NEMA/EIA/5/2/1202

KRYSTALLINE SALT LIMITED (MARERENI)

P.O BOX 80856-80100
MOMBASA

PROPOSED EXPANSION OF KRYSTALLINE SALT LTD MARERENI SALT WORKS

Land reference number 13427 off Malindi- Lamu Road, Marereni Sub-Location, Fundi Isa Location, Gongoni Division, Magarini Sub-County Kilifi County

ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT

PROJECT REPORT REF NO: NEMA/PR/5/2/12,319

COMPIILED BY

J.Morumbasi Mongoni – EIA/EA Lead Expert Reg. No.0357

Philip. Manyi Omenge – EIA/EA Lead Expert Reg. No. 1559

Dr. George Eshiamwata – EIA/EA Lead Expert Reg. No 1781

January 2015

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Submitted by

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Hasmita Patel
Compliance Manager

EXECUTIVE SUMMARY

This report presents findings of an Environmental Impact Assessment study for the proposed expansion of Krystaline Salt Limited Marereni salt works. The proposed expansion will involve construction of evaporators, dykes and one pump on a section of land reference number 13427 which is in Kilifi County, Magarini Sub-County, Gongoni Location, Fundi Issa Location, Marereni Sub-location at Marereni. This environmental Impact Study was carried out and report compiled as provided for in the Environmental Management and Coordination Act, 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003. Other legislations reviewed include; the Environmental Management and Coordination (Water Quality) Regulations, 2006, the Environmental Management and Coordination (Waste Management) Regulations, 2006, the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009, the Physical Planning Act, the Local Authorities Act, the Public Health Act, Water Act 2002, the Employment Act 2007, the Work Injuries Benefits Act 2007, the Labour Institutions Act 2007, the Occupational Safety And Health Act 2007, the Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit sharing) Regulations, the Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations 2009, the Standards Act, Cap 496, the Land Act 2012 and the Antiquities and Monument Act Cap 215.

Potential positive impacts likely to result from implementation of the proposed project may include export revenue, creation of employment opportunities, business spinoffs, tax revenue, development of Mrereni township, skill development and technology transfer. On the other hand negative impacts that may result from implementation of the proposed project may include; destruction of the seasonal wetland at the section of the proposed project site that may result in potential flooding of low laying areas adjacent to the seasonal wetland when it rains, loss of water sources within the proposed project site, disturbance of local fauna, destruction and removal of flora from site, destruction, disturbance and or alteration of local habitats for fauna including avifauna, change in local aesthetics, loss of animal grazing and watering areas, disruption and or fragmentation of local social fabric, change in local air quality, noise and dust disturbance and or pollution to neighbouring learning institutions and loss of community place of worship. The following are some of the proposed mitigation

measures for the identified potential negative impacts that may result from project implementation.

POTENTIAL NEGATIVE IMPACTS	MITIGATION MEASURES
Negative impacts on local water sources • Destruction of local seasonal swamp. • Destruction of local shallow water wells • Blockage of seasonal stream that drains into the seasonal swamp	**Potential negatively impacts likely to result from interference with local hydrology can be mitigated by:-** ✓ Ensuring that the seasonal stream that drains its waters into the local seasonal swamp (Lake Sudi) is not blocked but left to flow normally. ✓ The section of the proposed project site occupied by the seasonal swamp (Lake Sudi) to be curved out of the area to be developed and maintained as undeveloped to sustain the seasonal swamp. ✓ The vegetation within the seasonal swamp and around the seasonal swamp to be preserved for the preservation of the waters of the seasonal swamp and the fauna that live there in. ✓ Any existing upstream seasonal swamps outside the proposed project site to be preserved. ✓ Any downstream seasonal swamps outside the proposed project site to be preserved. ✓ In the case that the seasonal swamp area will be developed (if the relevant authorities issue the permission to the proponent to develop), then dams to be constructed upstream to capture stream

	water when it rains to avoid downstream flooding while ensuring that the seasonal stream channel is not interfered with but instead allowed to follow its course and drain its waters in the sea.
Negative impacts on local fauna The potential impacts on ecological fauna may include: • Interference with movements of animals (mammals and herpetofauna) • Potential destruction of herpetofauna habitats • Destruction of herpetofauna feeding grounds.	✓ Potential negatively impacts likely to result from inference with local fauna can be mitigated by;- ✓ Preserving key habitats of the fauna such as the large baobab trees. ✓ Preserving the seasonal swamp which is a habitat for local amphibians. ✓ Identifying feeding areas of the fauna and preserving them by maintaining pockets of vegetation within the proposed project site in identified strategic fauna feeding areas. ✓ Ensuring there is no capturing and or removal of any fauna from the proposed project site during implementation. ✓ Minimizing noise and vibration from equipment activity during construction phase that might cause some fauna to hibernate and or relocate. ✓ Maintain ecological sensitive vegetation that is essential for the sustenance of local fauna.

Negative impacts on local flora	Potential negative impacts likely to result from inference with local flora can be mitigated by:-
The resulting impact of vegetation clearance will include the following: • Loss of the identified *Crotalaria malindensis*, a plant species endemic in Kenyan and *Crinum kirkii*, a plant species endemic in East African. • Diminishing of local carbon sink resulting in reduced area capacity of carbon sequestration. • Overall reduction of flora in the area and overall loss and/or reduction of ecological and economic services derived from the lost vegetation. • Loss of grazing ground and fodder for animals in the area. • Reduction in local greenery. • Destruction and fragmentation of avifauna habitats that may result in migration of the affected species that will disrupt local food chain. • Destruction of habitats of Herpetofauna, invertebrate, mammals and other animals on site resulting destruction of local feeding	✓ Ensuring endemic species of plants at the proposed project site are preserved. ✓ Mature trees including the large baobab trees to be preserved. ✓ Vegetation within the seasonal wetland and at the periphery of the seasonal wetland to be preserved. ✓ A twenty meter vegetation greenbelt to be maintained between the boundary of the adjacent learning institutions (Marereni Primary School and Marereni Secondary School) and the proposed project site and between the boundary of the adjacent farms and the proposed project site and between the boundary of the adjacent villages and the proposed project site. ✓ Vegetation removal to be done in stages as opposed at once on the entire area to be developed. ✓ Management to substantially invest in tree planting and developed in all open areas that are not earmarked for developed but are within the boundaries of the company land. ✓ Management to support tree planting efforts outside company land

chains and local food webs. • Reduction in local soil nutrients occasioned by reduced nutrient recycling and loss of nitrogen fixing leguminous vegetation.	but within the community to boost overall tree cover in the area to offset trees that will be lost from vegetation to be cleared at the proposed project site.
Negative impacts on avifauna The potential negative impacts on avifauna at the proposed site may include • Direct habitat loss due to annihilation of the species habitats, through various processes and activities including:- ✓ Construction activities will result in destruction of bird habitats at the construction sites. ✓ Trampling on habitats of ground dwelling birds, including bird nests during implementation. ✓ Bird habitat fragmentation making the habitat less attractive to area-sensitive grassland bird species such as pipits. ✓ Disturbance of birds may occur during all phases of the project as a result of increased on-site human activities during site preparation, salt extraction from the pans, maintenance activities.	**Potential negatively impacts likely to result from inference with local avifauna can be mitigated by:-** ✓ Vegetation within the seasonal wetland and at the periphery of the seasonal wetland which is vital for water birds to be preserved. ✓ Maintain a green belt of vegetation along the boundary of the adjacent learning institutions (Marereni Primary School and Marereni Secondary School) and the proposed project site and between the boundary of the adjacent farms and the proposed project site and between the boundary of the adjacent villages and the proposed project site. ✓ Management to substantially invest in establishment of alternative habitats for avifauna by planting tree and developed in all open areas that are not earmarked for developed but are within the boundaries of the company land. ✓ Management to support development of alternative avifauna habitats by supporting tree planting efforts outside company land

• Habitat modification due to changes in land management especially for some of the wetland birds, which may eventually lead to; ✓ Disruption on breeding patterns which will results on diminished bird population. ✓ Migration and relocation of the affected bird species from the area which will affect the local food chain. ✓ Loss of ecological services associated with birds such as pollination. ✓ Destruction of migration route for migrant bird species. ✓ Destruction of foraging grounds of local resident species and migrants (grassland birds, bush land birds, woodland birds, wetlands birds and water birds. ✓ Disruption of the interaction and mutualistic relationship between cattle egrets and heard of cattle which grass at the proposed project site. ✓ The high bird species diversity (sixty nine species) recorded at the proposed project site will diminish as a result of	but within the community to boost overall tree cover in the area to offset trees that will be lost from vegetation to be cleared at the proposed project site.

implementation of the proposed project. ✓ Large population of common and abundant grassland bird species sighted mainly Red-billed quelea; Cattle egrets and African Sacred Ibis will diminish or disappear altogether. • Indirect habitat loss due to the displacement of birds as a result of construction, and maintenance activities, or due to the presence of salt pans and destruction of marshes.	
Visual impacts • Alteration of local aesthetics as a result of; ✓ Clearing the existing variety of vegetation on site ✓ Potential disappearance of species of animals on site ✓ Exposure of open ground ✓ Construction of the evaporators ✓ Construction of dykes ✓ Introduction of brine for salt production. • Glare.	**Potential negative visual impacts can be mitigated by:-** ✓ Establishing a buffer zone between the adjacent schools and the proposed project site and the adjacent villages and the proposed project site. This buffer zone will consist of a twenty meter vegetation greenbelt. ✓ Supporting local community to plant as many trees as possible within their farms that can farther improve on local aesthetics. ✓ The project proponent to plant as many trees as possible in all open undeveloped company land to improve on local aesthetics.

Negative impacts on local agriculture	**Potential negative impacts on local agriculture can be mitigated by:-**
Implementation of the proposed project may potentially affect local agriculture in two ways; ✓ Loss of livestock grazing grounds used by people from the local community ✓ Loss of livestock watering ground used by people from the local community ✓ Reduction of flock of livestock for people from the local community due to diminished grazing and watering areas. ✓ Abandoning livestock farming due to diminished grazing and watering area ✓ Farmers will be forced to look for alternative grazing and watering grounds. ✓ Negative effect on local crop production from neighbouring farms which could be as a result of ground seepage of saline (brine) water in the evaporators adjacent to local farms that may result in salinization of local soils which will eventually alter local soil chemistry that may result in reduced crop productivity and in the very extreme case drying of some of the crops in the	✓ A buffer zone of twenty meters between the neighbouring farms and the proposed evaporators to be maintained. The buffer zone to be planted with trees and other vegetation. ✓ The evaporators to be constructed in such a way that there will be no underground seepage of brine into neighbouring farms. ✓ The seasonal wetland to be preserved as water source for livestock among other uses.

farms.	
Negative impacts on local social fabric ✓ Lure and or involvement of young underage school going girls and boys and the economically disadvantage women from the local community into illicit sexual acts for money and other favours which may damage the social fabric. ✓ The manifestation of illicit sexual behaviour will be a fertile ground for acquiring sexually transmitted diseases including HIV and AID, teenage pregnancy, teenage motherhood, teenage fatherhood and single parenthood among young school going girls and boys which may translate to termination of education.	**Potential negative impacts on the social fabric can be mitigated by:-** ✓ Educating and sensitizing new and existing workers of the salt works on matters of reproductive health, how to manage and be in control of their sexuality and they can relate with the local community in a mutually beneficial way to both the workers and the community. ✓ Conducting peer educator programmes within the salt firm and the neighbouring community on reproductive health, prevention of sexually transmitted infections including HIV and AIDS. ✓ Encouraging workers to live with their spouses. ✓ Educating school going pupils and students to practice sexual abstinence at all times. ✓ Conducting educative seminars on teenage pregnancy prevention in all neighbouring schools and within the community.

Negative impacts on local air quality ✓ Solar and wind action on the brine to be circulated in the pans may result in evaporation of some of the brine into the local atmosphere, this may impact negatively on the quality of air locally.	**Potential negative impacts on local air quality can be mitigated by:-** ✓ Planting as many trees as possible in all open areas within company land which will aid in local air purification. ✓ Establishing a buffer zone between the local community boundary (including neighbouring schools) and the boundary of the salt works to ensure there are salt pans adjacent to the local community and planting as many trees as possible within this buffer zone. ✓ Supporting the local community to plant trees within their farms which will farther contribute in local air purification.
Negative impacts on neighbouring learning institutions Implementation of the proposed development may negatively impact on the institutions in the following ways: ✓ Construction of the evaporators up to the proposed expansion land adjacent to the schools will be a source of noise from equipment activity. ✓ Construction of the evaporators up to the proposed expansion land adjacent to the schools will be a source of dust as a result of excavation and other site works.	**Potential negative impacts to local neighbouring institutions can be mitigated by:-** ✓ There should be no salt pans at close proximity to the schools' boundary instead a buffer zone between the schools' boundary and the salt pans to be created and trees be planted to camouflage the salt pans. ✓ Appropriate access route preferably along the perimeter dyke away from the salt pans to be provided for students to access the school with ease.

✓ Construction of the evaporators up to the proposed expansion land adjacent to the schools will be a source of vibration from equipment activity, disturbance to teachers, pupils and workers of the schools. This will affect learning in the school and other school activities. ✓ Charging of brine in the evaporators for circulation will be a potential safety hazard to school children especially those on nursery and lower primary who may drop in the charged evaporators adjacent to the school and drawn. ✓ Construction of the salt pans may result in blockage of the access route to the schools from the neighbouring villages this may result the pupils forced to use alternative longer routes to school. ✓ Wind action on heaps of harvested salt may result in salt in the local atmosphere that may contribute to corrosion of iron sheets that have roofed the schools.	✓ Krystalline Salt Limited management to support the schools to plant trees in their school compound. ✓ Krystalline Salt Limited to set aside a budget for supporting replacement of corroded iron sheets in the schools as part of the company's corporate social responsibility
Negative impacts on cultural shrine/grove ✓ Within the proposed project site there is a sacred grove which is a place of worship for some members of the local community. Implementation of the proposed project may interfere with the	**Potential negative impacts to local shrine/grove can be mitigated by:-** ✓ Talks between Krystalline Salt Limited and the Elders of the shrine

accessibility, availability, functioning and sacredness of the grove. ✓ The local people may not be able to carry out their traditional worship and associated rituals at the grove.	to be held. ✓ Company management to seek appropriate advice and support of the shrine Elders on how best the shrine and worship activities in the shrine will be handled bearing in mind of the proposed developments in the area.

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1. BACKGROUND OF THE PROJECT

1.1 Project Definition

This is an environmental impact assessment (EIA) study report for the proposed expansion of Krystaline Salt Limited Marereni salt works. The proposed expansion will involve construction of evaporators, dykes and one pump. Under the Classification of Projects which must undergo an environmental impact assessment as outline in the second schedule of the Environmental Management and Coordination Act (EMCA) No. 8 of 1999, the proposed project falls under the second schedule, category 1 (c) major changes in land use.

1.2 Location

Krystalline Salt Limited Marereni is located in Kilifi County, Magarini Sub-County, Gongoni Location, Fundi Issa Location, Marereni Sub-location off Malindi- Lamu Road on land reference number 13427. The proposed expansion will be carried out on a section of the undeveloped land of the said land reference number which falls within the following GPS Coordinates UTM X- 0629397, UTM Y- 9683901, UTM X-0629933, UTM Y-9686198, UTM X-06281010, UTM Y-9686140, UTM X-0628108, and UTM Y-9683877. The approximate area for the proposed expansion will be 800 hectares. Maps 1 give the location of the proposed project site; appendix 1 is the land title deed for the proposed project site.

1.2.1The proposed project site

The proposed project site has a history of land ownership tussle between the local community and Krystalline Salt Limited. The struggle to determine the ownership at one time ended in the court of law by a case filed by members of the local community. The case was later determined by the court in favour of Krystalline Salt Limited (appendix 2 is documentation of the land history tussle including the court determination). Despite this determination, the situation on the ground is different, the community still believe the land belongs to them as reflected in questionnaire survey responses and minutes of public barazas all conducted during stakeholder consultation exercise (see chapter 9 of this report and appendix 14-23). It is however important to note that Krystalline Salt Limited holds a title to the proposed project site and secondly as at the time of field survey and data collection there was no any community settlement at the proposed project site.

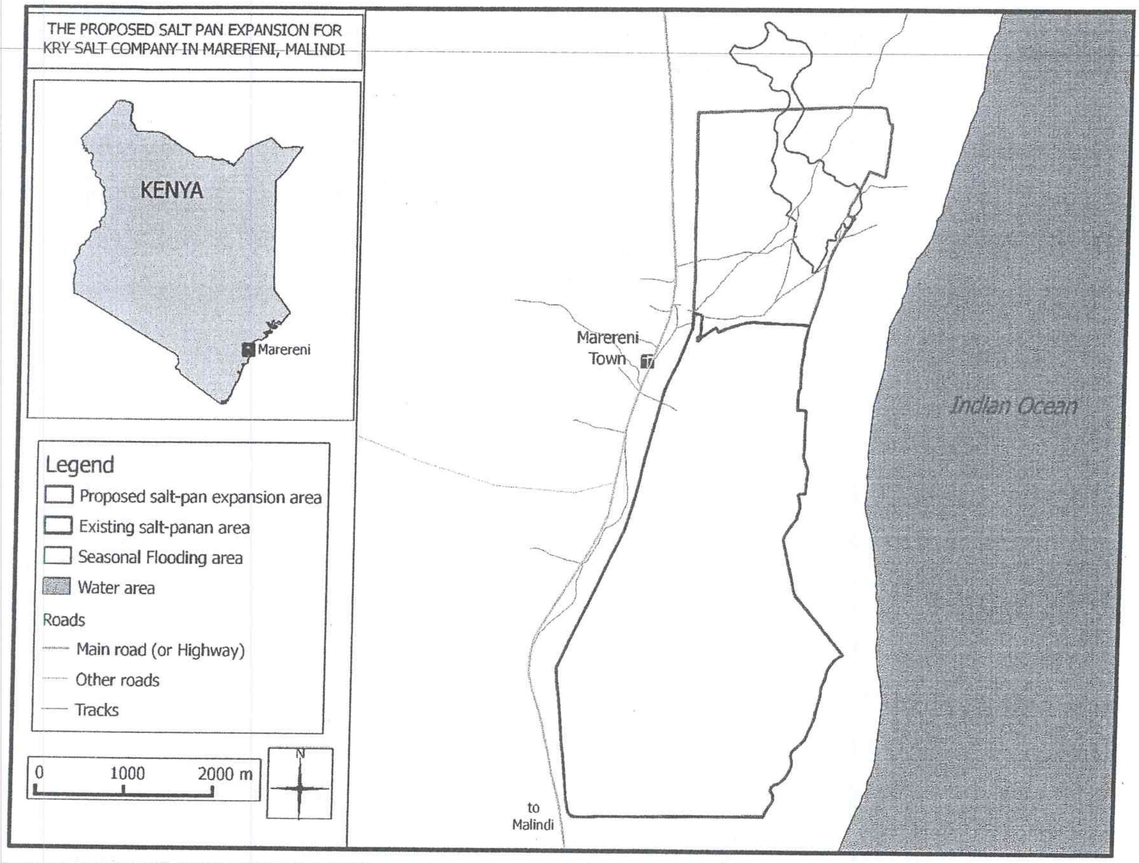


Figure 1: **Location of the proposed project site**

1.3 Project Proponent

The proponent is Krystalline Salt Limited (KSL), a locally incorporated limited company registration number C26958 and personal identification number P0510921151. The company is involved in the business of production, warehousing and sale of iodized table salt, bakery salt and cattle salt. Appendix 3 is copy of certificate of incorporation and PIN. The company operates two salt works, a salt refinery and salt warehouse; the salt works are at Gongoni and Marereni, the salt refinery is at the Gongoni salt works while the warehouse is at Mombasa Changamwe.

1.4 Project Objective and Scope

The objective of the proposed project is to expand the current Krystalline Salt Limited Marereni salt works by constructing new salt evaporating pans referred to as evaporators for the evaporation of brine, new dykes and one pump in an approximate area of 800 hectares.

1.5 Proponent's commissioning instructions

This environmental impact assessment study report was carried out and a report compiled on written instruction from the project proponent to the lead expert and his team. Appendix 4 is a copy of the proponent's written instructions.

1.6 Project Report

An environmental impact assessment project report (NEMA/PR/5/2/12319) for the proposed expansion of the Krystalline Salt Limited Marereni Sat works was prepared and submitted to the National Environment Management Authority (NEMA) on May 15th 2014, appendix 5 is copy of letter of acknowledgement from NEMA of receipt of the project report. Initial review of the project report revealed that the risks associated with the proposed project demands wider public consultation and in depth coverage of the foreseen impacts and mitigation measures. The proponent was then asked to initiate an environmental impact assessment study to facilitate in depth evaluations of potential impacts associated with the proposed project and to materialise harmony with the affected and interested stakeholders. Appendix 6 is a copy of the letter of the initial review from NEMA.

1.7 Terms of reference

Terms of reference (ToR) for the environmental impact assessment study were developed and submitted to NEMA. The ToR was approved by NEMA on the 15TH of September 2014.
This paved way for data collection and compilation of this environmental impact assessment study report. Appendix 7 is copy of the ToR approval letter from NEMA

2. BACKGROUND TO ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Definition of Environmental Impact Assessment

Broadly environmental impact assessment (EIA) refers to the need 'to identify and predict the impact on the environment and on man's health and wellbeing of legislative proposals, policies, programmes, projects and operational procedures, and to interpret and communicate information about the impacts'(Munn 1979). UNECE (1991) defines EIA as 'an assessment of the impacts of planned activity on the environment', IAIA (2009) on the other hand defines EIA as 'the process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of proposed development proposals prior to major decision being taken and commitments made'. Glasson *et.al* (2012) defines EIA as 'a systematic process that examines the environmental consequences of development actions in advance'. EIA is thus a vital tool that aid formulation of development actions, decision making, an instrument for sustainable development and vehicle for stakeholder consultation and participation (Glasson *et.al* 2012).

2.2 The purposes of EIA

2.2.1 An aid to decision making

EIA is an aid to decision-making. For the decision maker, for example, a local authority, it provides a systematic examination of the environmental implications of a proposed action, and sometimes alternatives, before a decision is taken. The EIA can be considered by the decision-maker along with other documentation related to the planned activity. EIA is normally wider in scope and less quantitative than other techniques, such as cost-benefit analysis (CBA).It is not a substitute for decision making, but it does help to clarify some of the trade-offs associated with a proposed development action, which should lead to more informed and structured decision-making. The EIA process has a potential, not always taken up, to be a basis for negotiation between the developer, public interest groups and the planning regulator. This can lead to outcome that balances well the interests of the development action and the environment.

2.2.2 An aid to the formulation of development actions

Developers may see the EIA process as another set of hurdles to jump before they can proceed with their various activities; the process can be seen as yet another costly and time-consuming activity in the development consent process. However, EIA can be of great benefit to them, since it can provide a framework for considering location and design issues and environmental issues in parallel. It can be an aid to the formulation of development actions, indicating areas where a project can be modified to minimize or eliminate all together its adverse impacts on the environment. The consideration of environmental impacts early in the planning life of a development can lead to more environmentally sensitive development; to improved relations between the developer, the planning authority and the local communities; to a smoother development consent process, and sometimes to a worthwhile financial return on the extra expenditure incurred. O'Riordan (1990) links such concepts of negotiation and redesign to the important environmental themes of 'green consumerism' and 'green capitalism'. The growing demand by consumers to goods that do no environmental damage, plus a growing market for clean technologies, is generating a response from developers. EIA can be the signal to the developer of potential conflict; wise developers may use the process to negotiate 'environmental gain' solutions, which may eliminate or offset negative environmental impacts, reduce local opposition and avoid costly public inquiries. This can be seen in the wider and contemporary context of corporate social responsibility (CSR) being increasingly practiced by major businesses (Crane et al.2008)

2.2.3 A vehicle for stakeholder consultation and participation

Development actions may have wide-ranging impacts on the environment, affecting many different groups in society. There is increasing emphasis by government at many levels on the importance of consultation and participation by key stakeholders in the planning and development of projects. EIA can be a very useful vehicle for engaging with communities and stakeholders, helping those potentially affected by a proposed development to be much better informed and to be more fully involved in the planning and development process.

2.2.4 An instrument for sustainable

Existing environmentally harmful developments have to be managed as best as they can. In extreme cases, they may be closed down, but they can still leave residual environmental problems for decades to come. It would be much better to mitigate the harmful effects in advance, at the planning stage, or in some cases avoid the particular development together. This of course leads on to the fundamental role of EIA as an instrument for sustainable development-a role some writers have drawn attention to as one often more hidden than it should be when EIA effectiveness is being assessed (Jay et al.2007)

2.3 Origins and development of EIA

The first EIA legislation was formerly established in the United States of America in 1969 (NEPA 1970), in Europe the 1985 European Community directive on EIA (Directive 85/337) introduced broadly uniform requirements for EIA for all member states (CEC, 1985). In Australia, the Commonwealth EIA system was established in 1974 under the Environmental Protection (Impact of Proposal) Act (Wood 2003, Ellott and Thomas, 2009). The United Kingdom enacted a formal legislation on EIA in 1988 (Glasson *et.al* 2012). China formerly enacted its first EIA legislation in 1979 (Moorman and Ge 2007). In Africa and the Middle East, Israel and Algeria pioneered in enactment and implementation of EIA legislations in 1982, 2003 and 1983, 1990 respectively (Economic Commission for Africa, (2005) Almagi *et.al* (2007). In East Africa Uganda pioneered in enacting EIA legislation in 1998, Kenya EIA legislation was enacted in 2000, and implemented in 2003 (Morara *et.al* 2011).

2.4 This Environmental Impact Assessment Study

Detailed environmental impact assessment study for the current proposed project involved, but was not necessarily limited to, the following:

- ✓ Collection of baseline data and information
- ✓ Description of affected environments
- ✓ Participation of stakeholders
- ✓ Identification and assessment of potential impacts (both negative and positive) of the project to the environment
- ✓ Proposal of possible mitigation measures to curb any potential negative impacts, while outlining interventions to enhance the positive impacts
- ✓ Development of an appropriate Environmental Management Plan (EMP).

The role of the stakeholder participation was to:

(a) Establish common stakeholder needs and ensure that the project continues to satisfy these needs or even enhance the needs.

(b) Provide background information which will form an important part of baseline data.

(c) Create awareness amongst the stakeholders and sensitise them on environmental issues related to the project.

2.5 Preparation of the EIA Study Report

EIA Study Report prepared for the proposed project contains detailed information on the project, including the following:-

- ✓ Location of the project
- ✓ The objectives of the project

- ✓ Baseline information such as descriptions of the natural, social and operational environments the current policy and legal framework and the administrative arrangement under which the project will operate.
- ✓ The technology, procedures and processes to be used in implementation of the project.
- ✓ Alternative technologies and processes available and reasons for preferring the chosen technology and processes.
- ✓ The wastes to be generated by the project and ways of handling it.
- ✓ A description of potentially affected environments.
- ✓ The environmental effects of the project: including the social and cultural effects and the direct, indirect, cumulative, irreversible, short term and long term effects anticipated.
- ✓ An EMP proposing measures for eliminating, minimising or mitigating adverse impacts on the environment, while enhancing the positive effects; including the cost, time frame, and responsibility to implement these measures.
- ✓ Provision of an action plan for the prevention and management of foreseeable accidents and hazardous activities.
- ✓ Measures to prevent health hazards and to ensure security in the working environment for the employees and users of the facility, and for management of emergencies.
- ✓ An economic and social analysis of the project.
- ✓ An identification of gaps in knowledge and uncertainties which were encountered in compiling the information.
- ✓ A non-technical summary outlining the key findings, conclusions and recommendations of the study.

2.6 Team of Experts

The Team of Experts who undertook the environmental impact assessment study are James Morumbasi Mong'oni a registered EIA/EA Lead Expert a licensed Safety Advisor and authorized Inspector of pressure vessels and lifting equipment, Dr. George Eshiamwata registered EIA/EA Lead Expert, an ornithologist and ecologist, Philip Manyi Omenge EIA/EA Lead Expert, Natural resources management scientist and rural development specialist, Dickens Odeny Land Ecologist and GIS specialist and Brenda Nyaboke Nyandika a Botanist. Appendix 8 is certificate of registration and practicing licence of the lead experts, table 1 is the details of the team of specialists.

Table 1: Team of specialists

Name	Profession / Designation	Education Background
James.Morumbasi.	EIA/EA Lead Expert,	Master Business Administration. MBA

Mong'oni (MBA)	Occupational Safety and Health (OSH) Practitioner Trainer in Occupational Safety and Health in the workplace OSH Risk Assessment Expert Fire safety Auditor Authorized Plant Inspector (Pressure Vessels and Lifting Appliances)	Postgraduate Certificate in Occupational safety and Health Risk Assessment Postgraduate certificate in Environmental Impact Assessment Postgraduate Certificate on Advanced Information Processing, Postgraduate Certificate in Occupational Safety and Health Bachelor of Science in Mechanical Engineering, BSc(Mech Eng)
Dr. George Eshiamwata (PhD)	EIA/EA Lead Expert, Ornithologist/ ecologist	PhD; land cover change at key biodiversity sites vs. site protection, community conservation, agricultural intensity and human population density in Eastern Africa using remote sensing M.Sc.; Conservation Biology, Bsc; Natural Resources Management
Philip Manyi Omenge (MSc.)	EIA/EA Lead Expert, Natural Resources Management Scientist/Rural Development specialist	MSc. (with dissertation) Rural Development Studies, SLU, Uppsala Bsc (Hons), Natural Resources Management, Egerton University Cert. Environmental Audit; KNCPC, Nairobi
Dickens Odeny (MSc.)	Land Ecologist/ GIS Specialist	Currently undertaking PhD in GeoInformation University of Nairobi. Topic biodiversity and carbon storage modelling in eastern Africa mountain forests: Taita Hills (Kenya) and Mt. Kilimanjaro Area (Tanzania). MSc. Water and Coastal Management University of Plymouth (Plymouth City, United Kingdom) and Universidade do Algarve (Faro, Portugal) BSc. Environmental Science. Kenyatta University
Brenda Nyaboke Nyandika (B.Phi Biotec)	Ecologist/Botanist	Bachelors of Philosophy in Biotechnology University of Nairobi. DNA Barcording of Plants University c

		Johannesburg, Higher Diploma in Biotechnology Ken Polytechnic University College Diploma in Applied Biology Mombasa Polytechnic

3. POLICY AND LEGAL FRAMEWORK

3.1 Introduction

Legislation, laws, policies and regulations specific to environmental management can directly or indirectly affect the implementation of proposed project. Kenya is a signatory to many international conventions and treaties. Some of the International Treaties and Conventions Binding Kenya include:

- Agenda 21
- The World Commission on Environmental and Development (The Brundtland Commission) – signed/ratifies 1987
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – ratified 1978
- Convention on Biological Diversity (CBD) – signed/ratified 1992
- United Nations Framework Convention on Climate Change (UNFCCC) – signed/ratified 1994
- United Nations Framework Convention on Climate Change (UNFCCC) – Kyoto Protocol signed/ratified (1997)
- African Convention on the Conservation of Nature and Natural Resources
- International Union for Conservation of Nature

Kenyan Environmental Legislation are determined and enforced through various levels of statutes the majority of which are sector specific. The Environment Management and Coordination Act (EMCA) 1999 is the governing law for the Protection and Development of the Environment in the Kenya. It is considered the base for various environmental regulations and guidelines. Some of the legislation that arse relevant to this project include

- □ The Environmental Management and Coordination Act of 1999
- □ The Environmental Management and Coordination (Water Quality) Regulations, 2006

- The Environmental Management and Coordination (Waste Management) Regulations, 2006
- The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009
- The Physical planning Act
- The Local Authority Act
- The Public Health Act
- The Water Act of 2002
- The Employment Act 2007
- The Work Injuries Benefits Act 2007
- The labour Institutions Act 2007
- The Occupational Safety and Health Act 2007
- The Environmental Management and Coordination (Conservation of Biological Diversity an Resources, Access to Genetic Resources and Benefit sharing) Regulations
- The Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Se Shore Management) Regulations 2009
- The Environmental (Impact Assessment and Audit) Regulations 2003
- The Standards Act, Cap 496
- Government Land Act Cap 280
- Land Control Act Cap 302
- Land Planning Act (Cap. 303)
- The Land Acquisition Act Cap 295
- The Antiquities and Monument Act Cap 215

3.1 Binding multilateral agreements/ conventions

3.1.1 Agenda 21

Kenya continues to implement Agenda 21 to support sustainable development through the integration of environmental concerns into the national development policies, plans, and programmes

3.1.2 The World Commission on Environmental and Development (The Brundtland Commission) – signed/ratifies 1987

The commission focuses on the environmental aspects related to development and requires all development projects to be sustainable economically, socially and environmentally. The principle of the organisation emphasis that development project should not have permanent negative impact on the biosphere and in particular the ecosystems.

3.1.3 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – ratified 1978

This is an international agreement to which countries adhere voluntarily. CITES is legally binding on the parties but it does not take the place of national law. Kenya has signed this convention and it seeks to regulate trade in certain species and their parts, as well as products made from such species e.g. certain tree and fish species. This convention protects forests as habitat for endangered species.

3.1.4 Convention on Biological Diversity (CBD) – signed/ratified 1992

Commonly known as the Bio-diversity Treaty, this is one of the treaties that was open for signature at UNCED, 1992. This convention is a practical tool for translating the principles of Agenda 21 (Rio Earth Summit) into reality. The Convention is dedicated to promoting sustainable development. Parties to the treaty solemnly affirm sovereign rights over their biological sources, while accepting responsibility for conserving biological diversity and using biological resources in a sustainable manner. All developers need to ensure their operation promote national strategies, legislation, plans and programmes and avoid loss of biodiversity within their property.

3.1.5 United Nations Framework Convention on Climate Change (UNFCCC) – signed/ratified 1994

The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. Kenya and other states gather and share information on greenhouse gas (GHG) emissions, national policies and best practices.

3.1.6 African Convention on the Conservation of Nature and Natural Resources

This convention reaffirms the importance of natural resources both renewable and non-renewable, particularly the soil, water, flora and fauna. The main objective is to facilitate sustainable use of the above resources. The convention was adopted in Algiers on 15th September 1966 and came into force on 16th June 1969.

3.1.7 International Union for Conservation of Nature

International Union for Conservation of Nature (IUCN) helps the world find pragmatic solutions to our most pressing environment and development challenges. IUCN categorises protected areas by management objective and has identified six distinct categories of protected areas according to their management objectives. The categories are recognised by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation.

3.2 Kenya Environmental legislation

3.2.1 Environmental Management and Co-Ordination Act (EMCA), 1999

The EMCA, 1999 provides the legal framework for management of the environment and other related issues in Kenya. It is the policy of the Government of Kenya that EIA be conducted for planned projects that are likely to cause, or will have, significant impacts on the environment, so that adverse impacts can be foreseen, eliminated or mitigated. It is also policy of the government that the EIA process be interdisciplinary, fully transparent so that the stakeholders have access and can express their views. This is in order that the process serves to provide a balance between environmental, economic, financial, social and cultural values for purposes of sustainable development of the entire country. The policy therefore, through the use and application of EIA, seeks to integrate environmental concerns in all development policies, plans, projects and programs at national, regional, district and local levels with full public participation of all stakeholders.

The undertaking and administration of the EIA process for the proposed project will be in accordance with the Environmental (Impact Assessment and Audit) Regulations, 2003. Some of the administrative procedures of EMCA include:

- The EIA process will be applicable to both public and private sector development projects and programs.
- The projects to be subjected to EIA are specified in the second schedule of the EMCA, 1999. Besides the scheduled activities, the Act empowers the Minister in charge of environment to prescribe for EIA appraisal any other activities, which in his view carries significant environmental impacts.
- NEMA will designate environmental committees to oversee implementation at Provincial and District levels.
- NEMA will initiate public participation through uses of public notices and meetings with regard to proposed EIA studies and review of reports.
- A scheduled activity will not receive the necessary authorisation from NEMA to proceed, until all EIA requirements have been fulfilled and accepted by NEMA and relevant lead agencies.
- EIA License will be granted when NEMA and the Minister are satisfied that an EIA has been satisfactorily conducted and that an Environmental Management Plan of the activity has been sufficiently developed.
- Complains with regard to compliance with EIA licensing requirements and procedures that NEMA may not resolve will be subject to a review by the Environment Tribunal. Under the Act there are general provisions for appeal to high courts and to bring proceedings in a court of law where necessary, for judicial review by third parties including concerned citizens and/or organisations other than the Government.

3.2.2 The Environmental Management and Coordination (Water Quality) Regulations, 2006

The regulations protect all water resources. Relevant features of this regulation as far as this study is concerned include:-

- ✓ Every person shall refrain from any act which will directly or indirectly cause pollution and it shall be immaterial whether or not the water resource was polluted before the enactment of these regulations;
- ✓ No person shall throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance as to cause pollution;

- ✓ Discharge of effluent from sewer must be licensed according to the act; and the carry out daily effluent discharge quality and quantity monitoring and shall comply with the standard set in the fifth Schedule of the act.
- ✓ Water abstraction must only be done after approval of an Environmental Impact Assessment study;
- ✓ The regulations also set out standards to be followed for effluent discharge to the environment.
- ✓ No person shall be permitted to use waste water for irrigation purposes unless such water complies with the quality guidelines set out in the 8^{th} Schedule of the act.
- ✓ No person shall use or allow to be used any natural water body for recreational purposes unless the water body meets the quality standards for recreational standards as set out in the tenth schedule of the regulation.

3.2.3 The Environmental Management and Coordination (Waste Management) Regulations, 2006

Relevant parts of this regulation include

- ⇒ Prohibition of any waste disposal on a public highway, street, road, recreation area or in any public place except in designated waste receptacle;
- ⇒ All waste generator to collect, segregate and dispose such waste in a manner provided for under these regulations;
- ⇒ All waste generators to minimize waste generated by adopting cleaner production methods through:
    - improvement of production process;
    - monitoring the product cycle from beginning to the end;
    - incorporating environmental concerns in the design and disposal of products;
- ⇒ All waste transporters to be licensed according to the act;
- ⇒ All vehicles used to transport waste to be labelled in such a manner as may be directed by the Authority;
- ⇒ Collection and transportation of the waste to be done in such a manner no to cause scattering of the waste;
- ⇒ The vehicle and equipment for waste transportation to be in such a manner not to cause scattering of or flowing out of waste; and

⇒ The vehicles for transportation and other means of conveyance of waste to follow the scheduled routes approved by the authority from the point of collection to the disposal site.

⇒ No person shall engage in any activity likely to generate any hazardous waste without a valid EIA licence issued by Authority

⇒ Every generator of hazardous waste shall ensure that every container or package for storing such waste is labelled in easily legible characters, written in both English and Kiswahili: 'CAUTION', 'WARNING', 'POISON', 'DANGER', 'KEEP AWAY FROM UNAUTHORISED PERSON' and pictogram of skull and crossbones.

The proposed project shall generate solid wastes and liquid wastes which must be subjected to the mentioned parts of the regulations.

3.2.4 The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009

Part II of the general prohibition of this regulation state that except as otherwise provided for in this regulations, no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. Part (2) of the general prohibitions stated that in determining whether noise is loud, unreasonable, unnecessary or unusual the following factors may be considered:-

⇒ Time of the day;

⇒ Proximity to residential area;

⇒ Whether the noise is recurrent, intermitted or constant;

⇒ The level and intensity of the noise;

⇒ Whether the noise has been enhanced in level or range by any type of electronic or mechanical means; and

⇒ Whether the noise can be controlled without much effort or expense to the person making the noise.

Part 2 of section III states that any person wishing to operate or repair any machinery, motor vehicle, construction equipment or other equipment, pump, fan, air-conditioning apparatus or similar mechanical device or engage in any maisonettes or industrial activity which is likely to emit noise or excessive vibrations shall carry out the activity or activities within relevant levels prescribed in the first schedule to these regulations. Part III section 13 (1) states that except for the purpose specified in sub-Regulation (2)… no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or electric hoist) or perform any outside construction or repair work so as to emit noise in excess of the permissible levels as set out in the second schedule of the regulations.

3.2.5 The Physical Planning Act

The Physical Planning Act governs how development is to be carried out in major towns and urban centres. The Department of Physical Planning, in the Ministry of Lands and Settlement, administers the Act. Under the Act, the Department of Physical Planning first approves all Partial Development Plans (PDPs) of infrastructure and other developments before the projects are implemented.

3.2.6 The Local Authorities Act

Under the Local Authorities Act the Kilifi County assumes a number of roles in its area of jurisdiction, which includes the proposed project area. The roles include issuance of licenses for businesses, collection of refuse, setting up of adequate lighting, provision of water and sewerage services in the area, among others.

3.2.7 The Public Health Act

The Public Health Act outlines how different aspects of a project have to be undertaken to ensure the safety and health of users and neighbours. The Act gives guidelines on construction, maintenance and inspection of drainage system, septic tanks, cesspool or latrines.

3.2.8 Water Act 2002

The water Act of 2002 aims to "make better provision for conservation, apportionment and use of water resources of Kenya". Section 5 of the Act prohibits any persons from diverting, abstracting, obstructing or using water from a body of water except as provided for in the Act. The Act stipulates that a permit shall be required in all cases of proposed diversion, obstruction, storage or use of water with exception in the use for domestic purposes. However, general rules within the Act provide that any rights acquired under the permit are subject to the Public Health Act and the Malaria Prevention Act in addition to the Water Act.

Definitions

a) Catchment Area ……….. This is a designated area from which rainwater flows into watercourses.

b) Catchment Area Advisory Committee………This refers to a Committee of not more than 15 members appointed by the Minister.

c) "In-Stream Habitat"…………These includes the physical structure of a water resource and the associated vegetation in relation to the bed of the water course.

d) "Ground water"………..Means the water of underground streams, channels, artesian basins, reservoirs, lakes and other bodies of water in the ground, and includes water in interstices below the water table;

e) "Landholder" In relation to lands, means the registered of the land or the person whom the land is otherwise vested by law, and includes:-

- Any person who by any established right, custom or estate whatsoever is, or is entitled to be the holder or possession of the land;
- Any person lawfully holding or occupying land in accordance with the provisions of any law empowering the allotment of land upon the promise of title, subject to the fulfilment by the allottee of prescribed conditions; and
- Any person to whom a mining lease or mining location has been granted under the Mining Act.

f) Pollution…….. In relation to water resource, means any direct or indirect alteration of the physical, thermal, chemical or biological properties of the water resources so as to make it:-

- Less fit for any beneficial purpose for which it is or may reasonably be expected to be used; or
- Harmful or potential harmful to –

- The welfare, health safety of human beings;
- Any aquatic or non-aquatic life or property; or
- The Environment

g) "Resource Quality"…….This means the quality of all the aspects of a water resource including:-

- ✓ The water Quality stipulated for the reserve;
- ✓ The Quantity, pattern, timing, water level and assurance of in stream flow;
- ✓ The physical, chemical and biological characteristics of the water;

- ✓ The character and condition of the in-stream and the riparian habitat; and
- ✓ The characteristics, condition and distribution of the aquatic biota.

h) "Riparian habitat"..........means the dynamic complex of plant, animal and microorganism communities and their non-living environment adjacent to and associated with a water course;

i) "Spring".....means water emerging from beneath the surface of the ground otherwise than as a result of drilling or excavation operations;

j) "Stream".......Means the water contained in a watercourse, and includes a river;

k) "Water resource".........This refers to any lake, pond, swamp, marsh, stream, watercourse, estuary, aquifer, artesian basin, or other body of or standing water, whether above or below ground;

l) "Watercourse"........This means any natural channel or depression in which water flows regularly or intermittently, unless declared not to be a watercourse.

Ownership and Control of Water

In the section 3 of the Act, it is therefore stated that every water resource is hereby vested in the State, subject to any rights of user granted by or under the Act or any other written Law.

a) Powers and duties of the Minister

The Minister shall have and may exercise control over every water resource in accordance with this Act.

It shall be the duty of the Minister to promote the investigation, conservation and proper use of water resources throughout Kenya and to ensure the effective exercise and performance by any authorities or persons under the control of the Minister of their powers and duties in relation to water.

The Minister shall be assisted in the discharge of his duties under this section by the director of water.

b) Right to use water

The right to use of water from any water resource is hereby vested in the Minister, except to the extent that it is alienated by or under section 5 of the Act.

c) Acquisition of water rights

In section 6 of the Act, it is stipulated that from the commencement of the Act, no conveyance, lease, or other instrument shall be effectual to convey, assure, demise, transfer or vest in any person any property or right or any interest or privilege in respect of any water resource, and no such property, right, interest or privilege shall be acquired otherwise than under this Act.

Water Resources Management

a) Establishment of the Authority

In section 7 of the Act, there is established Authority known as the Water Resources Management Authority which is a body corporate with perpetual succession and a common seal and shall have power, in and by its corporate name, to sue and be sued and, in the exercise and performance of its powers and functions, to do and permit all such things as may lawfully be done or permitted by a body corporate in furtherance of its objects

b) Powers and functions of the Authority

Section 8 of the Act thereby enlists the powers and functions of the Authority as:-

To develop principles, guidelines, and procedures for the allocation of water resources;

To monitor, and from time to time re-assess, the national water resources management strategy;

To receive and determine applications for permits for water use;

To monitor and enforce conditions attached to permits for water use;

To regulate and protect water resources and quality from adverse impacts;

To manage and protect water catchments;

In accordance with guidelines in the national water resources management strategy, to determine charges to be imposed for the use of water from any water resource;

To gather and maintain information on water resources and from time to time to publish forecasts, projections and information on water resources,

To liaise with other bodies for the better regulation and Management of water resources; and

To advise the Minister concerning any matter in connection with water resources.

c) Catchment Management Strategy

Section 15 of the Act states that the Authority, following the public consultation, shall formulate a catchment management strategy for the management, use, development, conservation, protection and control of water resources within each catchment area.

A catchment management strategy shall:-

- ✓ Take into account the class of water resource and resource quality objectives for the water;

- ✓ Be consistent with the national water resources strategy;
- ✓ Prescribe the principles, objectives, procedures and institutional arrangements of the Authority for the Management, use, development, conservation and control of water resources within each catchment area;
- ✓ Contain water allocation plans which set out principles for allocating water; and
- ✓ Provide mechanisms and facilitates for enabling the public and communities to participate in managing the water resources within each catchment area.

d) Catchment area advisory committee

In Section 16 of the Act, there states that the Authority, in consultation with the Minister, shall appoint a committee of not more than 15 members in respect of each catchment area. The Catchment area advisory committee shall, in relation to the catchment for which it is appointed, advise officers of the Authority at the appropriate regional office concerning:-

- ✓ Water resources conservation, use and apportionment;
- ✓ The grant, adjustment, cancellation or variation of any permit; and
- ✓ Any other matters pertinent to the proper management of water resources.
- ✓ The members of the catchment area advisory committee shall be chosen from among:-
- ✓ Representatives of Ministries or public bodies responsible for matters relating to water resources in the catchment area;
- ✓ Representatives of any regional development authorities and local authorities whose areas of jurisdiction or any part thereof fall within the catchment area concerned;
- ✓ Representatives of farmers of pastoralists within the catchment area concerned;
- ✓ Representatives of the business community operating within the catchment area concerned;
- ✓ Representatives of the Non-Governmental Organizations engaged in water resources management programmes within the catchment area concerned; and
- ✓ Other persons who have demonstrated competence in matters relating to the management of water resources.

National Monitoring of and information on water resources management

The National water resources management strategy shall provide for national monitoring and information systems on water resources.

The system shall provide for-

- ❖ The collection and management of Data and information regarding water resources and the management; and
- ❖ Procedures for gathering data and the analysis and dissemination of information on water resources.

3.2.9 Employment Act 2007

General Principal

The Act constitutes minimum terms and conditions of employment of an employee and any agreement to relinquish vary or amend the terms set shall be null and void.

The act stipulates that no person shall use or assist any other person, in using forced labour. Clause 5 of the act states that its shall be the duty of the Minister, Labour officer, the National Labour Court and the subordinate labour courts to; Promote equality of opportunity in employment in order to eliminate discrimination in employment Promote and guarantee equality of opportunity for a person who, is a migrant worker or a member of the family of the migrant worker lawfully within Kenya

No employer shall discriminate directly or indirectly, against an employee or prospective employee or harass an employee or prospective employee on the following grounds; race, colour, sex, language, religion, political or other opinion, nationality, ethnic or social origin, disability, pregnancy, mental status or HIV status. An employer shall pay his employees equal remuneration for work of equal value

Part IV Rights and duties of employment

The provisions of this part and part VI constitute basic minimum and conditions of contract of service. The employer shall regulate the hours of work of each employee in accordance with provisions of this Act and any other written law. Subsection (2) of section 27 states that an employee shall be entitles to at least one rest day in every period of seven days. An employee shall be entitles to not less that twenty-one working days of leave after every twelve consecutive months. Section 29 of the Act stipulates that a female employee shall be entitled to three months maternity leave with full pay. Subsection 8 of section 29 further states that no female employee shall sacrifice her annual leave entitlement on account of having taken her maternity leave. *Section 37 (conversion of casual employment to term contract)* Where a casual employee works for a period or a number of continuous working days which amount in the aggregate to the equivalent of not less than one month; or performs work which cannot reasonably be expected to be completed within a period, or a number of working days amounting in the aggregate to the equivalent of three months or more. The contract of service of the casual employee shall be deemed to be one where wages are paid monthly. In calculating wages and the continuous working days, a casual employee shall be deemed to be entitled to one paid rest day after a continuous six days working period and such rest day or public holiday which falls during the period under consideration shall be counted as part of continuous working days.

3.2.10 Work Injuries Benefits Act 2007

Obligations of Employers

Section 7 of the Act stipulates that every employer shall obtain and maintain an insurance policy, with an insurer approved by the Minister in respect of any liability that the employer may incur under this Act to any of his employees.

Registration of employer

Every employer carrying on business in Kenya shall within the prescribed period and in the prescribed manner register with the Director of Occupational Health and Safety Services and any other information as the Director may require.

Subsection 4 of section 8 of the Act states that where an employer carries on business in more than one workplace, or carries on more than one class of business, the Director may require the employer to register separately in respect of each place or class of business.

Employer to keep record (Section 9)

Section 9 states that an employer shall; Keep a register or other record of the earnings and other prescribed particulars of all employees and produce the same on demand by the director for inspection. Such records shall be retained for at least six years after the date of last entry.

Right to compensation

An employee who is involved in an accident resulting in the employee's disablement or death is subject to the provisions of this Act, and entitled to the benefits provided for under the Act. Subsection 3 of section 10 of the ACT however states that no employee shall be entitled to compensation if an accident, not resulting in serious disablement or death, is caused by the deliberate and wilful misconduct of the employee. Section 12 of the act stipulates that if an employee is injured in an occupational accident or contracts an occupational disease while the employee, with the consent of the employer. is engaged in any organized first aid, ambulance or rescue work, or fire fighting or other emergency services, the accident or disease is for the purpose of this Act, deemed to have arisen out of an in the course of the employee's employment

Reporting of accidents

A written or verbal notice of any accident shall be given by or on behalf of the employee concerned to the employer and a copy to the Director of occupational health and Safety within twenty-four hours of its occurrence in case of fatal accident.

Lapse of right to benefits

A right to benefits in accordance with this Act shall lapse if the accident is not reported to the employer within twelve months after the date of such accident. However, it shall not be bar to compensation if it is proved that the employer had knowledge of the accident from any other source. Section 30 of the Act states that compensation for permanent disablement shall be calculated on the basis of ninety six months earnings subject to the minimum and maximum amounts determined by the minister after consultation with the board. In case of a fatal accident compensation shall be paid to the dependants of the employee in accordance with the set provisions in the third schedule. The employer shall further be liable to pay reasonable expenses for the funeral of the deceased employee subject to the maximum amount determined by the minister, after consultation with the National council for occupational Health and Safety

The First Schedule of the Act gives the minimum degree of Disablement for various body parts while the second Schedule gives a list of work description and the associated occupational disease.

3.2.11 Labour Institutions Act 2007

The Act establishes the National Labour Board whose functions shall be to advice the minister on;

- All matters concerning employment and labour
- Legislation affecting employment and labour
- Any matter relating to labour relations and trade unionism
- Labour inspection service
- Reported strikes and lockouts
- Labour facility information and indices etc.
- The board shall in consultation with the minister, establish;
- Work permit committee
- National manpower development committee

- Trade dispute committee
- Productivity committee and such other committees or panel as are necessary for the performance of board's functions.

Section 34 of the act stipulates that an authorized officer may either alone or in the presence of another person, enter any premises or place where persons are, or may be employed for the purpose of performing his duties as specified under the Act.

The labour officer may, for the purpose of monitoring or enforcing compliance with any law require the production of wages sheets or other employment records kept by an employer, enter inspect and examine all latrines and other sanitary arrangements or water supply, inspect and examine all food provided or appearing to be provided for employees, and take samples thereof in duplicate, in the presence of the employer or the employers representative which samples shall be sealed and one sample so sealed shall be left with the employer, order that all buildings and premises where employees are housed or employed be kept in a clean and sanitary condition.

Section 37 of the act states that the medical officer shall exercise the powers conferred upon the labour officer and in addition;

- Order an employee who, in his opinion is sick and for whom the conditions prevailing at the place of employment are not conducive to rapid recovery of his health to proceed to hospital and in that case the employer shall at the earliest opportunity and at his own expense send the employee to the place of work or to a hospital, as the case may be.
- Condemn any food provided for employees which, in the opinion of the medical officer, is unfit for human consumption, and all food so condemned shall be destroyed forthwith in the presence of the medical officer.
- Order at the expense of the employer, such variety of food for an employee as he may deem necessary
- Inspect all drugs and medicine provided for the use of employees

3.2.12 The Occupational Safety And Health Act 2007

Part II – General Duties of the Occupiers

In Section 6 (1), it is stated that the occupier shall ensure the safety, health and welfare at work of all persons working in his work place.

Without prejudice to the generality of an occupier's duty under sub section 1 above, the duties of the occupier includes:-

- The provision and maintenance of plant and systems and procedures of work that are safe and without risk to health;
- Arrangements for ensuring safety and absence of risks to health and connection with the use, handling, storage and transport of articles and substances;
- The provision of such information, instruction, training and supervision as is necessary to ensure the safety and health at work of every person employed;
- The maintenance of any workplace under the occupier's control, in a condition that is safe and without risks to health and the provision and maintenance of means of access to and egress from it that are safe and without such risks to health;
- The provision and maintenance of a working environment for every person employed that is, safe, without risks to health, and adequate as regards facilities and arrangements for the employees welfare at work;
- Inform all persons employed of:-
    - Any risks from new technologies; and
    - Imminent danger; and
- Ensuring that every person employed participates in the application and review of safety and health measures.

Every occupier shall carry appropriate risk assessments in relation to the safety and health of persons employed and adopt preventive and protective measures to ensure that under all conditions of their intended use without risk to health and comply with the requirements of safety and health provisions.

The occupier shall send a copy of a report of Risk Assessment carried out under this section to the area occupational safety and health officer and shall take (occupier) immediate steps to stop any operation or activity where there is an imminent and serious danger to safety and health and to evacuate all persons employed as appropriate.

Duty to prepare a safety and health policy statement

In Section 7 (1) (a) and (b), it is established that except in such cases that as may be prescribed, it is the duty of every occupier to:-

- Prepare and, as often as may be appropriate, revise a written statement of his general policy with respect to the safety and health at work of his employees and the organization and arrangements for the time being in force for carrying out that policy; and
- To bring the statement and any revision of it to the notice of all of his employees.

Discrimination against employee

Sub section (1) of Section (8) states that the occupier shall not dismiss an employee, injure the employee or discriminate against or disadvantage an employee in respect of the employee's employment, or alter the employee's position to the detriment of the employee by reason only that the employee:-

- Makes a complaint about a matter which employee considers is not safe or is a risk to his health;
- Is a member of a safety and health committee established pursuant to this Act; or
- Exercises any of his functions as a member of the safety and health committee.

Safety and Health Committee

Section (9) (1) Illustrates that an occupier shall establish a safety and health committee at the workplace in accordance with the regulations prescribed by the Minister if:-

- There are twenty or more persons employed at the workplace; or
- The Director directs the establishment of such a committee at any other workplace.

Duty not to charge employees for things done or provided

Section (10) (1) states that an Employer shall not make any deduction from an employee's remuneration or levy, or permit to be levied on any of his employees any charge in respect of anything done or provided in pursuance of this Act or any regulation made there under.

Safety and Health Audits

Section 11 (1) of the Occupational Safety and Health Act 2007 outlines that the occupier of a workplace shall cause a thorough safety and health audit of his workplace to be carried out at least once in every period of twelve months by a safety and health advisor, who shall issue a report of such an audit containing the prescribed particulars to the occupier on payment of a prescribed fee and shall send a copy of the report to the Director. The Audit report referred above shall be preserved and be kept available for inspection by the Occupational Safety and Health Officer.

Duties of Self Employed person

Every self-employed person shall:-

⇒ Take all the necessary precautions to ensure his own safety and health and that of any other person in his workplace or within the environs of his workplace;

⇒ All times use appropriate systems of work, preventive and control measures and where not feasible, use suitable personal protective appliances and clothing required under this Act;

⇒ Comply with any safety and health rules, regulations instructions and procedures issued under this Act;

⇒ Report to the Director:-

- Any situation which he has reason to believe would present imminent danger or hazard and which he cannot correct, and
- Any incident or injury that arises in the course of or in connection with his works, as required under this Act.

Duties of Employee

Every employee shall, while at workplace:-

- Ensure his own safety and health and that of other persons who may be affected by his Acts or omissions;

Co-operate with his employer or any other person in the discharge of any duty or requirement imposed on the employer or that other person by this Act or any regulation made hereunder;

- At all times wear or use any protective equipment or clothing provided by the employer for the purpose of preventing risks to his safety and health;
- Comply with the safety and health procedures, requirements and instructions given by a person having authority over him for his own or any other person's safety;
- Report to the supervisor, any situation which he has reason to believe would present a hazard and which he cannot correct;
- Report to his supervisor any accident or injury that arises in the course of or in connection with his work; and

- With regard to any duty or requirement imposed on his employer or any other relevant statutory provision, co-operate with the employer or other person to enable that or requirement to be performed or compiled with.

Notice of accidents and dangerous occurrences

Section 21(1) Stipulates that; an employer or self-employed person shall notify the area Occupational Safety and Health Officer of any accident, dangerous occurrence, or occupational poisoning which has occurred at the work place.

Where an accident in a workplace, causes the death of a person therein, the employer or self-employed person shall:-

- ➢ Inform the area occupational safety and health officer within twenty-four hours of the occurrence of the accident; and
- ➢ Send a written notice of the accident in the prescribed form to the area occupational safety and health officer, within seven days of the occurrence of the accident.
- ➢ Where an accident in the workplace cause non-fatal injuries to a person therein, the employer shall send to the area occupational safety and health officer, a written notice of the accident in the prescribed form within seven days of the occurrence of the accident; and
- ➢ In case of death due to a workplace accident, non-fatal injuries arising from a workplace accident, an occupational disease or a dangerous occurrence at the workplace, involving a self-employed person incapable of submitting notification, such notification shall be submitted to the area occupational safety and health officer.

Health - General Provisions

Under Section 47 (1) It is established that Every workplace shall be kept in a clean state and free from effluvia arising from any drain, sanitary convenience or nuisance, and, without prejudice to the generality of sub section (1):-

- Accumulations of dirt and refuse shall be removed daily by a suitable method from the floors and benches of workrooms, and from a staircases and passages;
- The floor of every workroom shall be cleaned at least once in every week by washing or, if it is effective and suitable, by sweeping or by any other method;
- All inside walls and partitions, and all ceilings or tops of rooms, and all walls, sides and tops of passages and staircase, shall:-

- ✓ Where they have a smooth impervious surface, at least once in every period of twelve months, be washed with hot water and soap or cleaned other suitable method;
- ✓ Where they are kept painted with oil paint or varnished, be repainted or varnished at least once in every period of five years, or such other period as the director may deem necessary, and at least once in every period of twelve months be washed with hot water and soap or cleaned by other suitable method; and
- ✓ In other cases, be kept whitewashed or colour washed and the white washing or colour washing shall be repeated at least once in very period of twelve months.

After the completion of the proposed project so many local people will be absorbed and employed. Foreigners will also visit the place and they will be from different parts of the country and outside the country. As required by the law the employer shall comply with the Occupational Safety and Health Act 2007.

3.2.13 The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit sharing) Regulations

The Environmental Management and Coordination *Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit sharing Regulations – 2006* regulation applies to conservation of biodiversity which includes conservation of threatened species, inventory and monitoring of biodiversity and protection of environmentally significant areas, access to genetic resources, benefit sharing and offences and penalties. As per this Act *"no person shall engage in any activity that may have an adverse impact on any ecosystem; may lead to the introduction of any exotic species or to unsustainable use of natural resources, without an Environmental Impact Assessment License issued by the Authority under the Act"*.

3.2.14 The Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations 2009

The Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations 2009 ensures the conservation and sustainable use of wetlands, river banks, lake shores and sea shore. This regulation provides guidelines on management of these areas. This regulation also provides precautionary principal when working near wetlands in order to conserve them.

3.2.15 The Environmental (Impact Assessment and Audit) Regulations 2003

The *Environmental Impact Assessment and Audit Regulations, 2003* provide guidelines for conducting an EIA as well as environmental auditing and monitoring. The Regulations state in Regulation 3 that *"the Regulations should apply to all policies, plans, programmes, projects and activities specified in Part III and V of the Regulations"* basically lists the guidelines of undertaking, submission and approval of the EIA/ESIA/SEA Report.

3.2.16 The Standards Act, Cap 496

The Kenya Bureau of Standard is the authority responsible for implementation of this act. The *Standard Act, Cap 496* provides standards on the requirements of Equipment and project materials.

3.2.17 The Land Act 2012

The Land Act 2012 is "an Act of Parliament to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land based resources, and for connected purposes". Part I of the act is preliminary provisions, part II of the act deals with management of public land, part III of the act deals with administration of public land (Leases, Licenses and Agreements), part IV of the act deals with community land, part V of the act deals with administration and management of private land, part VI of the act deals with general provisions of leases, part VII of the act deals with general provisions of charges, part VIII of the act deals with compulsory acquisition of interests in land, part IX of the act deals with settlement programmes, part X of the act deals with easements and analogous rights, part XI of the act deals with miscellaneous, the schedule lists repealed laws i.e. The Wayleaves Act, Cap. 292 and The Land Acquisition Act, Cap. 295.

3.2.18 The Antiquities And Monument Act Cap 215

The Antiquities and Monument Act mandates the National Museums of Kenya to protect preserve and conserve archaeological and historical landscapes in Kenya.

Interpretation

a) "Antiquity"........This means any movable object other than a book or document made in or imported into Kenya before the year 1895, or any human, faunal or floral remains of similar minimum age which may exist in Kenya;

b) "Monument"……….this means:-

An immovable structure built before the year 1895 other than an immovable structure which the Minister may by notice in the Gazette either specifically or by reference to all immovable structures in a specified area declare not to be a monument for the purposes of this Act;

A rock- painting, carving or inscription made on an immovable surface before that year;

An earthwork or other immovable object attributable to human activity constructed before that year;

A place or immovable structure of any age which, being of historical interest, has been and remain and remains declared by the Minister under Section 4 a(1) (a) to be a monument, and includes the site thereof and such adjoining land as may be required for maintenance thereof;

c) "Private land"……..This means land privately owned and land the subject of a grant, lease or licence from the Government, and includes Trust land;

d) "Protected area"…….. this means a site on which a buried monument or object of archaeological or paleontological interest exists or is believed to exist, and such adjoining land as may be required for maintenance thereof, which has been and remains declared by the Minister under Section 4(1) (b) to be protected area;

e) "Protected object"………Means

A door or door –frame curved in an African or Oriental style before the year 1946;

Any other object or type of object, whether or not part of an immovable structure, which being of historical or cultural interest has been and remains declared by the Minister under section 4 (1) (c) to be a protected object.

Protective Declarations

a) Declaration of monuments

Under the Section 4 of the Act, it is thereby stipulated that the Minister may, by notice in the Gazette, declare

A specified place or immovable structure which he considers to be of historical interest, and a specified area of land under or adjoining it which is in his opinion required for maintenance thereof, to be a monument within the meaning of this Act; or

A specified site on which a buried monument or object of archaeological interest exists or is believed to exist, and a specified area of land adjoining it which is in his opinion required for maintenance thereof, to be a protected area within the meaning of this Act; or

A specified object or type of object, whether or not part of an immovable structure, which he considers to be of historical or cultural interest, to be protected object within the meaning of this Act.

b) Control of access to protected area

The Section 12 of part IV thereby states the Minister may, in respect of a protected area, from time to time-

By a notice in the Gazette, prohibit or restrict access thereto, or any development thereof, or the use thereof for agriculture or livestock, or any other activity thereon which in his opinion is liable to damage a monument or object of archaeological or palaeontological interest therein;

Place the protected area under the control of the National Museums Board, on such terms and with the subject to such powers and duties as he may direct;

Take, or authorize the National Museums Board to take, such steps as are in his opinion necessary or desirable for the maintenance thereof;

Make or authorize the National Museums Board to make by-laws for controlling access thereto, with or without payment, and the conduct therein of visitors thereto.

Compensation to owner of land in protected area

Where private land is included in a protected area, and the development or any other use on that land by the owner or occupier thereof is prohibited or restricted by the Minister, or, by reason of any steps taken by the Minister, or by the National Museums Board with the Authority of the Minister, on or in relation to the private land, the rights or owner of occupier are disturbed in any way, or damage to the land, or to crops, trees, buildings, stocks or works therein or thereon is caused, the Government shall on demand pay or make to the owner or occupier such compensation as is fair and reasonable having regard to the extent of the prohibition, restriction, disturbance or damage and to the interest of the owner or occupier in the land.

4. BASELINE ENVIRONMENTAL CONDITION OF THE PROPOSED PROJECT SITE

4.1 Vegetation at the proposed project site

4.1.1 Introduction

To understand and document the vegetation at the proposed project site, a vegetation survey was carried out. The vegetation survey employed the plot-less method developed by Hall and Swaine (1981) and used in modification by Mwachala, *et al.* (2004), was used to capture plant diversity in the various habitat types. The survey method involved random walks through the various habitats or patches. To ensure complete and representative observations, sampling was stopped after considerable time, usually two hours or when the discovery of unrecorded species is less than one in two minutes. In addition, collections were recorded randomly where possible to cover the edges and other unique habitats. All the vascular plant species encountered was recorded in each of the habitat and specimens selectively collected using standard methods (Foreman & Bridson, 1992). The encountered environmental indicator and/or threatened species atypical of the coastal lowland were noted. The difficulty and unique plant species were confirmed at the East African Herbarium and specimens prepared for preservation. Species uniqueness (endemism, rarity, threat i.e. vulnerable, endangered) was determined through literature review, voucher specimens and databases at the EA Herbarium based on List of East Africa Plants (LEAP) (Knox & Berghe, 1996) as well as using experienced botanical experts.

4.1.2 Vegetation communities

The study site is in the coastal lowland vegetation and was once a settlement .This has had a major impact on the vegetation type as there is more secondary vegetation and the trees were very minimal with *Adansonia digitata* being the main species few *Acacia species* and invasion by *Prosopis juliflora* The area could be divided into 3 vegetation communities: open grassland with secondary bushes; wetland vegetation and remnant wooded bush land (plate1 – 3).

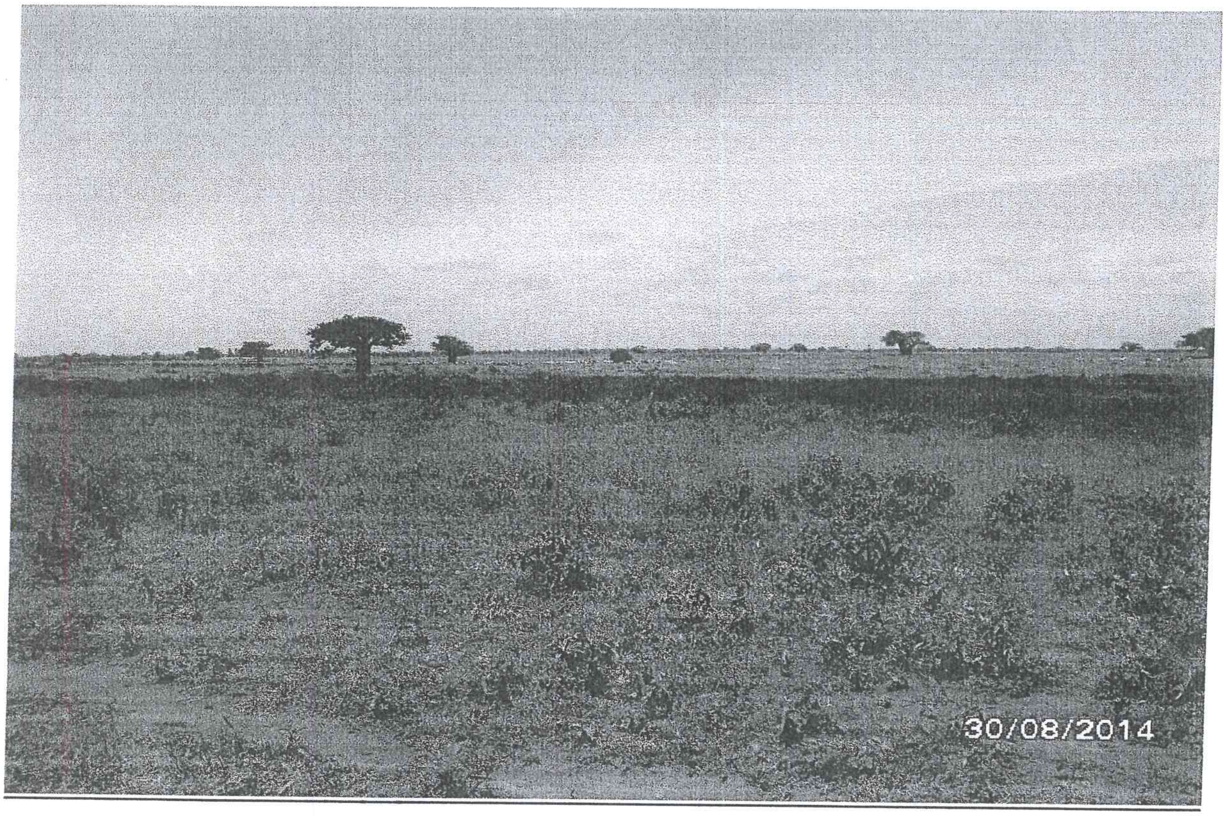
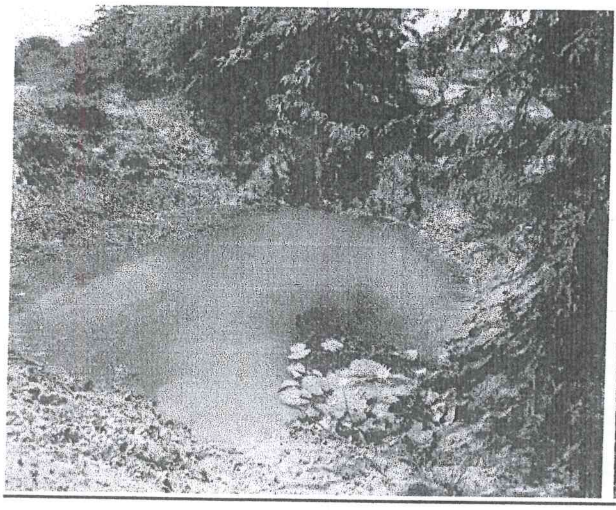


Plate 1 Open grassland with secondary bushes



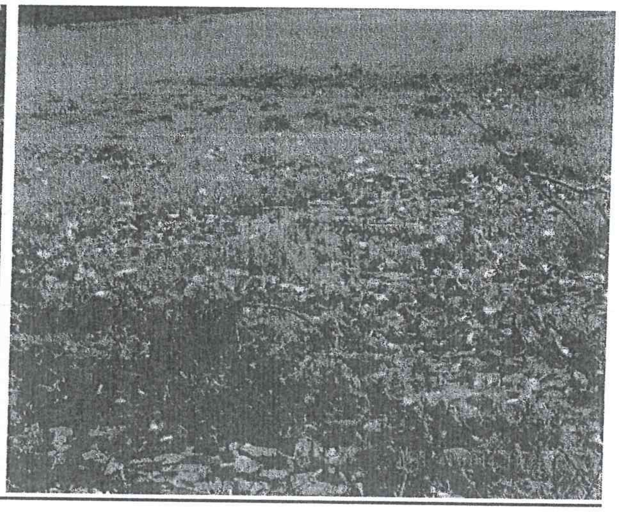
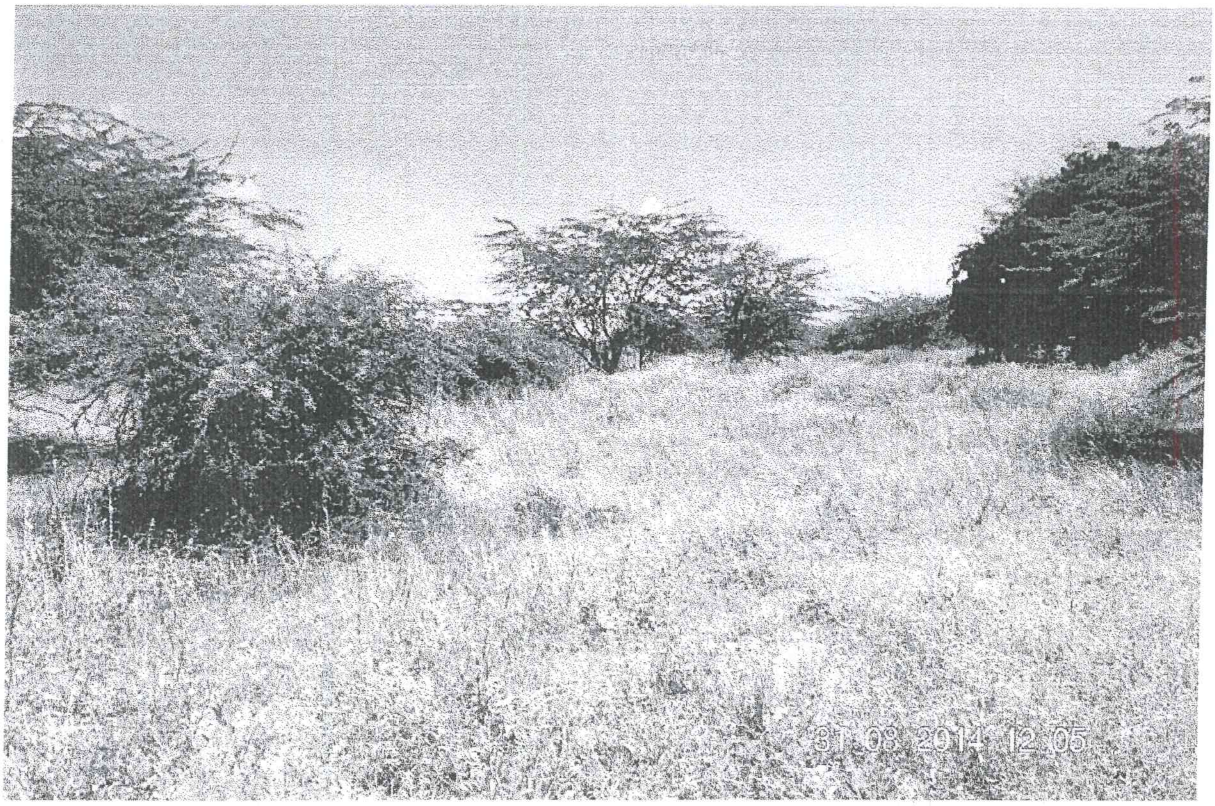


Plate 2: Wetland vegetation



Wooded bush land

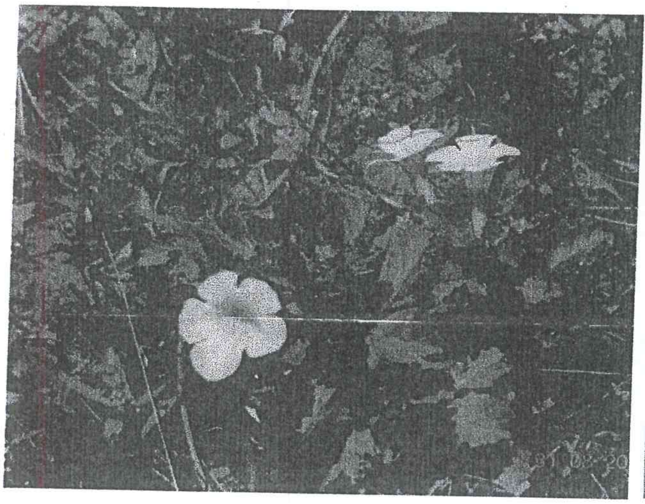
Plate 3: Wooded bush land

4.1.2.1 Grassland with secondary bushes and herbaceous species

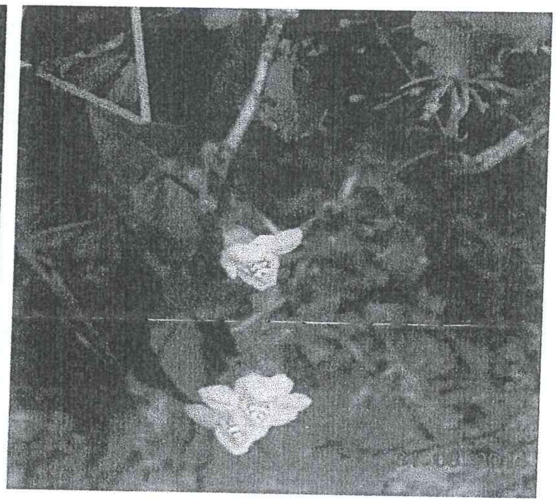
The larger area of the proposed project site had very few mature trees; less than 50 individuals and they were mainly *Adansonia digitata Acacia sp and Prosopis juliflora* .The small shrubs were also present with *Cassia occidentalis, Ricinus communis* being the dominant species. The grasses and the herbs were the most dominant with *Heliotropium steudneri, Sida ovate Eragrostis cilliari, Dactylotenium aegyptica* and *Digitaria sp* being dorminant. Plate 4 captures some of the plant species found in the grassland with secondary bushes.

Heliotropium steudneri

Senna occidentalis

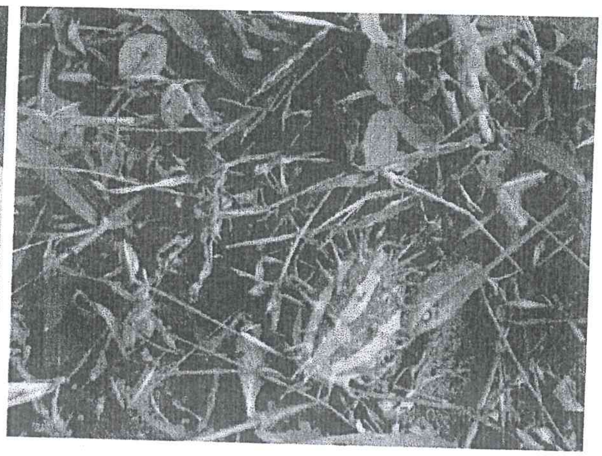


Pedalium murex

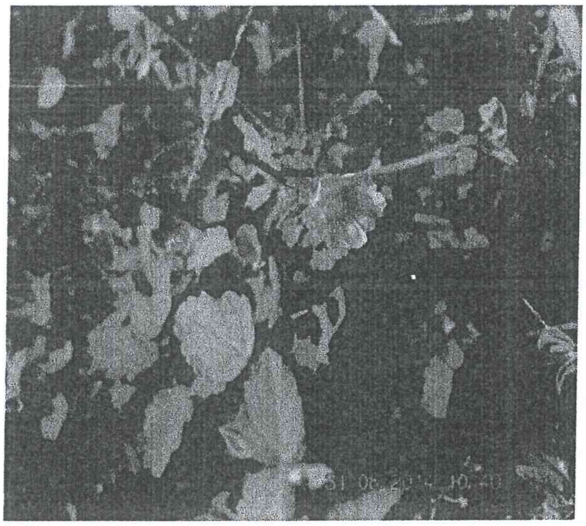


Asystacia gangetica

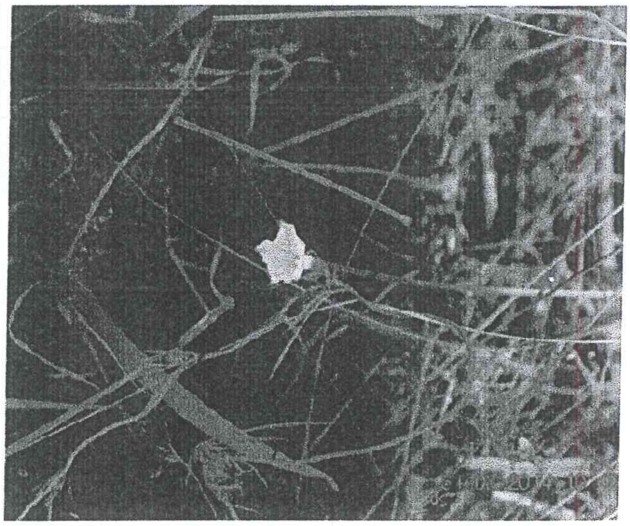
Hibiscus vitifolius



Cucumis sp



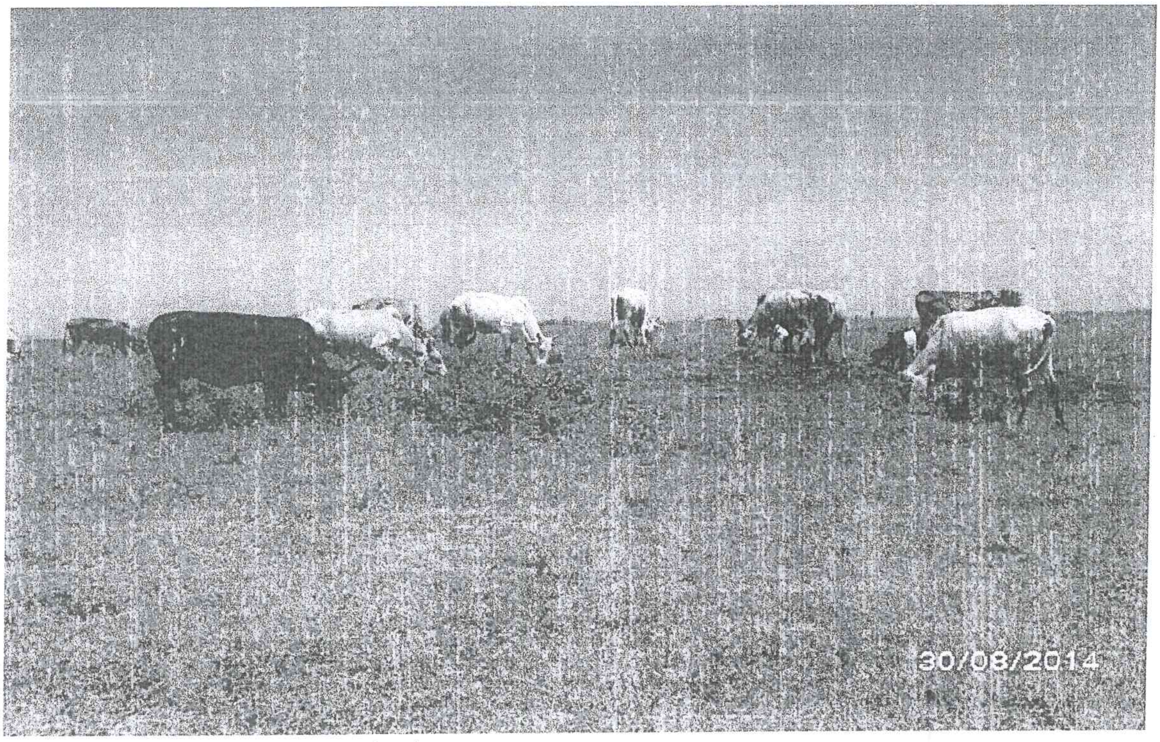
Sida ovata



Ipomoea sp

Plate 4:_some of the plant species found in the grassland with secondary bushes

There was no succession with big trees as the land is already being used for grazing and this hinders the growth of tree seedlings and saplings as they are grazed and browsed by the goats (plate 5).



Cattle grazing on the open grassland

Plate 5: Cows and goat grazing and browsing at the proposed project site

The table below is a checklist of the Grassland and bush land vegetation species identified at the proposed project site

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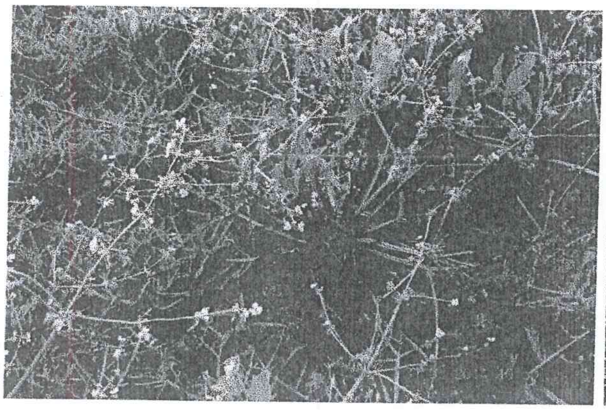
Table 2: Grassland and bushland vegetation species at the proposed project site

Family	Genus	Species	author	Life Form
Leguminosae	*Cassia*	*occidentalis*	L.	shrub
Bombacaceae	*Adansonia*	*digitata*	L.	Tree
Labiatae	*Ocimum*			Herb
Gramineae	*Digitaria*	*milanjiana*	(Rendle) Stapf	Grass
Leguminosae	*Zornia*	*glochidiata*	DC.	Herb
Convolvulaceae	*Ipomoea*	*mombassana*	Vatke	Herb
Solanaceae	*Datura*	*stramonium*	L.	Herb
Boraginaceae	*Heliotropium*	*steudneri*	Vatke	Herb
Malvaceae	*Sida*	*ovata*	Forssk.	Herb
Gramineae	*Eragrostis*	*ciliaris*	(L.) R.Br.	Grass
Acanthaceae	*Asystasia*	*gangetica*	(L.) T.Anderson	Herb
Boraginaceae	*Cordia*	*sp*		shrub
Leguminosae	*Crotalaria*	*malindiensis*	Polhill	Herb
Sterculiaceae	*Melhania*	*ovata*	(Cav.) Spreng.	shrub
Cyperaceae	*Cyperus*	*compressus*	L.	Sedge
Amaranthaceae	*Aerva*	*lanata*	(L.) Juss	Herb
Amaranthaceae	*Gomphrena*	*celosioides*	Mart.	Herb
Gramineae	*Eleusine*	*indica*	(Kenn.-O'Byrne) S.M.Phillips	Grass
Solanaceae	*Solanum*	*incanum*	L.	shrub
Cyperaceae	*Cyperus*	*denudatus*	L.f.	Sedge
Gramineae	*Digitaria*	*macroblephara*	(Hack.) Stapf	Grass
Rubiaceae	*Oldenlandia*	*corymbosa*	L.	
Compositae	*Gutenbergia*	*cordifolia*	Benth. ex Oliv.	Herb
Gramineae	*Urochloa*	*mosambicensis*	(Hack.) Dandy	Grass

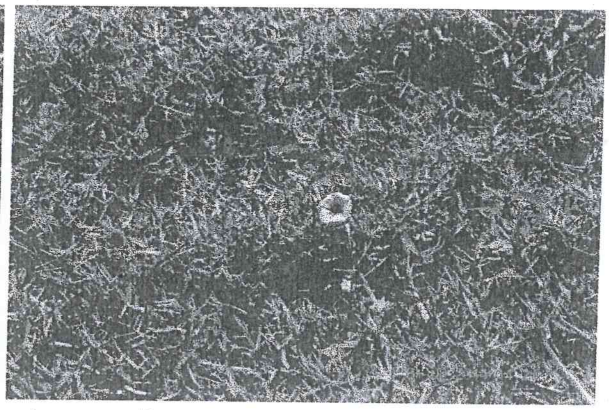
Family	Genus	Species	author	Life Form
Gramineae	*Dactyloctenium*	*aegyptium*	(L.) Willd	Grass
Gramineae	*Cenchrus*	*ciliaris*	L.	Grass
Commelinaceae	*Commelina*	*benghalensis*	Wall.	Herb
Leguminosae	*Indigofera*			Herb
Polygonaceae	*Oxygonum*	*sinuatum*	(Meisn.) Dammer	Herb
Tiliaceae	*Triumfetta*	*rhomboidea*	Jacq.	shrub
Leguminosae	*Acacia*	*nilotica*	(L.) Willd. ex Delile	Tree
Zygophyllaceae	*Tribulus*	*terrestris*	L.	Herb
Sterculiaceae	*Waltheria*	*indica*	L.	shrub
Campanulaceae	*Wahlenbergia*			Herb
Tiliaceae	*Grewia*	*plagiophylla*	K.Schum.	shrub
Tiliaceae	*Grewia*	*forbesii*	Harv. ex Mast.	shrub
Amaranthaceae	*Alternanthera*	*pungens*	Kunth	Herb
Cucurbitaceae	*Cucumis*			Herb
Agavaceae	*Agave*	*sisalana*	Perr. ex Engelm.	shrub
Gramineae	*Chloris*	*robusta*	Stapf	Grass
Amaranthaceae	*Achyranthes*	*aspera*	L.	Herb
Pedaliaceae	*Pedalium*	*murex*	L.	Herb
Gramineae	*Chloris*	*roxburghiana*	Schult	Grass
Euphorbiaceae	*Euphorbia*	*hirta*	L.	Herb
Malvaceae	*Hibiscus*	*vitifolius*	L.	Shrub
Convolvulaceae	*Ipomoea*	*Sp.*		Herb
Mimosaceae	*Acacia*	*Sp.*		Tree
Leguminosae	*Prosopis*	*juliflora*		Tree

4.1.2.2 Wetland vegetation

The Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009 define wetlands as "areas permanently or seasonally flooded by water where plants and animals have become adapted; and include swamps, areas of marsh, peat land, mountain bogs, bank of rivers, vegetation, areas of impeded drainage or brackish, salt or alkaline; including areas of marine water the depth of which at low tide does not exceed 6 maters. It also incorporates riparian and coastal zones adjacent to the wetlands". Wetland ecosystems provide a range of vital ecological services including food, filter water and offer a unique habitat for many different species. Studies have shown that threats to weather land ecosystems include conversion of wetlands for commercial development, drainage schemes, extraction of minerals and peat, overfishing, tourism, siltation, pesticide discharges from intensive agriculture, toxic pollutants from industrial waste, and the construction of dams and dikes, (Barbier et al 1997). A section of the proposed project site is a depression that during the wet season tends to have water accumulated forming a seasonal swamp; this seasonal swamp is locally referred to as Lake Sudi. During the vegetation survey part of the seasonal swamp area was fairy dry while part of it had water. The dominant grass species is noted in the area was *Echinocloa haploclada*, and wild rice *Oryza punctata*. Dominant herbs were *Limnophyton obtusifolium Ipomoea aquatica and ,Ludwigia stolonifera* (plate)



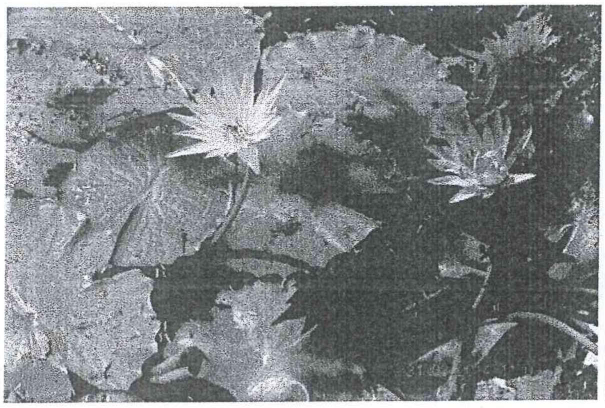
Limnophyton obtusifolium



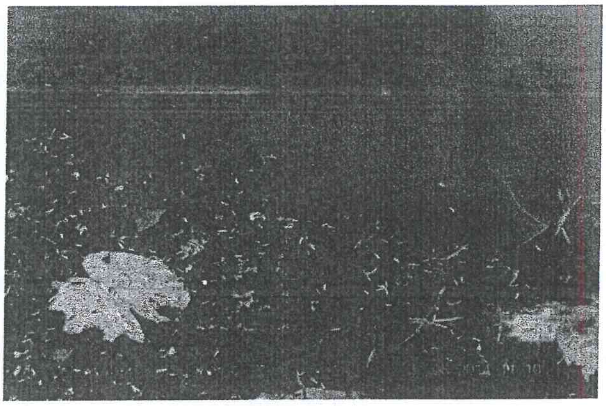
Ipomoea aqatica

Plate 6 Wetland herb species at the proposed project site

Limnophyton obtusifolium is an aquatic herb that grows at the margin of ponds and in muddy places and it is rather common in fresh water habitat. There were also some shallow water pans that the locals have dug and they had submerged and floating aquatic vegetation of *Nymphea nouchali* var. *caerulea and Cyperus denudatus* on the edges.



Nymphea nouchali var.caerulea



Submerged *Ceratophyllum demersum*

Plate 7: The aquatic species encountered in the ponds

There was a large area where there was heavy invasion by *Prosopis juliflora* (plate 8). The species is a small, fast growing, drought-resistant, evergreen, tree of tropical American origin. Its pods can be used as livestock food and are fed upon by native herbivores. It has good timber and shade and quickly turns bare arid environments green. These qualities rendered it an attractive candidate for arid land environmental rehabilitation programmes. In the 80s and early 90s it was a preferred species in afforestation, fuel-energy and fodder programmes in Kenya. *Prosopis* is equipped with a number of biological characteristics that foster its rapid invasion of new areas. These include:

- production of many, small and hard seeds capable of surviving passage through the digestive system of animals, entering into the soil to form soil seed banks and remaining viable until favourable conditions for germination and seedling establishment appear.
- Attractive and rewarding pods for animals, containing fleshy and sweet mesocarp embodying the numerous small seeds, which is sought after by both domestic and wild animals, meant for long-distance dispersal.
- Accumulation of dormant but long-lived viable seed reserves that would serve as sources of regeneration of new *Prosopis* plants in the event of disturbance that might eliminate the above-ground stands.
- production of a mixture of seeds, with a few capable of germinating immediately after dispersal to exploit the favourable conditions that might exist at the time of dispersal, while the majority remain dormant for spreading germination over time and space.
- Great ability of re sprouting and fast coppice growth from stumped/damaged trees, making it a very strong competitive invader combined with its sexual reproduction.

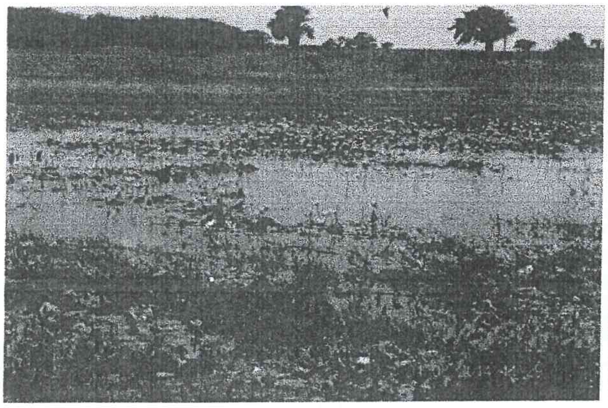
Combinations of all these characteristics make *Prosopis* a powerful noxious invader as can be evidenced from its rampant invasion in the study site.

Invasion by *Prosopis juliflora*

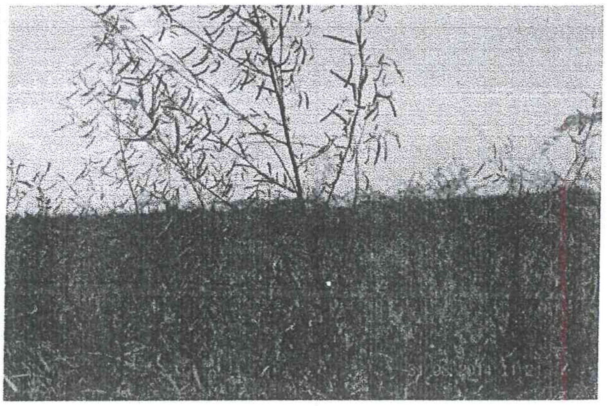
Plate 8; The invasive Prosopis *juliflora*

4.1.2.3 Swamp

Further south there was a swampy habitat that is dominated by grasses including: *Echinocloa haploclada*, *Nymphea nouchali*, *Aeschenomene indica* and *Ipomoea aquatica* (plate 9).



Nyphea sp and *Limnophyton obtusifolium*



Aeschenomene indica

Plate 9: Swamp vegetation at the proposed project site

This indigenous wetland vegetation commonly found in lakes, pools and slow flowing rivers usually thrives when there is no invasive species invasion. *Nyphea sp* is quickly eliminated when alien species invade any particular wetland. Table 2 is a checklist of wetland vegetation at the proposed project site.

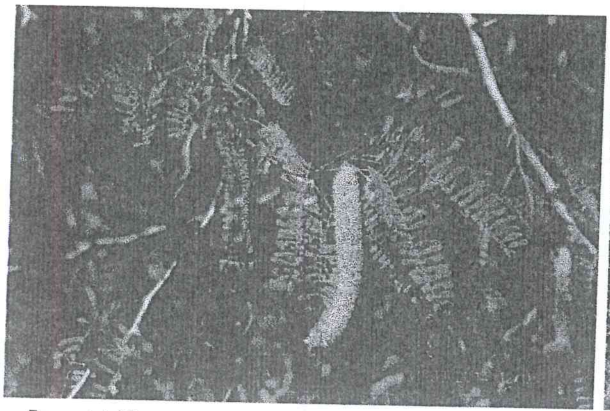
Table 3: Checklist of wetland vegetation

Family	Genus	Species	author	Life Form
Nymphaeaceae	*Nymphaea*	*Caerulea*	-	Herb
Alismataceae	*Limnophyton*	*obtusifolium*	(L.) Miq.	Herb
Gramineae	*Oryza*	*punctata*	Steud.	Grass
Nyctaginaceae	*Boerhavia*	*erecta*	L.	Herb
Leguminosae	*Indigofera*	-	-	Herb
Commelinaceae	*Commelina*	*benghalensis*	Wall.	Herb
Onagraceae	*Ludwigia*	*stolonifera*	(Guill. & Perr.) P.H. Raven	Herb
Convolvulaceae	*Ipomoea*	*aquatica*	Forssk.	Herb
Leguminosae	*Aeschynomene*	*indica*	L.	shrub
Gramineae	*Echinochloa*	*haploclada*	(Stapf) Stapf	Grass
Lobeliaceae	*Lobelia*	*fervens*	Thunb.	Herb
Flacourtiaceae	*Ludwigia*	*octovalis*	-	Herb

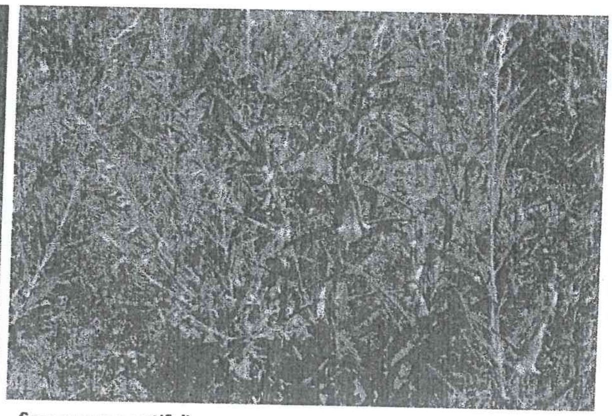
Family	Genus	Species	author	Life Form
Cyperaceae	*Cyperus*	*denudatus*	L.f.	Sedge
Leguminosae	*Tephrosia*	*villosa*	(L.) Pers.	shrub
Ceratophyllaceae	*Ceratophyllum*	*demersum*	L.	Herb
Asclepiadaceae	*Calotropis*	*procera*	(Aiton) W.T.Aiton	shrub
Onagraceae	*Ludwigia*	*octovalis*	(Jacq.) P.H. Raven	Herb
Asclepiadaceae	*Gomphocarpus*	*sp.*	-	Herb
Lythraceae	*Lythrum*	-	-	Herb
Pedaliaceae	*Pedalium*	*murex*	L.	Herb
Malvaceae	*Hibiscus*	*vitifolius*	L.	Herb
Compositae	*Acanthospermum*	*hispidum*	DC.	Herb

4.1.2.4 Remnant wooded bush land

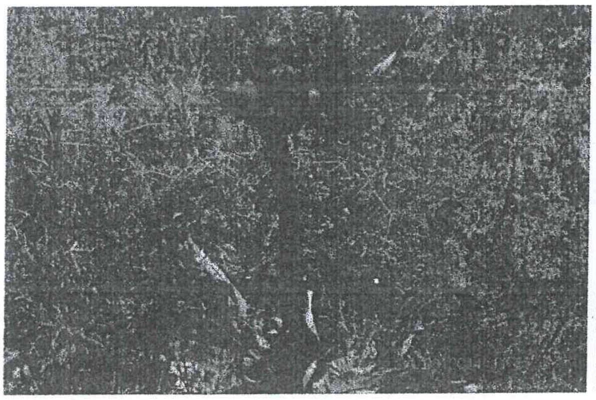
This vegetation type was dominated by *Acacia* sp and there was invasion of *prosopis juliflora* in some patches. The undergrowth was dominated by *Sesamum, Ocimum* and *Eragrostis* cilliaris, *Digitaria milanjiana* and *Dactylotenium aegyptica* as the dominant grass species. *Terminalis* sp, *Lawsonia inermis* were the dominant bushes. There were also patches of *Thespesia danis as* Remnant woodland vegetation shown in plate 10.



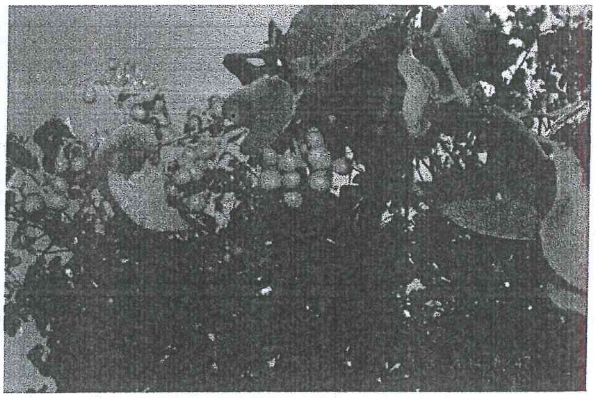
Prosopis juliflora



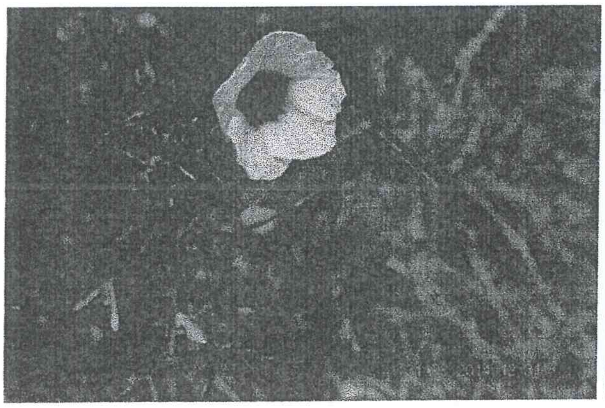
Sesamum angustifolium



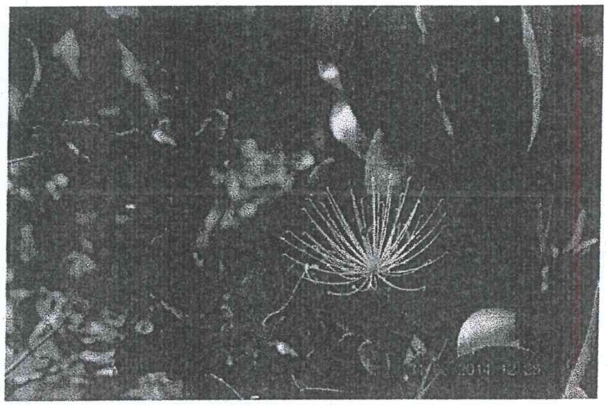
Crinum kirkii



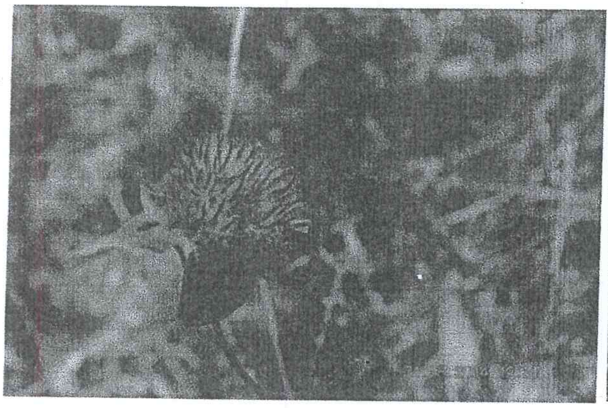
Cissus rotundifolia



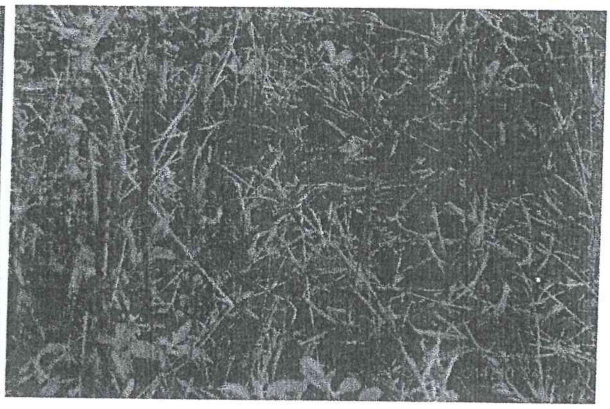
Hibiscus cannabinus



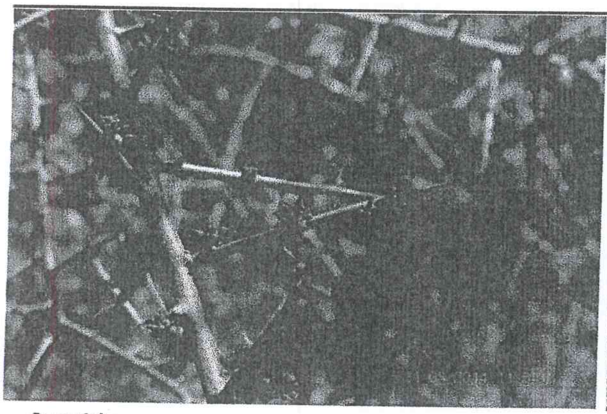
Thylachium thomasii



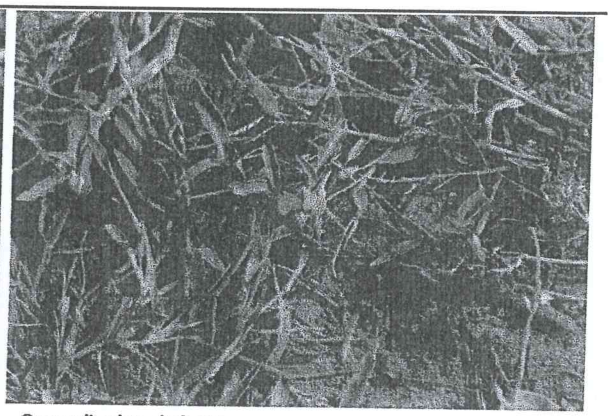
Jacquemontia tamnifolia



Eragrostis cilliaris



Commiphora sp



Commelina benghalensis

Plate 10: Vegetation species observed at the remnant wooded bushland at the proposed project site

Table 3 is a checklist for vegetation species observed at the remnant wooded bush land at the proposed project site.

Table 4: vegetation species observed at the remnant wooded bush land

Family	Genus	Species	author	Life Form
Malvaceae	*Thespesia*	*danis*	Oliv.	Tree
Leguminosae	*Acacia*	*zanzibarica*	(S.Moore) Taub.	Tree
Combretaceae	*Terminalia*	*brevipes*	Pamp.	Tree
Burseraceae	*Commiphora*	*edulis*	(Klotzsch) Engl.	Tree
Lythraceae	*Lawsonia*	*inermis*	L.	shrub
Tiliaceae	*Grewia*	*plagiophylla*	K.Schum.	shrub
Leguminosae	*Prosopis*	*juliflora*		Tree

Family	Genus	Species	author	Life Form
Vitaceae	*Cissus*	*rotundifolia*	(Forssk.) Vahl	Herb
Gramineae	*Digitaria*	*milanjiana*	(Rendle) Stapf	Grass
Gramineae	*Eragrostis*	*ciliaris*	(L.) R.Br.	Grass
Pedaliaceae	*Sesamum*	*angustifolium*	(Oliv.) Engl.	Herb
Rubiaceae	*Feretia*	*apodanthera*	Delile	Herb
Labiatae	*Ocimum*			Herb
Solanaceae	*Solanum*	*incanum*	L.	shrub
Leguminosae	*Crotalaria*			Herb
Leguminosae	*Acacia*	*nilotica*	(L.) Willd. ex Delile	Tree
Amaryllidaceae	*Crinum*	*kirkii*	Baker	Herb
Convolvulaceae	*Ipomoea*	*cairica*	(L.) Sweet	Herb
Leguminosae	*Rhynchosia*	*velutina*	Wight & Arn.	Herb
Compositae	*Conyza*	*bonariensis*	(L.) Cronquist	Herb
Leguminosae	*Zornia*			Herb
Compositae	*Acanthospermum*	*hispidum*	DC.	Herb
Commelinaceae	*Commelina*	*benghalensis*	Wall.	Herb
Cucurbitaceae	*Cucumis*	*prophetaram*	L.	Herb
Cyperaceae	*Cyperus*	*denudatus*	L.f.	Sedge
Leguminosae	*Indigofera*	*strobilifera*	(Hochst.) Baker	Herb
Boraginaceae	*Heliotropium*	*steudneri*	Vatke	Herb
Acanthaceae	*Acanthus*			Herb
Dracaenaceae	*Sansevieria*	*suffruticosa*	N.E.Br.	shrub
Rubiaceae	*Catunaregam*	*nilotica*	(Stapf) Tirveng.	Herb
Rubiaceae	*Spermacoce*	*filituba*	(K.Schum.) Verdc.	Herb
Convolvulaceae	*Jacquemontia*	*tamnifolia*	(L.) Griseb.	Herb
Pedaliaceae	*Pedalium*	*murex*	L.	Herb
Amaranthaceae	*Cyathula*	*polycephala*	Baker	Herb
Burceraceae	*Commiphora*	*sp*		Tree

4.1.3 Vegetation Species Conservation status

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction i.e. those listed as Critically Endangered, Endangered and vulnerable. The IUCN Red List also includes information on plants that are categorized as Extinct or Extinct in the Wild; on taxa that cannot be evaluated because of insufficient information (i.e., are Data Deficient); and on plants that are either close to meeting the threatened thresholds or that would be threatened were it not for an on-going taxon-specific conservation programme (i.e., are Near Threatened). None of the species observed and identified during the vegetation survey was listed in IUCN red list. However it is important to note that two of the species identified and observed at the proposed project site *Crotalaria malindensis* is a Kenyan endemic species and *Crinum kirkii* is an East African endemic

4.2 Fauna at the proposed project site

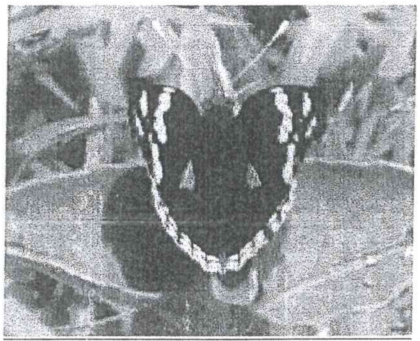
Terrestrial survey covered mammals, herpetiles (reptiles and amphibians) and the invertebrates. Local account was used to supplement information on existence of species or taxa. The survey site has two common habitat types. These include the seasonally flooded areas (occupied by the Acacia species), grassland (dotted with baobabs) and have the herbaceous species, wetlands.

4.2.1 Herpetofauna

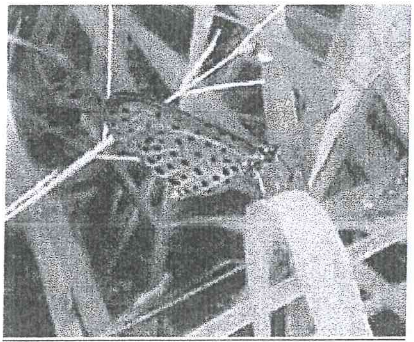
The survey for reptiles and amphibians targeted the seasonally flooded areas and around the baobab trees. These are inhabitable areas for the taxa. Normally, the taxa comprise the snakes, lizards and geckos. This group was very rare to observe in the area except in localized areas such as the baobab tree area where they would be expected to occur. The Red-headed Rock Agama (*Agama agama)* can be observed on Baobab tree but quickly dashes away at the sense of any danger. Together with this consisted of the *Mabuya sp.* that was spotted on baobab on a quick dash on the tree trunk. Other taxa existence was informed by the local inquiry. For instance the snakes have been encountered around the area probably the black mamba, by description by the local people. The seasonally flooded area was not observed of the species but has some burrows/holes that are probably used by lizard

4.2.2 Invertebrate

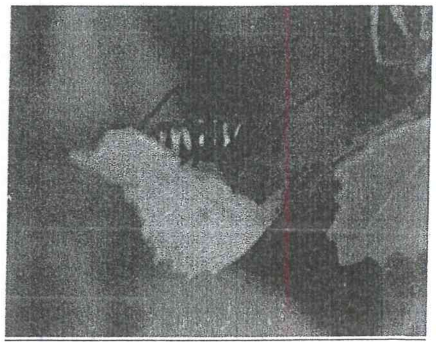
Physical observation was used to assess the diversity of invertebrates within the proposed salt-pan expansion and the overlapping areas outside. Taxa that were observed included the insect pollinators; beetles, ants. The most striking and common invertebrates in the area is the butterflies. The herbaceous constituents of the grassland were notably flowering across the landscape. This characteristic nature of annual flowering herbaceous plants on the landscape support wide diversity of flower dependent insects including the butterflies and bee families. Some of the butterflies that were observed have been noted in other part of the Kenya coast. These include *Junonia oenone* and *Papilio demodocus* (table 4). The common bee species was the *Apis melifera* other taxa observed consist of Bees (Apis mellifera, most common). Burrows were observed on the soil on some plant roots. These were certainly ant activities that removed soils on the plant roots and heaped them in circular around the plant. This phenomenon was common on the roots of certain shrub species.

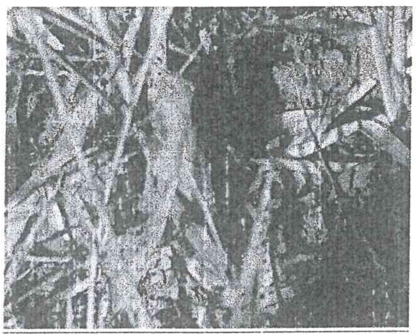


Junonia oenone

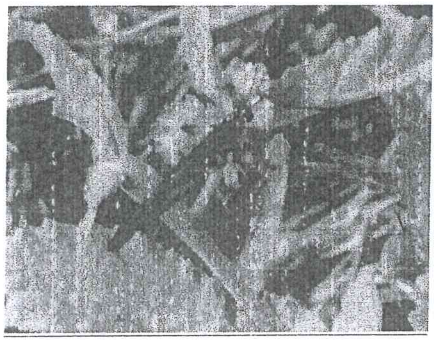


Pardopsis punctatissima





Green Grasshopper



Byblia ilithyia observed with folded wings up

Plate 11: Some of the invertebrates observed at the proposed project site

Table 5: Some butterfly species observed in and around the proposed salt pan expansion

Acraea eponina	*Papilio demodocus*	*Eurema floricola*	*Byblia ilithyia*
Acraea insignis	*Pardopsis punctatissima*	*Eurema regularis*	*Catopsilia florella*
Amauris niavius	*Phalanta phalantha*	*Eurytela dryope*	*Colitis daira*
Amauris ochlea	*Physcaeneura leda*	*Freyeria trochylus*	*Colitis euippe*
Anthene butleri	*Salamis parhassus*	*Graphium angolanus*	*Colitis vesta*
Axiocerses harpax	*Tirumala petiverana*	*Hypolimnas misippus*	*Colotis danae*
Azanus jesous	*Tuxentius calice*	*Hypolycaena philippus*	*Colotis protomedia*
Baliochila hildegarda	*Vanessa cardui*	*Junonia hierta*	*Colotis vesta*
Belenois aurota	*Ypthima asterope*	*Junonia natalica*	*Cupidopsis iobates*
Belenois creona	*Zizina antanossa*	*Junonia oenone*	*Danaus chrysippus*
Belenois thysa	*Zizula hylax*	*Junonia orithya*	*Deudorix antalus*

4.2.3 Mammals

The survey was undertaken by a walk across the landscape through the various habitat characteristics. These consisted of making observations in the flooding areas (occupied by the Acacia species), grassland and seasonal wetland area. It was very rare to see mammal species here. There are no large mammals inhabiting the area. Certainly, only wild dog has been spotted in the *prosopis* mosaic areas by locals, which are that overlap with the mangroves towards the sea. Existence of rodents was deemed to be obvious due to their widespread in various biomes. The African hare could only be noted by very few old droppings and that might to some extent indicate the area forms possible ranges of some rodents.

4.2.4 Conservation Status of fauna species observed

Species that were observed were assessed in the record of the IUCN red list for threatened species (2014). There are different categories of conservation status of species and are described in the IUCN red list data. These categories include Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Lower Risk, Data Deficient and Not Evaluated. Only species that were enlisted in the endangered list would be highlighted in the result section.

4.3 Avifauna species at the proposed project site

4.3.1 Background

Birds are very good barometers of the state of the environment, providing early warning systems of deteriorating environmental health and habitat loss and therefore good indicators of biological change. Birds occur in all types of habitats, everywhere in the world. They are highly visible, easy to monitor, and much research has been done on them. Monitoring bird populations is important – it allows us to monitor subtle environmental changes that could potentially affect biodiversity, or have socio-economic implications. According to Vielliard (2000), the structure of a bird community is a good indicator of biodiversity, particularly useful where biodiversity is high. According to BirdLife International, (2013), changes in bird populations can also provide a useful indication of broad environmental change. BirdLife International (2013) has demonstrated using ten reasons why birds are very good indicators for state of biodiversity (Appendix 9). The ornithological survey of Krystalline Salt Limited Marereni salt works site was carried out to provide an up to date qualitative baseline survey of birds species currently found at the proposed project site as part of the Environmental Impact Assessment for the proposed expansion of salt production as well as for future implementation of the Environmental Management and Monitoring Plan. The principal goal of the bird surveys was to:

1. Provide information on avian diversity and use of the project site that is useful in evaluating potential impacts from the proposed salt production works.
2. Provide information on avian movement over the proposed development area that is useful in evaluating the relative risk of the proposed salt production project.
3. Provide information on avian sensitive species use of the project site .
4. Provide recommendations for further monitoring studies and potential mitigation measures.

4.3.2 Avifauna species diversity

A total of 69 species were recorded at the proposed project site during the survey (appendix 10). This includes 51 species recorded during point counts and an extra 18 species sighted during opportunistic observations. The species comprised different assemblages of birds from various feeding guilds and families. These included grassland birds, wetlands birds, waterbirds, woodland birds and birds associated with human dominated landscapes. Common and abundant grassland birds sighted during point counts include Red-billed quelea (4,554 individuals and sighted in 19 of the 22 points). These were common given the expansive grasslands and as a result of plenty of grass-heads and grains which comprise a significant portion of their diet. This was followed by Cattle egrets (155 individuals, recorded at 9 of the 22 points). The egrets have a mutualistic interaction with cattle and hence their abundance could be attributed to this as they were sighted foraging alongside livestock especially cattle. In that order was the African Sacred Ibis (124 individuals sighted at 8 out of the 22 points. Table 1 presents bird species recorded during the point counts including the conservation status based on the IUCN Red List status.

Table 6: Bird species recorded during the point count and their conservation status

No.	Species	Common Name	Category	Species counts at 22 points (n/22)	Total individuals
1.	*Coturnix delegorguei*	Harlequin Quail	LC	1	1
2.	*Alopochen aegyptiaca*	Egyptian Goose	LC	2	10
3.	*Halcyon leucocephala*	Grey-headed Kingfisher	LC	3	5
4.	*Merops nubicus*	Northern Carmine Bee-eater	LC	15	60
5.	*Chrysococcyx caprius*	Diederik Cuckoo	LC	1	1
6.	*Centropus superciliosus*	White-browed Coucal	LC	2	2
7.	*Cypsiurus parvus*	African Palm-swift	LC	3	3
8.	*Criniferoides leucogaster*	White-bellied Go-away-bird	LC	1	1
9.	*Streptopelia capicola*	Ring-necked Dove	LC	5	7
10.	*Turtur chalcospilos*	Emerald-spotted Wood-dove	LC	3	4
11.	*Oena capensis*	Namaqua Dove	LC	10	34
12.	*Tringa ochropus*	Green Sandpiper	LC	1	1
13.	*Actophilornis africanus*	African Jacana	LC	2	2
14.	*Charadrius pecuarius*	Kittlitz's Plover	LC	1	1
15.	*Vanellus spinosus*	Spur-winged Lapwing	LC	1	4
16.	*Glareola pratincola*	Collared Pratincole	LC	5	37
17.	*Terathopius ecaudatus*	Bateleur	NT	1	1
18.	*Polyboroides typus*	African Harrier-hawk	LC	1	1
19.	*Melierax poliopterus*	Eastern Chanting-goshawk	LC	2	2
20.	*Accipiter melanoleucus*	Black Sparrowhawk	LC	1	1
21.	*Lophaetus occipitalis*	Long-crested Eagle	LC	1	1
22.	*Ardea cinerea*	Grey Heron	LC	1	1
23.	*Ardea melanocephala*	Black-headed Heron	LC	6	30
24.	*Ardea alba*	Great White Egret	LC	1	1
25.	*Bubulcus ibis*	Cattle Egret	LC	9	155
26.	*Bostrychia hagedash*	Hadada Ibis	LC	3	7
27.	*Threskiornis aethiopicus*	African Sacred Ibis	LC	8	124
28.	*Platalea alba*	African Spoonbill	LC	2	5
29.	*Mycteria ibis*	Yellow-billed Stork	LC	2	3
30.	*Anastomus lamelligerus*	African Openbill	LC	1	14
31.	*Lanius cabanisi*	Long-tailed Fiscal	LC	4	17
32.	*Tchagra senegalus*	Black-crowned Tchagra	LC	2	2
33.	*Cichladusa guttata*	Spotted Morning-thrush	LC	1	1
34.	*Lamprotornis superbus*	Superb Starling	LC	2	2
35.	*Hirundo fuligula*	Rock Martin	LC	1	1
36.	*Hirundo rustica*	Barn Swallow	LC	8	75

37.	*Hirundo aethiopica*	Ethiopian Swallow	LC	1	2
38.	*Andropadus importunus*	Sombre Greenbul	LC	1	1
39.	*Tmetothylacus tenellus*	Golden Pipit	LC	14	92
40.	*Anthus melindae*	Malindi Pipit	LC	7	12
41.	*Bubalornis niger*	Red-billed Buffalo-weaver	LC	2	27
42.	*Ploceus cucullatus*	Village Weaver	LC	2	2
43.	*Quelea erythrops*	Red-billed Quelea	LC	19	4554
44.	*Vidua chalybeata*	Village Indigobird	LC	1	1
45.	*Vidua macroura*	Pin-tailed Whydah	LC	1	1
46.	*Ciconia episcopus*	African Woollyneck	LC	1	1
47.	*Egretta garzetta*	Little Egret	LC	2	2
48.	*Corythornis cristatus*	Malachite Kingfisher	LC	1	2
49.	*Anthus cinnamomeus*	Grassland Pipit	LC	4	8
50.	*Corvus splendens*	House Crow	LC	5	48
51.	*Lagonosticta senegala*	Red-billed Firefinch	LC	1	1

The 69 species recorded fall within the following feeding guilds:

Table 7 Feeding guilds of bird species recorded at the proposed project site

Feeding Guild	Principal food material	Example
Carnivores	Birds, mammals, reptiles	Eagles,
Scavengers	Dead animals	Vultures, Marabou Stork
Piscivores	Fish	cormorants,
Insectivores	Insect/arthropod eaters Include sallying, aerial, ground feeding, gleaning (leaves/bark)	Bee-eaters, swifts
Omnivores	A variety of animal and plant foods	Thrushes,
Molluscivores	snails	Open-billed Stork,
Granivores	Grain & seeds	Sparrows, waxbills
Frugivores	Fruit-eating	Tinkerbird, barbets
Nectarivore	Feeding on nectar	Sunbirds,
Herbivores	Green vegetation	Geese,

4.3.3 Species Accumulation Curve

Bird species increased in number with survey efforts for example during the point counts, the numbers of new species were added onto the checklist with time. This may be an indication that if more survey efforts were invested in terms of more days, perhaps mode species would have been recorded. Figure 2 represents the species accumulation curve for point count data.

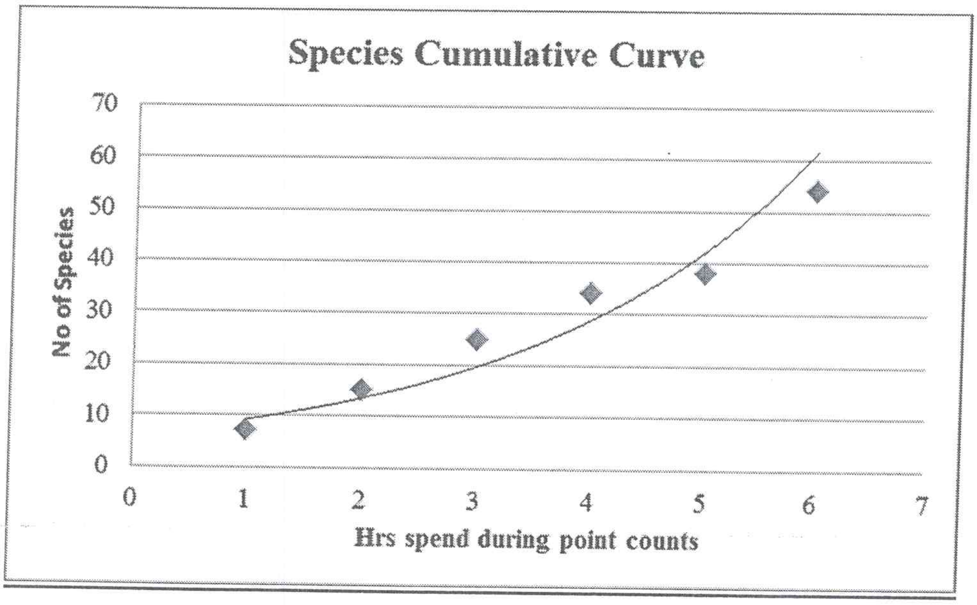


Figure 2: Avifauna species accumulation curve from point counts at the proposed project site

4.3.4 Importance of the proposed project site for avifauna

Grassland birds such as queleas and pipits dominated the grassland habitats and are also common residents of the area, woodland birds mostly warblers dominated the Acacia woodlands with the riparian habitats. The study confirmed that the site is an important passage and feeding site for migratory birds especially the Barn swallow and Golden pipit which are palaearctic migrants and the Northern Carmine bee-eater, Golden pipit and Abdim's stork which fall under the category of Afrotropical migrants. The area is used basically as a feeding, flight route and passageway.

4.3.5 Spatial and Temporal use of Habitat and Bird Distribution

Results from surveys showed high bird activities on the western and central portions of the study area and lowest in the eastern portion of the proposed site. The same pattern was observed for species richness (number of species per survey point) mainly concentrating within the grasslands the wetlands areas and the central portion of the proposed area with high density of natural vegetation. It is most likely that the same pattern would be consistent both in dry and wet season corresponding to the area with short grass for grassland birds and acacia woodland habitat and waterbirds concentrating in the wetlands and seasonally overflooded areas that run north-south of the proposed site . Observations on spatial use of the site showed that the western portions stood out as receiving far greater habitat use by species than others. The open areas were also associated with significant concentration of low flying birds including the Barn Swallow (Palaearctic migrant), Ethiopian swallow, Rock martin, Carmine bee-eater (Afrotropical migrants) and Namaqua dove. Most of these are insectivores, whose diet mainly comprise of insects and open areas are very ideal for their foraging flying lowly sallying and grassland feeding birds such as Malindi pipit, Golden pipit (Afrotropical migrant), Grassland pipit, Red-billed quelea Results from observations also indicate different impacts on different bird species. There will be risks at different stages of the project depending on the group of birds e.g. most grassland birds whose habitat may be transformed into salt pans. Woodland and grassland species would be impacted during the construction phase. Mitigation measures will therefore be specific to species within the different stages of the project considering also the level of significance.

5. SALT PRODUCTION TECHNOLOGIES

5.1 Introduction

Salt producers use three basic technologies to create salt for its myriad uses. Now-buried dried-up oceans of geologic ages past have left many areas, under both land and sea, with concentrated salt sedimentary layers which can exceed fifty feet in thickness. Two technologies exploit these underground deposits: conventional shaft mining where miners go underground to remove solid rock salt and solution mining where water is pumped underground dissolving the solid salt and then pumping out the salty brine which is de-watered to crystallize the salt. The third method extracts salt from oceans and saline lakes, growing salt crystals much as a farmer grows crops of vegetables or grain. Respectively, the products of these technologies are known as rock salt, evaporated salt (or vacuum pan salt) and solar (or sea) salt. Among the three technologies, most producers around the world are engaged in solar salt production, the least expensive technology available, when favoured by a dry and windy climate. But vast quantities of rock salt are extracted in large commercial mines and chemical companies utilize an enormous amount of salt in the form of brine that never is crystallized into dry salt. Logistical considerations heavily influence production facility site selection decisions and these, in turn, heavily influence the size of production units and the structure of the salt industry.

5.2 Evaporated salt (Vacuum pan salt) production

The vacuum evaporation method involves salt production by evaporation of salt brine by steam heat in large commercial evaporators, called vacuum pans. This method yields a very high purity salt, fine in texture, and principally used in those applications requiring the highest quality salt. The method involves pumping brine into vacuum pans; these are huge closed vessels under vacuum about three stories high. They are normally arranged in a series of three, four or five, with each one in the line under greater vacuum than the preceding one. This series of vacuum pans operates on a very simple principle: Whenever pressure is lowered, the temperature at which water will boil is also lowered. For instance, under normal air pressure at sea level, water boils at 212°F. But at ten thousand feet above sea level, where air pressure is much less, water boils at 194°F. Vacuum pans may operate at as low as 100°F. In the vacuum pan process, steam is fed to the first pan. This causes the brine in the pan to boil. The steam from the boiling brine is then used to heat the brine in the second pan. The pressure in the second pan is lower, allowing the steam made by the boiling in the first pan to boil the brine in the second pan. The pressure is reduced still further in each succeeding pan. This allows the steam made by the boiling brine in the previous pan to boil the brine in the next pan. While the boiling operation could be done with just one pan, several pans in a row produce more salt per pound of steam, thus allowing greater energy efficiency.

5.3 Rock salt production

Rock salt is mined from underground deposits by drilling and blasting. Deposits are reached through a circular shaft, typically about 20 feet in diameter and as deep as 2,000 feet, depending on the depth and location of the salt deposit. Shafts are lined with concrete, at least through the overburden and into the top of the salt deposit, and often all the way to the shaft bottom. Mining methods depend on whether the salt is configured as a relatively horizontal sedimentary deposit or a more vertical salt dome. The differences in mining methods depend on the thickness and structure of the salt deposit. Bedded or layered deposits are mined using the room and pillar mining method, as horizontal rooms or entries of about 10-25 feet high and 50 feet wide. Openings or cross-cuts are created perpendicular to the length of the rooms to connect the rooms at planned intervals. Salt pillars are left in place to provide structural support for the overlying roof and other layers. Most room-and-pillar mines recover about 45-65% of the salt available, with the remainder left behind as pillar supports with margins both above and below the mined area. Each day, based on production needs, several rooms are blasted, each blast bringing down 350-900 tons. In salt domes, after a level of room-and-pillar extraction is completed, the usual practice is to “bench” the mine by drilling and blasting the floor extending the excavation downward and removing vast quantities with each blast. Typically salt is mined using large, diesel-powered equipment designed for undercutting, drilling, blasting, loading and transporting the blasted salt. More recently, continuous mining machines have been more common; formerly they produced too many unusable fines. Diesel-powered trucks take the salt freed by blasting to a system of crushers and conveyor belts and, ultimately, to the hoist or “skip.” Sometimes the salt is stockpiled in the mine waiting hoisting; other operations maintain surface storage stockpiles. Each skip can lift 18-20 tons of salt and they move quickly – a large mine may be able to hoist up to 900 tons an hour.

5.4 Solar salt production

This is the oldest method of salt production. It has been used since salt crystals were first noticed in trapped pools of sea water. Its use is practical only in warm climates where the evaporation rate exceeds the precipitation rate, either annually or for extended periods, and ideally, where there are steady prevailing winds. Solar salt production is, typically, the capturing of salt water in shallow ponds where the sun evaporates most of the water. The concentrated brine precipitates the salt which is then gathered by mechanical harvesting machines. Any impurities that may be present in the brine are drained off and discarded prior to harvesting. Usually two types of ponds are used. First is the concentrating pond, where the salty water from the ocean or salt lake is concentrated. The second is called the crystallizing pond, where the salt is actually produced.

Commercial solar salt is produced by natural evaporation of seawater or brine in large, diked, earthen concentration ponds called condensers. Seawater averages about 3.5% NaCl when it enters the condensers. Climate is very important in solar salt production. The sun and wind provide the energy to evaporate the water and raise the salt concentration to the point of crystallization, 25.8% NaCl (25.4o Bé). As the water concentrates, calcium carbonate is the first chemical to crystallize. By moving the increasingly-saline brine through a series of ponds, over a period , the calcium carbonate is thus removed from the final salt product. When the concentration has increased to the most favourable crystallizing level, 26^{o} Bé, the brine is introduced into the crystallizing ponds. As salt crystallization proceeds, the concentration continues to increase. At 29^{o} or 30^{o} Bé between 72% and 79% of the total salt has been crystallized. Proper brine control during concentration and crystallization results in salt of purity of >99.7% NaCl. The crystallizing pond is then drained of the remaining highly concentrated magnesium brine (called "bitterns" because of its taste) which are either discharged or further processed for other minerals. The crystallised salt is harvested either mechanically using mobile harvester equipment by striping the newly-deposited layer of salt crystals or manually. The harvested salt is then washed (in clean brine to prevent loss), crushed and sometimes dried in kilns or fluidized-beds driers.

6. CURRENT USE OF THE PROPOSED PROJECT SITE BY THE LOCAL COMMUNITY

6.1 Grazing

The proposed project site is used by the local community to graze their livestock. According to observations made on the ground and presentations made during community consultative public

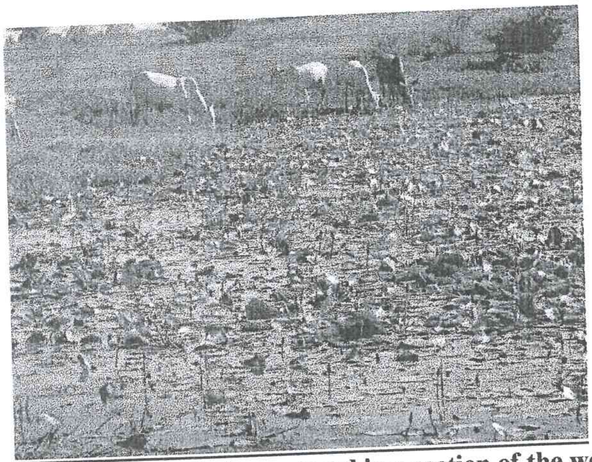
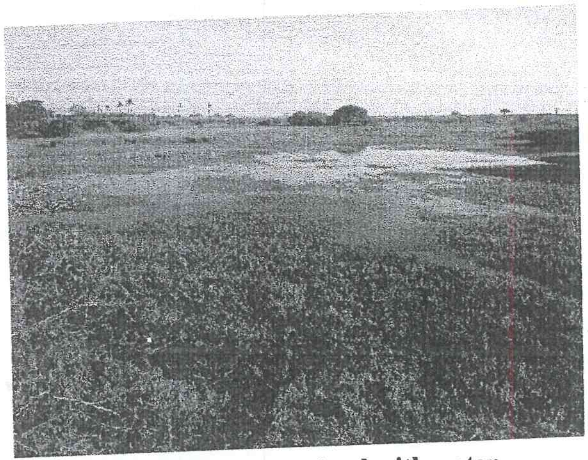



Plate 13: Cattle being watered in a section of the wetland, note the vast area of the wetland with water


Plate 14: Young men from the community fetching water from one of the shallow well at the proposed project site

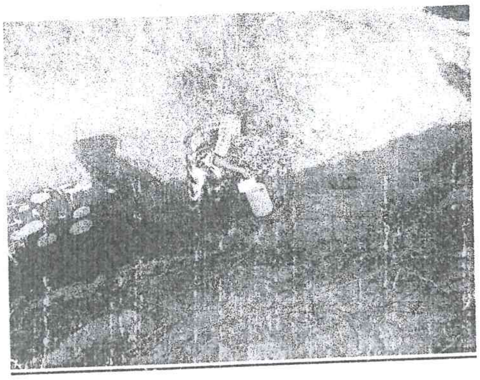
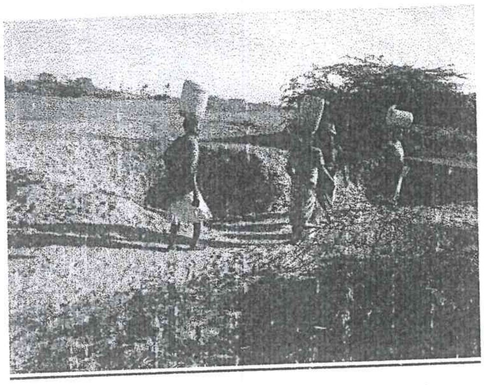



Plate 15: An old man from the community fetches water from another shallow well as a group of women carry out water they have fetched from the shallow wells

6.3 Access route

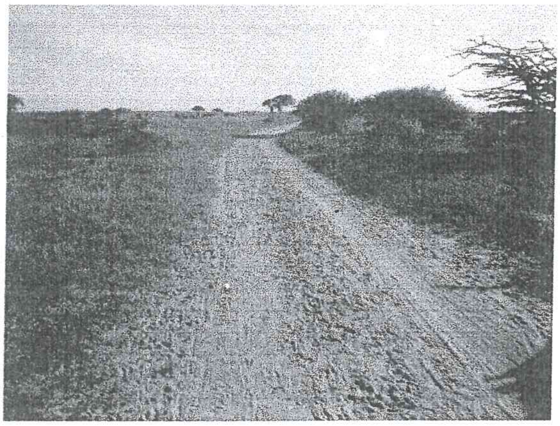
There are footpaths and feeder roads passing through the proposed project site, these footpaths and feeder roads are access routes to the villages adjacent to the proposed project site (such as Maui WA Kea), access routes to Marereni shopping Centre and to learning institutions adjacent to the proposed project site.

meetings, the wider communities rely on the proposed project site for the survival of their livestock. Large herds of cattle, flocks of sheep and goats were observed grazing at the proposed project site during data collection (plate 12). According to presentations made during community consultation meetings the peak of grazing at the proposed project site is during dry spell when livestock from far and wide in search of pastures move into the proposed project site to graze.

Plate 12: Flock of sheep and herd of cattle grazing at the proposed project site during data collection

6.2 Water source

A section of the proposed project site is a seasonal wetland which the local communities refer to as Lake Sudi, this seasonal wetland is a source of water for community livestock and other domestic uses. Also within the proposed project site there is a sandy section where local community members have dug shallow wells to access water beneath. The wells are handy during dry spells the wider community relies on the wells for water provision especially in the dry season. During field work for the current study we encountered people from the local community fetching water from the shallow wells at the proposed project site and community livestock being watered at the seasonal wetland.



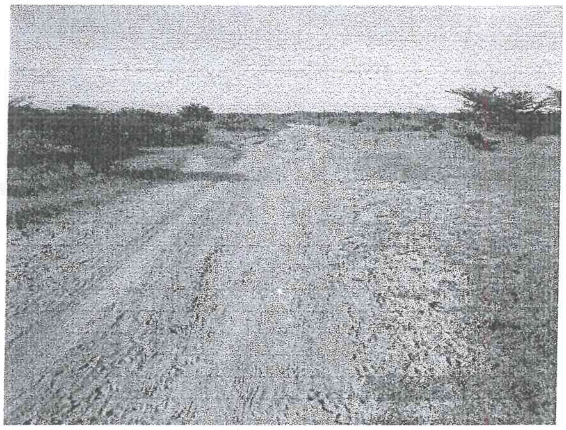
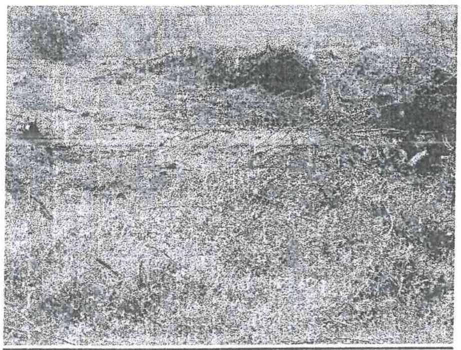


Plate 16: A section of a feeder road at the proposed project site that connects Marereni centre and Mui Wa Kae village

6.4 Source of fire wood and charcoal

Consultations and deliberations with the local community during public meetings indicated that the local community source firewood for domestic consumption from a section of the proposed project site. The site is also a source of wood for charcoal production; during transect walks through the proposed project site we encountered signs of charcoal burning.



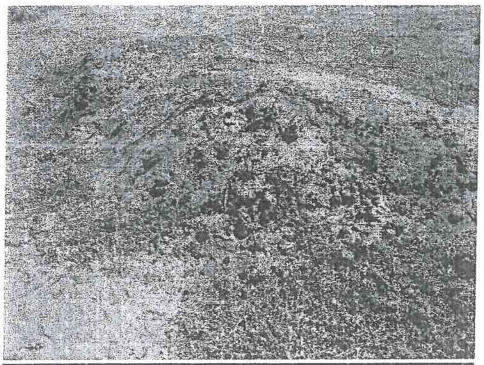


Plate 17: Charcoal burning in a section of the proposed project site

6.5 Source of building materials

The proposed project site is also a source of building material for the local community. Interactions during meetings with the local community and observations made at the proposed project site indicated that local community source building materials such as rafters and sand from a section of the proposed project site.

6.6 Cultural shrine for worship

According to presentation made during community consultative meetings and responses from a questionnaire survey, the site has a shrine which is a place of worship for the local community. The shrine the community said is part of the large Baobab tree at the periphery of seasonal swamp area locally referred to as Lake Sudi.

7. PROJECT DESCRIPTION AND ALTERNATIVES

7. 1 Existing salt production system

Production of raw salt at the existing Krystalline Salt Limited Marereni salt works starts with timely intake of sea water of 3°Be -3.5°Be concentration through tide capturing system and/or pumping the brine from the creek through the intake channel during high tide. This brine is pumped by the intake pump into initial evaporators[1], after initial evaporation and the brine concentration raises to between 4 °Be-4.5 °Be the brine flows to the next series of evaporators where farther evaporation takes place to attain 6 °Be -10 °Be concentration. This brine by means of lifting pump is pumped into a series of condensers where farther evaporation takes place to attain concentration of 20 °Be. This now concentrated brine flows out of the evaporators into pre-crystallizers where farther evaporation takes place to raise the concentration to 24.5 °Be -25 °Be. The now concentrated brine is ready to start crystalizing, the brine flows into crystallizers where it settles until salt crystallizes out in the form of white crystals. As salt continue crystalizing and the brine concentration in the crystallizers rises to 26.5°Be farther charging of brine of 25°Be from the pre-crystallizers into the crystallizers is done about three times to attain salt crust of two inches. At this point the salt will be ready for harvesting.

7.2 Design of the proposed expansion

The proposed expansion of Krystalline Salt Limited Marereni salt works will involve construction of salt ponds known as evaporators, construction of dykes that separate the ponds and installation of one pump to pump the brine into the evaporators. The evaporating ponds will be excavated to an approximate depth of 18-20 inches; each evaporating pond will measure 30metres wide by 20 meters long approximately. The dykes will be constructed in between the ponds from excavated earth material from the ponds and will approximately be 10 meters wide. The ponds and dykes will be designed to occupy an approximated area of 800 hectares (appendix 12).

7.2.1 Project activities

The activities that shall be undertaken during the project cycle will include the following.

[1] Salt evaporation ponds, also called salterns or salt pans, are shallow artificial ponds designed to extract salts from sea water or other brines. The seawater or brine is fed into large ponds and water is drawn out through natural evaporation which allows the salt to be subsequently harvested

7.2.1.1 Construction phase activities

Activities that will be undertaken during the construction phase of the salt evaporating ponds and dykes will include the following:-

- ✓ Clearance of vegetation and removal of cleared vegetation from the project site.
- ✓ Uprooting of tree stamps and roots from the cleared site.
- ✓ Site excavation, levelling and compaction.
- ✓ Trenching and stabilization of trench slopes.
- ✓ Construction of salt evaporators.
- ✓ Construction of dykes.
- ✓ Construction of culverts to link the new salt ponds (evaporators) to the existing salt ponds.
- ✓ Installation of water pump.

7.2.1.2 Operational phase activities

During the operational phase some of the activities that will be undertaken will include

- ✓ Circulation of brine within the salt ponds.
- ✓ Feeding the circulated and more concentrated brine to existing pre-crystallizers for the continuation of salt production process.
- ✓ Repair and maintenance of the evaporators.
- ✓ Repair and maintenance of the dykes.
- ✓ Operation of the pump, repair and maintenance of the pump.

7.2.2 The physical area to be affected by project activities

The proposed expansion of the salt works will occupy an approximate area of 800 hectares.

Apart from the acreage that will be under the project other areas will be affected in one way or another during project construction. Such areas may include:-

- ✓ Public roads from where project equipment will be mobilised to the project site.
- ✓ Exiting dykes which will be connected to the new dykes
- ✓ Existing open areas outside the proposed project site but with Krystalline premises where project camp will be established
- ✓ Existing evaporators that will be linked to the new evaporators.

7.3 Construction of the new ponds and dykes

7.3.1 Vegetation clearance

Vegetation on the ground will be cleared to pave way for construction of the ponds to begin. Large trees will first be felt followed by smaller tree, shrubs and grasses will be cleared last. Stamps of tree and roots will then be uprooted. Various tools and equipment will used to clear vegetation, uproot stumps of trees and roots on site. The equipment will include power saws and wood cutters.

7.3.2 Ground excavation

Excavation of the cleared ground will be undertaken to attain required levels and depths. Excavation works will utilise heavy duty equipment including caterpillar excavator, excavator trench digging bucket and caterpillar bulldozers. Once excavation is complete ground levelling to attain desired gradient and compaction to required specifications will be undertaken using levelling and dumping unit with theodolite set and vibrating rollers respectively. The excavated earth material will be used to construct the dykes. At the end of it all the required ponds and separating dykes will be developed and constructed to specification.

7.3.3 Brine intake and circulation

Once the ponds and separating dykes have been constructed to require specification circulation of brine in the evaporating ponds will begin. Brine will be injected into the new evaporating pond from the existing initial ponds via the gravity flow. In case boosting of the flow will be required the new pump will be handy. Since the evaporators will be in series the brine will flow from one pond to another. Monitoring of the concentration of the brine will be carried out from one pond to another as the brine flows from one evaporating pond to another. The last evaporator in the series will be connected to the existing pre-crystallizer.

7.4 Products, by-products and waste

7.4.1 Products and by-products

The expected end product from solar salt production is edible table salt and bakery salt. The expected by-produced is low grade salt also referred to as cattle salt.

7.4.2 Waste
Waste to be generated from the construction phase is organic plant matter from site clearing, overburden material from excavation works and trenching. Waste from operational phase will be bitten resulting from salt harvesting and effluent from salt washing.

7.4.3 Waste management and disposal
Tree and other plant matter that will be realised from site clearance some will be used to fire the boiler refinery at Gongoni, remaining plant material can be used as firewood. The overburden material from excavation work will be used to build dykes. Remaining overburden material will be used to fill up low-lying areas within company premises. Bitten from salt harvesting will be channelled to existing bitten tanks and be used to produced low grade salt referred to as cattle salt while effluent from salt washing will the channelled to the existing settling tanks for recycling.

7.5 Project cost
The estimated project cost as was given during the preparation of the project report was KSH 50,000,000 (fifty million Kenya Shillings). The prescribed EIA processing and licensing fees of this project cost were paid to the National Environment Management Authority when the project report was submitted (appendix 11).

7.6 Project alternatives
Three project alternatives are available namely the 'no project' alternative, 'yes project' alternative and 'modified project' alternative. Analysis of each alternative is as follows.

7.6.1 The No Project Alternative
The no project alternative means that the project as currently proposed i.e. construction of salt evaporators, dykes and installation of one pump on the approximate area of 800 hectares to be totally rejected. This means that the proposed project site to remain undeveloped as currently is. The no project alternative implies that the developer will not be able to achieve the proposed plans to develop the company land that is not currently developed, to increase the company's salt production capacity.

7.6.2 The Yes Project Alternative
The yes project alternative means that the proposed project to be implemented as currently proposed without alterations i.e. construction of salt evaporators, dykes and installation of one

pump on the approximate area of 800 hectares. The yes project alternative will enable the project proponent achieve the proposal of increasing salt production capacity by increasing company land under salt production.

7.6.3 The modified project alternative

The modified project alternative means that the proposed project to be implemented but with modifications. The modifications may be in design i.e. to modify the project design, it may be in the components i.e. modifying the project components, or it may be in the size and magnitude i.e. scale up or scale down the size and magnitude of the project.

7.6.4 Alternative use of the proposed project site

The proposed project site can be used for other alternative projects besides the proposed one. Such alternative use of the site may include planting the entire site with trees to establish a woodlot, converting the site to arable farming by planting crops such as maize, cow peace, coconuts,. Other uses may include establishing a recreational centre with various facilities, establishing a leaning institution, building a tourist hotel or simply leaving the land undeveloped as currently is the case.

7.6.5 Alternative site for the proposed project

Alternative site for the proposed project will have to be land available within the salt belt. Such areas should have large and expansive undeveloped parcels of land adjacent to a creek with clay soils which is relatively impermeable to favour solar salt production from sea water. Potential areas that can be considered may include areas towards Kurawa and Kemu sides within the coastal salt belt.