya, The Penal Code Act (Cap.63) government printer, Nairobi
- 34) Republic of Kenya, The Petroleum Act (Cap 116), Government Printers, Nairobi
- 35) Republic of Kenya, The Public Health Act (Cap. 242) government printer, Nairobi
- 36) Republic of Kenya, The Public Roads and Roads of Access Act (Cap 399) Government Printers, Nairobi
- 37) Republic of Kenya, The Registration of Titles Act (Cap 281) Government Printers, Nairobi
- 38) Republic of Kenya, The Tana and Athi Rivers Development Authority Act (Cap 443) Government Printers, Nairobi
- 39) Republic of Kenya, The Trust Land Act (Cap 288) Government Printers, Nairobi
- 40) Republic of Kenya, The Wayleaves Act (Cap 292) Government Printers, Nairobi
- 41) Republic of Kenya, The Wildlife Conservation and Management Act (Cap 376) Government Printers, Nairobi
- 42) TARDA 2004. TARDA Strategic Plan 2004 – 2009
- 43) The Government Lands Act (Cap 280) Government Printers, Nairobi
- 44) UNEP and ACTS (2001). The making of a framework Environmental law in Kenya. ACTS press, Nairobi
- 45) University of Nasirobi - Institute for Development Studies 1982 (Alila PO, Migot-Adhola SE and Ruigu GM): Evaluation of small scale Irrigation projects in Tana South, Coast Province.
- 46) World Bank (1991). Environmental Assessment sourcebook volume I: Policies, procedures and cross-sectoral issues. World Bank, Washington.
- 47) World Bank (1998). Environmental Assessment sourcebook volume II: Sectoral Guidelines. World Bank, Washington.
- 48) Campbell, K., Coe, C & M. Sunders. 1986. A survey of fishes of the Tana River at Kora and a checklist of fishes of the Tana River. In Coe, M & Collins, N. M (Eds). An ecological inventory of the Kora National Reserve, Kenya. Royal Geographical Society, London, p; 175-188.
- 49) Copley, H. 1941. A short account on the freshwater fishes of Kenya. J. E. Africa Uganda nat. Hist.
- 50) Copley, H. 1958. Common freshwater fishes of East Africa. London, Witherby: 172 p.
- 51) IUCN. 2003. Tana River, Kenya: Integrating Downstream Values into Hydropower Planning. Case Studies in Wetland Valuation No. 6. May 2003.
- 52) Mann, J. J. 1966. A preliminary report on a survey of fisheries of the Tana River, Kenya EAFFRO.
- 53) Mann, M. J. 1969. A brief report on a survey of the fish and fisheries of the Tana River, with special reference to the probable effects of the proposed barrages. EAFFRO., Occ. Pap., 10 (2):13 p.
- 54) Van Someren, V. D. 1952. The biology of trout in Kenya Colony. Government printer, Nairobi, 144 pp.
- 55) Whitehead, P. J. P. 1959. Note on collection of fishes from the Tana River below Garissa, Kenya.
- 56) Bennun, L and Njoroge, P. 1999. Important Bird Areas in Kenya. Nature Kenya, the East Africa Natural History Society, Nairobi.
- 57) Thenya, T., Wandago, B & Nahama, E, 2007. Participatory Forest Management experiences in Kenya 1996-2006. Paper presented during the 1st National Participatory Forest Management (PFM) Conference, KEFRI Muguga, Kenya.
- 58) NEMA, 2004. Mission Report on the Preliminary Assessment of Conservation and Economic Development in the Tana Delta.
- 59) Luke, Q, Hatfield, R and Cunneyworth, 2005. Rehabilitation of the Tana Delta Irrigation Project, Kenya. An Environmental Assessment.

- 60) Government of Kenya, 2002. Tana River District Development Plan 2002-2008. Government Printers, Nairobi.
- 61) Tana River Task Force, 2004. State of the Ecosystem Report- Tana River Ecosystem, Kenya.
- 62) Tana Delta Wetlands Steering Committee, 1999. Analysis of the Situation on the Ground. The Tana Delta environmental Awareness Programme.
- 63) Gichuki, N. N., Oyieke, H. A., Handa, C. Rotich, D.C., Dahiye, Y., Mwangi, S., (Eds). 2002. Biodiversity Research and Monitoring in Tana River Primate National Reserve and its Environs, Kenya. Final Report of GEF/World Bank Tana River Biodiversity Project (1997-2001). National Museums of Kenya (Center for Biodiversity), Nairobi.